IN VITRO GROWTH OF OSTEOLASTS ON POLY LACTIC-CO-GLYCOLIC ACID
SCAFFOLDS CREATED VIA GAS FOAMING

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Master of Biomedical Engineering

by
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ABSTRACT

In Vitro Growth of Osteoblasts on Poly Lactic-co-Glycolic Acid Scaffolds Created Via Gas Foaming

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This study analyzed the feasibility of using gas foaming to create Poly Lactic-co-Glycolic Acid (PLGA) scaffolds for use as a substrate in bone tissue engineering and set out to determine whether the presence of osteoblasts on these scaffolds enhanced their material stiffness. The process of bone formation involves osteoblasts depositing extracellular matrix and calcifying this matrix with calcium phosphate crystals (Hasegawa et al., 2017) and pits between 30-40 μ m in diameter on tissue engineering scaffold surfaces have been shown to best promote osteogenic activity in the presence of bone-forming cells (Halai et al., 2014). The scaffolds were determined to contain pits within this 30-40 μ m range and the ability of osteoblasts to lay down and calcify extracellular matrix on gas foamed PLGA scaffolds was confirmed by the image analysis of inverted optical microscope images of Alizarin Red S-stained scaffold cryosections. The presence of osteogenic activity combined with the desired scaffold porosity led us to conclude gas foaming PLGA scaffolds is a feasible method of scaffold fabrication for bone tissue engineering and allowed us to solidify the optimized gas foaming apparatus as an instrument to be used in further bone tissue engineering experiments at California Polytechnic State University, San Luis Obispo. However, this study failed to determine whether the presence of osteoblasts improved the material stiffness of the PLGA scaffolds due to a lack of statistical significance in compression testing results.

Keywords: Osteoblasts, Gas Foaming, PLGA

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LIST OF ABBREVIATIONS

ANOVA - Analysis of Variance

DAQ - Data Acquisition Board

dPBS - Dulbecco's Phosphate Buffered Saline

ECM - Extracellular Matrix

NI - National Instruments

Ob - Osteoblasts

OCT - Optimum Cutting Temperature

ODM - Human Osteoblast Differentiation Media

PID - Proportional Integral Derivative Controller

PGA - Poly(Glycolic Acid)

PLA - Poly(Lactic Acid)

PLGA - Poly (Lactic-co-Glycolic Acid)

SEM - Scanning Electron Microscope

Chapter 1

INTRODUCTION

Diseases and injuries can cause trauma to tissues within the body that require reparations or replacement. Tissue regeneration and replacement is commonly achieved through tissue engineering. Tissue engineering is the combination of cells grown in vitro with porous biocompatible scaffolds. There are multiple different methods of scaffold creation along with multiple different biomaterials used to create these scaffolds. Different combinations of scaffold creation methods and materials better suit different tissue engineering needs.

This study investigates gas foaming as a novel method for creating Poly (Lactic-co-Glycolic Acid) (PLGA) scaffolds for bone tissue engineering. Gas foaming is not a commonly used scaffold creation method, yet it holds promise due its ability to create highly porous scaffolds when combined with particulate leaching. It also avoids the use of organic solvents and it can easily be modified to create different intentional results (Harris, Kim, & Mooney, 1998).

1.1 Purpose of Thesis

This thesis serves to investigate the ability to use gas foaming to create PLGA scaffolds for bone tissue engineering and to determine whether these PLGA scaffolds in the presence of osteoblasts better replicate the mechanical stiffness of native trabecular bone than these PLGA scaffolds alone.

1.2 Scope of Thesis

There were five main steps involved in the successful completion of this thesis.

The first step was to build and test the gas foaming apparatus and control system. This involved creating a reproducible method of releasing gas pressure from the gas foaming chamber. Two different methods were focused on and detailed in Section 3.1. Pressure over time graphs during pressure release were recorded and analyzed, and Scanning Electron Microscope images were taken of PLGA scaffolds made via both methods and compared to determine which release method was most suitable for this study.

The second step was to fabricate the PLGA scaffolds via gas foaming. PLGA flakes and deionized salt were ground down and sieved to obtain a controlled range of 63 to 250 micron diameter particles. The PLGA and salt particles were then weighed out to achieve a mass ratio of 80% salt and 20% PLGA. The salt and PLGA were combined and pressed into the desired scaffold shape. This pressed pellet was then subjected to 800 psi of carbon dioxide gas for 22 hours. The release of the gas after 22 hours then allowed the PLGA particles to fuse together. The salt was then leached out in water for 24 hours, yielding a porous PLGA scaffold.

The third step was to culture osteoblasts for deposition and culture on the scaffolds. Aseptic procedures were strictly followed to ensure sterility as one vial of one million osteoblasts was expanded to 9 flasks with approximately 1 million osteoblasts each. The osteoblasts were stripped from these flasks and deposited onto scaffolds soaking in human Osteoblast Differentiation Medium (ODM) in a 48-well plate. One million osteoblasts per scaffold are deposited onto 7 scaffolds soaking in ODM. There are also 7 scaffolds soaking in ODM that do

not have osteoblasts deposited on them, 7 scaffolds soaking in Dulbecco's Phosphate-Buffered Saline (dPBS), and 4 scaffolds that were left dry in the 48-well plate.

The fourth step was to determine the Young's modulus of each scaffold via compression testing. Four of each scaffold treatment group were used in compression testing. Compressive load versus extension data for each scaffold were recorded. These data were used to determine the maximum load recorded, the load at the yield point, and the Young's modulus of each scaffold. These obtained values were compared to the literature values seen in native trabecular bone.

The fifth and final step was to test that the scaffolds that had osteoblasts deposited on them showed signs of calcification. Osteoblasts will deposit and calcify extracellular matrix, so calcium deposits were used as a measure of osteogenic action. This was completed by freezing the scaffolds in optimum cutting temperature (OCT) gel and using a cryostat to obtain cryosections of each scaffold. These cryosections were then stained with Alizarin Red S, which stains calcium-containing components red. These cryosections were viewed under an inverted optical microscope and analyzed to show that the amount of calcium-containing components on the scaffolds increased in the presence of osteoblasts, thereby demonstrating osteogenesis had occurred on gas foamed PLGA scaffolds.

When all five of these steps were completed, the thesis project was considered complete.

Chapter 2

LITERATURE REVIEW

Bone tissue engineering first started gaining popularity in the second half of the 1990s, as it offered a novel approach to bone repair (Liu & Ma, 2004). At the time, calcium supplements, autografts, and allografts were common treatments and procedures prescribed to those in need of bone tissue repair or replacement. However, each of these approaches have significant limitations. The body does not make calcium naturally, but instead acquires it through diet. If one's diet is low in calcium, bone mechanical strength can be compromised leading to injury or disease. Calcium supplements are intended to add additional calcium to the body to strengthen, or increase the stiffness of one's bones. However, the effectiveness of calcium supplements is highly debated. The supplements are reported to slow bone resorption, but not stop or reverse bone resorption. Calcium supplements have also been rumored to increase the likelihood of adverse cardiovascular effects (Shin & Kim, 2015). An autograft is bone tissue taken from one part of the patient's body that is then transplanted to another part of their body to enable the repair of compromised bone tissue. However, autografts have been shown to lead to pain, infection, scarring, and blood loss (Polo-Corrales, Latorre-Esteves, & Ramirez-Vick, 2014). An allograft is bone tissue that is taken from one patient and implanted into another. Allografts have the risk of carrying infectious agents (Polo-Corrales et al., 2014). Calcium supplements, autografts, and allografts can all help in reducing bone resorption, but tissue engineering shows more promise in mitigating the effects of damage in bone tissue.

Tissue engineering requires a scaffold on which to grow cells and there are numerous methods to create these scaffolds. This study utilized gas foaming to create Poly Lactic-co-Glycolic Acid (PLGA) scaffolds. Using gas foaming to create synthetic polymer scaffolds first started gaining traction in 1998 in the Mooney Lab documented in the article "Open pore biodegradable matrices formed with gas foaming" (Harris et al., 1998). Mooney, et al. created porous PLGA scaffolds by pressing pellets of 85:15 PLGA and salt at various salt:PLGA ratios and subjecting the pellets to 800 psi of carbon dioxide gas for 48 hours. The salt was then leached from the pellets by soaking in deionized water for 48 hours. This created porous PLGA scaffolds that smooth muscle cells readily adhered to. The porosity of the scaffolds could be controlled by the ratio of salt to PLGA used and the salt particle size. These findings demonstrated gas foaming as a viable process for creating polymer scaffolds for three-dimensional tissue growth.

Two of the more common methods of tissue scaffold synthesis are electrospinning and solvent casting. Electrospinning creates polymeric fibers on the order of hundreds of nanometers in diameter via electric force and overlays them to mimic extracellular matrix components and geometry (Bhardwaj & Kundu, 2010). Electrospun scaffolds have high surface to volume ratio (an advantageous characteristic for cell retention), have high porosity, and can be easily manipulated to achieve a wide range of geometries. However, electrospinning does not replicate the bulk morphology of trabecular bone to the same extent as gas foaming. Solvent casting involves dissolving a polymer in a solvent, mixing in salt particles, and pouring this solution into a mold. The solvent is removed in a vacuum and the salt is leached out in water to create a polymeric tissue scaffold (Liao et al., 2002). Solvent casting replicates the bulk morphology of trabecular bone tissue well, but residues of organic solvents that can remain in the polymer

scaffolds after solvent casting have been a cause for concern (Harris et al., 1998). Gas foaming manages to model the bulk morphology of trabecular bone without the use of solvents. Figure 2.1 shows Scanning Electron Microscope (SEM) images of scaffolds created by each of the methods described compared to an SEM image of healthy adult trabecular bone.

Fig 2.1 Scanning electron microscope (SEM) images of tissue scaffolds created via **a**) electrospinning (Bhardwaj & Kundu, 2010), **b**) solvent casting and particulate leaching (Liao et al., 2002), and **c**) gas-foaming and particulate leaching (Harris et al., 1998) compared to **d**) an SEM image of healthy trabecular bone (Hansma, 2004)

The remainder of the literature review will cover information necessary to understand the various facets within this project.

2.1 Poly (Lactic-co-Glycolic Acid)

Poly (Lactic-co-Glycolic Acid) or PLGA is a common synthetic polymer used as a scaffold material for bone growth due to its biocompatibility, controllable degradation rate, and ability to be easily modified. PLGA is FDA-approved and can be exported universally due to its

lack of animal-derived products (Avgoustakis, 2005). PLGA scaffolds and composites (PLGA combined with other biocompatible materials) have been used in a variety of tissue engineering applications as a substrate for cell deposition and ECM formation. Numerous studies have demonstrated that osteoblasts exhibit great adhesion and proliferation properties on PLGA (Palin, Liu, & Webster, 2005). The most common applications of PLGA in bone tissue engineering on the market are orthopedic implants, drug delivery, interference screws, suture anchors, bone plates, and anterior cruciate ligament reconstruction (Gentile, Chiono, Carmagnola, & Hatton, 2014).

PLGA is a copolymer between polylactide (PLA) and polyglycolide (PGA), and the ratio of lactide to glycolide determines the material's mechanical properties. PLGA can come in two different crystalline forms: semicrystalline and amorphous (Harding, 2018). Semicrystalline polymers have a highly-ordered molecular structure. They remain solid until they reach their melting points where they rapidly become a liquid of low viscosity (RTP, 2016). Amorphous polymers, on the other hand, do not show any sign of crystallinity (Ngai, Floudas, Plazek, & Rizos, 2002). The molecular structures of semicrystalline and amorphous polymers are illustrated in Figure 2.2. Amorphous PLGA polymers are suitable for biomedical applications, as they provide a more homogeneous distribution of sites for cell integration (Kang, La, & Kim, 2009).

Fig 2.2 Visual representation of the molecular organization of amorphous vs. semicrystalline polymers (MacVarish, 2017)

PLA is more hydrophobic than PLGA and PGA is less hydrophobic than PLGA. Therefore, PLGA that is more lactide than glycolide will be more hydrophobic. PLGA degrades faster than both PLA and PGA, with a 50lactide:50glycolide ratio degrading the fastest. Figure 2.3 demonstrates the effect of PLA:PGA ratio on PLGA degradation time.

Fig 2.3 Time until polymer is to half of its density after degrading in water based on ratio of PLA to PGA present in PLGA (Felton, 2011)

2.2 Gas Foaming

Gas foaming is the process of fusing polymer particles together to create a solid polymer. A polymer that has been pressed into its desired shape is placed into a sealed chamber connected

to a carbon dioxide tank and a release valve. The pressed polymer pellet is then subjected to high gas pressure with the release valve closed for enough time to allow the polymer to saturate with carbon dioxide gas. By rapidly releasing the pressure from the valve and allowing the pressure inside the chamber to return to ambient conditions, a thermodynamic instability is created within the polymer particles. The carbon dioxide gas then separates from the polymer and the polymer undergoes pore nucleation and growth, a process in which the atoms of the polymer self-organize and the polymer particles expand into each other to create a solid. Once this process is completed, a solid polymer structure is created (Harris et al., 1998).

2.3 Proportional-Integral-Derivative Controller

To allow for proper pore nucleation and growth, the rate at which pressure is released from the gas foaming chamber is important. If the carbon dioxide gas is released too slow, the polymer particles will not fuse together. If the carbon dioxide gas is released too fast, the polymer pores will grow too fast and can result in gross defects of the scaffold as shown in Figure 2.4. This is where having a repeatable method of pressure release becomes important. A Proportional-Integral-Derivative Controller (PID) can be used to control the rate at which pressure is released from a gas foaming chamber by controlling the voltage being sent to a positioner on an actuated release valve. In this scenario, a PID would take the pressure reading inside the chamber, compare it to the programmed, desired pressure reading at that point in the pressure release, and attempt to correct the current pressure to the desired pressure.

Fig 2.4 An unsuccessful PLGA scaffold creation attempt where pressure was released too rapidly from the gas foaming chamber

Fig 2.5 Basic block diagram of a process controlled by a PID(Knospe, 2006)

A PID regulates a process by the steps shown in Figure 2.5. The most essential parts to understanding this block diagram are the set point and process variable. The set point is the value we want the process to be at a given time. The PID controller compares the value of the set point to the value of the process variable, the actual measured value of the process at a given time. The PID then applies three calculations to the process variable to calculate how much to change the process variable to achieve the set point. The three calculations are called modes of control and they are proportional, integral, and derivative. The three modes of control are all added together. Therefore, the overall changes the PID makes to the process is the sum of the proportional, integral, and derivative modes of control. The proportional mode of control multiplies the difference between the set point and process variable by a determined constant, K_p . The integral mode of control sums all of the values of error that have happened so far in the process and

multiplies them by a determined integral constant, K_i . A larger integral constant should bring the process variable to the set point faster since it will be evaluating the trend the process variable has been taking further back in the process. The derivative mode of control predicts what is about to happen by projecting the current rate of change into the future. It also has a determined derivative constant, K_d (Knospe, 2006). Getting the process variable to follow a given set point involves adjusting K_p , K_i , and K_d .

2.4 Scanning Electron Microscopy

A Scanning Electron Microscope (SEM) allows people to view samples at a resolution of 10-100nm (Savage, 2017). To put this in perspective, the human eye has a natural resolution limit of 100 μ m and optical microscopes have a resolution limit of 0.25 μ m. SEMs work by bombarding a sample surface with electrons and detecting the secondary electrons that are scattered off the material surface. These secondary electrons are interpreted to produce a grayscale image of the sample's surface. A common problem with SEMs is that a nonconductive sample surface can become overcharged by a buildup of electrons resulting in bright streaks across the surface of images (Ammrf, 2014). To prevent overcharging, a thin layer of gold is often sputtered onto a sample's surface to act as a conductive surface, thereby decreasing the accumulation of static electric fields (Höflinger, 2013).

2.5 Osteoblasts

Osteoblasts are the cells responsible for the deposition of bone matrix. The bones in the human body are constantly undergoing resorption and restoration. Osteoclasts disintegrate bone matrix via the release of hydrogen ions which converts water and carbon dioxide into

bicarbonate, an acid that dissolves bone (Väänänen, Zhao, Mulari, & Halleen, 2000). Osteoblasts then secrete extracellular matrix (ECM) which is composed of collagen-1 fibrils and non-collagenous proteins in bone. The ECM is then mineralized by matrix vesicles containing calcium-phosphate crystals secreted by the osteoblasts (Hasegawa et al., 2017).

The process of bone formation is called osteogenesis, and there are two distinct osteogenic processes, intramembranous ossification and endochondral ossification. The primary difference between these two forms of bone formation is that endochondral ossification utilizes cartilage as a precursor for bone whereas intramembranous ossification does not. The process of osteogenesis starts when mesenchymal stem cells cluster together and begin replicating. This cluster is called a nidus, and when a nidus is completely formed the mesenchymal stem cells stop replicating and begin experiencing morphological changes (Figure 2.6). These morphological changes cause the mesenchymal stem cells in the nidus to become osteoblasts. The osteoblasts begin laying down collagen-1 and extracellular matrix proteins (Brighton & Hunt, 1997) and then secrete matrix vesicles containing calcium-phosphate crystals. It is believed that these calcium-phosphate crystals are formed by the influx of calcium and phosphate ions across the matrix vesicle's plasma membrane. The crystals form on the inside of the matrix's plasma membrane and then rip through the plasma membrane, resulting in the deposition of mineralized nodules on the extracellular matrix of bone (Hasegawa et al., 2017). This process is illustrated in Figure 2.7. The growth of osteoblasts in-vitro has been cited as limited in its capacity to replicate the organization and density of osteoblasts in-vivo, which has been theorized to be due to the lack of inhibitory cytokines secreted by osteoblasts which indicate the site for calcification and growth from osteoblasts (Blair et al., 2017).

Fig 2.6 Light micrograph image of mesenchymal stem cells clustering to form a nidus (Brighton & Hunt, 1997)

Fig 2.7 Transmission Electron Microscope images of a matrix vesicle secreted from an osteoblast during osteogenesis. **a)** shows the beginning of crystallization on the inner plasma membrane, **b)** shows the growth of calcium-phosphate crystals within the vesicle, and **c)** shows the crystals tearing through the plasma membrane (Hasegawa et al., 2017)

It has previously been determined that the diameter of an average osteoblast is between 15 μ m and 20 μ m and pits in scaffold surfaces between 30-40 μ m in diameter best promote ossification (Tanaka-Kamioka, Kamioka, Ris, & Lim, 1998). Pores larger than the 30-40 μ m diameter range are still desirable as there will be smaller pits within these larger pores that do fall within this range. Therefore, scaffolds with pores at least 30 μ m in diameter would be suitable for osteoblast attachment, growth, and calcium deposition onto the scaffold.

2.6 Compression Testing

Compression testing is a mechanical testing process that yields real-time data of compressive load over extension, the distance a compression platen travels from its start position, of materials tested. It involves two stainless steel plates, known as compression platens, that the material sits between, and as the platens slowly get closer together, the compressive load exerted on the material is recorded. Other material properties such as stress, strain, and Young's modulus can be calculated from the recorded data. The Young's modulus is a measure of the stiffness of a material (Rho, Ashman, & Turner, 1993), and it is often calculated as stress over strain in the linear portion of a stress-strain diagram, as shown in Figure 2.8.

Fig 2.8 Example stress-strain diagram (Figari, 2015)

2.7 Cryosectioning

Cryosectioning is the process of creating slices of a frozen sample embedded in clear optimum cutting temperature (OCT) gel. This process is commonly used to create sections of tissue for observing under a microscope. The tissue sample is first embedded into a well of OCT gel and then frozen instantaneously by being submerged in liquid nitrogen. This frozen sample is

kept in a freezer for 48 hours prior to cryosectioning. The sample is then clamped into place in a cryostat and moved past a sharp blade that creates thin slices of tissue samples. These samples are fixed onto microscope slides to be observed under the microscope of choice.

2.8 Alizarin Red S

Alizarin Red S is a histochemical stain that appears red in the presence of calcium. Alizarin Red S can be added to frozen tissue slices to stain calcified areas red. The presence of calcium staining can easily be viewed under an optical microscope (Figure 2.9). When applying Alizarin Red S to a cryosectioned sample, the sample is submerged in Alizarin Red S for three minutes on a microscope slide and preserved by being dipped in acetone and xylene (Byon et al., 2011).

Fig 2.9 Alizarin Red S staining of calcium deposits from pre-osteoblast MC3T3-E1s (Li et al., 2016)

Chapter 3

MATERIALS AND METHODS

There were five essential steps taken to complete this project. An optimal gas foaming method for Poly(Lactic-co-Glycolide) (PLGA) scaffold fabrication had to be determined. PLGA scaffolds had to be created using this gas foaming method. Osteoblasts had to be cultured and deposited on to the PLGA scaffolds. Compression testing of PLGA scaffolds that had osteoblasts grown on them and control treatment groups had to be performed. Lastly, PLGA scaffolds that had osteoblasts grown on them and control treatment groups had to be cryosectioned and stained to test for viability. The process described in this chapter can be viewed as numerical steps in Appendix E.

3.1 Scaffold Fabrication

First, we created the PLGA scaffolds and determined the optimal gas foaming procedure in the process. The primary steps involved in this process were milling, pressing, gas foaming, and salt leaching. Milling is the process of grinding a material into a powder. Pressing involves applying pressure to the milled powder in a die to form a shaped pellet. Gas foaming is the process of subjecting the pressed pellet to carbon dioxide gas at a high pressure and releasing the gas to allow the PLGA particles to fuse together. Lastly, salt leaching entails soaking the gas-foamed pellet in deionized water such that the salt diffuses out, leaving a porous PLGA scaffold.

Ultra Epsom medium grain premium salt crystals and Resomer ester-terminated 85 lactide: 15 glycolide PLGA with a molecular weight of 190,000-240,000 g/mol were used for scaffold fabrication. We chose Ultra Epsom salt for its high level of purity and ability to be

easily dissolved in water (Ultra Epsom, 2010). We chose the Resomer PLGA for a few reasons. For one, the lactide-to-glycolide ratio has been shown to work in past research (Harris et al., 1998). The Resomer PLGA is also described as being made for bioabsorbable implantable devices, which would be a desirable material attribute if we ultimately used this method of scaffold fabrication for bone replacement therapy. The Resomer PLGA has an amorphous molecular structure which is desirable for tissue engineering due to having a more homogeneous distribution of sites for cell integration (Kang et al., 2009). It has a degradation time of approximately 9 months and was stored in a freezer when not in use.

The salt was ground with a 550mL Eisco Labs porcelain mortar and pestle and the powder was sieved in the American Educational screen sieves set (Fig 3.1) into particles with diameters between 250 and 63 microns (mesh sizes 60 and 230). The salt was then collected in a plastic tupperware, and the mortar and sieves were thoroughly cleaned. The PLGA was then also milled and sieved into the same size particles. These PLGA particles were collected into a separate plastic tupperware. Conicals were filled with 0.8g of salt and 0.2g of PLGA, such that each conical represented the materials necessary for one pressed pellet. The pellets were designed to be one gram each and made of 80% salt and 20% PLGA by weight. This ratio was used to achieve a moderately porous scaffold when the salt is leached out. More salt was not used to ensure the PLGA particles would not be too far apart to fuse in the gas foaming process. The conicals were then vortexed to thoroughly mix the salt and PLGA particles.

Fig 3.1 a) Eisco Labs porcelain mortar and pestle
b) American Educational screen sieves set

Once the salt and PLGA were ground and divided up into their proper proportions, the materials were ready to be pressed into pellets. The pellets were made one at a time. The contents of a conical with 0.8g of salt and 0.2g of PLGA were carefully scooped into a 5mm Type KB Precision die (Figure 3.2a). We placed the die under a 2kN press (Figure 3.2b) and pressure was manually added to the die by pressing down on the lever arm of the press. The one gram of mixed salt and PLGA powder was now shaped and compacted into a cylindrical pellet (Fig 3.1.2c) inside of the die and carefully removed. The pellets have a diameter of 5mm and an average height of 3mm.

Fig 3.2 a) 5mm Type KB Precision die b) Die under 2kN press
c) Pressed pellets of mixed PLGA and salt

We fused the PLGA particles together using gas foaming. Gas foaming fuses PLGA particles in the pressed pellet together by creating a thermodynamic instability as pressure is released from the gas foaming chamber that leads to the nucleation and growth of gas pores inside the PLGA particles (Harris et al., 1998). A pre-existing carbon dioxide pressure vessel on

campus, which had previously been used in Cal Poly MEDITEC projects, was modified and used for the purpose of gas foaming. First, the carbon dioxide tank was switched from a liquid tank to a gas tank. The setup originally ran through two pressure vessels, one of which could be temperature-controlled and the other had a pressure transducer for reading the pressure within. The gas line to the temperature-controlled vessel had been broken and would leak carbon dioxide gas when run. The plumbing was reconstructed such that the temperature-controlled vessel was skipped. The carbon dioxide tank now ran to a manual needle valve then to the pressure vessel with a pressure transducer. A pipe ran out of the pressure vessel and led to another manual needle valve which led to ambient air. This needle valve was how carbon dioxide gas was released from the pressure vessel. We replaced this needle valve with a Valworx Electric Actuated Stainless Ball Valve with Electronic Positioning System, also called a positioner, because we wanted a more reproducible method of gas pressure release.

The carbon dioxide gas needs to be released in a controlled fashion. Releasing the gas too fast will result in excessive pore nucleation of the PLGA scaffolds. The result is gross scaffold architecture that does not maintain its original cylindrical shape, taking on a ‘popcorn’-like appearance due to the excessive and uncontrolled pore expansion. Releasing the gas too slow will yield a lack of pore nucleation in the PLGA scaffold, resulting in a lack of or inefficient fusing of adjacent PLGA particles and the scaffold will easily crumble. To accomplish a controlled gas release, we built a controlled gas release apparatus consisting of a data acquisition board (DAQ) that sends pressure readings from the pressure transducer in terms of AC current to an National Instruments Labview program, where the pressure readings are interpreted, and then the DAQ sends a set DC voltage to the positioner on the actuated release valve. This process is diagrammed in Figure 3.3. The DAQ used is National Instruments' USB-6002 Multifunction I/O

device. When 0V are sent to the positioner, the ball valve is completely closed, and when 10V are sent to the positioner, the ball valve is completely open. Each voltage in between 0V and 10V corresponds proportionally with how open the ball valve is. For example, 5V corresponds to a halfway open ball valve. The DAQ reads the pressure inside the gas foaming chamber via a male McMaster standard, 4-20 mA output, 1/4" NPT, 5000 psi pressure transducer. This allows the pressure over time to be recorded and plotted for evaluation purposes. A proportional-integral-derivative controller (PID) was implemented and programmed in the National Instruments LabView software to provide a feedback control loop between real-time pressure transducer measurements and the magnitude and duration of valve opening. Multiple gas releases (approximately 75) were performed with the PID, incrementally changing the PID constants by orders of magnitude then fine-tuning inwards until the optimal PID constants were found to get the process variable to follow our predetermined set point of a linear decrease from 800psi to 0psi over 30s. The PID constants were found to be $K_p = 0.056$, $K_i = 20,000$, and $K_d = 0.44$. These values are confirmed in Appendix A. However, despite the ability of the PID to provide real-time feedback, we found that sending a constant voltage to the actuated release valve yielded reduced variability and resulted in more consistent foaming outcomes. More information on how this particular release method was chosen can be found in Section 4.1. The DAQ was connected via USB to a laptop containing a LabView program that I constructed which allows the user to send a predetermined voltage to the positioner. This program also allows pressure readings over time to be collected and exported to a comma-separated values (CSV) file.

Fig 3.3 Schematic of DAQ setup. DAQ reads pressure in terms of AC current and sends a pressure reading to the NI LabView program. The NI LabView program sends a signal for a specified AC voltage to the DAQ which sends that AC voltage to the positioner on the release valve.

After the PLGA and salt were pressed into pellets, the lid of the gas foaming chamber was carefully unscrewed to expose the interior of the chamber. Inside there was a removable shelf to place the pressed pellets on (Figure 3.4a & Figure 3.4b). Six pellets were loaded into the chamber at a time. Once the pellets were on the shelf and carefully lowered into the chamber, the lid was sealed shut. A proper seal and complete closure of the lid is important because it is very easy for a gas leak to occur between the lid and chamber if the lid is not clamped down as tight as possible. We carefully moved the chamber into place and connected it to a gas line attached to a 800psi CO₂ tank. The chamber had to remain vertical the entire time so as not to move the pellets around on the shelf. Once it was certain that everything was correctly connected and the release valve was shut, the CO₂ tank was opened, filling the gas foaming chamber with 800psi of CO₂ gas. The tank was then closed and the scaffolds were left for 22 hours to saturate with the carbon dioxide gas. Once the 22 hours was up, it was time to release the gas pressure from the chamber.

Fig 3.4 a) Removable shelf for scaffolds in gas foaming chamber, b) Demonstration of shelf being removed from the gas foaming chamber, c) Gas foaming chamber and Valworx automated release valve and positioner

Before connecting the actuated valve to the wall, the DAQ was connected via USB to a computer with the LabView software. To calibrate, we sent the LabView program a constant 0V to the actuated release valve. Then, we plugged the actuated release into a wall socket. When the valve was powered on, it received the 0V signal and moved to the prescribed shut position. Then, we set the LabView program to send 1.5V to the valve. The valve moves accordingly. This was still a closed position, but on the precipice of opening. The LabView program was then set to run. The DAQ sent 2V to the actuated release valve, allowing the valve to open up one fifth of the way and the pressure inside the gas foaming chamber returned to ambient conditions within one minute. The graphs of all of the gas foaming pressure releases can be found in Appendix B. A picture of the gas foaming chamber and actuated release valve can be seen in Figure 3.4c.

Once all of the carbon dioxide gas had been released from the chamber, the chamber was disconnected from the gas line. We opened the chamber to reveal PLGA scaffolds that had slightly expanded in volume from their previous pellet state (See Fig 3.6). The scaffolds were then left to soak in deionized water for 22 hours to leach out the salt particles, leaving behind porous PLGA structures. The scaffold fabrication process was now complete. This process was

repeated until 30 scaffolds had been made. Scaffolds maintained their 5mm diameter, but the height increased from approximately 3mm to 7mm.

Fig 3.5 A successfully gas foamed PLGA scaffold

3.1.1 SEM Images of Scaffolds

To help in determining the most reliable method of gas pressure release for scaffold fabrication, a JEOL JSM-6390 Scanning Electron Microscope (SEM) (Figure 3.7b) was used to take high magnification images of the scaffolds made using the PID-controlled valve and the scaffolds made by sending a constant 2V directly to the pressure cylinder release valve positioner. A Denton Vacuum Desk IV (Figure 3.7a) was used to sputter gold on to the surfaces of these scaffolds to prevent the SEM from overcharging the PLGA. The pressure in the Vacuum Desk IV was lowered to 100mTorr and the sputter time was set to 60s. Once gold sputtering was complete one scaffold was loaded into the SEM. The scaffold was placed into a locking mechanism that was screwed into place to prevent the scaffold from moving inside the chamber of the SEM (Figure 3.7c). The door to the SEM was closed and the pressure inside was lowered

to 50 μ Torr. The SEM's high-voltage cathode was turned on and an image was created in the JEOL JSM-6390 software. Four pictures were taken of each scaffold: one at 30x magnification that attempted to capture the majority of the surface of the scaffold and three at 100x magnification. The 100x magnification images were taken at the center of the scaffold, just to the left of the image taken at the center of the scaffold, and just to the right of the image taken at the center of the scaffold. Using the software, scalar measurements were taken of various pore widths to help make conclusions about the nature of the scaffold pores created in the two gas foaming methods.

Fig 3.6 a) Denton Vacuum Desk IV gold-sputtering scaffold top surfaces, b) JEOL JSM-6390 SEM, c) loading a gold-sputtered scaffold into the SEM

Along with the qualitative analyses made on these images, Fiji ImageJ was used to make further quantitative analyses. The settings for color threshold were set as shown in Figure 3.8. These settings were determined since they filtered all the pixels that were visibly black and nothing else as shown in Figure 3.9, where a&d show examples of the original SEM images, b&e show a mask applied to these images per the settings set in Figure 3.8, and c&f show that mask being selected for measurement. These same settings were used for each SEM image and

the filtered pixels were measured and these values were recorded into a Microsoft Excel spreadsheet.

Fig 3.7 Threshold Color settings in Fiji ImageJ for detecting pores in the surface of PLGA scaffolds

Fig 3.8 a&d) Original SEM images of scaffolds, b&e) Filtered SEM images of scaffolds, c&f) Filtered regions selected for measurements

3.2 Cell Culture

The following section describes the culture and expansion of osteoblasts for deposition on the PLGA scaffolds. I cultured osteoblasts concurrently with scaffold creation since the osteoblasts can be frozen down and later thawed for use at the appropriate time. The major processes I performed were plating, expansion, and freezing of osteoblasts. The osteoblasts used in this experiment were Cell Applications, Inc. primary adult human osteoblasts purchased from Sigma-Aldrich. The osteoblasts were on their second passage upon arrival with less than 500,000 osteoblasts present. They came in a frozen vial of basal medium containing 10% fetal bovine serum (FBS) and 10% dimethyl sulfoxide (DMSO). Aseptic procedures were strictly followed to maintain sterility when handling cells and while working under a class II biological safety cabinet.

3.2.1 Plating

The osteoblasts were plated in a flask to expand the population of cells. First, 15mL of human osteoblast growth medium (Sigma Aldrich) were pipetted into a T-75 flask. The 1mL of human osteoblasts was then removed from a portable Dewar, a cryogenic storage container containing liquid nitrogen, and allowed to mostly thaw (a small pellet of ice remaining) in a water bath kept at approximately 37°C. The osteoblasts were triturated using a pipette and carefully pipetted into the flask containing growth medium. The flask was gently rocked back and forth to evenly distribute the osteoblasts across the bottom of the flask. The flask of osteoblasts was then placed in a humidified incubator maintained at 37°C with 5% carbon dioxide. The growth medium was changed 24 hours later and then every 48 hours. When 60% confluency, a qualitative term for how much of the flask's surface area was covered by cells, was

reached, the 15mL of growth medium were replaced with 30mL of growth medium. Once 80% confluency was reached, the plating process was complete, and the osteoblasts were ready to be expanded. This process is outlined in Figure 3.10. An image of the osteoblasts at approximately 80% confluency under an optical microscope is shown in Figure 3.11.

Fig 3.9 Osteoblast plating procedure flowchart

Fig 3.10 Picture of osteoblasts at ~80% confluency taken under an optical microscope

3.2.2 Expansion

One flask of osteoblasts was expanded to yield a total of 9 flasks of osteoblasts. One extra flask was made for an on-campus senior project and three extra flasks were made to be frozen down for later use. This was achieved by first expanding the original flask into 4 flasks and dedicating one of those to the senior project. The remaining 3 flasks were expanded to 6 flasks and 3 of these flasks were frozen down for later use. The remaining 3 flasks were then expanded into the final 9 flasks. From these 9 flasks, all cells used for deposition on PLGA scaffolds were collected. Four were reserved for compression testing, 3 were reserved for Alizarin Red S staining, and 2 were reserved as extras. This is demonstrated in Figure 3.12.

Fig 3.11 Osteoblast expansion flowchart

Each passage of osteoblasts between flasks followed similar steps. The only variability between passages was the ratio to which osteoblasts were passed. Once the flasks in one passage reached a confluency of 80%, they were passed. The necessary amounts of trypsin, trypsin inhibitor, Dulbecco's phosphate-buffered saline (dPBS), and human osteoblast growth medium

were pipetted into 50mL conicals. For each flask being passed, 2mL of trypsin, 5mL of trypsin inhibitor, 15mL of dPBS, and 8mL of human osteoblast growth medium were needed. An additional 25mL of human osteoblast growth medium were needed for each flask being passed into. These materials were gathered and placed into the water bath for 15 minutes. The necessary number of new flasks were placed inside the hood. Once the 15 minutes were up, the conicals in the water bath were removed, sprayed down with 70% alcohol and placed upright inside the hood. The first flask of osteoblasts was removed from the incubator and brought inside the hood. One flask of osteoblasts was passed at a time to minimize the osteoblasts' exposure to ambient conditions. The osteoblast growth medium currently in the flask of osteoblasts was aspirated out, and the monolayer of cells was rinsed in 15mL of dPBS that was then also aspirated out. Following the rinse, 2mL of trypsin were pipetted into the flask, and the flask was rocked back and forth, continuously being checked for cell separation from the bottom of the flask. Once it had been determined that the osteoblasts had sufficiently separated from the bottom of the flask, 5mL of trypsin inhibitor and 8mL of human osteoblast growth medium were added to the flask. The entire 15mL inside the flask was suspended in a pipette and thoroughly mixed before being divided up proportionally between each of the new flasks the osteoblasts were being passed to. For example, if the passage ratio was 3:1, 5ml of the total 15ml was added to each of the 3 new flasks. Another 25mL of human osteoblast growth medium were then added to each new flask, and the new flasks were placed into the incubator. This process was followed until all osteoblasts had been passed accordingly.

3.2.3 Freezing

Throughout the expansion process, some osteoblasts were frozen down. One flask of cells was frozen down for a senior project, 3 were frozen down for future projects, and the 9 flasks at the end of the expansion process were frozen down until the scaffold fabrication process was finished. A cryovial per flask to be frozen down was obtained and labeled. The first flask to be frozen down was removed from the incubator and brought to the hood. The osteoblast growth medium in the flask was aspirated out, and 15mL of dPBS were added to the flask and also aspirated out. Then, 2mL of trypsin were added to the flask and rocked back and forth until it was determined that the osteoblasts had properly dislodged from the bottom of the flask. In addition to the 2mL of trypsin in the flask, 5mL of trypsin inhibitor and 8mL of human osteoblast growth medium were added to the flask to neutralize trypsin's effects. The resultant cell suspension was collected into a conical. The conical was then placed in a centrifuge and balanced by a conical with 15mL of water. The conical was centrifuged in an International Equipment Company model CL CLINICAL centrifuge for 4 minutes at 2,000rpm while freezing medium was made. Freezing medium is 80% human osteoblast growth medium, 10% dimethyl sulfoxide (DMSO), and 10% fetal bovine serum (FBS). 1mL is needed per cryovial. The necessary constituents of the freezing medium were micropipetted together in the hood and vortexed thoroughly. The centrifuged conical of cells was then sprayed with 70% IPA and brought inside the hood as well. The medium in the conical was aspirated off leaving behind a pellet of osteoblasts. The pellet was resuspended in 1ml of freezing medium and mixed gently with a pipette to break up any clumps of osteoblasts. The freezing medium with cells was then pipetted into a labeled cryovial and placed inside a ThermoScientific Mr. Frosty freezing

container. Once all cryovials had been made, Mr. Frosty was placed in a -80°C freezer for 24 hours and then transferred into a liquid nitrogen Dewar for long term storage.

Fig 3.12 Three cryovials of frozen human adult osteoblasts

3.2.4 Counting

There were three instances along the cell expansion process where the number of osteoblasts present in a flask were counted: before freezing down osteoblasts from passage 3, before freezing down the osteoblasts from passage 4, and before depositing osteoblasts onto the PLGA scaffolds. The cell counts were performed the same way during each of these instances. After a flask of cells had been trypsinized off the surface of a flask and stored in a conical with a certain volume of medium (specifics are given in their respective sections), a micropipette was used to collect $100\mu\text{L}$ of the cell suspension. The $100\mu\text{L}$ of cell suspension was added to a 2mL collection tube. Outside of the biological safety cabinet, $100\mu\text{L}$ of Trypan Blue was pipetted into the same collection tube and mixed within the micropipette tip. The $200\mu\text{L}$ of Trypan Blue-stained osteoblast suspension was pipetted into a BRAND hemocytometer. The hemocytometer

was placed under an optical microscope and live and dead cells were counted. The live cells were transparent and the dead cells were stained blue by the Trypan Blue. Once an average amount of viable cells per volume was determined, reverse calculations were performed to estimate how many viable cells were in the original flask or flasks of cells.

3.2.5 Growth of Osteoblasts on Scaffolds

Once the scaffolds had all been fabricated, 8 of the 9 vials of frozen osteoblasts were plated again following the same steps as the original plating procedure. When it was determined the 8 flasks of osteoblasts were one day away from reaching 80% confluency a 48-well plate with 25 scaffolds in it was set up for cell deposition. Four rows of the 48-well plate were to be used: two with Cell Applications, Inc. Human Osteoblast Differentiation Medium (ODM), one with Dulbecco's Phosphate Buffered Saline (dPBS), and one without solution. The 25 PLGA scaffolds were first soaked in 70% ethanol inside of the biological safety cabinet for 10 minutes for sterility. Then, they were removed from the ethanol and washed in dPBS, which is sterile, 5 times each to rid them of any excess ethanol which could later cause damage to deposited osteoblasts. The sterilized scaffolds were then placed in the 48-well plate with 7 in the rows A,B, and C and 4 in row D. One mL of ODM was pipetted into each well with a scaffold in rows A and B. One mL of dPBS pipetted into each well with a scaffold in row C. Row D was left without solution in it. Figure 3.14 illustrates this 48-well plate setup. The 48-well plate was then placed in the incubator for 24 hours to allow the scaffolds to soak in their respective solutions.

Fig 3.13 48-well plate setup for scaffold soak and osteoblast growth with the respective media in each well listed on the left and the dedicated experiment for each well listed above

On the second to last day of cell proliferation in the 8 plated flasks, 4 of the flasks had been contaminated with a fungal infection likely caused by a medium spill in the incubator. Immediately, these 4 flasks were properly disposed of and the incubator thoroughly cleaned. The experiment was continued on with the remaining 4 flasks of osteoblasts in hope that there would still be enough cells to accomplish the goal. When the 4 remaining plated flasks of osteoblasts reached 80% confluency, the osteoblasts were ready to be deposited onto the scaffolds. The medium was aspirated out from one flask of osteoblasts. The osteoblasts were rinsed in dPBS that was also aspirated out. Then, 2mL of trypsin were added to the flask and rocked back and forth until it had been determined that the osteoblasts had sufficiently been stripped from the surface of the flask. Afterwards, 8mL of ODM was added to the flask. The entire 10mL inside the flask was then pipetted into a 50mL conical. This was repeated for each flask of osteoblasts,

resulting in one 50mL conical with 40mL of osteoblasts, neutralized trypsin, and ODM. One hundred μ L of this solution was pipetted with a micropipette into a 2mL collection tube for cell counting. Upon completing the cell count detailed in Section 3.2.4, it was discovered that there were 8.55 million osteoblasts in the 40mL inside the 50mL conical which was greater than 7 million osteoblasts required for the experiment. Another 50mL conical was filled with 39.9mL of water. These two conicals were placed opposite of each other into an International Equipment Company model CL CLINICAL centrifuge and spun on setting 4 (2,000rpm) for 4 minutes. After centrifuging, the conical with osteoblasts was sterilized with 70% IPA and brought back into the biological safety cabinet. The supernatant was removed from the conical, and the osteoblasts were mixed inside of a pipette and pipetted into a conical with 1.7mL of ODM, the necessary amount to have approximately 1 million cells in every 0.2ml of ODM.

The 48-well plate was then removed from the incubator for osteoblast deposition. The medium and dPBS within each well of the 48-well plate was aspirated out carefully making sure not to touch the scaffolds with the aspirating pipette. Then, 0.2mL of the osteoblast solution was pipetted directly onto the 7 scaffolds in row A. After each deposition the remaining solution that seeped out of the scaffold was pipetted back onto the scaffold 5 times to ensure as many osteoblasts stuck to the scaffold as possible. The 48-well plate was then placed back inside the incubator for 2 hours to allow the osteoblasts to lodge within the scaffolds before the remaining medium was added. After 2 hours, the 48-well plate was retrieved from the incubator and brought back inside the biological safety cabinet. The remaining 0.8mL of ODM was added to each scaffold-containing well in Row A, 1mL of ODM was added to each scaffold-containing well in Row B, and 1mL of dPBS was added to each scaffold-containing well in Row C. The 48-well plate was then placed back in the incubator and the dPBS and medium were changed every

other day for what was originally planned to be 10 days, but on day 6, it was found that the contamination had made its way to the 48-well plate. The scaffolds were removed from the plate and compression tests were performed that day. The 9 scaffolds used in the calcification tests were also frozen in OCT gel, detailed in Section 3.4, that day.

3.3 Compression Testing

Compression tests were performed on 16 scaffolds to determine the Young's modulus of each. Four scaffolds were soaked in ODM with osteoblasts, 4 were soaked in ODM without osteoblasts, 4 were soaked in dPBS, and 4 were left dry. The hope was to find that the presence of osteoblasts increased the Young's modulus, and therefore material stiffness, in the PLGA scaffolds. The scaffolds soaked in ODM without osteoblasts were the control and main comparison. The scaffolds soaked in dPBS were to determine if the ODM was contributing to any observed difference in Young's moduli from dPBS. The dry scaffolds were to determine how much of an impact being wet instead of dry had on the Young's moduli of the scaffolds.

An Instron 3342 single-column tensile/compression testing machine was used with the included software, Bluehill 3, to measure the Young's moduli of scaffolds in compression. Compression platens were designed to be used with the Instron by Leah Torres. The platens were 50mm in diameter and have a capacity of 10kN. The schematic for the platens was then sent to the Cal Poly machine shop to be fabricated from 316 stainless steel. A 500N load cell was used with the Instron, meaning the compressive load was not to exceed 500N during testing. The setup of the Instron with compression platens can be seen in Figure 3.15. A program was setup within the Bluehill 3 software to run the compression tests. The program was set to measure the maximum load, Young's modulus, and ultimate compressive yield of each scaffold, and export

the raw data of load over extension into a .csv file. The program was also set with a constraint to stop testing when the load reaches 450N to protect the load cell. There were also emergency stops for if the two platens got too close together. A starting position for the top platen was arbitrarily picked to be the 6.6in. tick mark on the vertical ruler on the Instron.

The scaffolds were removed from the 48-well plate with tweezers and placed on labeled paper towels to dry for 10 minutes. One dry scaffold was placed in the center of the bottom platen. In Bluehill 3, the load and the extension were zeroed. This is the only time the extension was zeroed, however the load was zeroed at the beginning of each compression. The program was set to run, and a plot for load (N) over extension (mm) was plotted and the Young's modulus was automatically calculated. The Bluehill 3 program exported the raw data of load over extension along with a spreadsheet with the values of maximum load (N), the load at ultimate compressive yield (N), and the Young's modulus (MPa). The four dry scaffolds were all run and plotted onto one graph, then the dPBS-soaked scaffolds, then the medium-soaked scaffolds, then the medium-soaked scaffolds with osteoblasts. The platens were removed from the Instron and cleaned with 70% IPA in between each run as drops of dPBS and medium could get left behind between each compression. The compression platens were autoclaved once all compression tests were run.

Fig 3.14 Instron 3342 single-column tensile/compression testing machine with top and bottom compression platens attached

3.4 Staining

On the same day that the compression tests were run, the 9 remaining scaffolds were prepared for cryosectioning. The scaffolds were washed in 1mL dPBS twice within their wells. They were then left to sit in 1mL of 70% ethanol within their wells for 10 minutes before the ethanol was also aspirated out. Each scaffold was placed at the bottom of a labeled cryosectioning mold top down that was then filled halfway with optimum cutting temperature gel (OCT gel). The molds with OCT gel were then dipped in a portable Dewar filled with liquid nitrogen via tweezers until all the OCT gel was frozen as seen in Figure 3.16a. These molds were stored in a -18°C freezer for 48 hours.

After 48 hours, one mold was cut with a razor and popped open. The frozen OCT gel block was removed and placed on the center of a die with OCT gel on the middle. The die was placed on a shelf in a ThermoScientific Cryotome FSE cryostat to allow the fresh OCT gel to harden. The die was then placed in the main apparatus of the cryostat, and the cryostat blade was placed in its proper position as seen in Figure 3.16b. The cryostat was set to take 60µm sections

(cryostat sections are generally between 40 μ m and 60 μ m, however the 40 μ m setting failed to produce full scaffold slices). The blade was moved up against the surface of the frozen OCT block and the handle on the outside of the cryostat was spun to start taking sections of the OCT block. Sections that were deemed to be of proper quality were picked up with a tweezer and placed onto a labeled Vectabond-cured optical microscope slide. A quality section entailed a full section that included an entire cross-section of the scaffold. Efforts were made to only collect slices that did not roll up, however this was shown to be quite a difficult task. Five quality sections from each scaffold were placed on a slide dedicated to that scaffold as seen in Figure 3.16c. One dPBS-soaked scaffold OCT block was discarded due to a failure to retrieve any quality cryosections. This resulted in 8 slides being created: 2 with 5 slices of dPBS-soaked scaffold, 3 with 5 slices of ODM-soaked scaffold, and 3 with 5 slices of ODM-soaked scaffolds with deposited osteoblasts.

Fig 3.15 a) Scaffolds frozen in OCT gel in molds, b) Frozen OCT gel block in cryostat on die, c) Five cryosections from a dPBS-soaked scaffold on a Vectabond-treated slide

The next step was to stain and preserve the scaffold cryosections. Alizarin Red S purchased from Sigma Aldrich (Model # MFCD00013049) was used to stain for calcium present in the scaffold cryosections. A 75mm x 25mm glass staining jar was filled with 200mL of deionized water, and 200mg of Alizarin Red S dye was added to the water and stirred with a stirring rod under a fume hood. The 8 slides of cryosections were placed in a staining tray and submerged in the 1% Alizarin Red S solution for 4 minutes as seen in Figure 3.17a. The tray was pulled out of the solution and excess staining was shaken off as best as possible. The slides were placed on a paper towel and left to dry for 20 minutes as seen in Figure 3.17b. The Alizarin Red S solution was disposed of in an organic solvents waste container.

Images of the stained slides were taken with an Olympus CKX41 inverted microscope with the software QCapture Pro 6. All images were taken at 4x magnification, and 5 images were taken of each slide of the spots with most Alizarin Red S staining showing. It was noticed that there was physical Alizarin Red S dye on the slides that showed up in the images without staining anything in particular, so we decided to take more pictures after going through the steps to preserve the slides.

To preserve the slides, the slides were dipped in staining jars filled with 200mL of pure acetone, 200mL of a 1:1 solution of acetone and xylene, and then 200mL of pure xylene. The slides were dipped for one second 20 times in each solution and drip dried as well. The xylene and acetone-xylene solution were disposed of in a xylene waste container, and the acetone was disposed of in a organic solvents waste container.

Pictures were taken again with the inverted optical microscope after undergoing the steps to preserve the slides. These pictures were determined to show a more accurate representation of what was actually being stained and what was excess Alizarin Red S dye.

Fig 3.18 a&d) Original inverted optical microscope images of Alizarin Red S-stained cryosections, **b&e)** Filtered images of Alizarin Red S-stained cryosections, **c&f)** Filtered regions selected for measurements

RESULTS AND DISCUSSION

4.1 Comparison of Gas Foaming Release Methods

We originally planned to use a proportional-integral-derivative controller (PID) to control the release of carbon dioxide gas pressure from the gas foaming chamber before switching to sending a constant 2V to the positioner to open the release valve. This section shows the comparison of the two methods of release both graphically and via scanning electron microscope (SEM) images of scaffolds produced from both methods.

Figures 4.1 and 4.2 show six consecutive pressure over time graphs for the two different gas foaming release methods. Tables 4.1 and 4.2 collect the line of best fit constants for the second-degree polynomial lines of best fit from each graph in Figures 4.1 and 4.2 and then calculate the coefficient of variation (CoV) between the constants for each gas foaming method. Second-degree polynomial fits were chosen since they provided the best fits, R^2 values closest to 1, overall between different sets of data. The percent difference between the CoVs of each line of best fit constant between each gas foaming method tells the percent difference in variability between the different lines of best fit for the two gas foaming methods. Table 4.3 shows that the lines of best fit for the pressure releases performed with the 2V method are 59.43% less variable in the x^2 term, 50.98% less variable in the x term, and 32.76% less variable in the constant term than the pressure releases performed via the PID. This allowed us to claim that the constant 2V method produces more consistent, reproducible gas foaming pressure releases than the PID method.

Fig 4.1 Pressure vs. time graphs of six consecutive gas releases utilizing the PID to control carbon dioxide gas release

Table 4.1 Line of best fit constants from Fig 4.1 and the coefficient of variation (CoV) for each constant between gas foaming releases

		Graph						CoV
		a	b	c	d	e	f	
Lobf Constant	x ²	0.25	1.97	0.83	-0.02	0.90	-0.23	130.03
	x	-25.43	-88.88	-49.05	-12.00	-55.96	-24.13	-65.89
	c	849.45	1070.30	842.06	862.93	925.82	848.51	9.89

Fig 4.2 Pressure vs. Time graphs of six consecutive gas releases where a constant 2V was sent to the positioner

Table 4.2 Line of best fit constants from Fig 4.2 and the coefficient of variation (CoV) for each constant between gas foaming releases

		Graph						CoV
		a	b	c	d	e	f	
Lobf Constant	x ²	0.61	0.83	0.39	0.50	0.15	0.28	52.75
	x	-42.36	-49.10	-31.82	-32.97	-21.96	-22.34	-32.30
	c	848.79	817.96	831.48	759.78	855.79	866.80	4.65

Table 4.3 Calculated percent difference between the coefficients of variations (CoV), a measure of difference in variability, in the lines of best fit constants for the two gas foaming methods.

		CoV PID	CoV 2V	% less variable
Lobf Constant	x ²	130.03	52.75	59.43
	x	-65.89	-32.3	50.98
	c	9.89	6.65	32.76

The next comparison we wanted to make was between SEM images of scaffolds made with the two different methods. We originally intended to compare the number of pores in a frame and the size of the maximum diameters of these pores, but upon viewing the scaffolds under the SEM it was determined impractical to establish what was considered a pore and where to start the measurement of maximum diameter sizes from. However, even though these results are not fully quantitative, there is a lot to be compared between the impacts that the two gas foaming release methods had on scaffold formation, and measurements were made in ImageJ to get a better representation of the difference in porosity. Some measurements within the SEM program of what were considered to be pores were made as well to put perspective to the images. The gas foaming pressure release graph for the scaffolds made utilizing the PID that are being analyzed in these SEM images can be viewed in Figure 4.1f. The gas foaming pressure release graph for the scaffolds made via sending a constant 2V to the positioner that are being analyzed in these SEM images can be viewed in Figure 4.2f.

Fig 4.3 SEM images taken at 30x magnification of scaffolds made by (a&b) using a PID (c&d) sending a constant 2V to the positioner

Figure 4.3 shows SEM images of the scaffolds made via the two different methods at 30x magnification to capture their major surface structures. It can be seen that the scaffolds made utilizing the PID have large, smooth, puffed-out features likely caused by too rapid of a gas foaming release, resulting in an over-nucleation of gas pores in the PLGA particles. Looking at the scaffolds made by sending a constant 2V to the positioner at this magnification, the presence of pores is not clearly evident. There appears to be a fibrous layer covering the entire top layer of the scaffold. This is likely due to the gold that was sputtered on to the scaffolds to prevent them from overcharging in the SEM. However, when looking at SEM images at 100x magnification the approximate location of pores can be determined with higher accuracy.

Figures 4.4 and 4.5 show SEM images of the scaffolds made via the two different methods at 100x magnification to analyze the size and distribution of pores on the surface of these scaffolds. Osteoblasts are approximately 15-20 μ m in diameter (Tanaka-Kamioka et al., 1998) and pits between 30-40 μ m in diameter on scaffold surfaces have been shown to best promote osteogenic activity in the presence of bone-forming cells (Halai et al., 2014). Pores larger than the 30-40 μ m diameter range are still desirable as there will be smaller pits within these larger pores that do fall within this range. Therefore, scaffolds with pores at least 30 μ m in diameter would be suitable for osteoblast attachment, growth, and calcium deposition onto the scaffold. The SEM images in Figure 4.4 demonstrate a lack of evenly-distributed pores that are at least 30-40 μ m in diameter at the surface of the scaffolds made with the PID. There are a few pores that fit these parameters most prominently localized where the smooth puffed-out PLGA surfaces interface with the more fibrous layers underneath. However, it is doubtful that these pores penetrate far enough into the PLGA matrix to create an interconnected system of pores.

Fig 4.4 SEM images taken at 100x magnification for scaffolds made utilizing the PID. Images (a-c) are of the scaffold shown in Figure 4.3(a). Images (d-f) are of the scaffold shown in Figure 4.3(b).

Fig 4.5 SEM images taken at 100x magnification for scaffolds made by sending a constant 2V to the positioner. Images (a-c) are of the scaffold shown in Figure 4.3(c). Images (d-f) are of the scaffold shown in Figure 4.3(d).

The 100x magnification SEM images of the scaffolds made via sending a constant 2V (Figure 4.5) appear to be more promising. Multiple pores greater than 30 μ m in diameter can be seen in each image. A few prime examples are highlighted in each via the green scalar lines. A completely accurate portrayal of the porosity of these scaffolds is obscured by the gold-sputtered layer placed on these scaffolds, however, it still is evident that the scaffolds made via the constant 2V method produced results closer to what was desired for osteogenic integration due to the more evenly-distributed pores and larger pore sizes.

To further this conclusion, ImageJ was used to determine the amount of pixels in each SEM image that were dark enough to be considered surface pores. This provides quantitative data to the SEM images, however it is still important to note that this does not provide data on the number of pores and size of pores within the image, but rather an estimate on surface porosity.

Figure 4.6 shows a boxplot comparing the amount of pixels determined to be surface pores in each SEM image between the two gas foaming methods. It is evident from this figure that the scaffolds made by sending a constant 2V to the positioner tend to have a higher surface porosity. The minimum amount of pixels determined to be surface pores for scaffolds created with the 2V method is greater than 200,000 pixels, and the maximum is 425,000 pixels. In contrast, the minimum amount of pixels determined to be surface pores for scaffolds created using the PID is approximately 50,000 pixels, and the maximum is approximately 250,000 pixels. Table 4.4 gives statistical evidence to this comparison of filtered pixel values between SEM images of the scaffolds made in the two different ways via an ANOVA test. The F-ratio is 15.82, which is greater than 4, and the P-value is 0.0026, which is less than 0.05. This allows us to reject the null hypothesis that there is no statistically significant difference between the mean

amount of pixels in the SEM images determined to be surface pores between the two gas foaming methods and accept the alternative hypothesis that there is a statistically significant difference between the mean amount of pixels in the SEM images determined to be surface pores between the two gas foaming methods.

Figure 4.6 Boxplot created in JMP 12 comparing the number of pixels in an SEM image that are considered to be surface pores in the PLGA scaffolds created via the two different gas foaming methods

Table 4.4 Mean values of pixels determined to be pores in ImageJ and the resulting F-stat and P-value from running an ANOVA in JMP 12 on the number of measured pore pixels in the SEM images of scaffolds made via the different gas foaming methods

2V Mean (Pore Pixels)	PID Mean (Pore Pixels)	F-stat	P-value
294643	134573	15.82	0.0026

The combined results from the pressure release graphs and SEM images taken for the two different gas foaming methods show the constant 2V method to be the more ideal method of gas foaming pressure release. Using the PID, even with its most ideal PID constants, is unreliable in producing reproducible results in scaffold fabrication. Using the PID instead of the constant 2V

method would be a waste of both materials and time. Most likely, SEM images would need to be taken of one scaffold from each batch of scaffolds fabricated to determine if the gas foaming was successful in producing scaffolds of proper porosity. The constant 2V method produces much more consistent results as seen by the extreme difference in the variability of line of best fit constants between Tables 4.1 and 4.2. The SEM images of the scaffolds made via the constant 2V method show an interconnected matrix of pores with diameters larger than the necessary 30 μ m for osteoblast adhesion, whereas the SEM images for the scaffolds made with the PID show a lack of desirable pore sizes and a lack of connectivity of pores. JMP 12 was used to further demonstrate that the surface porosity of the scaffolds made with the constant 2V was significantly greater than the surface porosity of scaffolds made with the PID. Due to these results, the PID in the NI LabView program was bypassed and a constant 2V was sent to the positioner during gas foaming releases.

4.2 Discussion Regarding the Contamination

The growth of osteoblasts onto the PLGA scaffolds was stopped prematurely due to a fungal infection that had contaminated the 48-well plate. There were four potential reasons for this infection: human error during culture, a medium stain in the incubator, an old bottle of human osteoblast growth medium was used during plating (3 months old), and the aspirating waste container was full past the normal disposal line. The medium stain in the back of the incubator was near the affected flasks of osteoblasts at the time and had what could have been identified as white hairs on it, however this diagnosis is uncertain. The origin of this medium stain is uncertain. The old osteoblast growth medium showed no signs of pH change, indicated

by medium color, whereas the contaminated osteoblast-containing medium turned to a yellowish-salmon from its usual red hue, indicating a decrease in pH. It also seems very unlikely that the contamination arose from the aspirating waste container, but it still must be documented as a possibility. Human error in aseptic protocol is also always a potential source for contamination and therefore must be taken into account as well. All potential sources of contamination were taken care of as soon as they were noticed. The growth of osteoblasts onto scaffolds was not restarted due to the expense of both time, which would have been approximately 1.5 months to make new scaffolds and expand osteoblasts, and money, largely due to the price of human osteoblast growth medium. While the fact that osteoblasts were grown on to the scaffolds for only 6 days as opposed to 10 days is unfortunate, any extracellular matrix secreted by the osteoblasts while they were alive could still be determined with Alizarin Red S staining, and any effect on Young's moduli from secreted extracellular matrix components could still be determined through compression testing.

4.3 Results of Staining

Alizarin Red S staining was performed to look for calcium in the cryosectioned scaffolds. There were 3 scaffold treatments being looked at: Dulbecco's Phosphate Buffered Saline (dPBS)-soaked scaffolds, Human Osteoblast Differentiation Medium (ODM)-soaked scaffolds, and ODM-soaked scaffolds that had osteoblasts deposited on them. The hypothesis was that the scaffolds that had osteoblasts deposited on them would have the most calcium present due to the calcium that would be synthesized by the osteoblasts. The ODM-soaked scaffolds without osteoblasts were thought to potentially have some calcium present as the components of the

media were nondisclosed to the public, but likely contains calcium to help promote osteogenesis. The dPBS-soaked scaffolds were to serve as a control as calcium is not a component of dPBS, nor was it used in scaffold fabrication.

Figure 4.7 shows the images taken of the different scaffold treatment groups via an inverted optical microscope. As expected, there was no Alizarin Red S staining in the dPBS-soaked scaffolds as there were no calcium-containing components present. There was some staining present in the ODM-soaked scaffolds which was not unexpected. Most of the staining in the ODM-soaked scaffolds was aqueous, however there were a few aggregated stains most noticeably in ODM3. These aggregated stains were even more present in the ODM-soaked scaffolds that had osteoblasts on them. These aggregated stains were more pronounced, stained more heavily, and appeared more frequently than the aggregated stains of the ODM-scaffolds without osteoblasts. Larger versions of the images in Figure 4.7 can be found in Appendix C.

The perceived increase in aggregated clumps of Alizarin Red S-stained material seen in the scaffold cryosections that had osteoblasts deposited on them tells us that, in the 6 days of osteoblast growth on the scaffolds, the osteoblasts deposited calcium on the PLGA matrix. The perceived increase in Alizarin Red S-stained material seen in the scaffolds that had osteoblasts deposited on them should allow us to make correlations of any perceived trend in compression testing data if proven significant.

Fig 4.7. Images taken with an inverted optical microscope at 4x magnification of scaffold cryosections stained in Alizarin Red S. There are 2 dPBS-soaked scaffolds labeled as dPBS[scaffold #]. There are 3ODM-soaked scaffolds labeled as ODM[scaffold #]. There are 3ODM-soaked scaffolds that had osteoblasts deposited on them labeled as Ob[scaffold #]. Components stained red contain calcium.

Fiji ImageJ was used in an attempt to gain quantitative insight on the trend seen qualitatively by measuring the amount of pixels in the different 4x magnification inverted optical microscope images that were stained by Alizarin Red S. These values of Alizarin Red S-stained pixels were analyzed in JMP 12 for statistical significance. Figure 4.8 shows a boxplot of the different scaffold treatment groups' Alizarin Red S-stained pixels. The dPBS-soaked scaffolds clearly show much less Alizarin Red S staining than the other two treatment groups. The scaffolds that had osteoblasts deposited on them show on average more Alizarin Red S staining than the ODM-soaked scaffolds without osteoblasts, and one image had significantly more Alizarin Red S-stained pixels (almost 5x as much as the next largest measurement) than the rest of the images. Table 4.5 shows the mean values of total number of pixels in each inverted optical microscope image determined to be Alizarin Red S-stained material in ImageJ and the results of an ANOVA run between all of the treatment groups. The F-statistic of 7.47, which is greater than 4, and the P-value of 0.0019, which is less than 0.05, allows us to reject the null hypothesis that the means between each treatment group are the same (not statistically significant), and accept the alternative hypothesis that at least one of the means is different (statistically significant). Table 4.6 allows us to determine which means are statistically significantly different from the others by performing a Tukey's HSD post-hoc analysis. This analysis compares each treatment group with each treatment group. Table 4.6 shows that the scaffolds that had osteoblasts deposited on them have a statistically significantly larger amount of Alizarin Red S-stained pixels than both the scaffolds that were soaked in ODM without osteoblasts and the dPBS-soaked scaffolds via the P-value less than 0.05. The ODM-soaked scaffolds without osteoblasts and the dPBS-soaked scaffolds are not statistically significantly different. This furthers our belief that that the osteoblasts had a significantly positive effect on the amount of calcium present in

the PLGA scaffolds. It is important to take into account that the variability in the cryosectioned slices diminishes the complete accuracy of the quantitative results, nonetheless, the extreme difference in Alizarin Red S-stained pixels shown by the JMP 12 output allows us to continue to claim that the osteoblasts deposited on the scaffolds had a significant effect.

Fig 4.8 Boxplot created in JMP 12 comparing the distribution of amount of Alizarin Red S-stained pixels in each inverted optical microscope image for the three treatment groups

Table 4.5 Mean values of pixels determined to be Alizarin Red S-stained material in ImageJ and the resulting F-stat and P-value from running an ANOVA in JMP 12

Ob Mean (ARS pixels)	ODM Mean (ARS pixels)	PBS mean (ARS pixels)	F-stat	P-value
49841	7371	149	7.47	0.0019

Table 4.6 P-values from all pairs Tukey's HSD output comparing individual treatment groups with each other for the amount of Alizarin Red S-stained pixels in each inverted optical microscope image

Comparison	P-value
Ob - PBS	0.0051
Ob - ODM	0.0075
ODM - PBS	0.8773

4.4 Results of Compression Testing

Compression tests were ran on 16 scaffolds: 4 soaked in Human Osteoblast Differentiation Medium (ODM) that had osteoblasts deposited on them, 4 soaked in ODM without osteoblasts, 4 soaked in Dulbecco's Phosphate Buffered Saline (dPBS), and 4 left dry. Graphs of the compressive load (N) over extension (mm) were created in real time. The Bluehill 3 software also calculated and exported the Young's modulus (MPa), maximum load experienced (N), and load at the ultimate compressive yield point (N) of each scaffold tested.

Figure 4.9 shows graphs of applied compressive load over extension of each scaffold tested. There are no obvious irregularities between the curves between samples or treatment groups. Figure 4.9 seems to show that the scaffolds compressed similarly. There are no yield points as characterized by Figure 2.8 and therefore no values for load at yield were recorded. All of the compression runs set off the condition to terminate the test when 450N were reached and as such all the recorded values for maximum load are all around 450 N. The raw data of the compression tests can be seen in Appendix D.

Fig 4.9 The compressive load (N) over extension (mm) of each scaffold in each treatment condition. The orange line represents the first scaffold of a treatment group test, the red is the second, the green is the third, and the light blue is the fourth. The load starts increasing at roughly the same point in extension for each sample in a treatment group, but is shown shifted for visibility.

Table 4.7 shows the Young's moduli for all the scaffolds that underwent compression testing and it shows the mean value and standard deviation for each treatment group. We thought that the second scaffold tested for the scaffolds that had osteoblasts deposited on them might be an outlier due to the way in which it compressed, in which case the mean for the Young's modulus of scaffolds that had osteoblasts deposited on them would be 173.20MPa. The scaffold in question had a slanted top surface as opposed to the other scaffolds' top surfaces which were more parallel to the compression platens. The software, JMP 12 was used to determine if the scaffold was indeed an outlier. A specimen can be determined to be an outlier if it exceeds 1.5x the interquartile range from the first or third quantile (Zinc, 2010).

Table 4.7 Table of Young's moduli of each scaffold compressed in each treatment group in MPa.

		Young's Moduli (MPa)			
Specimen #		Scaffold Type			
		Dry	PBS	ODM	ODM + Ob
	1	153.26	166.63	164.20	153.93
	2	166.48	184.53	183.41	128.73
	3	158.70	156.53	179.27	181.43
	4	148.70	154.98	161.76	184.25
	Mean	156.79	165.67	172.16	162.09
	Std. Dev.	7.648685	13.5932	10.78221	26.107403

Table 4.8 shows the interquartile range and the first quantile of the Young's moduli values for compression testing on the osteoblast-containing scaffolds. From this, we can determine that 1.5x the interquartile range from the first quantile is 86.51 (135.03 - 48.52). This means that the value of 128.73MPa cannot be determined as an outlier, since it is not lower than 86.51. However, that does not necessarily mean that it is not an outlier. With such a small sample size (n=4), every data point has an influential impact on where the quantiles rest, and the Young's modulus value of 128.73MPa has a very influential impact on the value of the first quantile.

Table 4.8 The interquartile range and first quantile of the Young's moduli values for the compression tests run on the osteoblast-containing scaffolds

Interquartile Range	First Quantile
48.52	135.03

Tables 4.9 and 4.10 show the JMP 12 output for the student's t-test between each pair of scaffold types (indicated by levels) and gives the p-value of each comparison. In these comparisons the null hypothesis is that there is no statistically significant difference between scaffold types and the alternative hypothesis is that there is a statistically significant difference between scaffold types. In both scenarios, with and without the 128.73MPa value, we fail to

reject the null hypothesis that there is no statistically significant difference between scaffold types since there is no P-value lower than the α value of 0.05. Therefore, it does not matter if the 128.73MPa value is an outlier or not as the difference in mean values for the Young's moduli between scaffold types cannot be proven as statistically significant.

Table 4.9 Individual student's T-test Young's moduli between each pair of scaffold types including the 128.73 value ($\alpha = 0.05$)

Comparison		
Type	Type	P-value
ODM	ob	0.3945
ODM	PBS	0.5798
ODM	Dry	0.2026
PBS	ob	0.7589
PBS	Dry	0.4513
ob	Dry	0.6505

Table 4.10 Individual student's T-test Young's moduli between each pair of scaffold types excluding the 128.73 value ($\alpha = 0.05$)

Comparison		
Type	Type	P-value
ODM	ob	0.9129
ODM	PBS	0.4678
ODM	Dry	0.1025
PBS	ob	0.4361
PBS	Dry	0.3256
ob	Dry	0.106

The small sample size used is another factor towards why statistical significance cannot be proved. This can be illustrated by the equation for standard error. The standard error for a sample statistic indicates the precision of the sample mean of a given population (Diong, 2016). In this case, the standard error indicates the precision of the mean value for the Young's modulus of each scaffold treatment. Standard error is equal to the standard deviation of a set of data over the square root of the sample size. Therefore, larger sample sizes produce smaller standard

errors, which in turn produce smaller confidence intervals, increasing the chance of attaining a statistically significant p-value (CASC, 2018).

Even though the results of the compression testing were shown to be inconclusive, the possibility that the presence of osteoblasts strengthens the material stiffness of PLGA has not been disproven. Past experiments have shown that osteoblasts should increase the stiffness of the material they are grown on as they increase mineral volume on that material (Turner, 2006). The growth of osteoblasts onto the scaffolds was stopped prematurely and looking at the Young's moduli without the questionable scaffold compression data point shows a higher Young's modulus (173.20MPa) than any of the other treatment conditions. However, the values of Young's moduli received from our compression testing do approximate literature values seen for the Young's modulus of trabecular bone. Values for the Young's modulus of native trabecular bone have been reported to range from 1MPa to 199.5MPa (Lakatos, Magyar, & Bojtár, 2014). All of the scaffolds' Young's moduli fall within the range of native trabecular bone and therefore our scaffold fabrication process shows promise in replicating the material properties of trabecular bone tissue. It may be beneficial to attempt to measure some other material property or multiple different material properties to gain further insight on the ability of gas foaming to create scaffolds that replicate native trabecular bone. The Young's moduli values from compression testing all fall within the range of trabecular bone, making determining statistical significance a challenge in whether the presence of osteoblasts make these gas foamed scaffolds more similar to trabecular bone or not.

Chapter 5

SUMMARY AND CONCLUSIONS

This experiment intended to determine if the presence of osteoblasts made PLGA scaffolds more similar to native trabecular bone. The results of compression testing failed to show any statistically significant difference in stiffness via the Young's moduli for any of the scaffold treatments. However, there are multiple factors involved in this lack of statistical significance. For one, the growth of osteoblasts onto the PLGA scaffolds was stopped prematurely due to a fungal infection that had contaminated the 48-well plate. The small sample size of the scaffolds tested in compression testing was another influential factor in the lack of statistical significance between Young's moduli for each treatment. One scaffold that had osteoblasts deposited on it had a calculated Young's modulus that was much smaller in comparison to the other scaffolds that had osteoblasts deposited on them. This can possibly be attributed to the irregular nature of the top surface of that particular scaffold, where the top surface was slanted as opposed to parallel with compression platens, affecting the way in which the scaffold was compressed. However, the scaffold in question cannot be proven as an outlier largely due to the small sample size of $n=4$. While there is no statistically significant difference in Young's moduli between the different treatment groups, all of the values fall within the literature value range for native trabecular bone of 1MPa to 199.5MPa (Lakatos et al., 2014).

This experiment also intended to determine if gas foaming could be utilized to create scaffolds for bone regenerative therapies. Our test for calcification showed an increased expression of calcium-containing components on the scaffolds that had osteoblasts deposited on

them by a more defined and larger presence of Alizarin Red S-stained components. This provides evidence that osteoblasts can be grown on gas foamed PLGA scaffolds and that the osteoblasts will secrete calcium-phosphate crystals onto the PLGA scaffold.

The pressure vessel on the California Polytechnic State University of San Luis Obispo campus has now been modified and improved for the purpose of gas foaming scaffolds for bone tissue engineering. This project sets the guidelines on how gas foaming polymer scaffolds can be accomplished and it is flexible enough to be modified for various needs. The NI LabView software created to control the gas pressure release valve can either send a constant voltage to the valve positioner or make use of a programmed Proportional-Integral-Derivative controller. Making use of either of these with different parameters may better suit different polymers and tests will need to be done to determine which method with what parameters is necessary to produce the desired gas foaming results for a specific project.

This project determined that using the NI LabView program to send a constant 2V to the positioner produced the most desirable results for gas foaming PLGA to produce scaffolds for osteoblast growth. The observed porosity of these scaffolds showed an interconnected matrix of pores with diameters larger than 30 μ m, the diameter shown to best promote osteogenic activity in the presence of bone-forming cells (Halai et al., 2014). The best PID constants for producing gas foamed PLGA scaffolds were determined to be $K_p = 0.056$, $K_i = 20,000$, and $K_d = 0.44$, however, even under these conditions, sending a constant 2V to the positioner proved to create more consistent gas foaming results with desirable pore sizes.

In future projects, it would be beneficial to try different salt to PLGA ratios to determine if a particular ratio produced more desirable results than the ratio of 80% salt and 20% PLGA we

used. We used this ratio since we feared, if less PLGA was used, the PLGA particles would not be close enough together to properly fuse when gas foamed. However, we believe the scaffolds could be even more porous as that would provide more sites for osteoblasts to adhere to. The overall substrate stiffness should decrease in the gas foamed scaffolds, but the presence of osteoblasts may have a more noticeable effect on stiffness due to having more sites for cell integration. This experiment will need to be redone to achieve the full 10 days of osteoblast growth on to the scaffolds and we suggest attempting to use a 90% salt and 10% PLGA ratio for increased porosity. It would also be interesting to test different copolymers such as PLGA/hydroxyapatite to determine if these copolymers better promote osteogenic activity than pure PLGA scaffolds and to record how these copolymers respond to the gas foaming method. There are two reasons hydroxyapatite would be interesting to include as a substrate material. One, the senior project that used a flask of the osteoblasts we grew showed increase osteoblast vitality in the presence of osteoblasts. Two, 50% of the volume of human bone is made up of hydroxyapatite crystals (Junqueira & Carneiro, 2005). In future experiments, it could also be beneficial to increase the cell seeding density of osteoblasts onto individual scaffolds as one million osteoblasts was an arbitrary value picked for this experiment. It also would be beneficial to look into different methods of mechanically testing the scaffolds for similarities to native trabecular bone as measuring stiffness via compression testing did not provide statistically significant results and all the Young's moduli for the different scaffolds fell within the range of trabecular bone already.

This experiment tested two things: the ability and efficiency of using gas foaming to create PLGA scaffolds for cell deposition and whether or not the presence of osteoblasts on PLGA scaffolds made the scaffolds more similar to trabecular bone. Gas foaming was proven to

be a useful and innovative tool in the world of bone tissue engineering to create PLGA scaffolds, and it was shown that osteoblasts successfully secreted extracellular matrix components onto the scaffolds. The presence of osteoblasts did not have a statistically significant effect on the stiffness of the PLGA scaffolds, but the Young's modulus values found did fall in the range of literature values for native trabecular bone furthering the evidence of gas foaming being a practical method of creating scaffolds for tissue engineering. Gas foaming was proven to be an effective, novel method of creating scaffolds for bone tissue engineering, but the presence of osteoblasts was not shown to increase the scaffolds' stiffness to that of native trabecular bone.

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APPENDIX A: DETERMINING THE PROPORTIONAL-INTEGRAL-DERIVATIVE CONSTANTS

The most crucial consideration when gas foaming is the rate of carbon dioxide release from the gas foaming chamber. During a successful gas release, a thermodynamic instability occurs, fusing the polymer particles together. To create a repeatable process for releasing the valve, a National Instruments LabView program was created, shown in Figure A.1. This program reads the pressure inside the gas foaming chamber from a pressure transducer connected to a National Instruments USB-6002 Data Acquisition board (DAQ). The program also sends out a voltage through the DAQ to a positioner on the actuated release valve (Valworx #565255), and the voltage sent out, ranging from 0 to 10V, determines the position of the release valve. Originally, a Proportional-Integral-Derivative controller (PID) was used to create a reproducible method of gas release, but it was later discarded when it was found that just sending 2V to the positioner yielded the desired pressure release in a more reproducible manner. However, it is still important to mention that this PID program exists if future projects plan to make use of the gas foaming chamber and sending a constant 2V to the actuated valve doesn't produce desired foaming results. More information on how a PID works is detailed in Section 2.4.

For this experiment, the most optimum PID constants were found to be $K_p = 0.056$, $K_i = 20,000$, and $K_d = 0.44$. The range of voltages the PID sent to the DAQ to the actuator valve was 1.5V to 2.25V. The set point was made to decrease pressure from 800 psi to 0 linearly over the course of 30 seconds. Figures A.2-A.8 and Tables A.1 and A.2 showcase the pressure releases over time with these values and with changing each value by 1% in either direction to demonstrate that these values are the most optimum values to get the process variable to follow the set point.

Figure A.1 NI LabView program of PID controller for controlling actuated release valve on gas foaming apparatus

Figure A.2 Three repetitions of gas release over 30s with a PID setting of P=0.056, I=20000, D=0.44 (Chosen PID settings)

Figure A.3 Three repetitions of gas release over 30s with a PID setting of P=0.055, I=20000, D=0.44 (-1% P)

Figure A.4 Three repetitions of gas release over 30s with a PID setting of $P=0.057$, $I=20000$, $D=0.44$ (+1% P)

Figure A.5 Three repetitions of gas release over 30s with a PID setting of $P=0.056$, $I=19800$, $D=0.44$ (-1% I)

Figure A.6 Three repetitions of gas release over 30s with a PID setting of $P=0.056$, $I=20200$, $D=0.44$ (+1% I)

Figure A.7 Three repetitions of gas release over 30s with a PID setting of $P=0.056$, $I=20000$, $D=0.40$ (-1% D)

Figure A.8 Three repetitions of gas release over 30s with a PID setting of P=0.056, I=20000, D=0.48 (+1%D)

Table A.1 Summarized line-of-best-fit values from each PID run in Figures A.2 - A.8

	P	I	D	x ²	x	c	R ²
	Ideal	Ideal	Ideal	0	-26.7	800	1
Chosen	0.056	20000	0.44	-0.02	-12.00	862.90	0.9883
	0.056	20000	0.44	0.90	-55.96	925.82	0.9906
	0.056	20000	0.44	-0.23	-24.13	894.51	0.9515
"-1% P"	0.055	20000	0.44	-0.02	-3.22	789.22	0.7412
	0.055	20000	0.44	1.77	-84.30	1041.00	0.9638
	0.055	20000	0.44	2.38	-92.82	864.70	0.8331
"+1% P"	0.057	20000	0.44	2.15	-84.18	796.92	0.8305
	0.057	20000	0.44	0.35	-33.52	846.08	0.9928
	0.057	20000	0.44	0.13	-8.76	830.65	0.9012
"-1% I"	0.056	19800	0.44	1.95	-74.27	693.70	0.7936
	0.056	19800	0.44	2.29	-91.74	900.12	0.8668
	0.056	19800	0.44	1.95	-73.23	665.11	0.7257
"+1% I"	0.056	20200	0.44	2.08	-89.73	968.14	0.9133
	0.056	20200	0.44	2.15	-86.29	850.99	0.9186
	0.056	20200	0.44	2.05	-89.44	984.23	0.9072
"-1% D"	0.056	20000	0.40	0.20	-24.02	831.77	0.9757
	0.056	20000	0.40	0.25	-12.11	845.22	0.7434
	0.056	20000	0.40	0.21	-19.54	876.36	0.982
"+1% D"	0.056	20000	0.48	1.37	-73.73	1021.60	0.9401
	0.056	20000	0.48	0.29	-45.52	1015.10	0.8745
	0.056	20000	0.48	1.90	-71.86	655.80	0.7205

Table A.2 Average line-of-best-fit values from PID runs in Figures A.2 - A.8 and their percent difference from the ideal values.

P	I	D	x ²	x	c	
Ideal	Ideal	Ideal	0	-26.7	800	
0.056	20000	0.44	0.22	-30.70	894.41	Avg.
			N/A	14.97%	11.80%	% diff from ideal
0.055	20000	0.44	1.38	-60.11	898.31	Avg.
			N/A	125.14%	12.29%	% diff from ideal
0.057	20000	0.44	0.88	-42.15	824.55	Avg.
			N/A	57.88%	3.07%	% diff from ideal
0.056	19800	0.44	2.06	-79.75	752.98	Avg.
			N/A	198.68%	-5.88%	% diff from ideal
0.056	20200	0.44	2.09	-88.49	934.45	Avg.
			N/A	231.41%	16.81%	% diff from ideal
0.056	20000	0.40	0.22	-18.56	851.12	Avg.
			N/A	-30.50%	6.39%	% diff from ideal
0.056	20000	0.48	1.19	-63.70	897.50	Avg.
			N/A	138.59%	12.19%	% diff from ideal

The NI LabView program was set up such that the PID tried to match the actual pressure release (process variable) to a linear decline from 800psi to 0 over 30s (set point), shown as the ideal values in Tables A.1 and A.2. Table A.2 demonstrates the PID values of $P = 0.056$, $I = 20,000$, and $D = 0.44$ as the most ideal PID constants within 1% of their values. Changing either the P constant, I constant, or D constant by 1% in the positive or negative direction results in a further derivation from the set point. The fitted lines of best fit were second-degree polynomials and the set point was a linear decline, therefore, the x^2 term in the line of best fit closest to 0 was most ideal. The smallest percent difference from the set point for the x term and constant term for the line of best fit were also the most ideal. Of the tested values in Table A.2, the PID constant terms set to $P = 0.056$, $I = 20,000$, and $D = 0.44$, yielded the closest results on average to the set point.

APPENDIX B: GAS FOAMING PRESSURE RELEASE GRAPHS

There were five iterations of gas foaming during scaffold fabrication. Six scaffolds were gas foamed at a time, resulting in 30 scaffolds created in total. Figures B.1-B.5 show the pressure releases for each gas foam over time.

Fig. B.1 Gas foaming pressure release preformed on 05/10/2018

Fig. B.2 Gas foaming pressure release preformed on 05/11/2018

Fig. B.3 Gas foaming pressure release preformed on 05/12/2018

Fig. B.4 Gas foaming pressure release preformed on 05/14/2018

Fig. B.5 Gas foaming pressure release preformed on 05/15/2018

APPENDIX C: IMAGES FROM FIGURE 4.7

Figure 4.7 shows the results of the Alizarin Red S staining of scaffold cryosections. The same images from that figure are displayed here but larger for closer analysis.

Fig C.1 Five inverted optical microscope images of Alizarin Red S-stained dPBS-soaked scaffold #1 cryosections taken at 4x magnification

Fig C.2 Five inverted optical microscope images of Alizarin Red S-stained dPBS-soaked scaffold #2 cryosections taken at 4x magnification

Fig C.3 Five inverted optical microscope images of Alizarin Red S-stained ODM-soaked scaffold #1 cryosections taken at 4x magnification

Fig C.4 Five inverted optical microscope images of Alizarin Red S-stained ODM-soaked scaffold #2 cryosections taken at 4x magnification

Fig C.5 Five inverted optical microscope images of Alizarin Red S-stained ODM-soaked scaffold #3 cryosections taken at 4x magnification

Fig C.6 Five inverted optical microscope images of Alizarin Red S-stained ODM-soaked scaffold with osteoblast action #1 cryosections taken at 4x magnification

Fig C.7 Five inverted optical microscope images of Alizarin Red S-stained ODM-soaked scaffold with osteoblast action #2 cryosections taken at 4x magnification

Fig C.8 Five inverted optical microscope images of Alizarin Red S-stained ODM-soaked scaffold with osteoblast action #3 cryosections taken at 4x magnification

APPENDIX D: COMPRESSION TESTING RAW DATA

Table D.1 Osteoblast-Containing Scaffolds Specimen 1 Raw Compression Data

Extension (mm)	Load (N)	Compressive stress (MPa)	Compressive strain (mm/mm)	Extension (mm)	Load (N)	Compressive stress (MPa)	Compressive strain (mm/mm)
0	-0.00017	-0.00001	0	2.76031	0.00111	0.00006	0.55206
0.00328	-0.00035	-0.00002	0.00066	2.80312	0.00235	0.00012	0.56062
0.02547	0.01944	0.00099	0.00509	2.84562	0.00278	0.00014	0.56912
0.06813	0.05741	0.00292	0.01363	2.88797	0.00046	0.00002	0.57759
0.11375	0.07584	0.00386	0.02275	2.93047	-0.00119	-0.00006	0.58609
0.155	0.05843	0.00298	0.031	2.97297	0.00049	0.00003	0.59459
0.19797	0.03251	0.00166	0.03959	3.01516	0.00112	0.00006	0.60303
0.24703	0.0211	0.00107	0.04941	3.05703	-0.00063	-0.00003	0.61141
0.29766	0.01953	0.00099	0.05953	3.09859	-0.00043	-0.00002	0.61972
0.34594	0.01089	0.00055	0.06919	3.14062	-0.00022	-0.00001	0.62813
0.39281	-0.00146	-0.00007	0.07856	3.18297	0.00097	0.00005	0.63659
0.43984	-0.00708	-0.00036	0.08797	3.22562	0.00164	0.00008	0.64512
0.48703	-0.00557	-0.00028	0.09741	3.26781	0.00141	0.00007	0.65356
0.53344	-0.00144	-0.00007	0.10683	3.31031	0.00141	0.00007	0.66206
0.57844	-0.00366	-0.00019	0.11569	3.35281	0.00047	0.00002	0.67056
0.62281	-0.00449	-0.00023	0.12456	3.39453	0.00049	0.00003	0.67891
0.6675	-0.00205	-0.0001	0.1335	3.43609	-0.00041	-0.00002	0.68722
0.71266	0.00082	0.00004	0.14253	3.47859	0.00125	0.00006	0.69572
0.75719	0.00079	0.00004	0.15144	3.52203	0.00256	0.00013	0.70441
0.80094	-0.00052	-0.00003	0.16019	3.56547	0.00238	0.00012	0.71309
0.84469	-0.00173	-0.00009	0.16894	3.60828	-0.00067	-0.00003	0.72166
0.88844	-0.00096	-0.00005	0.17769	3.65047	-0.00118	-0.00006	0.73009
0.93172	-0.00247	-0.00013	0.18634	3.6925	0.00018	0.00001	0.7385
0.97516	-0.00322	-0.00016	0.19503	3.73391	0.00042	0.00002	0.74678
1.01922	0.00004	0	0.20384	3.77562	0.00155	0.00008	0.75512
1.06297	0.00083	0.00004	0.21259	3.81781	0.00212	0.00011	0.76356
1.10609	-0.00185	-0.00009	0.22122	3.86031	0.00064	0.00003	0.77206
1.14875	-0.00395	-0.0002	0.22975	3.90266	0.00186	0.00009	0.78053
1.19109	-0.00257	-0.00013	0.23822	3.94531	0.0039	0.0002	0.78906
1.23328	-0.0015	-0.00008	0.24666	3.98781	0.00383	0.0002	0.79756
1.27563	-0.00079	-0.00004	0.25513	4.03031	0.00192	0.0001	0.80606
1.31828	-0.00007	0	0.26366	4.07281	-0.00165	-0.00008	0.81456
1.36094	0.00215	0.00011	0.27219	4.11547	-0.00161	-0.00008	0.82309
1.40328	0.00182	0.00009	0.28066	4.15766	-0.00245	-0.00012	0.83153
1.44594	0.0001	0	0.28919	4.19922	-0.00324	-0.00017	0.83984
1.48891	0.00185	0.00009	0.29778	4.24141	-0.00074	-0.00004	0.84828
1.53172	0.0052	0.00026	0.30634	4.28469	0.00088	0.00004	0.85694
1.57438	0.00532	0.00027	0.31488	4.3275	0.00084	0.00004	0.8655
1.61734	0.00235	0.00012	0.32347	4.36875	0.00032	0.00002	0.87375
1.66031	0.00069	0.00004	0.33206	4.41047	0.00016	0.00001	0.88209
1.70297	0.00146	0.00007	0.34059	4.45313	0.00284	0.00014	0.89063
1.74516	0.00016	0.00001	0.34903	4.49563	0.00388	0.0002	0.89913
1.78734	-0.00207	-0.00011	0.35747	4.53797	0.00221	0.00011	0.90759
1.82922	-0.00028	-0.00001	0.36584	4.58063	0.00081	0.00004	0.91613
1.87078	-0.00142	-0.00007	0.37416	4.62359	0.00042	0.00002	0.92472
1.91266	-0.00176	-0.00009	0.38253	4.66594	0.00229	0.00012	0.93319
1.955	0.00033	0.00002	0.391	4.70859	0.00151	0.00008	0.94172
1.99734	0.00196	0.0001	0.39947	4.75156	0.00103	0.00005	0.95031
2.03984	0.00389	0.0002	0.40797	4.79437	0.00158	0.00008	0.95888
2.08266	0.00375	0.00019	0.41653	4.83672	0.00035	0.00002	0.96734
2.12563	0.00289	0.00015	0.42513	4.87828	-0.00215	-0.00011	0.97566
2.16828	0.00246	0.00013	0.43366	4.91984	-0.00101	-0.00005	0.98397
2.21078	0.00184	0.00009	0.44216	4.96156	0.00178	0.00009	0.99231
2.25359	0.00069	0.00004	0.45072	5.00359	0.00203	0.0001	1.00072
2.29641	0.0005	0.00003	0.45928	5.04625	0.00187	0.0001	1.00925
2.33875	-0.00142	-0.00007	0.46775	5.08875	0.00445	0.00023	1.01775
2.38078	-0.00215	-0.00011	0.47616	5.13094	0.00535	0.00027	1.02619
2.42297	-0.00241	-0.00012	0.48459	5.17312	0.00423	0.00022	1.03462
2.46469	-0.00165	-0.00008	0.49294	5.21578	0.00318	0.00016	1.04316
2.50625	-0.00021	-0.00001	0.50125	5.25844	0.00257	0.00013	1.05169
2.54828	0.00093	0.00005	0.50966	5.30094	0.00108	0.00005	1.06019
2.59078	0.00046	0.00002	0.51816	5.34312	-0.00208	-0.00011	1.06862
2.63312	-0.00022	-0.00001	0.52662	5.38562	-0.00156	-0.00008	1.07712
2.675	0.00074	0.00004	0.535	5.42859	0.0017	0.00009	1.08572
2.71734	0.00032	0.00002	0.54347	5.47141	0.00107	0.00005	1.09428

Extension (mm)	Load (N)	Compressive stress (MPa)	Compressive strain (mm/mm)	Extension (mm)	Load (N)	Compressive stress (MPa)	Compressive strain (mm/mm)
5.51375	-0.00053	-0.00003	1.10275	8.2625	0.00362	0.00018	1.6525
5.55547	-0.00189	-0.0001	1.1109	8.30516	0.00345	0.00018	1.66103
5.59688	-0.00173	-0.00009	1.11937	8.34797	0.00491	0.00025	1.66959
5.63812	-0.00067	-0.00003	1.12762	8.39062	0.00371	0.00019	1.67813
5.68031	0.00147	0.00007	1.13606	8.43281	0.00081	0.00004	1.68656
5.72281	0.00365	0.00019	1.14456	8.47516	0.00061	0.00003	1.69503
5.76562	0.0022	0.00011	1.15313	8.51766	0.00247	0.00013	1.70353
5.80828	0.00249	0.00013	1.16166	8.56	0.00344	0.00018	1.712
5.85078	0.00289	0.00015	1.17016	8.6025	0.00399	0.0002	1.7205
5.89328	0.00311	0.00016	1.17866	8.64516	0.00383	0.0002	1.72903
5.93578	0.00367	0.00019	1.18716	8.68734	0.00119	0.00006	1.73747
5.97844	0.00137	0.00007	1.19569	8.72891	-0.00172	-0.00009	1.74578
6.02109	-0.00087	-0.00004	1.20422	8.77063	-0.00125	-0.00006	1.75412
6.06344	-0.0018	-0.00009	1.21269	8.81281	0.00238	0.00012	1.76256
6.10578	-0.00048	-0.00002	1.22116	8.85531	0.0037	0.00019	1.77106
6.14813	-0.00184	-0.00009	1.22963	8.8975	0.00103	0.00005	1.7795
6.19031	-0.00181	-0.00009	1.23806	8.93984	0.00017	0.00001	1.78797
6.23203	-0.00124	-0.00006	1.24641	8.9825	0.00138	0.00007	1.7965
6.27391	-0.0029	-0.00015	1.25478	9.02531	0.00228	0.00012	1.80506
6.31625	-0.00227	-0.00012	1.26325	9.06781	0.00272	0.00014	1.81356
6.35859	0.00105	0.00005	1.27172	9.11016	0.0041	0.00021	1.82203
6.40078	0.00379	0.00019	1.28016	9.15281	0.00448	0.00023	1.83056
6.44344	0.00445	0.00023	1.28869	9.19531	0.00302	0.00015	1.83906
6.48562	0.00341	0.00017	1.29712	9.23797	0.00251	0.00013	1.84759
6.5275	0.00161	0.00008	1.3055	9.28047	0.00426	0.00022	1.85609
6.57	0.00309	0.00016	1.314	9.3225	0.00293	0.00015	1.8645
6.61297	0.00288	0.00015	1.32259	9.36391	-0.00043	-0.00002	1.87278
6.65594	0.0046	0.00023	1.33119	9.40578	0.00075	0.00004	1.88116
6.69828	0.00437	0.00022	1.33966	9.44812	0.00214	0.00011	1.88962
6.74062	0.00195	0.0001	1.34812	9.49078	0.00345	0.00018	1.89816
6.78281	0.00078	0.00004	1.35656	9.53312	0.00259	0.00013	1.90663
6.82453	0.00117	0.00006	1.36491	9.57563	0.00231	0.00012	1.91513
6.86609	0.00367	0.00019	1.37322	9.61828	0.00287	0.00015	1.92366
6.90813	0.00328	0.00017	1.38163	9.66078	0.00376	0.00019	1.93216
6.95047	0.00285	0.00015	1.39009	9.70328	0.00398	0.0002	1.94066
6.99297	0.0032	0.00016	1.39859	9.74609	0.02032	0.00103	1.94922
7.03547	0.00352	0.00018	1.40709	9.78891	0.095	0.00484	1.95778
7.07828	0.00194	0.0001	1.41566	9.83141	0.24829	0.01265	1.96628
7.12094	0.00286	0.00015	1.42419	9.87359	0.48745	0.02483	1.97472
7.16359	0.00344	0.00017	1.43272	9.91547	0.81143	0.04133	1.98309
7.20609	0.00229	0.00012	1.44122	9.95719	1.21765	0.06201	1.99144
7.24875	0.00274	0.00014	1.44975	9.99875	1.68917	0.08603	1.99975
7.29141	0.00264	0.00013	1.45828	10.04078	2.22444	0.11329	2.00816
7.33375	0.00401	0.0002	1.46675	10.08313	2.81215	0.14322	2.01663
7.37609	0.00379	0.00019	1.47522	10.12547	3.44155	0.17528	2.02509
7.41859	0.00313	0.00016	1.48372	10.16797	4.09746	0.20868	2.03359
7.46047	0.00005	0	1.49209	10.21047	4.77197	0.24303	2.04209
7.50203	-0.0008	-0.00004	1.50041	10.25328	5.46796	0.27848	2.05066
7.54406	0.00169	0.00009	1.50881	10.29594	6.1868	0.31509	2.05919
7.58641	0.00306	0.00016	1.51728	10.33844	6.932	0.35304	2.06769
7.62891	0.00253	0.00013	1.52578	10.38141	7.70794	0.39256	2.07628
7.67125	0.00213	0.00011	1.53425	10.42422	8.48794	0.43229	2.08484
7.71312	0.00122	0.00006	1.54262	10.46656	9.10772	0.46385	2.09331
7.75516	-0.00049	-0.00002	1.55103	10.50891	9.50492	0.48408	2.10178
7.7975	0.00023	0.00001	1.5595	10.55078	9.77937	0.49806	2.11016
7.84016	0.00295	0.00015	1.56803	10.59219	10.01594	0.51011	2.11844
7.88328	0.00441	0.00022	1.57666	10.63359	10.36294	0.52778	2.12672
7.92594	0.00149	0.00008	1.58519	10.67578	11.00829	0.56065	2.13516
7.96812	0.00071	0.00004	1.59362	10.71813	11.88596	0.60535	2.14363
8.01062	0.0027	0.00014	1.60213	10.76031	12.90906	0.65745	2.15206
8.05281	0.00235	0.00012	1.61056	10.80281	14.02159	0.71411	2.16056
8.09422	0.00062	0.00003	1.61884	10.84562	15.195	0.77387	2.16913
8.13562	0.0015	0.00008	1.62713	10.88828	16.42106	0.83632	2.17766
8.17781	0.00189	0.0001	1.63556	10.93062	17.6923	0.90106	2.18613
8.22031	0.00263	0.00013	1.64406	10.97312	19.00143	0.96774	2.19462

Extension (mm)	Load (N)	Compressive stress (MPa)	Compressive strain (mm/mm)
11.01594	20.35987	1.03692	2.20319
11.05828	21.77502	1.10899	2.21166
11.10031	23.2463	1.18392	2.22006
11.14234	24.78502	1.26229	2.22847
11.18438	26.40514	1.3448	2.23688
11.22625	28.12587	1.43244	2.24525
11.26812	29.93759	1.52471	2.25362
11.31078	31.84958	1.62209	2.26216
11.35344	33.8854	1.72577	2.27069
11.39531	36.04839	1.83593	2.27906
11.43766	38.33357	1.95231	2.28753
11.48047	40.76493	2.07614	2.29609
11.52281	43.36512	2.20857	2.30456
11.56516	46.11535	2.34864	2.31303
11.60781	49.02795	2.49697	2.32156
11.65031	52.12078	2.65449	2.33006
11.69281	55.39218	2.8211	2.33856
11.73516	58.85316	2.99737	2.34703
11.77766	62.53292	3.18478	2.35553
11.81938	66.45048	3.38429	2.36388
11.86063	70.60126	3.59569	2.37213
11.9025	74.98656	3.81903	2.3805
11.94484	79.66535	4.05732	2.38897
11.98734	84.67841	4.31264	2.39747
12.02953	90.02114	4.58474	2.40591
12.07203	95.68906	4.8734	2.41441
12.11484	101.69812	5.17944	2.42297
12.1575	108.12687	5.50686	2.4315
12.19984	114.99017	5.8564	2.43997
12.24234	122.24084	6.22567	2.44847
12.285	129.96597	6.61911	2.457
12.32734	138.22557	7.03977	2.46547
12.36953	147.00972	7.48714	2.47391
12.41172	156.34169	7.96242	2.48234
12.45344	166.32115	8.47067	2.49069
12.49469	176.95869	9.01243	2.49894
12.53625	188.21748	9.58584	2.50725
12.57844	200.23936	10.19811	2.51569
12.62031	213.16719	10.85652	2.52406
12.66234	226.96295	11.55913	2.53247
12.70469	241.60651	12.30492	2.54094
12.74719	257.14737	13.09641	2.54944
12.78953	273.63669	13.9362	2.55791
12.83187	291.07312	14.82423	2.56638
12.87453	309.50183	15.7628	2.57491
12.91703	329.08002	16.75991	2.58341
12.95922	349.8804	17.81926	2.59184
13.00094	371.974	18.94448	2.60019
13.04266	395.35361	20.13519	2.60853
13.08406	420.07065	21.39402	2.61681
13.12531	446.3819	22.73404	2.62506
13.13344	451.85394	23.01273	2.62669

Table D.2 Osteoblast-Containing Scaffolds Specimen 2 Raw Compression Data

Extension (mm)	Load (N)	Compressive stress (MPa)	Compressive strain (mm/mm)	Extension (mm)	Load (N)	Compressive stress (MPa)	Compressive strain (mm/mm)
0	0.00372	0.00019	0	2.76016	0.00603	0.00031	0.55203
0.00281	0.00382	0.00019	0.00056	2.80266	0.00584	0.0003	0.56053
0.02359	0.02236	0.00114	0.00472	2.84516	0.00892	0.00045	0.56903
0.06547	0.05898	0.003	0.01309	2.8875	0.00391	0.0002	0.5775
0.11172	0.07989	0.00407	0.02234	2.93	0.0027	0.00014	0.586
0.15313	0.06394	0.00326	0.03063	2.97234	0.00692	0.00035	0.59447
0.19594	0.03654	0.00186	0.03919	3.01484	0.00675	0.00034	0.60297
0.24469	0.02647	0.00135	0.04894	3.05672	0.00361	0.00018	0.61134
0.29531	0.02496	0.00127	0.05906	3.09797	0.00273	0.00014	0.61959
0.34406	0.01687	0.00086	0.06881	3.13953	0.00342	0.00017	0.62791
0.39109	0.00519	0.00026	0.07822	3.18187	0.00699	0.00036	0.63638
0.43828	-0.0027	-0.00014	0.08766	3.22422	0.00917	0.00047	0.64484
0.48547	-0.00127	-0.00006	0.09709	3.26672	0.01022	0.00052	0.65334
0.53188	0.00185	0.00009	0.10638	3.30922	0.00773	0.00039	0.66184
0.57719	-0.00167	-0.00009	0.11544	3.35203	0.00575	0.00029	0.67041
0.62156	-0.00382	-0.00019	0.12431	3.39453	0.00495	0.00025	0.67891
0.66625	-0.00072	-0.00004	0.13325	3.43672	0.0025	0.00013	0.68734
0.71141	0.00231	0.00012	0.14228	3.47906	0.00281	0.00014	0.69581
0.75594	0.00394	0.0002	0.15119	3.52203	0.00484	0.00025	0.70441
0.8	0.00341	0.00017	0.16	3.56484	0.00531	0.00027	0.71297
0.84391	0.0054	0.00028	0.16878	3.60719	0.00349	0.00018	0.72144
0.88766	0.0056	0.00029	0.17753	3.64922	0.00298	0.00015	0.72984
0.93109	0.00212	0.00011	0.18622	3.69125	0.00496	0.00025	0.73825
0.97469	0.00363	0.00018	0.19494	3.73312	0.00481	0.00024	0.74663
1.01844	0.00392	0.0002	0.20369	3.77531	0.00405	0.00021	0.75506
1.06219	0.00246	0.00013	0.21244	3.8175	0.00568	0.00029	0.7635
1.10563	0.00205	0.0001	0.22113	3.85969	0.00546	0.00028	0.77194
1.14828	0.00079	0.00004	0.22966	3.90188	0.00747	0.00038	0.78038
1.19062	-0.00013	-0.00001	0.23812	3.94453	0.01054	0.00054	0.78891
1.23266	0.00143	0.00007	0.24653	3.98703	0.01146	0.00058	0.79741
1.275	0.00369	0.00019	0.255	4.02938	0.00864	0.00044	0.80588
1.31766	0.00682	0.00035	0.26353	4.07172	0.00541	0.00028	0.81434
1.36047	0.00775	0.00039	0.27209	4.11469	0.00746	0.00038	0.82294
1.40266	0.00624	0.00032	0.28053	4.15781	0.00848	0.00043	0.83156
1.44531	0.00454	0.00023	0.28906	4.20016	0.00652	0.00033	0.84003
1.48797	0.00632	0.00032	0.29759	4.24234	0.00702	0.00036	0.84847
1.53063	0.0075	0.00038	0.30613	4.28469	0.00673	0.00034	0.85694
1.57313	0.00675	0.00034	0.31462	4.32687	0.00307	0.00016	0.86537
1.61609	0.00698	0.00036	0.32322	4.36812	0.00298	0.00015	0.87363
1.65922	0.00529	0.00027	0.33184	4.40984	0.00585	0.0003	0.88197
1.70203	0.00599	0.0003	0.34041	4.45219	0.00782	0.0004	0.89044
1.74453	0.00666	0.00034	0.34891	4.49453	0.00827	0.00042	0.89891
1.78672	0.00602	0.00031	0.35734	4.53703	0.00991	0.0005	0.90741
1.82859	0.00593	0.0003	0.36572	4.57953	0.00813	0.00041	0.91591
1.87047	0.00353	0.00018	0.37409	4.62234	0.00696	0.00035	0.92447
1.91234	0.00409	0.00021	0.38247	4.66469	0.00996	0.00051	0.93294
1.95469	0.00573	0.00029	0.39094	4.70719	0.00724	0.00037	0.94144
1.99719	0.00737	0.00038	0.39944	4.75016	0.00476	0.00024	0.95003
2.03963	0.01015	0.00052	0.40794	4.79266	0.00603	0.00031	0.95853
2.08234	0.00744	0.00038	0.41647	4.835	0.00526	0.00027	0.967
2.12516	0.00528	0.00027	0.42503	4.87812	0.00601	0.00031	0.97562
2.16766	0.00731	0.00037	0.43353	4.92063	0.00863	0.00044	0.98413
2.21031	0.00534	0.00027	0.44206	4.96203	0.00856	0.00044	0.99241
2.25313	0.0067	0.00034	0.45063	5.00328	0.00531	0.00027	1.00066
2.29578	0.00658	0.00033	0.45916	5.04547	0.00515	0.00026	1.00909
2.33781	0.00376	0.00019	0.46756	5.08812	0.0093	0.00047	1.01762
2.37984	0.00551	0.00028	0.47597	5.13062	0.01101	0.00056	1.02612
2.42203	0.00348	0.00018	0.48441	5.17266	0.00925	0.00047	1.03453
2.46406	0.00294	0.00015	0.49281	5.215	0.0085	0.00043	1.043
2.50547	0.00648	0.00033	0.50109	5.25781	0.00831	0.00042	1.05156
2.54734	0.00673	0.00034	0.50947	5.30047	0.0067	0.00034	1.06009
2.59	0.00558	0.00028	0.518	5.34281	0.00421	0.00021	1.06856
2.6325	0.00655	0.00033	0.5265	5.38562	0.00478	0.00024	1.07712
2.675	0.00932	0.00047	0.535	5.42797	0.0061	0.00031	1.08559
2.71766	0.01015	0.00052	0.54353	5.47016	0.00516	0.00026	1.09403

Extension (mm)	Load (N)	Compressive stress (MPa)	Compressive strain (mm/mm)	Extension (mm)	Load (N)	Compressive stress (MPa)	Compressive strain (mm/mm)
5.51234	0.00329	0.00017	1.10247	8.26234	0.00919	0.00047	1.65247
5.55453	0.00415	0.00021	1.11091	8.30484	0.00695	0.00035	1.66097
5.59641	0.00703	0.00036	1.11928	8.34734	0.00849	0.00043	1.66947
5.63797	0.00568	0.00029	1.12759	8.38984	0.00968	0.00049	1.67797
5.68016	0.00689	0.00035	1.13603	8.43219	0.00479	0.00024	1.68644
5.72266	0.00892	0.00045	1.14453	8.47453	0.0069	0.00035	1.69491
5.765	0.0062	0.00032	1.153	8.51703	0.01009	0.00051	1.70341
5.80734	0.00553	0.00028	1.16147	8.55969	0.00811	0.00041	1.71194
5.85016	0.00721	0.00037	1.17003	8.60203	0.0115	0.00059	1.72041
5.89281	0.01039	0.00053	1.17856	8.64453	0.01047	0.00053	1.72891
5.93531	0.01207	0.00061	1.18706	8.68656	0.00719	0.00037	1.73731
5.97766	0.00726	0.00037	1.19553	8.72828	0.00676	0.00034	1.74566
6.02031	0.0069	0.00035	1.20406	8.77	0.0071	0.00036	1.754
6.06297	0.00796	0.00041	1.21259	8.81219	0.01067	0.00054	1.76244
6.10531	0.00626	0.00032	1.22106	8.85453	0.01059	0.00054	1.77091
6.14766	0.00549	0.00028	1.22953	8.89656	0.00642	0.00033	1.77931
6.18969	0.00522	0.00027	1.23794	8.93891	0.00678	0.00035	1.78778
6.23141	0.0048	0.00024	1.24628	8.98219	0.00694	0.00035	1.79644
6.27328	0.00525	0.00027	1.25466	9.02516	0.00682	0.00035	1.80503
6.31578	0.00601	0.00031	1.26316	9.06766	0.00879	0.00045	1.81353
6.35812	0.00785	0.00039	1.27162	9.11016	0.00899	0.00046	1.82203
6.40016	0.0101	0.00051	1.28003	9.15281	0.00701	0.00036	1.83056
6.44234	0.00904	0.00046	1.28847	9.19531	0.00659	0.00034	1.83906
6.48453	0.00576	0.00029	1.29691	9.23781	0.00649	0.00033	1.84756
6.52656	0.0057	0.00029	1.30531	9.28	0.00665	0.00034	1.856
6.56922	0.00807	0.00041	1.31384	9.32172	0.01042	0.00053	1.86434
6.61219	0.00777	0.0004	1.32244	9.36312	0.0594	0.00303	1.87262
6.655	0.01006	0.00051	1.331	9.40484	0.20958	0.01067	1.88097
6.69766	0.00861	0.00044	1.33953	9.44734	0.49591	0.02526	1.88947
6.73984	0.00604	0.00031	1.34797	9.48984	0.96899	0.04935	1.89797
6.78234	0.00738	0.00038	1.35647	9.53219	1.63577	0.08331	1.90644
6.82437	0.00593	0.0003	1.36487	9.57484	2.47278	0.12594	1.91497
6.86594	0.00742	0.00038	1.37319	9.61781	3.4518	0.1758	1.92356
6.90781	0.00939	0.00048	1.38156	9.66031	4.52527	0.23047	1.93206
6.95016	0.00796	0.00041	1.39003	9.7025	5.62857	0.28666	1.9405
6.9925	0.01024	0.00052	1.3985	9.74531	6.70415	0.34144	1.94906
7.035	0.00899	0.00046	1.407	9.78813	7.60117	0.38712	1.95763
7.07766	0.00885	0.00044	1.41553	9.83062	8.19285	0.41726	1.96612
7.12047	0.01045	0.00053	1.42409	9.87266	8.57228	0.43658	1.97453
7.16297	0.00687	0.00035	1.43259	9.91484	8.84507	0.45048	1.98297
7.20563	0.00824	0.00042	1.44113	9.95656	9.18327	0.4677	1.99131
7.24844	0.01018	0.00052	1.44969	9.99797	9.80545	0.49939	1.99959
7.29094	0.00683	0.00035	1.45819	10.04	10.67616	0.54373	2.008
7.33313	0.00826	0.00042	1.46663	10.0825	11.7107	0.59642	2.0165
7.37531	0.00789	0.0004	1.47506	10.125	12.84946	0.65442	2.025
7.4175	0.00634	0.00032	1.4835	10.16719	14.03755	0.71493	2.03344
7.45906	0.00862	0.00044	1.49181	10.20953	15.24817	0.77658	2.04191
7.50078	0.00505	0.00026	1.50016	10.25203	16.49222	0.83994	2.05041
7.54312	0.00695	0.00035	1.50862	10.29469	17.7652	0.90477	2.05894
7.58578	0.01152	0.00059	1.51716	10.33734	19.07375	0.97142	2.06747
7.62828	0.00671	0.00034	1.52566	10.38	20.43412	1.0407	2.076
7.67062	0.00783	0.0004	1.53412	10.42313	21.84387	1.1125	2.08463
7.71281	0.00704	0.00036	1.54256	10.46594	23.3137	1.18736	2.09319
7.75469	0.01041	0.00057	1.55094	10.50813	24.85001	1.2656	2.10162
7.79672	0.00697	0.00035	1.55934	10.54984	26.44952	1.34706	2.10997
7.83953	0.00873	0.00044	1.56791	10.59141	28.11227	1.43175	2.11828
7.8825	0.00807	0.00041	1.5765	10.63297	29.84202	1.51984	2.12659
7.92516	0.0105	0.00054	1.58503	10.67516	31.65908	1.61238	2.13503
7.9675	0.00554	0.00028	1.5935	10.7175	33.58932	1.71069	2.1435
8.01016	0.00857	0.00044	1.60203	10.75953	35.62963	1.8146	2.15191
8.05234	0.01081	0.00055	1.61047	10.80188	37.77345	1.92379	2.16038
8.09375	0.00489	0.00025	1.61875	10.84484	40.02516	2.03846	2.16897
8.135	0.00769	0.00039	1.627	10.88766	42.40305	2.15957	2.17753
8.17719	0.00717	0.00036	1.63544	10.93	44.90882	2.28719	2.186
8.21984	0.00548	0.00028	1.64397	10.97219	47.52856	2.42061	2.19444

Extension (mm)	Load (N)	Compressive stress (MPa)	Compressive strain (mm/mm)
11.01469	50.2826	2.56087	2.20294
11.05688	53.18743	2.70881	2.21137
11.09891	56.20848	2.86267	2.21978
11.14094	59.34925	3.02263	2.22819
11.18344	62.62106	3.18926	2.23669
11.22531	66.03916	3.36335	2.24506
11.26703	69.58332	3.54385	2.25341
11.30937	73.24028	3.7301	2.26187
11.35188	77.06839	3.92506	2.27038
11.39406	81.09778	4.13028	2.27881
11.43656	85.32386	4.34551	2.28731
11.47938	89.75729	4.5713	2.29588
11.52188	94.39699	4.8076	2.30438
11.56437	99.21317	5.05289	2.31288
11.60703	104.22002	5.30788	2.32141
11.64984	109.46078	5.57479	2.32997
11.69203	114.92144	5.8529	2.33841
11.73422	120.56026	6.14008	2.34684
11.77625	126.41331	6.43818	2.35525
11.81781	132.50987	6.74867	2.36366
11.85906	138.82936	7.07052	2.37181
11.90109	145.35954	7.4031	2.38022
11.94359	152.24341	7.75369	2.38872
11.98609	159.57309	8.12699	2.39722
12.02813	167.27727	8.51936	2.40563
12.07063	175.29984	8.92795	2.41413
12.11359	183.68768	9.35514	2.42272
12.15641	192.56262	9.80713	2.43128
12.19875	201.92357	10.28388	2.43975
12.24125	211.6944	10.78151	2.44825
12.28375	221.93576	11.30309	2.45675
12.32609	232.68947	11.85078	2.46522
12.36812	243.93285	12.4234	2.47362
12.41016	255.69075	13.02222	2.48203
12.45188	268.10425	13.65444	2.49038
12.49312	281.2803	14.32549	2.49863
12.53469	295.16858	15.03281	2.50694
12.57672	309.85968	15.78102	2.51534
12.61906	325.58652	16.58199	2.52381
12.66125	342.37781	17.43716	2.53225
12.70359	360.17148	18.34338	2.54072
12.74594	378.93793	19.29915	2.54919
12.78813	398.80508	20.31098	2.55763
12.83031	419.84619	21.38259	2.56606
12.8725	442.08167	22.51503	2.5745
12.88937	451.35965	22.98756	2.57787

Table D.3 Osteoblast-Containing Scaffolds Specimen 3 Raw Compression Data

Extension (mm)	Load (N)	Compressive stress (MPa)	Compressive strain (mm/mm)	Extension (mm)	Load (N)	Compressive stress (MPa)	Compressive strain (mm/mm)
0	0.0015	0.00008	0	2.80281	0.00344	0.00018	0.56056
0.00281	0.0018	0.00009	0.00056	2.84516	0.00222	0.00011	0.56903
0.02344	0.01837	0.00094	0.00469	2.8875	0.00034	0.00002	0.5775
0.06531	0.05728	0.00292	0.01306	2.93	-0.00157	-0.00008	0.586
0.11156	0.08018	0.00408	0.02231	2.97234	0.00003	0	0.59447
0.15313	0.06363	0.00324	0.03063	3.01453	0.00505	0.00026	0.60291
0.19578	0.03655	0.00186	0.03916	3.05656	0.00715	0.00036	0.61131
0.24438	0.02616	0.00133	0.04888	3.09781	0.00417	0.00021	0.61956
0.29516	0.0238	0.00121	0.05903	3.13937	0.0021	0.00011	0.62787
0.34375	0.016	0.00081	0.06875	3.18172	0.00446	0.00023	0.63634
0.39078	0.00475	0.00024	0.07816	3.22453	0.00619	0.00032	0.64491
0.43797	-0.00171	-0.00009	0.08759	3.26719	0.00554	0.00028	0.65344
0.48547	-0.00075	-0.00004	0.09709	3.30969	0.00424	0.00022	0.66194
0.53219	0.00005	0	0.10644	3.35219	0.00199	0.0001	0.67044
0.57719	-0.00083	-0.00004	0.11544	3.39438	-0.00049	-0.00003	0.67888
0.62156	-0.00253	-0.00013	0.12431	3.43656	-0.00001	0	0.68731
0.66641	-0.00261	-0.00013	0.13328	3.47922	0.00224	0.00011	0.69584
0.71156	0.00077	0.00004	0.14231	3.52187	0.00396	0.0002	0.70437
0.75625	0.00376	0.00019	0.15125	3.56453	0.00317	0.00016	0.71291
0.8	0.00421	0.00021	0.16	3.60703	0.00213	0.00011	0.72141
0.84375	0.00479	0.00024	0.16875	3.64953	0.0021	0.00011	0.72991
0.8875	0.00601	0.00031	0.1775	3.69172	0.00484	0.00025	0.73834
0.93078	0.0032	0.00016	0.18616	3.73328	0.00592	0.0003	0.74666
0.97422	0.00062	0.00003	0.19484	3.77516	0.00539	0.00027	0.75503
1.01828	0.00267	0.00014	0.20366	3.81734	0.006	0.00031	0.76347
1.06203	0.00439	0.00022	0.21241	3.85953	0.00624	0.00032	0.77191
1.10516	0.00444	0.00023	0.22103	3.90141	0.00465	0.00024	0.78028
1.14781	0.00213	0.00011	0.22956	3.94375	0.00349	0.00018	0.78875
1.19031	0.00109	0.00006	0.23806	3.98688	0.00607	0.00031	0.79738
1.23266	0.00152	0.00008	0.24653	4.02969	0.0075	0.00038	0.80594
1.27484	0.00119	0.00006	0.25497	4.07203	0.00468	0.00024	0.81441
1.31734	0.00095	0.00005	0.26347	4.11469	0.00279	0.00014	0.82294
1.36	0.00186	0.00009	0.272	4.1575	0.0046	0.00023	0.8315
1.40234	0.00426	0.00022	0.28047	4.20016	0.00587	0.0003	0.84003
1.44516	0.00469	0.00024	0.28903	4.2425	0.00442	0.00023	0.8485
1.48828	0.00421	0.00021	0.29766	4.28453	0.00505	0.00026	0.85691
1.53109	0.00291	0.00015	0.30622	4.32625	0.00549	0.00028	0.86525
1.57375	0.00265	0.00013	0.31475	4.36766	0.00456	0.00023	0.87353
1.61641	0.00171	0.00009	0.32328	4.40984	0.00392	0.0002	0.88197
1.65953	0.00097	0.00005	0.33191	4.4525	0.0076	0.00039	0.8905
1.70219	0.00155	0.00008	0.34044	4.49484	0.01064	0.00054	0.89897
1.74437	0.00284	0.00014	0.34887	4.53703	0.00813	0.00041	0.90741
1.78672	0.00432	0.00022	0.35734	4.57953	0.00467	0.00024	0.91591
1.82859	0.00455	0.00023	0.36572	4.62219	0.00329	0.00017	0.92444
1.87031	0.00477	0.00024	0.37406	4.66469	0.00363	0.00018	0.93294
1.91219	0.00404	0.00021	0.38244	4.7075	0.00474	0.00024	0.9415
1.95469	0.00296	0.00015	0.39094	4.75078	0.00724	0.00037	0.95016
1.99719	0.00314	0.00016	0.39944	4.79375	0.00747	0.00038	0.95875
2.03969	0.00508	0.00026	0.40794	4.83594	0.00448	0.00023	0.96719
2.08234	0.00583	0.0003	0.41647	4.87797	0.0023	0.00012	0.97559
2.125	0.00566	0.00029	0.425	4.92016	0.00227	0.00012	0.98403
2.16766	0.00475	0.00024	0.43353	4.96188	0.0043	0.00022	0.99238
2.21016	0.00301	0.00015	0.44203	5.00328	0.00529	0.00027	1.00066
2.25297	0.00402	0.0002	0.45059	5.045	0.00326	0.00017	1.009
2.29563	0.00422	0.00021	0.45913	5.0875	0.00402	0.0002	1.0175
2.33781	0.00256	0.00013	0.46756	5.13016	0.00705	0.00036	1.02603
2.38016	0.00223	0.00011	0.47603	5.17266	0.00799	0.00041	1.03453
2.42266	0.00288	0.00015	0.48453	5.215	0.00543	0.00028	1.043
2.46438	0.00166	0.00008	0.49288	5.25766	0.00402	0.0002	1.05153
2.50563	0.00128	0.00007	0.50113	5.30016	0.00472	0.00024	1.06003
2.54766	0.00254	0.00013	0.50953	5.34234	0.00255	0.00013	1.06847
2.59016	0.00467	0.00024	0.51803	5.385	0.00115	0.00006	1.077
2.63266	0.00422	0.00021	0.52653	5.42813	0.00427	0.00022	1.08563
2.67484	0.00353	0.00018	0.53497	5.47109	0.00635	0.00032	1.09422
2.7175	0.00417	0.00021	0.5435	5.51344	0.0051	0.00026	1.10269

Extension (mm)	Load (N)	Compressive stress (MPa)	Compressive strain (mm/mm)
5.55516	0.00139	0.00007	1.1103
5.59672	0.00083	0.00004	1.11934
5.63812	0.00294	0.00015	1.12762
5.68031	0.00594	0.0003	1.13606
5.72266	0.00809	0.00041	1.14453
5.76484	0.00753	0.00038	1.15297
5.80719	0.00576	0.00029	1.16144
5.84984	0.0044	0.00022	1.16997
5.8925	0.00497	0.00025	1.1785
5.935	0.00594	0.0003	1.187
5.9775	0.00498	0.00025	1.1955
6.02031	0.00361	0.00018	1.20406
6.06281	0.00222	0.00011	1.21256
6.10531	0.00263	0.00013	1.22106
6.1475	0.00331	0.00017	1.2295
6.18953	0.00481	0.00024	1.23791
6.23125	0.0057	0.00029	1.24625
6.27328	0.00633	0.00032	1.25466
6.31578	0.00673	0.00034	1.26316
6.35813	0.00623	0.00032	1.27163
6.40031	0.00663	0.00034	1.28006
6.44281	0.00881	0.00045	1.28856
6.485	0.00733	0.00037	1.297
6.52703	0.00289	0.00015	1.30541
6.56938	0.00112	0.00006	1.31388
6.61219	0.00172	0.00009	1.32244
6.65484	0.00349	0.00018	1.33097
6.69766	0.00384	0.0002	1.33953
6.74016	0.00371	0.00019	1.34803
6.78266	0.004	0.0002	1.35653
6.82422	0.00449	0.00023	1.36484
6.86578	0.00594	0.0003	1.37316
6.90781	0.00887	0.00045	1.38156
6.95016	0.00932	0.00047	1.39003
6.99234	0.0068	0.00035	1.39847
7.03469	0.0051	0.00026	1.40694
7.0775	0.00514	0.00026	1.4155
7.12031	0.00637	0.00032	1.42406
7.16281	0.00591	0.0003	1.43256
7.20531	0.00567	0.00029	1.44106
7.24813	0.00541	0.00028	1.44963
7.29078	0.00449	0.00023	1.45816
7.33297	0.00326	0.00017	1.46659
7.37531	0.0038	0.00019	1.47506
7.41766	0.00647	0.00033	1.48353
7.45937	0.00721	0.00037	1.49187
7.50125	0.0059	0.0003	1.50025
7.54359	0.00662	0.00034	1.50872
7.58609	0.00887	0.00045	1.51722
7.62844	0.00864	0.00044	1.52569
7.67047	0.00651	0.00033	1.53409
7.7125	0.00627	0.00032	1.5425
7.75469	0.00553	0.00028	1.55094
7.79688	0.00284	0.00014	1.55938
7.83938	0.00228	0.00012	1.56788
7.8825	0.00433	0.00022	1.5765
7.92531	0.00437	0.00022	1.58506
7.96766	0.00162	0.00008	1.59353
8.01	0.00178	0.00009	1.602
8.05219	0.00459	0.00023	1.61044
8.09375	0.00653	0.00033	1.61875
8.135	0.00688	0.00035	1.627
8.17734	0.0081	0.00041	1.63547
8.21984	0.00873	0.00044	1.64397
8.26203	0.00758	0.00039	1.65241

Extension (mm)	Load (N)	Compressive stress (MPa)	Compressive strain (mm/mm)
8.30453	0.00538	0.00027	1.66091
8.34734	0.0068	0.00035	1.66947
8.39	0.00756	0.00039	1.678
8.43219	0.00613	0.00031	1.68644
8.47469	0.0038	0.00019	1.69494
8.51734	0.00433	0.00022	1.70347
8.55984	0.00565	0.00029	1.71197
8.60219	0.00669	0.00034	1.72044
8.64469	0.00658	0.00034	1.72894
8.68672	0.00646	0.00033	1.73734
8.72828	0.00541	0.00028	1.74566
8.76984	0.00461	0.00023	1.75397
8.81188	0.00591	0.0003	1.76238
8.85406	0.00796	0.00041	1.77081
8.89656	0.00855	0.00044	1.77931
8.93953	0.00606	0.00031	1.78791
8.9825	0.00432	0.00022	1.7965
9.02516	0.00463	0.00024	1.80503
9.06734	0.00458	0.00023	1.81347
9.11	0.00478	0.00024	1.822
9.15281	0.00584	0.0003	1.83056
9.19547	0.00546	0.00028	1.83909
9.2375	0.00338	0.00017	1.8475
9.27969	0.00241	0.00012	1.85594
9.32172	0.00501	0.00026	1.86434
9.36328	0.00704	0.00036	1.87266
9.40516	0.00709	0.00036	1.88103
9.4475	0.00705	0.00036	1.8895
9.49	0.00718	0.00037	1.898
9.5325	0.00864	0.00044	1.9065
9.57516	0.00808	0.00041	1.91503
9.61781	0.00663	0.00034	1.92356
9.66031	0.00526	0.00027	1.93206
9.70266	0.00461	0.00023	1.94053
9.74547	0.00542	0.00028	1.94909
9.78813	0.00587	0.0003	1.95763
9.83047	0.00775	0.00039	1.96609
9.87266	0.00845	0.00043	1.97453
9.91469	0.00626	0.00032	1.98294
9.95656	0.00542	0.00028	1.99131
9.99813	0.00693	0.00035	1.99962
10.04031	0.00865	0.00044	2.00806
10.08266	0.00908	0.00046	2.01653
10.125	0.00965	0.00049	2.025
10.1675	0.01072	0.00055	2.0335
10.21031	0.00867	0.00044	2.04206
10.25297	0.00938	0.00048	2.05059
10.29547	0.02317	0.0018	2.05909
10.33813	0.09458	0.00482	2.06763
10.38094	0.30263	0.01541	2.07619
10.42359	0.67239	0.03424	2.08472
10.46594	1.1809	0.06014	2.09319
10.50813	1.79306	0.09132	2.10162
10.55	2.47592	0.1261	2.11
10.59141	3.20054	0.163	2.11828
10.63281	3.94944	0.20114	2.12656
10.675	4.71454	0.24011	2.135
10.71734	5.50082	0.28015	2.14347
10.75953	6.31992	0.32187	2.15191
10.80203	7.13323	0.36329	2.16041
10.84484	7.77324	0.39589	2.16897
10.88766	8.18921	0.41707	2.17753
10.93016	8.47413	0.43158	2.18603
10.97281	8.72018	0.44411	2.19456
11.01562	9.17116	0.46708	2.20312

Extension (mm)	Load (N)	Compressive stress (MPa)	Compressive strain (mm/mm)
11.09984	10.86935	0.55357	2.21997
11.14187	11.97989	0.61013	2.22837
11.18406	13.19842	0.67219	2.23681
11.22578	14.50222	0.73859	2.24516
11.26766	15.88015	0.80877	2.25353
11.31	17.33459	0.88284	2.262
11.3525	18.88697	0.96191	2.2705
11.39484	20.54773	1.04649	2.27897
11.43734	22.32336	1.13692	2.28747
11.48	24.22046	1.23354	2.296
11.52266	26.25404	1.33711	2.30453
11.565	28.42626	1.44774	2.313
11.6075	30.72808	1.56497	2.3215
11.65016	33.15852	1.68875	2.33003
11.6925	35.71856	1.81913	2.3385
11.73469	38.41426	1.95642	2.34694
11.77703	41.27765	2.10225	2.35541
11.81906	44.3418	2.25831	2.36381
11.86047	47.6352	2.42604	2.37209
11.90203	51.16899	2.60601	2.38041
11.94453	54.99373	2.80081	2.38891
11.98687	59.17081	3.01354	2.39737
12.02906	63.71133	3.24479	2.40581
12.07172	68.62314	3.49495	2.41434
12.11453	73.91726	3.76458	2.42291
12.15688	79.6123	4.05462	2.43138
12.19922	85.69425	4.36437	2.43984
12.24203	92.15021	4.69317	2.44841
12.28484	99.0623	5.0452	2.45697
12.32703	106.48797	5.42339	2.46541
12.36891	114.42158	5.82744	2.47378
12.41125	122.87756	6.2581	2.48225
12.45297	131.93806	6.71955	2.49059
12.49422	141.62378	7.21284	2.49884
12.53594	151.9353	7.738	2.50719
12.57812	163.00847	8.30195	2.51562
12.62016	174.9939	8.91237	2.52403
12.66219	187.86858	9.56807	2.53244
12.70437	201.62482	10.26867	2.54087
12.74688	216.37114	11.01969	2.54938
12.78938	232.28699	11.83028	2.55788
12.83156	249.50214	12.70704	2.56631
12.87406	268.12628	13.65556	2.57481
12.91656	288.33636	14.68485	2.58331
12.95859	310.21561	15.79915	2.59172
13.00047	333.8606	17.00338	2.60009
13.04219	359.39578	18.30388	2.60844
13.08328	386.99051	19.70926	2.61666
13.12422	416.90613	21.23285	2.62484
13.14062	429.55182	21.87689	2.62812

Table D.4 Osteoblast-Containing Scaffolds Specimen 4 Raw Compression Data

Extension (mm)	Load (N)	Compressive stress (MPa)	Compressive strain (mm/mm)	Extension (mm)	Load (N)	Compressive stress (MPa)	Compressive strain (mm/mm)
0	0.00422	0.00021	0	2.76031	0.00277	0.00014	0.55206
0.00281	0.00466	0.00024	0.00056	2.80297	0.00218	0.00011	0.56059
0.02359	0.0188	0.00096	0.00472	2.84516	0.00236	0.00012	0.56903
0.06531	0.05631	0.00287	0.01306	2.88719	0.00351	0.00018	0.57744
0.11125	0.08157	0.00415	0.02225	2.92953	0.0053	0.00027	0.58591
0.15297	0.06582	0.00335	0.03059	2.97219	0.00514	0.00026	0.59444
0.19578	0.034	0.00173	0.03916	3.01469	0.00301	0.00015	0.60294
0.24438	0.02389	0.00122	0.04888	3.05672	0.00344	0.00018	0.61134
0.29516	0.02236	0.00114	0.05903	3.09828	0.00479	0.00024	0.61966
0.34375	0.01165	0.00059	0.06875	3.14	0.00273	0.00014	0.628
0.39078	0.00066	0.00003	0.07816	3.1825	0.00395	0.0002	0.6365
0.43797	-0.00001	0	0.08759	3.225	0.00693	0.00035	0.645
0.48547	-0.00049	-0.00003	0.09709	3.26734	0.00411	0.00021	0.65347
0.53203	-0.00123	-0.00006	0.10641	3.30969	0.00229	0.00012	0.66194
0.57719	-0.002	-0.0001	0.11544	3.35219	0.00264	0.00013	0.67044
0.62156	-0.00176	-0.00009	0.12431	3.39406	0.00348	0.00018	0.67881
0.66656	-0.00106	-0.00005	0.13331	3.43609	0.00259	0.00013	0.68722
0.71156	0.00277	0.00014	0.14231	3.47875	0.00145	0.00007	0.69575
0.75594	0.00629	0.00032	0.15119	3.52187	0.00239	0.00012	0.70437
0.79969	0.00164	0.00008	0.15994	3.56484	0.00357	0.00018	0.71297
0.84359	0.0022	0.00011	0.16872	3.60734	0.00346	0.00018	0.72147
0.8875	0.00287	0.00015	0.1775	3.64937	0.00236	0.00012	0.72987
0.93094	0.00155	0.00008	0.18619	3.69125	0.00074	0.00004	0.73825
0.97422	0.00006	0	0.19484	3.73297	0.00128	0.00007	0.74659
1.01828	0.00027	0.00001	0.20366	3.77484	0.00284	0.00014	0.75497
1.06219	-0.00018	-0.00001	0.21244	3.8175	0.00293	0.00015	0.7635
1.10547	-0.0003	-0.00002	0.22109	3.86016	0.00516	0.00026	0.77203
1.14813	0.00174	0.00009	0.22963	3.90219	0.00621	0.00032	0.78044
1.19063	0.0019	0.0001	0.23813	3.94453	0.00441	0.00022	0.78891
1.23234	0.00211	0.00011	0.24647	3.98703	0.00201	0.0001	0.79741
1.27437	-0.00026	-0.00001	0.25488	4.02953	0.00221	0.00011	0.80591
1.31703	-0.00009	0	0.26341	4.07219	0.00442	0.00023	0.81444
1.36	0.00339	0.00017	0.272	4.11484	0.00436	0.00022	0.82297
1.4025	0.00448	0.00023	0.2805	4.15734	0.00354	0.00018	0.83147
1.44516	0.00562	0.00029	0.28903	4.19969	0.00429	0.00022	0.83994
1.48813	0.00668	0.00034	0.29763	4.24234	0.00496	0.00025	0.84847
1.53109	0.00432	0.00022	0.30622	4.28484	0.00361	0.00018	0.85697
1.57375	0.00348	0.00018	0.31475	4.32656	0.00265	0.00014	0.86531
1.61656	0.00235	0.00012	0.32331	4.36781	0.00329	0.00017	0.87356
1.65922	0.00293	0.00015	0.33184	4.40953	0.00347	0.00018	0.88191
1.70203	0.00427	0.00022	0.34041	4.45203	0.00374	0.00019	0.89041
1.74453	0.00447	0.00023	0.34891	4.49438	0.00458	0.00023	0.89888
1.78688	0.00362	0.00018	0.35737	4.53688	0.00462	0.00024	0.90738
1.82859	0.00276	0.00014	0.36572	4.58	0.00509	0.00026	0.916
1.87047	0.00287	0.00015	0.37409	4.62297	0.00638	0.00032	0.92459
1.9125	0.00356	0.00018	0.3825	4.66547	0.00592	0.0003	0.93309
1.95484	0.00472	0.00024	0.39097	4.70781	0.00279	0.00014	0.94156
1.99719	0.00384	0.0002	0.39944	4.75063	0.0019	0.0001	0.95013
2.03938	0.00348	0.00018	0.40788	4.79344	0.00349	0.00018	0.95869
2.08172	0.00297	0.00015	0.41634	4.83578	0.00496	0.00025	0.96716
2.12469	0.00242	0.00012	0.42494	4.87797	0.00574	0.00029	0.97559
2.1675	0.00481	0.00025	0.4335	4.92	0.00539	0.00027	0.984
2.21031	0.00578	0.00029	0.44206	4.96188	0.00363	0.00018	0.99238
2.25312	0.00562	0.00029	0.45063	5.00344	0.00221	0.00011	1.00069
2.29578	0.00372	0.00019	0.45916	5.04547	0.00263	0.00013	1.00909
2.33797	0.00218	0.00011	0.46759	5.08781	0.00218	0.00011	1.01756
2.38016	0.00443	0.00023	0.47603	5.13016	0.00296	0.00015	1.02603
2.42219	0.00645	0.00033	0.48444	5.17219	0.00378	0.00019	1.03444
2.46391	0.00598	0.0003	0.49278	5.21453	0.00371	0.00019	1.04291
2.50547	0.00336	0.00017	0.50109	5.25719	0.00366	0.00019	1.05144
2.5475	0.00102	0.00005	0.5095	5.30016	0.00656	0.00033	1.06003
2.59	0.0009	0.00005	0.518	5.34313	0.0081	0.00041	1.06863
2.6325	0.00128	0.00007	0.5265	5.38594	0.00384	0.0002	1.07719
2.675	0.00139	0.00007	0.535	5.42844	-0.00012	-0.00001	1.08569
2.71766	0.00185	0.00009	0.54353	5.47078	0.00024	0.00001	1.09416

Extension (mm)	Load (N)	Compressive stress (MPa)	Compressive strain (mm/mm)	Extension (mm)	Load (N)	Compressive stress (MPa)	Compressive strain (mm/mm)
5.55516	0.00384	0.0002	1.1103	8.47437	0.00444	0.00023	1.69488
5.59625	0.00365	0.00019	1.11925	8.51688	0.00533	0.00027	1.70338
5.6375	0.00401	0.0002	1.1275	8.55953	0.00549	0.00028	1.71191
5.67969	0.0048	0.00024	1.13594	8.60203	0.00565	0.00029	1.72041
5.72234	0.00353	0.00018	1.14447	8.64437	0.00482	0.00025	1.72887
5.76469	0.00283	0.00014	1.15294	8.68656	0.00306	0.00016	1.73731
5.80719	0.00476	0.00024	1.16144	8.72813	0.0028	0.00014	1.74563
5.84984	0.00476	0.00024	1.16997	8.76969	0.00463	0.00024	1.75394
5.89266	0.00473	0.00024	1.17853	8.81219	0.00736	0.00037	1.76244
5.935	0.0047	0.00024	1.187	8.855	0.00905	0.00046	1.771
5.9775	0.00654	0.00033	1.1955	8.89734	0.0089	0.00045	1.77947
6.02031	0.00833	0.00042	1.20406	8.93969	0.0082	0.00042	1.78794
6.06297	0.00701	0.00036	1.21259	8.9825	0.00691	0.00035	1.7965
6.10516	0.00502	0.00026	1.22103	9.02547	0.00582	0.0003	1.80509
6.1475	0.00279	0.00014	1.2295	9.06781	0.00556	0.00028	1.81356
6.18953	0.00169	0.00009	1.23791	9.11	0.00536	0.00027	1.822
6.23141	0.00106	0.00005	1.24628	9.15266	0.00572	0.00029	1.83053
6.27344	0.00238	0.00012	1.25469	9.19516	0.00622	0.00032	1.83903
6.31594	0.0063	0.00032	1.26319	9.23766	0.00729	0.00037	1.84753
6.35828	0.00812	0.00041	1.27166	9.27984	0.00473	0.00024	1.85597
6.40031	0.00618	0.00031	1.28006	9.32141	0.00162	0.00008	1.86428
6.44266	0.00399	0.0002	1.28853	9.36297	0.00096	0.00005	1.87259
6.48469	0.00371	0.00019	1.29694	9.40484	0.00216	0.00011	1.88097
6.52656	0.00432	0.00022	1.30531	9.44734	0.00552	0.00028	1.88947
6.56906	0.00464	0.00024	1.31381	9.48969	0.00835	0.00043	1.89794
6.61234	0.00637	0.00032	1.32247	9.53203	0.00993	0.00051	1.90641
6.65547	0.00727	0.00037	1.33109	9.57484	0.01037	0.00053	1.91497
6.69797	0.00582	0.0003	1.33959	9.61766	0.0093	0.00047	1.92353
6.74031	0.004	0.0002	1.34806	9.66031	0.01105	0.00056	1.93206
6.78266	0.00396	0.0002	1.35653	9.70266	0.01512	0.00077	1.94053
6.82438	0.00406	0.00021	1.36488	9.74531	0.02056	0.00105	1.94906
6.86594	0.00165	0.00008	1.37319	9.78828	0.02514	0.00128	1.95766
6.90766	0.00171	0.00009	1.38153	9.83094	0.02702	0.00138	1.96619
6.95	0.00529	0.00027	1.39	9.87313	0.03791	0.00193	1.97462
6.99219	0.00708	0.00036	1.39844	9.91516	0.07016	0.00357	1.98303
7.03453	0.00749	0.00038	1.40691	9.95687	0.12962	0.0066	1.99137
7.0775	0.00787	0.0004	1.4155	9.99828	0.21849	0.01113	1.99966
7.12047	0.00768	0.00039	1.42409	10.04047	0.33131	0.01687	2.00809
7.16297	0.00588	0.0003	1.43259	10.08297	0.46436	0.02365	2.01659
7.20547	0.00386	0.0002	1.44109	10.12516	0.64105	0.03265	2.02503
7.24813	0.00403	0.00021	1.44963	10.16734	0.89124	0.04539	2.03347
7.29078	0.00518	0.00026	1.45816	10.20984	1.22059	0.06216	2.04197
7.33313	0.00518	0.00026	1.46662	10.25266	1.61758	0.08238	2.05053
7.37547	0.0046	0.00023	1.47509	10.29516	2.06997	0.10542	2.05903
7.41781	0.0048	0.00024	1.48356	10.33797	2.56661	0.13072	2.06759
7.45969	0.00549	0.00028	1.49194	10.38094	3.10083	0.15792	2.07619
7.50125	0.00495	0.00025	1.50025	10.42375	3.6738	0.18711	2.08475
7.54344	0.00416	0.00021	1.50869	10.46609	4.28898	0.21844	2.09322
7.58594	0.00592	0.0003	1.51719	10.50813	4.95344	0.25228	2.10162
7.62813	0.00732	0.00037	1.52562	10.54984	5.66386	0.28846	2.10997
7.67047	0.00636	0.00032	1.53409	10.59141	6.41893	0.32691	2.11828
7.71266	0.00395	0.0002	1.54253	10.63297	7.22088	0.36776	2.12659
7.75453	0.0048	0.00024	1.55091	10.675	8.06362	0.41068	2.135
7.79672	0.0077	0.00039	1.55934	10.71719	8.92955	0.45478	2.14344
7.83938	0.00688	0.00035	1.56788	10.75953	9.68706	0.49336	2.15191
7.8825	0.00693	0.00035	1.5765	10.80219	10.20278	0.51962	2.16044
7.92531	0.00757	0.00039	1.58506	10.84531	10.53911	0.53675	2.16906
7.96766	0.00616	0.00031	1.59353	10.88812	10.80119	0.5501	2.17762
8.00984	0.0041	0.00021	1.60197	10.93047	11.12034	0.56635	2.18609
8.05188	0.00269	0.00014	1.61038	10.97266	11.78441	0.60018	2.19453
8.09359	0.00378	0.00019	1.61872	11.01547	12.74038	0.64886	2.20309
8.13547	0.00389	0.0002	1.62709	11.05781	13.89144	0.70749	2.21156
8.1775	0.00475	0.00024	1.6355	11.09969	15.16266	0.77223	2.21994
8.22	0.00825	0.00042	1.644	11.14172	16.51955	0.84133	2.22834
8.26234	0.00888	0.00045	1.65247	11.18391	17.95789	0.91459	2.23678

Extension (mm)	Load (N)	Compressive stress (MPa)	Compressive strain (mm/mm)
11.90188	63.43394	3.23066	2.38038
11.94422	67.97362	3.46187	2.38884
11.98656	72.87936	3.71172	2.39731
12.02875	78.16408	3.98086	2.40575
12.07141	83.87929	4.27194	2.41428
12.11437	90.04661	4.58604	2.42287
12.15672	96.67419	4.92358	2.43134
12.19875	103.72972	5.28291	2.43975
12.24141	111.17783	5.66224	2.44828
12.28422	119.09961	6.06569	2.45684
12.32656	127.55227	6.49618	2.46531
12.36859	136.51015	6.9524	2.47372
12.41078	145.98483	7.43495	2.48216
12.4525	156.09439	7.94982	2.4905
12.49391	166.88609	8.49944	2.49878
12.53563	178.38965	9.08531	2.50713
12.57781	190.76674	9.71567	2.51556
12.61984	204.20169	10.39991	2.52397
12.66187	218.71611	11.13912	2.53237
12.70406	234.347	11.93519	2.54081
12.74641	251.18568	12.79278	2.54928
12.78891	269.39114	13.71998	2.55778
12.83109	289.09979	14.72373	2.56622
12.87328	310.37128	15.80708	2.57466
12.91578	333.29208	16.97443	2.58316
12.95797	358.00687	18.23314	2.59159
12.99984	384.6499	19.59006	2.59997
13.04156	413.22308	21.04528	2.60831
13.08266	443.65094	22.59496	2.61653
13.09891	456.3707	23.24277	2.61978

Table D.5 ODM-Soaked Scaffolds Without Osteoblasts Specimen 1 Raw Compression Data

Extension (mm)	Load (N)	Compressive stress (MPa)	Compressive strain (mm/mm)	Extension (mm)	Load (N)	Compressive stress (MPa)	Compressive strain (mm/mm)
0	-0.0025	-0.00013	0	2.80312	0.00176	0.00009	0.56062
0.00281	-0.00006	0	0.00056	2.84547	0.00089	0.00005	0.56909
0.02344	0.0173	0.00088	0.00469	2.88766	-0.00021	-0.00001	0.57753
0.06531	0.05381	0.00274	0.01306	2.93	0.00097	0.00005	0.586
0.1141	0.07609	0.00388	0.02228	2.97234	0.00314	0.00016	0.59447
0.15297	0.06169	0.00314	0.03059	3.01453	0.00405	0.00021	0.60291
0.19594	0.0347	0.00177	0.03919	3.05656	0.00381	0.00019	0.61131
0.24484	0.02307	0.00117	0.04897	3.09813	0.00207	0.00011	0.61963
0.29547	0.02065	0.00105	0.05909	3.13969	0.00183	0.00009	0.62794
0.34406	0.01348	0.00069	0.06881	3.18219	0.00403	0.00021	0.63644
0.39109	0.0015	0.00008	0.07822	3.22484	0.00378	0.00019	0.64497
0.43812	-0.00483	-0.00025	0.08762	3.26719	0.00131	0.00007	0.65344
0.48547	-0.00358	-0.00018	0.09709	3.30969	-0.00004	0	0.66194
0.53203	-0.00178	-0.00009	0.10641	3.35203	-0.00038	-0.00002	0.67041
0.57719	-0.0026	-0.00013	0.11544	3.39406	-0.00104	-0.00005	0.67881
0.62166	-0.00473	-0.00024	0.12431	3.43594	-0.00145	-0.00007	0.68719
0.66641	-0.00418	-0.00021	0.13328	3.47859	0.00251	0.00013	0.69572
0.71141	-0.00014	-0.00001	0.14228	3.52219	0.0052	0.00027	0.70444
0.75594	0.00128	0.00007	0.15119	3.56516	0.00354	0.00018	0.71303
0.79984	0.00004	0	0.15997	3.6075	0.00209	0.00011	0.7215
0.84375	0.00057	0.00003	0.16875	3.64953	0.002	0.0001	0.72991
0.88734	0.00116	0.00006	0.17747	3.69141	0.00221	0.00011	0.73828
0.93063	-0.00153	-0.00008	0.18613	3.73281	0.00169	0.00009	0.74656
0.97406	-0.00423	-0.00022	0.19481	3.77453	0.00054	0.00003	0.75491
1.01812	-0.00044	-0.00002	0.20362	3.81687	0.00135	0.00007	0.76337
1.06203	0.00294	0.00015	0.21241	3.85969	0.00108	0.00005	0.77194
1.10547	0.00079	0.00004	0.22109	3.90203	0.00214	0.00011	0.78041
1.14828	-0.0017	-0.00009	0.22966	3.94422	0.00386	0.0002	0.78884
1.19063	-0.00083	-0.00004	0.23813	3.98688	0.0043	0.00022	0.79738
1.23266	-0.0003	-0.00002	0.24653	4.02938	0.00446	0.00023	0.80588
1.27484	-0.0014	-0.00007	0.25497	4.07172	0.00355	0.00018	0.81434
1.3175	0.00046	0.00002	0.2635	4.11391	0.00293	0.00015	0.82278
1.36031	0.00286	0.00015	0.27206	4.15641	0.00289	0.00015	0.83128
1.40281	0.00254	0.00013	0.28056	4.19922	0.00246	0.00013	0.83984
1.44531	0.00046	0.00002	0.28906	4.24219	0.00262	0.00013	0.84844
1.48813	0.00124	0.00006	0.29763	4.285	0.00247	0.00013	0.857
1.53094	0.00293	0.00015	0.30619	4.32703	0.00111	0.00006	0.86541
1.57359	0.00176	0.00009	0.31472	4.36844	-0.00097	-0.00005	0.87369
1.61656	-0.00042	-0.00002	0.32331	4.41031	-0.00201	-0.0001	0.88206
1.65953	-0.00098	-0.00005	0.33191	4.45281	0.00137	0.00007	0.89056
1.70203	0.00043	0.00002	0.34041	4.49516	0.00317	0.00016	0.89903
1.74437	0.00233	0.00012	0.34887	4.53734	0.00182	0.00009	0.90747
1.78672	0.00236	0.00012	0.35734	4.58	0.00155	0.00008	0.916
1.82859	0.00129	0.00007	0.36572	4.62266	0.00375	0.00019	0.92453
1.87031	0.00122	0.00006	0.37406	4.66516	0.00359	0.00018	0.93303
1.91234	0.00063	0.00003	0.38247	4.70781	0.00151	0.00008	0.94156
1.95484	0.00063	0.00003	0.39097	4.75078	0.00361	0.00018	0.95016
1.9975	0.00375	0.00019	0.3995	4.79313	0.00304	0.00015	0.95863
2.03984	0.00417	0.00021	0.40797	4.83484	-0.00116	-0.00006	0.96697
2.08234	0.0019	0.0001	0.41647	4.87734	-0.00055	-0.00003	0.97547
2.12516	0.00023	0.00001	0.42503	4.91984	0.00405	0.00021	0.98397
2.1675	0.00041	0.00002	0.4335	4.96219	0.00589	0.0003	0.99244
2.21	0.00047	0.00002	0.442	5.00344	0.0021	0.00011	1.00069
2.25297	0.00101	0.00005	0.45059	5.045	0.00062	0.00003	1.009
2.29563	0.00144	0.00007	0.45913	5.08734	0.00258	0.00013	1.01747
2.33797	0.0017	0.00009	0.46759	5.13016	0.00373	0.00019	1.02603
2.38016	0	0	0.47603	5.17281	0.00333	0.00017	1.03456
2.42219	-0.00015	-0.00001	0.48444	5.21531	0.00196	0.0001	1.04306
2.46406	0.00203	0.0001	0.49281	5.25797	0.00146	0.00007	1.05159
2.50547	0.00302	0.00015	0.50109	5.30047	0.00175	0.00009	1.06009
2.54719	0.00141	0.00007	0.50944	5.34281	0.00078	0.00004	1.06856
2.58938	0	0	0.51788	5.38578	0.00142	0.00007	1.07716
2.63172	0.0018	0.00009	0.52634	5.42844	0.00425	0.00022	1.08569
2.67438	0.00304	0.00015	0.53488	5.47078	0.00469	0.00024	1.09416
2.71734	0.0027	0.00014	0.54347	5.51281	0.00288	0.00015	1.10256

Extension (mm)	Load (N)	Compressive stress (MPa)	Compressive strain (mm/mm)
5.59594	0.00181	0.00009	1.11919
5.63719	0.00294	0.00015	1.12744
5.67969	0.00463	0.00024	1.13594
5.72297	0.00767	0.00039	1.14459
5.76531	0.00611	0.00031	1.15306
5.80734	0.00197	0.0001	1.16147
5.84984	0.00045	0.00002	1.16997
5.89266	0.00373	0.00019	1.17853
5.93516	0.00566	0.00029	1.18703
5.97781	0.00215	0.00011	1.19556
6.02047	0.0006	0.00003	1.20409
6.06297	0.00138	0.00007	1.21259
6.10531	0.00064	0.00003	1.22106
6.1475	-0.00065	-0.00003	1.2295
6.18953	0.00008	0	1.23791
6.23125	0.00211	0.00011	1.24625
6.27281	0.00276	0.00014	1.25456
6.31516	0.00307	0.00016	1.26303
6.3575	0.0058	0.0003	1.2715
6.40016	0.007	0.00036	1.28003
6.44297	0.00625	0.00032	1.28859
6.48531	0.00372	0.00019	1.29706
6.52719	0.00082	0.00004	1.30544
6.56938	0.00124	0.00006	1.31388
6.61234	0.00221	0.00011	1.32247
6.65516	0.00369	0.00019	1.33103
6.69766	0.00341	0.00017	1.33953
6.74016	0.00184	0.00009	1.34803
6.7825	0.00139	0.00007	1.3565
6.82438	0.00126	0.00006	1.36488
6.86594	0.00372	0.00019	1.37319
6.90781	0.00615	0.00031	1.38156
6.95016	0.00586	0.0003	1.39003
6.9925	0.00485	0.00025	1.3985
7.03484	0.00432	0.00022	1.40697
7.0775	0.00368	0.00019	1.4155
7.12016	0.00338	0.00017	1.42403
7.16266	0.0038	0.00019	1.43253
7.20516	0.00307	0.00016	1.44103
7.24828	0.00178	0.00009	1.44966
7.29094	0.00233	0.00012	1.45819
7.33328	0.0039	0.0002	1.46666
7.37563	0.00449	0.00023	1.47513
7.41813	0.00286	0.00015	1.48363
7.45969	0.00076	0.00004	1.49194
7.50125	0.00148	0.00008	1.50025
7.54359	0.00304	0.00015	1.50872
7.58609	0.00627	0.00032	1.51722
7.62844	0.00783	0.0004	1.52569
7.67063	0.0071	0.00036	1.53413
7.7125	0.00434	0.00022	1.5425
7.75453	0.00185	0.00009	1.55091
7.79688	0.00223	0.00011	1.55938
7.83953	0.00402	0.0002	1.56791
7.88234	0.00522	0.00027	1.57647
7.92516	0.00474	0.00024	1.58503
7.96766	0.00294	0.00015	1.59353
8.01031	0.00295	0.00015	1.60206
8.05234	0.00361	0.00018	1.61047
8.09406	0.00376	0.00019	1.61881
8.13562	0.00336	0.00017	1.62713
8.17766	0.0041	0.00021	1.63553
8.22	0.00338	0.00017	1.644
8.26219	0.00243	0.00012	1.65244
8.30469	0.00251	0.00013	1.66094

Extension (mm)	Load (N)	Compressive stress (MPa)	Compressive strain (mm/mm)
8.39	0.00424	0.00022	1.678
8.43219	0.00148	0.00008	1.68644
8.47453	0.001	0.00005	1.69491
8.51703	0.00278	0.00014	1.70341
8.55969	0.00258	0.00013	1.71194
8.60188	0.00177	0.00009	1.72038
8.64422	0.00159	0.00008	1.72884
8.68641	0.00004	0	1.73728
8.72813	-0.00164	-0.00008	1.74563
8.76984	0.0001	0	1.75397
8.81219	0.004	0.0002	1.76244
8.85469	0.00528	0.00027	1.77094
8.89719	0.00342	0.00017	1.77944
8.93969	0.00081	0.00004	1.78794
8.9825	0.00143	0.00007	1.7965
9.02516	0.00285	0.00014	1.80503
9.06734	0.00254	0.00013	1.81347
9.10969	0.00339	0.00017	1.82194
9.15234	0.00498	0.00025	1.83047
9.19484	0.00547	0.00028	1.83897
9.23734	0.00543	0.00028	1.84747
9.27984	0.0066	0.00034	1.85597
9.32172	0.00665	0.00034	1.86434
9.36312	0.00395	0.0002	1.87262
9.40516	0.0015	0.00008	1.88103
9.4475	0.00272	0.00014	1.8895
9.49	0.00503	0.00026	1.898
9.5325	0.00411	0.00021	1.9065
9.575	0.00304	0.00015	1.915
9.61781	0.0036	0.00018	1.92356
9.66047	0.00166	0.00008	1.93209
9.70297	0.00243	0.00012	1.94059
9.74562	0.02068	0.00105	1.94912
9.78844	0.09027	0.0046	1.95769
9.83078	0.30215	0.01539	1.96616
9.87281	0.78984	0.04023	1.97456
9.91469	1.54445	0.07866	1.98294
9.95656	2.47624	0.12611	1.99131
9.99797	3.5118	0.17882	1.99959
10.04016	4.60056	0.2343	2.00803
10.0825	5.72051	0.29134	2.0165
10.125	6.8489	0.34881	2.025
10.1675	7.87136	0.40088	2.0335
10.21016	8.58833	0.4374	2.04203
10.25281	9.04562	0.46069	2.05056
10.29531	9.34951	0.47617	2.05906
10.33781	9.69718	0.49387	2.06756
10.38047	10.34676	0.52696	2.07609
10.42328	11.25739	0.57333	2.08466
10.46562	12.34247	0.6286	2.09312
10.50797	13.52975	0.68906	2.10159
10.54969	14.77337	0.7524	2.10994
10.59109	16.04027	0.81692	2.11822
10.63266	17.31923	0.88206	2.12653
10.67469	18.6205	0.94833	2.13494
10.71719	19.97054	1.01709	2.14344
10.75953	21.385	1.08913	2.15191
10.80219	22.87406	1.16497	2.16044
10.845	24.4376	1.2446	2.169
10.88766	26.07967	1.32823	2.17753
10.92984	27.7907	1.41537	2.18597
10.97234	29.55092	1.50502	2.19447
11.01516	31.37759	1.59805	2.20303
11.05734	33.28081	1.69498	2.21147
11.09937	35.24226	1.79487	2.21987

Extension (mm)	Load (N)	Compressive stress (MPa)	Compressive strain (mm/mm)
11.18359	39.40364	2.00681	2.23672
11.22547	41.66018	2.12174	2.24509
11.2675	44.03904	2.24289	2.2535
11.30984	46.53734	2.37013	2.26197
11.35234	49.18346	2.50489	2.27047
11.39437	51.97981	2.64731	2.27887
11.43688	54.91506	2.7968	2.28737
11.47953	58.01405	2.95463	2.29591
11.52234	61.31381	3.12269	2.30447
11.56484	64.79343	3.2999	2.31297
11.60719	68.43219	3.48522	2.32144
11.64984	72.24099	3.6792	2.32997
11.6925	76.24426	3.88309	2.3385
11.73469	80.45405	4.09749	2.34694
11.77687	84.88269	4.32304	2.35537
11.81859	89.53122	4.55979	2.36372
11.86	94.39301	4.8074	2.372
11.90172	99.46677	5.0658	2.38034
11.94406	104.81733	5.3383	2.38881
11.98641	110.50576	5.62801	2.39728
12.02844	116.52595	5.93462	2.40569
12.07109	122.87875	6.25816	2.41422
12.11422	129.61217	6.60109	2.42284
12.15672	136.7751	6.9659	2.43134
12.19875	144.31984	7.35015	2.43975
12.24141	152.21959	7.75248	2.44828
12.28422	160.63715	8.18118	2.45684
12.32672	169.65593	8.64051	2.46534
12.36875	179.22391	9.1278	2.47375
12.41078	189.33582	9.64279	2.48216
12.4525	200.08844	10.19042	2.4905
12.49375	211.56204	10.77477	2.49875
12.53516	223.82738	11.39943	2.50703
12.57734	237.09828	12.07532	2.51547
12.61922	251.5887	12.81331	2.52384
12.66141	267.29239	13.61309	2.53228
12.70359	284.2142	14.47491	2.54072
12.74609	302.41537	15.40189	2.54922
12.78859	321.95972	16.39727	2.55772
12.83078	342.86417	17.46193	2.56616
12.87281	365.14426	18.59664	2.57456
12.91531	388.95563	19.80935	2.58306
12.95766	414.55957	21.11335	2.59153
12.99953	442.24133	22.52317	2.59991
13.01594	453.91934	23.11792	2.60319

Table D.6 ODM-Soaked Scaffolds Without Osteoblasts Specimen 2 Raw Compression Data

Extension (mm)	Load (N)	Compressive stress (MPa)	Compressive strain (mm/mm)	Extension (mm)	Load (N)	Compressive stress (MPa)	Compressive strain (mm/mm)
0	0.00226	0.00012	0	2.80281	-0.00124	-0.00006	0.56056
0.00281	0.00306	0.00016	0.00056	2.84516	-0.00036	-0.00002	0.56903
0.02375	0.01983	0.00101	0.00475	2.8875	-0.00094	-0.00005	0.5775
0.06563	0.0574	0.00292	0.01313	2.93	0.0005	0.00003	0.586
0.11188	0.07837	0.00399	0.02238	2.97234	0.00351	0.00018	0.59447
0.15344	0.06176	0.00315	0.03069	3.01453	0.00424	0.00022	0.60291
0.19625	0.03383	0.00172	0.03925	3.05625	0.00176	0.00009	0.61125
0.24484	0.0218	0.00111	0.04897	3.0975	-0.00126	-0.00006	0.6195
0.29563	0.02	0.00102	0.05913	3.13906	-0.00034	-0.00002	0.62781
0.34406	0.01198	0.00061	0.06881	3.18172	0.00313	0.00016	0.63634
0.39109	0.00047	0.00002	0.07822	3.22438	0.0045	0.00023	0.64487
0.43828	-0.00455	-0.00023	0.08766	3.26688	0.00662	0.00034	0.65338
0.48547	-0.00103	-0.00005	0.09709	3.30953	0.00748	0.00038	0.66191
0.53203	0.00097	0.00005	0.10641	3.35219	0.00549	0.00028	0.67044
0.57734	-0.00239	-0.00012	0.11547	3.39453	0.00155	0.00008	0.67891
0.62172	-0.00633	-0.00032	0.12434	3.43641	0.00171	0.00009	0.68728
0.66641	-0.00613	-0.00031	0.13328	3.47875	0.00525	0.00027	0.69575
0.71141	-0.00249	-0.00013	0.14228	3.52219	0.0057	0.00029	0.70444
0.75594	0.00034	0.00002	0.15119	3.56516	0.00313	0.00016	0.71303
0.79969	0.00059	0.00003	0.15994	3.60766	0.0009	0.00005	0.72153
0.84328	0.00029	0.00001	0.16866	3.64984	0.00079	0.00004	0.72997
0.88703	-0.00136	-0.00007	0.17741	3.69172	0.00106	0.00005	0.73834
0.93062	-0.00154	-0.00008	0.18612	3.73328	-0.00008	0	0.74666
0.97438	0.00061	0.00003	0.19488	3.77516	0.00048	0.00002	0.75503
1.01828	0.00182	0.00009	0.20366	3.81703	0.00038	0.00002	0.76341
1.06203	0.00092	0.00005	0.21241	3.85922	-0.00014	-0.00001	0.77184
1.10531	0.0002	0.00001	0.22106	3.90156	0.00122	0.00006	0.78031
1.14812	0.00105	0.00005	0.22962	3.94406	0.00496	0.00025	0.78881
1.19062	0.00006	0	0.23812	3.98656	0.00632	0.00032	0.79731
1.23266	-0.00299	-0.00015	0.24653	4.02906	0.00259	0.00013	0.80581
1.275	-0.00345	-0.00018	0.255	4.07203	0.00196	0.0001	0.81441
1.3175	0.00039	0.00002	0.2635	4.115	0.00529	0.00027	0.823
1.36016	0.00305	0.00016	0.27203	4.15766	0.00418	0.00021	0.83153
1.40281	0.0037	0.00019	0.28056	4.19984	0.00103	0.00005	0.83997
1.44547	0.00301	0.00015	0.28909	4.24234	0.00171	0.00009	0.84847
1.48813	0.00445	0.00023	0.29763	4.285	0.00386	0.0002	0.857
1.53078	0.00496	0.00025	0.30616	4.32687	0.00142	0.00007	0.86537
1.57359	0.00295	0.00015	0.31472	4.36797	-0.00195	-0.0001	0.87359
1.61688	0.00065	0.00003	0.32338	4.40984	-0.00002	0	0.88197
1.65969	-0.00157	-0.00008	0.33194	4.45266	0.00532	0.00027	0.89053
1.70234	-0.00204	-0.0001	0.34047	4.49516	0.00636	0.00032	0.89903
1.74453	-0.0025	-0.00013	0.34891	4.5375	0.00379	0.00019	0.9075
1.78688	0.0004	0.00002	0.35737	4.57984	0.00226	0.00011	0.91597
1.82875	0.00237	0.00012	0.36575	4.62234	0.00278	0.00014	0.92447
1.87031	0.00052	0.00003	0.37406	4.66422	0.00267	0.00014	0.93284
1.91234	-0.00013	-0.00001	0.38247	4.70656	0.00368	0.00019	0.94131
1.95453	0.00349	0.00018	0.39091	4.75	0.00616	0.00031	0.95
1.99687	0.00791	0.0004	0.39937	4.79359	0.00673	0.00034	0.95872
2.03938	0.00703	0.00036	0.40788	4.83609	0.00419	0.00021	0.96722
2.08219	0.00387	0.0002	0.41644	4.87812	0.00115	0.00006	0.97562
2.125	0.00267	0.00014	0.425	4.92016	0.00147	0.00007	0.98403
2.1675	0.0026	0.00013	0.4335	4.96156	0.00152	0.00008	0.99231
2.21016	0.00104	0.00005	0.44203	5.00297	0.00021	0.00001	1.00059
2.25313	0.00026	0.00001	0.45063	5.045	0.00071	0.00004	1.009
2.29562	0.00185	0.00009	0.45913	5.08797	0.00425	0.00022	1.01759
2.33781	0.00019	0.00001	0.46756	5.13047	0.00631	0.00032	1.02609
2.37984	-0.00115	-0.00006	0.47597	5.17281	0.00549	0.00028	1.03456
2.42203	0.00111	0.00006	0.48441	5.21531	0.00366	0.00019	1.04306
2.46391	0.00266	0.00014	0.49278	5.25797	0.00124	0.00006	1.05159
2.50547	0.00311	0.00016	0.50109	5.30047	-0.00046	-0.00002	1.06009
2.5475	0.00504	0.00026	0.5095	5.34281	-0.00014	-0.00001	1.06856
2.59	0.00611	0.00031	0.518	5.38531	0.00217	0.00011	1.07706
2.63266	0.00613	0.00031	0.52653	5.42766	0.00345	0.00018	1.08553
2.675	0.00532	0.00027	0.535	5.47	0.00149	0.00008	1.094
2.7175	0.00207	0.00011	0.5435	5.51297	0.00025	0.00001	1.10259

Extension (mm)	Load (N)	Compressive stress (MPa)	Compressive strain (mm/mm)
5.59688	0.00175	0.00009	1.1937
5.63797	0.00097	0.00005	1.12759
5.68	0.00363	0.00018	1.136
5.72266	0.00693	0.00035	1.14453
5.765	0.00712	0.00036	1.153
5.80703	0.00448	0.00023	1.16141
5.84953	0.00373	0.00019	1.16991
5.8925	0.00521	0.00027	1.1785
5.93516	0.0069	0.00035	1.18703
5.9775	0.00599	0.00031	1.1955
6.02031	0.00307	0.00016	1.20406
6.06297	0.00252	0.00013	1.21259
6.105	0.00287	0.00015	1.221
6.14703	0.00166	0.00008	1.22941
6.18922	0.00048	0.00002	1.23784
6.23125	0.00076	0.00004	1.24625
6.27344	0.00261	0.00013	1.25469
6.31594	0.00418	0.00021	1.26319
6.35812	0.0055	0.00028	1.27162
6.40016	0.00636	0.00032	1.28003
6.44266	0.00554	0.00028	1.28853
6.48469	0.00357	0.00018	1.29694
6.52656	0.00195	0.0001	1.30531
6.56891	0.00297	0.00015	1.31378
6.61203	0.00515	0.00026	1.32241
6.65531	0.00549	0.00028	1.33106
6.69781	0.00461	0.00023	1.33956
6.74016	0.00272	0.00014	1.34803
6.78266	0.00198	0.0001	1.35653
6.82469	0.00261	0.00013	1.36494
6.86609	0.00329	0.00017	1.37322
6.90781	0.00273	0.00014	1.38156
6.95031	0.00263	0.00013	1.39006
6.9925	0.004	0.0002	1.3985
7.03484	0.00517	0.00026	1.40697
7.07734	0.00456	0.00023	1.41547
7.12016	0.00561	0.00029	1.42403
7.16281	0.00649	0.00033	1.43256
7.20547	0.00598	0.0003	1.44109
7.24828	0.00633	0.00032	1.44966
7.29094	0.00642	0.00033	1.45819
7.33313	0.00496	0.00025	1.46663
7.37531	0.00368	0.00019	1.47506
7.41781	0.004	0.0002	1.48356
7.45984	0.00207	0.00011	1.49197
7.50156	0.0009	0.00005	1.50031
7.54375	0.00322	0.00016	1.50875
7.58594	0.00562	0.00029	1.51719
7.62828	0.00689	0.00035	1.52566
7.67062	0.00733	0.00037	1.53412
7.71281	0.0067	0.00034	1.54256
7.75484	0.0039	0.0002	1.55097
7.79688	0.00361	0.00018	1.55938
7.83953	0.0067	0.00034	1.56791
7.88281	0.0066	0.00034	1.57656
7.92547	0.00377	0.00019	1.58509
7.96781	0.00177	0.00009	1.59356
8.01	0.00224	0.00011	1.602
8.05219	0.00352	0.00018	1.61044
8.09375	0.00376	0.00019	1.61875
8.13516	0.0042	0.00021	1.62703
8.17719	0.006	0.00031	1.63544
8.21938	0.0063	0.00032	1.64388
8.26203	0.00746	0.00038	1.65241
8.30469	0.00767	0.00039	1.66094

Extension (mm)	Load (N)	Compressive stress (MPa)	Compressive strain (mm/mm)
8.38984	0.00498	0.00025	1.67797
8.43203	0.00148	0.00008	1.68641
8.47422	0.00219	0.00011	1.69484
8.51688	0.00431	0.00022	1.70338
8.55937	0.00413	0.00021	1.71187
8.60188	0.00354	0.00018	1.72038
8.64437	0.00407	0.00021	1.72888
8.68672	0.0052	0.00027	1.73734
8.72859	0.0038	0.00019	1.74572
8.77031	0.00283	0.00014	1.75406
8.8125	0.00593	0.0003	1.7625
8.85484	0.0086	0.00044	1.77097
8.89703	0.00672	0.00034	1.77941
8.93953	0.00418	0.00021	1.78791
8.98219	0.0043	0.00022	1.79644
9.02484	0.00394	0.0002	1.80497
9.06719	0.00291	0.00015	1.81344
9.11	0.00321	0.00016	1.822
9.15266	0.00372	0.00019	1.83053
9.19516	0.00163	0.00008	1.83903
9.2375	0.00148	0.00008	1.8475
9.27984	0.00319	0.00016	1.85597
9.32187	0.00461	0.00023	1.86437
9.36328	0.00306	0.00016	1.87266
9.405	0.0033	0.00017	1.881
9.44734	0.00613	0.00031	1.88947
9.48984	0.00806	0.00041	1.89797
9.53219	0.00849	0.00043	1.90644
9.575	0.00743	0.00038	1.915
9.61781	0.00666	0.00034	1.92356
9.66031	0.00637	0.00032	1.93206
9.70281	0.00573	0.00029	1.94056
9.74562	0.00476	0.00024	1.94912
9.78828	0.00545	0.00028	1.95766
9.83078	0.00679	0.00035	1.96616
9.87281	0.00407	0.00021	1.97456
9.91484	0.00208	0.00011	1.98297
9.95686	0.00413	0.00021	1.99131
9.99797	0.0062	0.00032	1.99959
10.04016	0.00676	0.00034	2.00803
10.08266	0.00667	0.00034	2.01653
10.12516	0.00731	0.00037	2.02503
10.1675	0.00717	0.00037	2.0335
10.21	0.00629	0.00032	2.042
10.25281	0.00662	0.00034	2.05056
10.29547	0.00779	0.0004	2.05909
10.33844	0.00704	0.00036	2.06769
10.38125	0.00415	0.00021	2.07625
10.42375	0.00409	0.00021	2.08475
10.46594	0.00726	0.00037	2.09319
10.50813	0.0167	0.00085	2.10162
10.54984	0.05669	0.00289	2.10997
10.59125	0.16102	0.0082	2.11825
10.63281	0.3502	0.01784	2.12656
10.675	0.62739	0.03195	2.135
10.71734	0.99892	0.05087	2.14347
10.75969	1.45666	0.07419	2.15194
10.80203	1.98727	0.10121	2.16041
10.845	2.58471	0.13164	2.169
10.88797	3.24119	0.16507	2.17759
10.93047	3.9497	0.20116	2.18609
10.97281	4.70449	0.2396	2.19456
11.01547	5.51703	0.28098	2.20309
11.05797	6.39936	0.32592	2.21159
11.10031	7.35254	0.37446	2.22006

Extension (mm)	Load (N)	Compressive stress (MPa)	Compressive strain (mm/mm)
11.05797	6.39936	0.32592	2.21159
11.10031	7.35254	0.37446	2.22006
11.14234	8.37009	0.42629	2.22847
11.18422	9.36096	0.47675	2.23684
11.22578	10.10955	0.51488	2.24516
11.26781	10.59497	0.5396	2.25356
11.31016	10.94347	0.55735	2.26203
11.35266	11.24294	0.5726	2.27053
11.39484	11.85497	0.60377	2.27897
11.43719	12.85535	0.65472	2.28744
11.47984	14.14203	0.72025	2.29597
11.5225	15.63755	0.79641	2.3045
11.565	17.28265	0.8802	2.313
11.6075	19.0455	0.96998	2.3215
11.65016	20.9123	1.06505	2.33003
11.69266	22.8827	1.16541	2.33853
11.73516	24.96626	1.27152	2.34703
11.77766	27.18876	1.38471	2.35553
11.81969	29.58528	1.50677	2.36394
11.86094	32.15771	1.63778	2.37219
11.90266	34.8992	1.7774	2.38053
11.94484	37.83553	1.92695	2.38897
11.98734	40.994	2.08781	2.39747
12.02953	44.38172	2.26034	2.40591
12.07188	48.00283	2.44476	2.41438
12.11484	51.8949	2.64299	2.42297
12.1575	56.11897	2.85812	2.4315
12.19969	60.67152	3.08997	2.43994
12.24234	65.53982	3.33792	2.44847
12.285	70.78289	3.60494	2.457
12.32734	76.44941	3.89354	2.46547
12.36938	82.53914	4.20368	2.47388
12.41156	89.05612	4.53559	2.48231
12.45344	96.03597	4.89107	2.49069
12.49469	103.48216	5.2703	2.49894
12.53641	111.4131	5.67422	2.50728
12.57859	119.98801	6.11094	2.51572
12.62094	129.36642	6.58858	2.52419
12.66281	139.57187	7.10834	2.53256
12.70516	150.61588	7.6708	2.54103
12.74766	162.56374	8.2793	2.54953
12.79016	175.47987	8.93712	2.55803
12.8325	189.35252	9.64364	2.5665
12.875	204.18768	10.39919	2.575
12.9175	220.09558	11.20938	2.5835
12.95969	237.17447	12.0792	2.59194
13.00156	255.51051	13.01304	2.60031
13.04344	275.1145	14.01147	2.60869
13.08469	296.04623	15.07751	2.61694
13.12578	318.46317	16.2192	2.62516
13.16734	342.4512	17.4409	2.63347
13.20922	368.2962	18.75717	2.64184
13.25125	396.3295	20.18489	2.65025
13.29297	426.74759	21.73408	2.65859
13.32656	452.83224	23.06256	2.66531

Table D.7ODM-Soaked Scaffolds Without Osteoblasts Specimen 3 Raw Compression Data

Extension (mm)	Load (N)	Compressive stress (MPa)	Compressive strain (mm/mm)	Extension (mm)	Load (N)	Compressive stress (MPa)	Compressive strain (mm/mm)
0	-0.00038	-0.00002	0	2.8025	0.00123	0.00006	0.5605
0.00281	0.00139	0.00007	0.00056	2.84484	-0.00022	-0.00001	0.56897
0.02375	0.01869	0.00095	0.00475	2.88734	0.00256	0.00013	0.57747
0.06563	0.05873	0.00299	0.01313	2.92969	0.00461	0.00023	0.58594
0.11156	0.08056	0.0041	0.02231	2.97188	0.00295	0.00015	0.59438
0.15313	0.06148	0.00313	0.03063	3.01406	0.00281	0.00014	0.60281
0.19594	0.03287	0.00167	0.03919	3.05625	0.00319	0.00016	0.61125
0.24453	0.02319	0.00118	0.04891	3.09781	0.00188	0.0001	0.61956
0.29531	0.02331	0.00119	0.05906	3.13984	0.00136	0.00007	0.62797
0.34391	0.01398	0.00071	0.06878	3.1825	0.00421	0.00021	0.6365
0.39094	0.00091	0.00005	0.07819	3.22484	0.00707	0.00036	0.64497
0.43797	-0.00352	-0.00018	0.08759	3.26672	0.00513	0.00026	0.65334
0.48531	-0.00234	-0.00012	0.09706	3.30922	0.00255	0.00013	0.66184
0.53203	-0.00189	-0.0001	0.10641	3.35219	0.00434	0.00022	0.67044
0.57703	-0.00129	-0.00007	0.11541	3.39469	0.0059	0.0003	0.67894
0.62141	-0.00184	-0.00009	0.12428	3.43656	0.00442	0.00023	0.68731
0.66625	-0.00284	-0.00014	0.13325	3.47891	0.00358	0.00018	0.69578
0.71141	-0.00033	-0.00002	0.14228	3.52188	0.00412	0.00021	0.70438
0.75594	0.00321	0.00016	0.15119	3.565	0.00304	0.00015	0.713
0.79984	0.00419	0.00021	0.15997	3.6075	0.00115	0.00006	0.7215
0.84375	0.00327	0.00017	0.16875	3.64969	0.00072	0.00004	0.72994
0.8875	0.00194	0.0001	0.1775	3.69156	0.00149	0.00008	0.73831
0.93078	0.00022	0.00001	0.18616	3.73312	0.00276	0.00014	0.74663
0.97438	-0.00053	-0.00003	0.19488	3.77484	0.0024	0.00012	0.75497
1.01828	0.00138	0.00007	0.20366	3.81719	0.00299	0.00015	0.76344
1.06203	0.00388	0.0002	0.21241	3.85969	0.00444	0.00023	0.77194
1.10531	0.0042	0.00021	0.22106	3.90219	0.00484	0.00025	0.78044
1.14797	0.00153	0.00008	0.22959	3.94469	0.00354	0.00018	0.78894
1.19031	-0.00089	-0.00005	0.23806	3.98703	0.00238	0.00012	0.79741
1.23234	-0.00008	0	0.24647	4.02938	0.0013	0.00007	0.80588
1.27469	0.00289	0.00015	0.25494	4.07172	0.00068	0.00003	0.81434
1.31719	0.0031	0.00016	0.26344	4.11453	0.00143	0.00007	0.82291
1.35984	0.00111	0.00006	0.27197	4.15719	0.00334	0.00017	0.83144
1.4025	0.00163	0.00008	0.2805	4.2	0.00577	0.00029	0.84
1.44531	0.00402	0.0002	0.28906	4.24234	0.00521	0.00027	0.84847
1.48813	0.00345	0.00018	0.29763	4.28469	0.00424	0.00022	0.85694
1.53094	0.00137	0.00007	0.30619	4.32672	0.0025	0.00013	0.86534
1.57391	0.00164	0.00008	0.31478	4.36828	0.00208	0.00011	0.87366
1.61688	0.00248	0.00013	0.32338	4.41016	0.00138	0.00007	0.88203
1.65984	0.00247	0.00013	0.33197	4.45266	0.00258	0.00013	0.89053
1.70234	0.00239	0.00012	0.34047	4.49453	0.00321	0.00016	0.89891
1.74469	0.00451	0.00023	0.34894	4.53641	0.00194	0.0001	0.90728
1.78703	0.005	0.00025	0.35741	4.57906	0.00233	0.00012	0.91581
1.82906	0.00173	0.00009	0.36581	4.6225	0.0051	0.00026	0.9245
1.87047	0.00029	0.00001	0.37409	4.66547	0.00652	0.00033	0.93309
1.91234	0.00067	0.00003	0.38247	4.70797	0.00536	0.00027	0.94159
1.95469	0.00253	0.00013	0.39094	4.75062	0.00402	0.0002	0.95012
1.99703	0.00434	0.00022	0.39941	4.79312	0.00371	0.00019	0.95862
2.03938	0.00561	0.00029	0.40788	4.83547	0.00458	0.00023	0.96709
2.08188	0.00595	0.0003	0.41638	4.87781	0.00601	0.00031	0.97556
2.12453	0.00444	0.00023	0.42491	4.92016	0.00566	0.00029	0.98403
2.16703	0.0037	0.00019	0.43341	4.96203	0.00432	0.00022	0.99241
2.20984	0.00321	0.00016	0.44197	5.00328	0.00351	0.00018	1.00066
2.25313	0.00406	0.00021	0.45063	5.04516	0.00329	0.00017	1.00903
2.29578	0.0042	0.00021	0.45916	5.08766	0.00449	0.00023	1.01753
2.33813	0.00125	0.00006	0.46763	5.13016	0.00608	0.00031	1.02603
2.38031	0.00049	0.00003	0.47606	5.17219	0.00679	0.00035	1.03444
2.4225	0.00267	0.00014	0.4845	5.21453	0.00557	0.00028	1.04291
2.46422	0.00435	0.00022	0.49284	5.25719	0.00306	0.00016	1.05144
2.50563	0.00398	0.0002	0.50113	5.29953	0.0024	0.00012	1.05991
2.54766	0.00354	0.00018	0.50953	5.3425	0.00207	0.00011	1.0685
2.59031	0.00475	0.00024	0.51806	5.38609	0.0028	0.00014	1.07722
2.63281	0.00357	0.00018	0.52656	5.42891	0.00388	0.0002	1.08578
2.675	0.00151	0.00008	0.535	5.47094	0.00266	0.00014	1.09419
2.71766	0.0022	0.00011	0.54353	5.51312	0.001	0.00005	1.10263

Extension (mm)	Load (N)	Compressive stress (MPa)	Compressive strain (mm/mm)
5.47094	0.00266	0.00014	1.09419
5.51312	0.001	0.00005	1.10263
5.55531	0.00078	0.00004	1.11106
5.59656	0.00216	0.00011	1.11931
5.63781	0.0044	0.00022	1.12756
5.68016	0.00753	0.00038	1.13603
5.72281	0.00822	0.00042	1.14456
5.76484	0.00613	0.00031	1.15297
5.80703	0.00379	0.00019	1.16141
5.84969	0.00354	0.00018	1.16994
5.89234	0.00384	0.0002	1.17847
5.93453	0.00191	0.0001	1.18691
5.97687	0.00133	0.00007	1.19537
6.01969	0.00285	0.00014	1.20394
6.06266	0.00412	0.00021	1.21253
6.10547	0.00504	0.00026	1.22109
6.14781	0.00642	0.00033	1.22956
6.19	0.00642	0.00033	1.238
6.23156	0.00269	0.00014	1.24631
6.27359	0.00253	0.00013	1.25472
6.31578	0.00582	0.0003	1.26316
6.35797	0.00601	0.00031	1.27159
6.4	0.00473	0.00024	1.28
6.44266	0.00551	0.00028	1.28853
6.48484	0.00512	0.00026	1.29697
6.52672	0.00242	0.00012	1.30534
6.56906	0.00214	0.00011	1.31381
6.61203	0.00539	0.00027	1.32241
6.655	0.00612	0.00031	1.331
6.69766	0.00386	0.0002	1.33953
6.74016	0.00317	0.00016	1.34803
6.7825	0.00473	0.00024	1.3565
6.82437	0.00464	0.00024	1.36487
6.86578	0.00349	0.00018	1.37316
6.90766	0.00517	0.00026	1.38153
6.95	0.00632	0.00032	1.39
6.99219	0.00517	0.00026	1.39844
7.03453	0.00422	0.00022	1.40691
7.0775	0.00605	0.00031	1.4155
7.12047	0.00695	0.00035	1.42409
7.16281	0.00408	0.00021	1.43256
7.20531	0.00161	0.00008	1.44106
7.24813	0.00205	0.0001	1.44963
7.29094	0.00425	0.00022	1.45819
7.33344	0.00565	0.00029	1.46669
7.37578	0.00517	0.00026	1.47516
7.41781	0.00377	0.00019	1.48356
7.45984	0.00168	0.00009	1.49197
7.50156	0.00111	0.00006	1.50031
7.54359	0.00325	0.00017	1.50872
7.58578	0.0044	0.00022	1.51716
7.62797	0.00489	0.00025	1.52559
7.67016	0.00696	0.00035	1.53403
7.71234	0.00776	0.0004	1.54247
7.75438	0.00372	0.00019	1.55088
7.79688	0.00104	0.00005	1.55938
7.83969	0.0037	0.00019	1.56794
7.88281	0.00495	0.00025	1.57656
7.92547	0.00252	0.00013	1.58509
7.96781	0.00081	0.00004	1.59356
8.01	0.00021	0.00001	1.602
8.05203	0.00131	0.00007	1.61041
8.09406	0.00406	0.00021	1.61881
8.13547	0.00448	0.00023	1.62709
8.1775	0.00826	0.00042	1.6355

Extension (mm)	Load (N)	Compressive stress (MPa)	Compressive strain (mm/mm)
8.26219	0.01072	0.00055	1.65244
8.30469	0.00624	0.00032	1.66094
8.34719	0.00411	0.00021	1.66944
8.38953	0.00409	0.00021	1.67791
8.43141	0.00272	0.00014	1.68628
8.47391	0.00155	0.00008	1.69478
8.51703	0.00522	0.00027	1.70341
8.55953	0.00894	0.00046	1.71191
8.60188	0.00745	0.00038	1.72038
8.64422	0.00272	0.00014	1.72884
8.68641	0.00223	0.00011	1.73728
8.72813	0.00462	0.00024	1.74563
8.77	0.00571	0.00029	1.754
8.81234	0.00799	0.00041	1.76247
8.85484	0.01047	0.00053	1.77097
8.89703	0.00915	0.00047	1.77941
8.93969	0.00532	0.00027	1.78794
8.98281	0.00391	0.0002	1.79656
9.02547	0.00568	0.00029	1.80509
9.06766	0.00537	0.00027	1.81353
9.10984	0.00363	0.00019	1.82197
9.15234	0.00404	0.00021	1.83047
9.19516	0.00534	0.00027	1.83903
9.23766	0.00643	0.00033	1.84753
9.27984	0.00561	0.00029	1.85597
9.32172	0.0046	0.00023	1.86434
9.36312	0.004	0.0002	1.87262
9.405	0.003	0.00015	1.881
9.44734	0.00305	0.00016	1.88947
9.48969	0.00536	0.00027	1.89794
9.53219	0.01022	0.00052	1.90644
9.57484	0.01391	0.00071	1.91497
9.6175	0.01274	0.00065	1.9235
9.66	0.01061	0.00054	1.932
9.7025	0.00868	0.00044	1.9405
9.74547	0.00719	0.00037	1.94909
9.78844	0.00669	0.00034	1.95769
9.83094	0.00609	0.00031	1.96619
9.87328	0.00763	0.00039	1.97466
9.91531	0.00797	0.00041	1.98306
9.95687	0.00867	0.00044	1.99137
9.99828	0.019	0.00097	1.99966
10.04031	0.05415	0.00276	2.00806
10.08266	0.13163	0.0067	2.01653
10.125	0.26242	0.01337	2.025
10.16734	0.4462	0.02272	2.03347
10.21	0.67589	0.03442	2.042
10.25266	0.93635	0.04769	2.05053
10.29547	1.2176	0.06201	2.05909
10.33813	1.51494	0.07716	2.06763
10.38094	1.82638	0.09302	2.07619
10.42359	2.1515	0.10958	2.08472
10.46594	2.49258	0.12695	2.09319
10.50813	2.85391	0.14535	2.10162
10.55	3.23808	0.16491	2.11
10.59141	3.65499	0.18615	2.11828
10.63297	4.12131	0.2099	2.12659
10.67484	4.64365	0.2365	2.13497
10.71734	5.22072	0.26589	2.14347
10.75969	5.8479	0.29783	2.15194
10.80203	6.51838	0.33198	2.16041
10.845	7.22921	0.36818	2.169
10.88797	7.96369	0.40559	2.17759
10.93031	8.58521	0.43724	2.18606
10.97297	9.00171	0.45845	2.19459

Extension (mm)	Load (N)	Compressive stress (MPa)	Compressive strain (mm/mm)
11.05812	9.50424	0.48405	2.21162
11.10016	9.79314	0.49876	2.22003
11.14203	10.39079	0.5292	2.22841
11.18406	11.23995	0.57245	2.23681
11.22578	12.26098	0.62445	2.24516
11.2675	13.40378	0.68265	2.2535
11.30984	14.63714	0.74546	2.26197
11.3525	15.95763	0.81272	2.2705
11.39484	17.36797	0.88454	2.27897
11.43719	18.8672	0.9609	2.28744
11.48	20.46645	1.04235	2.296
11.5225	22.17985	1.12961	2.3045
11.565	24.00723	1.22268	2.313
11.60766	25.96341	1.32231	2.32153
11.65047	28.07069	1.42963	2.33009
11.69281	30.34074	1.54524	2.33856
11.73484	32.77691	1.66931	2.34697
11.77719	35.39027	1.80241	2.35544
11.81938	38.19099	1.94505	2.36388
11.86063	41.17299	2.09692	2.37213
11.90219	44.33416	2.25792	2.38044
11.94438	47.7252	2.43062	2.38888
11.98703	51.40145	2.61785	2.39741
12.02953	55.37825	2.82039	2.40591
12.07219	59.6725	3.0391	2.41444
12.115	64.32105	3.27584	2.423
12.1575	69.34299	3.53161	2.4315
12.19969	74.73737	3.80634	2.43994
12.24203	80.50349	4.10001	2.44841
12.28453	86.70141	4.41567	2.45691
12.32703	93.36797	4.75519	2.46541
12.36922	100.48454	5.11764	2.47384
12.41156	108.08588	5.50477	2.48231
12.45328	116.23923	5.92002	2.49066
12.49453	124.96115	6.36422	2.49891
12.53625	134.24548	6.83707	2.50725
12.57859	144.20064	7.34408	2.51572
12.62063	154.97623	7.89287	2.52413
12.6625	166.59021	8.48437	2.5325
12.70469	179.05968	9.11943	2.54094
12.74719	192.48811	9.80334	2.54944
12.78953	207.02203	10.54355	2.55791
12.83187	222.68954	11.34149	2.56638
12.87422	239.5228	12.1988	2.57484
12.91687	257.63748	13.12137	2.58337
12.95891	277.10275	14.11273	2.59178
13.00078	297.98544	15.17627	2.60016
13.04266	320.35437	16.31551	2.60853
13.08406	344.32468	17.53631	2.61681
13.125	370.05347	18.84667	2.625
13.16687	397.58365	20.24877	2.63337
13.20875	427.20599	21.75742	2.64175
13.24219	452.64185	23.05286	2.64844

Table D.8 ODM-Soaked Scaffolds Without Osteoblasts Specimen 4 Raw Compression Data

Extension (mm)	Load (N)	Compressive stress (MPa)	Compressive strain (mm/mm)	Extension (mm)	Load (N)	Compressive stress (MPa)	Compressive strain (mm/mm)
0	0.00509	0.00026	0	2.80234	0.00127	0.00006	0.56047
0.00203	0.00493	0.00025	0.00041	2.845	0.00208	0.00011	0.569
0.01688	0.01287	0.00066	0.00338	2.88766	0.00165	0.00008	0.57753
0.05469	0.04866	0.00248	0.01094	2.93	0.00317	0.00016	0.586
0.10344	0.0827	0.00421	0.02069	2.97219	0.00392	0.0002	0.59444
0.15	0.07854	0.004	0.03	3.01359	0.00293	0.00015	0.60272
0.19422	0.04628	0.00236	0.03884	3.05516	0.00231	0.00012	0.61103
0.24156	0.02152	0.0011	0.04831	3.09766	0.00385	0.0002	0.61953
0.29234	0.01486	0.00076	0.05847	3.14047	0.00625	0.00032	0.62809
0.34266	0.01164	0.00059	0.06853	3.18281	0.00347	0.00018	0.63656
0.39047	0.00341	0.00017	0.07809	3.22516	0.00001	0	0.64503
0.43703	-0.00442	-0.00023	0.08741	3.26766	0.00119	0.00006	0.65353
0.48344	-0.00639	-0.00033	0.09669	3.30984	0.00385	0.0002	0.66197
0.52969	-0.00581	-0.0003	0.10594	3.35188	0.00392	0.0002	0.67038
0.575	-0.00616	-0.00031	0.115	3.39422	0.003	0.00015	0.67884
0.62031	-0.00192	-0.0001	0.12406	3.43703	0.00471	0.00024	0.68741
0.66578	0.00197	0.0001	0.13316	3.48016	0.00434	0.00022	0.69603
0.71078	0.00337	0.00017	0.14216	3.52234	-0.00051	-0.00003	0.70447
0.75531	0.00233	0.00012	0.15106	3.56437	-0.00236	-0.00012	0.71288
0.79937	0.00079	0.00004	0.15987	3.60672	-0.00003	0	0.72134
0.84312	0.00075	0.00004	0.16862	3.64906	0.00155	0.00008	0.72981
0.88703	0.00029	0.00001	0.17741	3.69094	-0.00075	-0.00004	0.73819
0.93141	-0.00062	-0.00003	0.18628	3.73281	0.00049	0.00003	0.74656
0.97547	-0.00144	-0.00007	0.19509	3.77516	0.00451	0.00023	0.75503
1.01891	-0.00151	-0.00008	0.20378	3.81734	0.00619	0.00032	0.76347
1.06172	-0.00177	-0.00009	0.21234	3.85969	0.00617	0.00031	0.77194
1.10453	-0.00078	-0.00004	0.22091	3.90203	0.0056	0.00029	0.78041
1.14719	0.00137	0.00007	0.22944	3.94453	0.00331	0.00017	0.78891
1.18953	0.00214	0.00011	0.23791	3.98734	0.00106	0.00005	0.79747
1.23219	0.00085	0.00004	0.24644	4.03016	0.00055	0.00003	0.80603
1.275	-0.00035	-0.00002	0.255	4.07281	0.0024	0.00012	0.81456
1.31766	0.0012	0.00006	0.26353	4.11531	0.00187	0.0001	0.82306
1.36047	0.00162	0.00008	0.27209	4.15766	0.00032	0.00002	0.83153
1.40313	0.00044	0.00002	0.28063	4.19984	0.001	0.00005	0.83997
1.44609	0.00106	0.00005	0.28922	4.24172	0.00166	0.00008	0.84834
1.48875	0.00228	0.00012	0.29775	4.28266	0.00228	0.00012	0.85653
1.53141	0.00144	0.00007	0.30628	4.32438	0.00214	0.00011	0.86488
1.57438	0.00144	0.00007	0.31488	4.36766	0.00481	0.00024	0.87353
1.61703	0.00351	0.00018	0.32341	4.41062	0.00512	0.00026	0.88212
1.65953	0.00561	0.00029	0.33191	4.45281	0.00256	0.00013	0.89056
1.70172	0.00449	0.00023	0.34034	4.49516	0.0003	0.00002	0.89903
1.74391	0.00101	0.00005	0.34878	4.53797	0.00144	0.00007	0.90759
1.78562	-0.00038	-0.00002	0.35712	4.58078	0.00435	0.00022	0.91616
1.8275	-0.00015	-0.00001	0.3655	4.62313	0.00335	0.00017	0.92463
1.86969	0.00166	0.00008	0.37394	4.66609	0.00254	0.00013	0.93322
1.91188	0.00365	0.00019	0.38238	4.70906	0.00376	0.00019	0.94181
1.95406	0.00513	0.00026	0.39081	4.75141	0.00475	0.00024	0.95028
1.99703	0.00629	0.00032	0.39941	4.79359	0.00404	0.00021	0.95872
2.04031	0.00577	0.00029	0.40806	4.83547	0.00351	0.00018	0.96709
2.08312	0.00524	0.00027	0.41662	4.87703	0.00297	0.00015	0.97541
2.12578	0.00468	0.00024	0.42516	4.91844	0.0027	0.00014	0.98369
2.16859	0.004	0.0002	0.43372	4.96031	0.00285	0.00015	0.99206
2.21125	0.00152	0.00008	0.44225	5.00266	0.00511	0.00026	1.00053
2.25375	-0.00094	-0.00005	0.45075	5.045	0.00747	0.00038	1.009
2.29594	-0.0005	-0.00003	0.45919	5.08719	0.00677	0.00034	1.01744
2.33813	0.00088	0.00005	0.46763	5.13031	0.00632	0.00032	1.02606
2.37984	0.00157	0.00008	0.47597	5.17359	0.00631	0.00032	1.03472
2.42125	0.00137	0.00007	0.48425	5.21594	0.00618	0.00031	1.04319
2.46313	0.00273	0.00014	0.49263	5.25813	0.00389	0.0002	1.05163
2.50547	0.00283	0.00014	0.50109	5.30109	0.00249	0.00013	1.06022
2.54781	0.00221	0.00011	0.50956	5.34406	0.00446	0.00023	1.06881
2.59031	0.00403	0.00021	0.51806	5.38656	0.00357	0.00018	1.07731
2.63297	0.00539	0.00027	0.52659	5.42875	0.00162	0.00008	1.08575
2.67547	0.00319	0.00016	0.53509	5.47094	0.00075	0.00004	1.09419
2.71766	-0.00023	-0.00001	0.54353	5.5125	0.00112	0.00006	1.1025

Extension (mm)	Load (N)	Compressive stress (MPa)	Compressive strain (mm/mm)	Extension (mm)	Load (N)	Compressive stress (MPa)	Compressive strain (mm/mm)
5.21594	0.00618	0.00031	1.04319	8.00922	0.00562	0.00029	1.60184
5.25813	0.00389	0.0002	1.05163	8.05078	0.0031	0.00016	1.61016
5.30109	0.00249	0.00013	1.06022	8.09297	0.00201	0.0001	1.61859
5.34406	0.00446	0.00023	1.06881	8.13547	0.00359	0.00018	1.62709
5.38656	0.00357	0.00018	1.07731	8.17781	0.00573	0.00029	1.63556
5.42875	0.00162	0.00008	1.08575	8.22	0.00547	0.00028	1.644
5.47094	0.00075	0.00004	1.09419	8.26234	0.00503	0.00026	1.65247
5.5125	0.00112	0.00006	1.1025	8.30516	0.00495	0.00025	1.66103
5.55375	0.00231	0.00012	1.11075	8.34766	0.00346	0.00018	1.66953
5.59562	0.00367	0.00019	1.11913	8.39016	0.00215	0.00011	1.67803
5.63797	0.00538	0.00027	1.12759	8.43266	0.00295	0.00015	1.68653
5.68	0.00593	0.0003	1.136	8.47516	0.00557	0.00028	1.69503
5.72203	0.00618	0.00031	1.14441	8.5175	0.00481	0.00025	1.7035
5.76453	0.00626	0.00032	1.15291	8.55984	0.00156	0.00008	1.71197
5.80734	0.00568	0.00029	1.16147	8.60203	0.00087	0.00004	1.72041
5.85031	0.00531	0.00027	1.17006	8.64375	0.00132	0.00007	1.72875
5.89328	0.00539	0.00027	1.17866	8.68547	0.00187	0.0001	1.73709
5.93594	0.00285	0.00015	1.18719	8.72766	0.00449	0.00023	1.74553
5.97844	0.00125	0.00006	1.19569	8.77	0.00801	0.00041	1.754
6.02078	0.00215	0.00011	1.20416	8.81234	0.00797	0.00041	1.76247
6.06297	0.00163	0.00008	1.21259	8.855	0.00667	0.00034	1.771
6.105	-0.00089	-0.00005	1.221	8.89797	0.00682	0.00035	1.77959
6.14687	-0.00085	-0.00004	1.22938	8.94062	0.00654	0.00033	1.78812
6.18875	0.00168	0.00009	1.23775	8.9825	0.0044	0.00022	1.7965
6.23125	0.00288	0.00015	1.24625	9.025	0.00307	0.00016	1.805
6.27359	0.00465	0.00024	1.25472	9.06812	0.00409	0.00021	1.81362
6.31578	0.00633	0.00032	1.26316	9.11094	0.00584	0.0003	1.82219
6.35828	0.00669	0.00034	1.27166	9.15313	0.00607	0.00031	1.83063
6.40047	0.00466	0.00024	1.28009	9.19547	0.00449	0.00023	1.83909
6.44219	0.0018	0.00009	1.28844	9.23734	0.00414	0.00021	1.84747
6.48469	0.00258	0.00013	1.29694	9.27859	0.00283	0.00014	1.85572
6.52766	0.0042	0.00021	1.30553	9.32031	0.00257	0.00013	1.86406
6.57047	0.00376	0.00019	1.31409	9.36281	0.00423	0.00022	1.87256
6.61297	0.00116	0.00006	1.32259	9.40516	0.006	0.00031	1.88103
6.65547	0.00041	0.00002	1.33109	9.44734	0.00735	0.00037	1.88947
6.69766	0.00186	0.00009	1.33953	9.49	0.00647	0.00033	1.898
6.73969	0.00268	0.00014	1.34794	9.53281	0.005	0.00025	1.90656
6.78109	0.00244	0.00012	1.35622	9.57547	0.00567	0.00029	1.91509
6.82297	0.0022	0.00011	1.36459	9.61797	0.00922	0.00047	1.92359
6.86531	0.00322	0.00016	1.37306	9.66078	0.0259	0.00132	1.93216
6.90766	0.00473	0.00024	1.38153	9.70344	0.10694	0.00545	1.94069
6.94984	0.00562	0.00029	1.38997	9.74594	0.29876	0.01522	1.94919
6.9925	0.0062	0.00032	1.3985	9.78812	0.64058	0.03262	1.95762
7.03516	0.00672	0.00034	1.40703	9.83031	1.17598	0.05989	1.96606
7.07813	0.00535	0.00027	1.41563	9.87203	1.90205	0.09687	1.97441
7.12094	0.00382	0.00019	1.42419	9.91359	2.76591	0.14087	1.98272
7.16391	0.00478	0.00024	1.43278	9.95562	3.70844	0.18887	1.99112
7.20656	0.00515	0.00026	1.44131	9.99813	4.68916	0.23882	1.99963
7.24875	0.00393	0.0002	1.44975	10.04063	5.69307	0.28995	2.00813
7.29109	0.00436	0.00022	1.45822	10.08297	6.70776	0.34162	2.01659
7.33328	0.00516	0.00026	1.46666	10.12547	7.66432	0.39034	2.02509
7.37516	0.00278	0.00014	1.47503	10.16812	8.35139	0.42533	2.03362
7.41688	0.00219	0.00011	1.48338	10.21078	8.81542	0.44897	2.04216
7.45891	0.00468	0.00024	1.49178	10.25328	9.15023	0.46602	2.05066
7.50125	0.00655	0.00033	1.50025	10.29609	9.48988	0.48332	2.05922
7.54344	0.00545	0.00028	1.50869	10.33875	10.07662	0.5132	2.06775
7.58578	0.004	0.0002	1.51716	10.38125	10.93207	0.55677	2.07625
7.62828	0.00398	0.0002	1.52566	10.42344	11.98147	0.61021	2.08469
7.67047	0.00461	0.00023	1.53409	10.46516	13.16049	0.67026	2.09303
7.7125	0.00354	0.00018	1.5425	10.50672	14.42087	0.73445	2.10134
7.75453	0.0037	0.00019	1.55091	10.54828	15.73634	0.80145	2.10966
7.79766	0.00616	0.00031	1.55953	10.59031	17.09441	0.87061	2.11806
7.84063	0.0078	0.0004	1.56813	10.63266	18.49092	0.94174	2.12653
7.88312	0.00567	0.00029	1.57662	10.67516	19.93348	1.0152	2.13503
7.92531	0.00468	0.00024	1.58506	10.71766	21.43184	1.09151	2.14353

Extension (mm)	Load (N)	Compressive stress (MPa)	Compressive strain (mm/mm)
10.80328	24.61543	1.25365	2.16066
10.84562	26.31601	1.34026	2.16913
10.88797	28.07954	1.43008	2.17759
10.93062	29.91876	1.52375	2.18612
10.97312	31.85239	1.62223	2.19462
11.015	33.87836	1.72541	2.203
11.05719	36.00122	1.83353	2.21144
11.09922	38.22251	1.94666	2.21984
11.14094	40.55753	2.06558	2.22819
11.18266	43.01923	2.19095	2.23653
11.22484	45.60577	2.32268	2.24497
11.26719	48.34149	2.46201	2.25344
11.30953	51.2351	2.60938	2.26191
11.35203	54.27941	2.76443	2.27041
11.39484	57.47527	2.92719	2.27897
11.43766	60.84005	3.09856	2.28753
11.48	64.36849	3.27826	2.296
11.5225	68.05787	3.46616	2.3045
11.56516	71.92583	3.66315	2.31303
11.60766	75.98539	3.8699	2.32153
11.65	80.238	4.08649	2.33
11.69203	84.70663	4.31407	2.33841
11.73391	89.40456	4.55334	2.34678
11.77547	94.34798	4.8051	2.35509
11.81719	99.54963	5.07002	2.36344
11.85953	105.06197	5.35076	2.37191
11.90203	110.96237	5.65127	2.38041
11.94406	117.2498	5.97148	2.38881
11.98641	123.91078	6.31072	2.39728
12.02891	130.94736	6.66909	2.40578
12.07156	138.41605	7.04947	2.41431
12.11406	146.35551	7.45382	2.42281
12.15672	154.75343	7.88153	2.43134
12.19969	163.6582	8.33504	2.43994
12.24203	173.13687	8.81779	2.44841
12.28406	183.13515	9.327	2.45681
12.32609	193.61557	9.86076	2.46522
12.36781	204.68135	10.42434	2.47356
12.40922	216.4594	11.02419	2.48184
12.45062	228.99815	11.66278	2.49012
12.49266	242.43277	12.347	2.49853
12.53484	256.95441	13.08658	2.50697
12.57687	272.63055	13.88496	2.51537
12.61922	289.40936	14.7395	2.52384
12.66141	307.37344	15.6544	2.53228
12.70375	326.72504	16.63997	2.54075
12.74594	347.64227	17.70527	2.54919
12.78813	370.29791	18.85912	2.55763
12.83031	394.89081	20.11162	2.56606
12.8725	421.58963	21.47138	2.5745
12.91453	450.6297	22.95038	2.58291

Table D.9 PBS-Soaked Scaffolds Specimen 1 Raw Compression Data

Extension (mm)	Load (N)	Compressive stress (MPa)	Compressive strain (mm/mm)	Extension (mm)	Load (N)	Compressive stress (MPa)	Compressive strain (mm/mm)
0	0.00124	0.00006	0	2.80344	-0.00193	-0.0001	0.56069
0.00203	0.00286	0.00015	0.00041	2.84578	-0.00302	-0.00015	0.56916
0.01797	0.01538	0.00078	0.00359	2.88813	-0.00458	-0.00023	0.57763
0.05672	0.04745	0.00242	0.01134	2.93047	-0.00389	-0.0002	0.58609
0.10359	0.07656	0.0039	0.02072	2.97266	-0.00083	-0.00004	0.59453
0.14703	0.06937	0.00353	0.02941	3.01484	-0.00009	0	0.60297
0.19016	0.04088	0.00208	0.03803	3.05687	-0.00048	-0.00002	0.61137
0.23844	0.02388	0.00122	0.04769	3.09828	-0.00048	-0.00002	0.61966
0.28969	0.01985	0.00101	0.05794	3.14	-0.00074	-0.00004	0.628
0.33969	0.01355	0.00069	0.06794	3.1825	0.00078	0.00004	0.6365
0.38781	0.00051	0.00003	0.07756	3.22531	0.00474	0.00024	0.64506
0.43531	-0.00769	-0.00039	0.08706	3.26734	0.00562	0.00029	0.65347
0.48266	-0.00559	-0.00028	0.09653	3.30922	0.00339	0.00017	0.66184
0.52953	-0.00363	-0.00018	0.10591	3.35172	0.00235	0.00012	0.67034
0.57516	-0.00585	-0.0003	0.11503	3.39422	0.00264	0.00013	0.67884
0.61984	-0.00742	-0.00038	0.12397	3.43672	0.00349	0.00018	0.68734
0.66469	-0.00505	-0.00026	0.13294	3.47938	0.00247	0.00013	0.69588
0.71016	-0.00146	-0.00007	0.14203	3.52234	0.00062	0.00003	0.70447
0.755	-0.00074	-0.00004	0.151	3.565	-0.0012	-0.00006	0.713
0.79906	-0.00107	-0.00005	0.15981	3.60766	-0.00258	-0.00013	0.72153
0.84312	-0.00142	-0.00007	0.16862	3.65	-0.00223	-0.00011	0.73
0.88688	-0.00129	-0.00007	0.17738	3.69187	-0.00227	-0.00012	0.73838
0.93047	-0.00122	-0.00006	0.18609	3.73344	-0.00177	-0.00009	0.74669
0.97422	-0.00045	-0.00002	0.19484	3.77547	0.0003	0.00002	0.75509
1.01812	0.00043	0.00002	0.20362	3.81766	0.0019	0.0001	0.76353
1.06172	-0.00102	-0.00005	0.21234	3.85984	0.00322	0.00016	0.77197
1.105	-0.00368	-0.00019	0.221	3.90234	0.00478	0.00024	0.78047
1.14797	-0.00445	-0.00023	0.22959	3.94516	0.00486	0.00025	0.78903
1.19047	-0.00356	-0.00018	0.23809	3.98766	0.00112	0.00006	0.79753
1.2325	-0.00215	-0.00011	0.2465	4.02984	-0.0043	-0.00022	0.80597
1.27469	-0.00075	-0.00004	0.25494	4.07141	-0.00653	-0.00033	0.81428
1.3175	0.00145	0.00007	0.2635	4.11375	-0.00474	-0.00024	0.82275
1.36016	0.0019	0.0001	0.27203	4.15734	-0.0024	-0.00012	0.83147
1.4025	0.00101	0.00005	0.2805	4.20063	-0.00003	0	0.84013
1.44531	0.00068	0.00003	0.28906	4.24281	0.00083	0.00004	0.84856
1.48828	0.00159	0.00008	0.29766	4.28453	-0.00065	-0.00003	0.85691
1.53125	0.00166	0.00008	0.30625	4.32641	-0.00346	-0.00018	0.86528
1.57406	-0.00126	-0.00006	0.31481	4.36812	-0.00136	-0.00007	0.87362
1.61672	-0.00432	-0.00022	0.32334	4.41031	0.0035	0.00018	0.88206
1.65953	-0.00343	-0.00017	0.33191	4.45297	0.00645	0.00033	0.89059
1.70234	-0.00007	0	0.34047	4.49531	0.0068	0.00035	0.89906
1.74484	0.00048	0.00002	0.34897	4.53766	0.005	0.00025	0.90753
1.78719	-0.00024	-0.00001	0.35744	4.58031	0.004	0.0002	0.91606
1.82891	-0.00065	-0.00003	0.36578	4.62313	0.00295	0.00015	0.92463
1.87047	-0.00019	-0.00001	0.37409	4.66563	0.00013	0.00001	0.93313
1.91266	0.00061	0.00003	0.38253	4.70797	-0.0018	-0.00009	0.94159
1.95516	0.00431	0.00022	0.39103	4.75031	-0.0018	-0.00009	0.95006
1.99734	0.00688	0.00035	0.39947	4.79266	-0.00202	-0.0001	0.95853
2.03984	0.00431	0.00022	0.40797	4.83484	-0.00166	-0.00008	0.96697
2.08266	0.00068	0.00003	0.41653	4.87797	0.0006	0.00003	0.97559
2.12547	-0.00037	-0.00002	0.42509	4.92109	0.0047	0.00024	0.98422
2.16781	0.00006	0	0.43356	4.96281	0.00474	0.00024	0.99256
2.21047	0.00001	0	0.44209	5.00391	0.00103	0.00005	1.00078
2.25344	-0.00006	0	0.45069	5.04609	0.00015	0.00001	1.00922
2.29609	0.00001	0	0.45922	5.08875	0.00157	0.00008	1.01775
2.33844	-0.00196	-0.0001	0.46769	5.13109	0.0016	0.00008	1.02622
2.38063	-0.00353	-0.00018	0.47613	5.17313	0.0008	0.00004	1.03463
2.4225	-0.0029	-0.00015	0.4845	5.21547	0.00115	0.00006	1.04309
2.46406	-0.00157	-0.00008	0.49281	5.25813	0.00142	0.00007	1.05163
2.50631	-0.00111	-0.00006	0.50106	5.30063	-0.00043	-0.00002	1.06013
2.54688	-0.0017	-0.00009	0.50937	5.34328	-0.00181	-0.00009	1.06866
2.58922	0.00016	0.00001	0.51784	5.38609	-0.00134	-0.00007	1.07722
2.63188	0.00323	0.00016	0.52637	5.42875	-0.00145	-0.00007	1.08575
2.675	0.00516	0.00026	0.535	5.47078	-0.00374	-0.00019	1.09416
2.71813	0.00379	0.00019	0.54362	5.5125	-0.00419	-0.00021	1.1025

Extension (mm)	Load (N)	Compressive stress (MPa)	Compressive strain (mm/mm)
5.59656	0.00244	0.00012	1.11931
5.63875	0.00364	0.00019	1.12775
5.68094	0.00485	0.00025	1.13619
5.72297	0.00578	0.00029	1.14459
5.76531	0.00464	0.00024	1.15306
5.80781	0.00387	0.0002	1.16156
5.85047	0.00647	0.00033	1.17009
5.89313	0.00657	0.00033	1.17862
5.93547	0.00324	0.00016	1.18709
5.97813	-0.0003	-0.00002	1.19563
6.02078	-0.00342	-0.00017	1.20416
6.06328	-0.00334	-0.00017	1.21266
6.10547	-0.00184	-0.00009	1.22109
6.14781	-0.00033	-0.00002	1.22956
6.18969	0.00178	0.00009	1.23794
6.23109	0.0025	0.00013	1.24622
6.27297	0.00164	0.00008	1.25459
6.31531	0.00212	0.00011	1.26306
6.35797	0.00477	0.00024	1.27159
6.40047	0.00528	0.00027	1.28009
6.44266	0.00074	0.00004	1.28853
6.48484	-0.00266	-0.00014	1.29697
6.52703	-0.00195	-0.0001	1.30541
6.56953	-0.00216	-0.00011	1.31391
6.61266	-0.00288	-0.00015	1.32253
6.65562	-0.00141	-0.00007	1.33113
6.69828	0.00095	0.00005	1.33966
6.74062	0.00185	0.00009	1.34812
6.78281	0.00261	0.00013	1.35656
6.82453	0.00346	0.00018	1.36491
6.86609	0.00377	0.00019	1.37322
6.90828	0.0032	0.00016	1.38166
6.95063	0.00084	0.00004	1.39013
6.99281	-0.00072	-0.00004	1.39856
7.03516	0.00093	0.00005	1.40703
7.07797	0.00283	0.00014	1.41559
7.12078	0.00378	0.00019	1.42416
7.16344	0.0028	0.00014	1.43269
7.20578	0.00189	0.0001	1.44116
7.24844	0.00258	0.00013	1.44969
7.29141	0.00316	0.00016	1.45828
7.33391	0.00415	0.00021	1.46678
7.37594	0.00427	0.00022	1.47519
7.41813	0.00179	0.00009	1.48363
7.46031	-0.0009	-0.00005	1.49206
7.50219	-0.00052	-0.00003	1.50044
7.54422	0.00258	0.00013	1.50884
7.58641	0.00407	0.00021	1.51728
7.62875	0.00479	0.00024	1.52575
7.67109	0.00509	0.00026	1.53422
7.71328	0.00511	0.00026	1.54266
7.755	0.00276	0.00014	1.551
7.79703	0.00265	0.00014	1.55941
7.83969	0.00328	0.00017	1.56794
7.88266	0.00104	0.00005	1.57653
7.92547	-0.00211	-0.00011	1.58509
7.96766	-0.00339	-0.00017	1.59353
8.00984	-0.00233	-0.00012	1.60197
8.05219	-0.00006	0	1.61044
8.09406	0.00251	0.00013	1.61881
8.13578	0.0027	0.00014	1.62716
8.17797	0.00184	0.00009	1.63559
8.22047	0.00202	0.0001	1.64409
8.26297	0.00357	0.00018	1.65259
8.30531	0.0044	0.00022	1.66106

Extension (mm)	Load (N)	Compressive stress (MPa)	Compressive strain (mm/mm)
8.39031	0.00295	0.00015	1.67806
8.4325	0.00019	0.00001	1.6865
8.47469	-0.00087	-0.00004	1.69494
8.51734	0.0001	0.00001	1.70347
8.56	0.00055	0.00003	1.712
8.60234	0.00141	0.00007	1.72047
8.64469	0.00293	0.00015	1.72894
8.68703	0.0038	0.00019	1.73741
8.72875	0.00188	0.0001	1.74575
8.77047	0.00122	0.00006	1.75409
8.8125	0.0027	0.00014	1.7625
8.85469	0.00188	0.0001	1.77094
8.89703	-0.00104	-0.00005	1.77941
8.93969	0.00088	0.00004	1.78794
8.9825	0.00406	0.00021	1.7965
9.02547	0.00508	0.00026	1.80509
9.06797	0.00521	0.00027	1.81359
9.11031	0.00472	0.00024	1.82206
9.15297	0.00337	0.00017	1.83059
9.19563	0.00175	0.00009	1.83913
9.23781	0.00262	0.00013	1.84756
9.28	0.0028	0.00014	1.856
9.32187	0.00164	0.00008	1.86437
9.36359	-0.00013	-0.00001	1.87272
9.40531	-0.00166	-0.00008	1.88106
9.44766	-0.00027	-0.00001	1.88953
9.49016	0.0013	0.00007	1.89803
9.53266	0.00224	0.00011	1.90653
9.57516	0.00223	0.00011	1.91503
9.61766	0.00257	0.00013	1.92353
9.66031	0.0043	0.00022	1.93206
9.70281	0.00532	0.00027	1.94056
9.74562	0.00421	0.00021	1.94912
9.78844	0.00307	0.00016	1.95769
9.83078	0.00022	0.00001	1.96616
9.87313	0.0069	0.00035	1.97462
9.91531	0.06151	0.00313	1.98306
9.95687	0.20004	0.01019	1.99137
9.99844	0.43486	0.02215	1.99969
10.04047	0.75437	0.03842	2.00809
10.08313	1.13162	0.05763	2.01662
10.12547	1.54092	0.07848	2.02509
10.16781	1.97498	0.10058	2.03356
10.21031	2.44134	0.12434	2.04206
10.25313	2.9425	0.14986	2.05063
10.29578	3.47763	0.17711	2.05916
10.33875	4.04624	0.20607	2.06775
10.38156	4.6485	0.23675	2.07631
10.42406	5.28177	0.269	2.08481
10.46656	5.94081	0.30256	2.09331
10.50859	6.62775	0.33755	2.10172
10.55031	7.31143	0.37237	2.11006
10.59172	7.82633	0.39859	2.11834
10.63313	8.12038	0.41357	2.12663
10.67516	8.30377	0.42291	2.13503
10.71766	8.48842	0.43231	2.14353
10.75984	8.88573	0.45255	2.15197
10.8025	9.54839	0.4863	2.1605
10.84531	10.40316	0.52983	2.16906
10.88812	11.3884	0.58001	2.17762
10.93031	12.46352	0.63476	2.18606
10.97266	13.59826	0.69255	2.19453
11.01531	14.78558	0.75302	2.20306
11.05797	16.03511	0.81666	2.21159
11.10016	17.34682	0.88347	2.22003

Extension (mm)	Load (N)	Compressive stress (MPa)	Compressive strain (mm/mm)
11.18453	20.18003	1.02776	2.23691
11.22625	21.70566	1.10546	2.24525
11.26828	23.30662	1.187	2.25366
11.31047	24.99747	1.27311	2.26209
11.35281	26.81148	1.3655	2.27056
11.39484	28.76196	1.46483	2.27897
11.43719	30.85801	1.57159	2.28744
11.48016	33.12499	1.68704	2.29603
11.52266	35.57507	1.81182	2.30453
11.56516	38.20217	1.94562	2.31303
11.60766	41.01351	2.0888	2.32153
11.65031	44.02914	2.24239	2.33006
11.69297	47.25464	2.40666	2.33859
11.73516	50.67723	2.58097	2.34703
11.77734	54.30725	2.76585	2.35547
11.81922	58.15248	2.96168	2.36384
11.86063	62.22141	3.16891	2.37213
11.9025	66.52386	3.38803	2.3805
11.94484	71.10442	3.62132	2.38897
11.98734	76.00471	3.87089	2.39747
12.02938	81.23363	4.1372	2.40587
12.07203	86.79249	4.42031	2.41441
12.11484	92.71573	4.72197	2.42297
12.15719	99.06086	5.04513	2.43144
12.19938	105.83073	5.38991	2.43988
12.24219	113.02185	5.75616	2.44844
12.285	120.72215	6.14833	2.457
12.32719	128.90057	6.56485	2.46544
12.36906	137.50032	7.00283	2.47381
12.41141	146.53177	7.4628	2.48228
12.45297	156.09889	7.95005	2.49059
12.49422	166.25346	8.46722	2.49884
12.53594	177.05774	9.01748	2.50719
12.57812	188.70059	9.61044	2.51562
12.62	201.32216	10.25325	2.524
12.66187	214.89072	10.94429	2.53237
12.70422	229.39235	11.68286	2.54084
12.74703	244.91983	12.47366	2.54941
12.78953	261.62329	13.32436	2.55791
12.83172	279.53513	14.23661	2.56634
12.87391	298.65005	15.21012	2.57478
12.91641	319.08209	16.25072	2.58328
12.95875	341.0051	17.36725	2.59175
13.00063	364.55652	18.56671	2.60013
13.04219	389.68082	19.84628	2.60844
13.08328	416.33151	21.20359	2.61666
13.12437	444.68369	22.64755	2.62487
13.1325	450.57425	22.94756	2.6265

Table D.10 PBS-Soaked Scaffolds Specimen 2 Raw Compression Data

Extension (mm)	Load (N)	Compressive stress (MPa)	Compressive strain (mm/mm)	Extension (mm)	Load (N)	Compressive stress (MPa)	Compressive strain (mm/mm)
0	-0.00017	-0.00001	0	2.80281	0.00384	0.0002	0.56056
0.0025	0.00172	0.00009	0.0005	2.84516	0.0036	0.00018	0.56903
0.02203	0.01813	0.00092	0.00441	2.88766	0.00275	0.00014	0.57753
0.06312	0.05532	0.00282	0.01262	2.93016	0.00112	0.00006	0.58603
0.10969	0.07785	0.00396	0.02194	2.9725	0.00072	0.00004	0.5945
0.15188	0.06252	0.00318	0.03038	3.01453	0.00113	0.00006	0.60291
0.19469	0.03619	0.00184	0.03894	3.05625	0.00014	0.00001	0.61125
0.24313	0.02466	0.00126	0.04862	3.0975	-0.0009	-0.00005	0.6195
0.29406	0.02331	0.00119	0.05881	3.13937	0.00233	0.00012	0.62787
0.34297	0.01716	0.00087	0.06859	3.18219	0.00751	0.00038	0.63644
0.39031	0.00528	0.00027	0.07806	3.22484	0.00913	0.00046	0.64497
0.4375	-0.00314	-0.00016	0.0875	3.2675	0.00977	0.0005	0.6535
0.48469	-0.00336	-0.00017	0.09694	3.31016	0.00951	0.00048	0.66203
0.53141	-0.00081	-0.00004	0.10628	3.3525	0.00698	0.00036	0.6705
0.57672	-0.00111	-0.00006	0.11534	3.39438	0.00264	0.00013	0.67888
0.62109	-0.00367	-0.00019	0.12422	3.43625	0.00114	0.00006	0.68725
0.66594	-0.0027	-0.00014	0.13319	3.47906	0.00538	0.00027	0.69581
0.71109	0.00055	0.00003	0.14222	3.52234	0.00739	0.00038	0.70447
0.75578	0.00276	0.00014	0.15116	3.565	0.00506	0.00026	0.713
0.79984	0.00189	0.0001	0.15997	3.60734	0.00124	0.00006	0.72147
0.84359	0.00371	0.00019	0.16872	3.64969	0.00105	0.00005	0.72994
0.88734	0.00498	0.00025	0.17747	3.69172	0.00352	0.00018	0.73834
0.93094	0.00356	0.00018	0.18619	3.73344	0.00379	0.00019	0.74669
0.97453	0.00374	0.00019	0.19491	3.77516	0.00413	0.00021	0.75503
1.01844	0.00396	0.0002	0.20369	3.81734	0.00677	0.00034	0.76347
1.06219	0.00407	0.00021	0.21244	3.85984	0.00614	0.00031	0.77197
1.10563	0.00196	0.0001	0.22113	3.90156	0.00188	0.0001	0.78031
1.14844	-0.00231	-0.00012	0.22969	3.94359	0.00102	0.00005	0.78872
1.19078	-0.00343	-0.00017	0.23816	3.98556	0.00526	0.00027	0.79731
1.23281	-0.00148	-0.00008	0.24656	4.02884	0.00751	0.00038	0.80597
1.275	0.00067	0.00003	0.255	4.0725	0.0064	0.00033	0.8145
1.31766	0.00299	0.00015	0.26353	4.11469	0.00719	0.00037	0.82294
1.36031	0.00396	0.0002	0.27206	4.15688	0.00851	0.00043	0.83138
1.40234	0.006	0.00031	0.28047	4.19953	0.00777	0.0004	0.83991
1.44469	0.00516	0.00026	0.28894	4.24219	0.00826	0.00042	0.84844
1.48797	0.0047	0.00024	0.29759	4.28469	0.00807	0.00041	0.85694
1.53094	0.00705	0.00036	0.30619	4.32656	0.00485	0.00025	0.86531
1.57375	0.00604	0.00031	0.31475	4.36812	0.00179	0.00009	0.87362
1.61641	0.00315	0.00016	0.32328	4.41031	0.00383	0.00019	0.88206
1.65953	0.00233	0.00012	0.33191	4.45297	0.00831	0.00042	0.89059
1.70219	0.00352	0.00018	0.34044	4.49516	0.00931	0.00047	0.89903
1.74484	0.00421	0.00021	0.34897	4.53719	0.00825	0.00042	0.90744
1.78719	0.00285	0.00015	0.35744	4.57922	0.00586	0.0003	0.91584
1.82906	0.00308	0.00016	0.36581	4.62156	0.00595	0.0003	0.92431
1.87047	0.00398	0.0002	0.37409	4.66422	0.0073	0.00037	0.93284
1.91266	0.0048	0.00024	0.38253	4.7075	0.00818	0.00042	0.9415
1.95516	0.00531	0.00027	0.39103	4.75141	0.0085	0.00043	0.95028
1.9975	0.00715	0.00036	0.3995	4.79437	0.00617	0.00031	0.95888
2.03969	0.00719	0.00037	0.40794	4.83641	0.00303	0.00015	0.96728
2.08219	0.00465	0.00024	0.41644	4.87859	0.0007	0.00004	0.97572
2.125	0.00258	0.00013	0.425	4.92094	0.00108	0.00005	0.98419
2.16766	0.00214	0.00011	0.43353	4.9625	0.00229	0.00012	0.9925
2.21016	0.00265	0.00013	0.44203	5.00375	0.00122	0.00006	1.00075
2.25281	0.00396	0.0002	0.45056	5.04547	0.00124	0.00006	1.00909
2.29547	0.00527	0.00027	0.45909	5.08797	0.00449	0.00023	1.01759
2.33797	0.0032	0.00016	0.46759	5.13047	0.00847	0.00043	1.02609
2.38031	0.00178	0.00009	0.47606	5.17266	0.00907	0.00046	1.03453
2.42266	0.00152	0.00008	0.48453	5.21531	0.00722	0.00037	1.04306
2.46438	0.00074	0.00004	0.49288	5.25781	0.00646	0.00033	1.05156
2.50594	0.00105	0.00005	0.50119	5.29984	0.00383	0.00019	1.05997
2.54781	0.00272	0.00014	0.50956	5.34188	0.00132	0.00007	1.06837
2.59016	0.00315	0.00016	0.51803	5.38469	0.00318	0.00016	1.07694
2.6325	0.00209	0.00011	0.5265	5.42828	0.00753	0.00038	1.08566
2.675	0.00286	0.00015	0.535	5.47156	0.00595	0.0003	1.09431
2.71734	0.00384	0.0002	0.54347	5.51422	0.00224	0.00011	1.10284

Extension (mm)	Load (N)	Compressive stress (MPa)	Compressive strain (mm/mm)	Extension (mm)	Load (N)	Compressive stress (MPa)	Compressive strain (mm/mm)
5.59688	0.0001	0.00001	1.1937	8.39	0.00911	0.00046	1.678
5.63844	0.00158	0.00008	1.12769	8.43234	0.00589	0.0003	1.68647
5.68062	0.00537	0.00027	1.13612	8.47484	0.00516	0.00026	1.69497
5.72313	0.00867	0.00044	1.14463	8.51734	0.00689	0.00035	1.70347
5.765	0.0077	0.00039	1.153	8.55984	0.00647	0.00033	1.71197
5.80734	0.00411	0.00021	1.16147	8.60219	0.00576	0.00029	1.72044
5.85	0.00291	0.00015	1.17	8.64453	0.00556	0.00028	1.72891
5.89266	0.00437	0.00022	1.17853	8.68688	0.00522	0.00027	1.73738
5.93516	0.00414	0.00021	1.18703	8.72859	0.00223	0.00011	1.74572
5.97766	0.00368	0.00019	1.19553	8.77016	0.00069	0.00004	1.75403
6.02016	0.0034	0.00017	1.20403	8.81219	0.00504	0.00026	1.76244
6.0625	0.00444	0.00023	1.2125	8.85453	0.00818	0.00042	1.77091
6.10484	0.00658	0.00034	1.22097	8.89719	0.00813	0.00041	1.77944
6.14719	0.00523	0.00027	1.22944	8.94	0.0079	0.0004	1.788
6.18953	0.0046	0.00023	1.23791	8.98297	0.00871	0.00044	1.79659
6.23156	0.00517	0.00026	1.24631	9.02531	0.00873	0.00044	1.80506
6.27344	0.00438	0.00022	1.25469	9.06766	0.00799	0.00041	1.81353
6.31563	0.00391	0.0002	1.26313	9.11016	0.00765	0.00039	1.82203
6.35813	0.00666	0.00034	1.27163	9.15266	0.0069	0.00035	1.83053
6.40094	0.01183	0.0006	1.28019	9.19531	0.0037	0.00019	1.83906
6.44344	0.01229	0.00063	1.28869	9.23766	0.00221	0.00011	1.84753
6.48516	0.00782	0.0004	1.29703	9.27984	0.00335	0.00017	1.85597
6.52719	0.00535	0.00027	1.30544	9.32156	0.00523	0.00027	1.86431
6.56969	0.00579	0.00029	1.31394	9.36312	0.00389	0.0002	1.87262
6.61266	0.00549	0.00028	1.32253	9.405	0.00302	0.00015	1.881
6.65531	0.00595	0.0003	1.33106	9.44734	0.00514	0.00026	1.88947
6.69766	0.00666	0.00034	1.33953	9.48984	0.00765	0.00039	1.89797
6.74016	0.00587	0.0003	1.34803	9.53234	0.00875	0.00045	1.90647
6.78266	0.00432	0.00022	1.35653	9.575	0.00974	0.0005	1.915
6.82453	0.00287	0.00015	1.36491	9.61797	0.00914	0.00047	1.92359
6.86594	0.0017	0.00009	1.37319	9.66047	0.00711	0.00036	1.93209
6.90781	0.00361	0.00018	1.38156	9.70281	0.00484	0.00025	1.94056
6.95031	0.00549	0.00028	1.39006	9.74562	0.00484	0.00025	1.94912
6.9925	0.00598	0.0003	1.3985	9.78844	0.006	0.00031	1.95769
7.03484	0.00625	0.00032	1.40697	9.83094	0.0084	0.00043	1.96619
7.0775	0.00677	0.00034	1.4155	9.87297	0.00828	0.00042	1.97459
7.12047	0.00703	0.00036	1.42409	9.915	0.00668	0.00034	1.983
7.16344	0.00675	0.00034	1.43269	9.95672	0.00656	0.00033	1.99134
7.20594	0.00474	0.00024	1.44119	9.99828	0.00652	0.00033	1.99966
7.24844	0.00381	0.00019	1.44969	10.04031	0.0072	0.00037	2.00806
7.29109	0.0034	0.00017	1.45822	10.08281	0.00814	0.00041	2.01656
7.33344	0.00415	0.00021	1.46669	10.12531	0.00807	0.00041	2.02506
7.37594	0.00493	0.00025	1.47519	10.16766	0.0086	0.00044	2.03353
7.41828	0.00638	0.00032	1.48366	10.21047	0.03506	0.00179	2.04209
7.46	0.0045	0.00023	1.492	10.25328	0.12553	0.00639	2.05066
7.50172	0.00177	0.00009	1.50034	10.29578	0.30272	0.01542	2.05916
7.54391	0.00378	0.00019	1.50878	10.33844	0.55426	0.02823	2.06769
7.58609	0.00578	0.00029	1.51722	10.38109	0.86657	0.04413	2.07622
7.62828	0.00571	0.00029	1.52566	10.42375	1.22703	0.06249	2.08475
7.67047	0.0062	0.00032	1.53409	10.46625	1.62133	0.08257	2.09325
7.7125	0.00563	0.00029	1.5425	10.50828	2.03889	0.10384	2.10166
7.75453	0.00265	0.00014	1.55091	10.55	2.47227	0.12591	2.11
7.79656	0.00179	0.00009	1.55931	10.59156	2.91954	0.14869	2.11831
7.83938	0.00452	0.00023	1.56788	10.63313	3.37791	0.17204	2.12663
7.8825	0.00704	0.00036	1.5765	10.67531	3.85	0.19608	2.13506
7.92531	0.0057	0.00029	1.58506	10.71766	4.34317	0.2212	2.14353
7.96797	0.00462	0.00024	1.59359	10.76	4.86628	0.24784	2.152
8.01047	0.00511	0.00026	1.60209	10.80234	5.42256	0.27617	2.16047
8.0525	0.00369	0.00019	1.6105	10.84516	6.01163	0.30617	2.16903
8.09391	0.00347	0.00018	1.61878	10.88797	6.63939	0.33814	2.17759
8.13547	0.00479	0.00024	1.62709	10.93031	7.30274	0.37193	2.18606
8.17781	0.00671	0.00034	1.63556	10.97281	7.89454	0.40207	2.19456
8.22016	0.00648	0.00033	1.64403	11.01562	8.31589	0.42352	2.20312
8.2625	0.00585	0.0003	1.6525	11.05828	8.59655	0.43782	2.21166
8.30484	0.00684	0.00035	1.66097	11.10031	8.80987	0.44868	2.22006

Extension (mm)	Load (N)	Compressive stress (MPa)	Compressive strain (mm/mm)
11.18422	9.64634	0.49128	2.23684
11.22594	10.42852	0.53112	2.24519
11.26797	11.36268	0.5787	2.25359
11.31016	12.39387	0.63121	2.26203
11.3525	13.50276	0.68769	2.2705
11.39484	14.68513	0.74791	2.27897
11.4375	15.95236	0.81245	2.2875
11.48031	17.31718	0.88196	2.29606
11.52281	18.78122	0.95652	2.30456
11.56531	20.34599	1.03621	2.31306
11.60797	22.02321	1.12163	2.32159
11.65047	23.82559	1.21343	2.33009
11.69297	25.74479	1.31117	2.33859
11.73531	27.78571	1.41511	2.34706
11.77766	29.96643	1.52618	2.35553
11.81953	32.29924	1.64499	2.36391
11.86078	34.79654	1.77217	2.37216
11.90234	37.4753	1.9086	2.38047
11.94469	40.38305	2.05669	2.38894
11.98719	43.56932	2.21897	2.39744
12.02969	47.05027	2.39625	2.40594
12.07234	50.83776	2.58915	2.41447
12.11516	54.9413	2.79814	2.42303
12.1575	59.38493	3.02445	2.4315
12.19984	64.17563	3.26844	2.43997
12.2425	69.30537	3.52969	2.4485
12.28531	74.81943	3.81052	2.45706
12.3275	80.75051	4.11259	2.4655
12.36953	87.11837	4.4369	2.47391
12.41156	93.96339	4.78552	2.48231
12.45312	101.35036	5.16173	2.49062
12.49469	109.33307	5.56829	2.49894
12.53672	117.95625	6.00746	2.50734
12.57891	127.3131	6.484	2.51578
12.62109	137.50554	7.0031	2.52422
12.66313	148.53419	7.56478	2.53262
12.70531	160.42575	8.17042	2.54106
12.74781	173.2811	8.82513	2.54956
12.79016	187.22183	9.53513	2.55803
12.8325	202.29781	10.30294	2.5665
12.87469	218.53775	11.13004	2.57494
12.91719	236.07692	12.0233	2.58344
12.95906	255.02562	12.98835	2.59181
13.00094	275.44711	14.02841	2.60019
13.04281	297.35861	15.14435	2.60856
13.08406	320.78253	16.33732	2.61681
13.12531	345.83563	17.61326	2.62506
13.16703	372.57278	18.97498	2.63341
13.20922	401.28772	20.43742	2.64184
13.25078	432.28949	22.01632	2.65016
13.2675	445.36853	22.68243	2.6535

Table D.11 PBS-Soaked Scaffolds Specimen 3 Raw Compression Data

Extension (mm)	Load (N)	Compressive stress (MPa)	Compressive strain (mm/mm)	Extension (mm)	Load (N)	Compressive stress (MPa)	Compressive strain (mm/mm)
0	0.00351	0.00018	0	2.80234	0.00295	0.00015	2.80234
0.0025	0.00397	0.0002	0.0025	2.84484	0.00406	0.00021	2.84484
0.02141	0.01867	0.00095	0.02141	2.88734	0.0049	0.00025	2.88734
0.06219	0.05706	0.00291	0.06219	2.93	0.00057	0.00003	2.93
0.10859	0.08097	0.00412	0.10859	2.9725	-0.00093	-0.00005	2.9725
0.15094	0.06482	0.0033	0.15094	3.01484	0.00215	0.00011	3.01484
0.19391	0.03686	0.00188	0.19391	3.05687	0.00275	0.00014	3.05687
0.24234	0.0227	0.00116	0.24234	3.09844	0.00069	0.00003	3.09844
0.29328	0.02037	0.00104	0.29328	3.14016	0.0018	0.00009	3.14016
0.34219	0.01397	0.00071	0.34219	3.18266	0.00495	0.00025	3.18266
0.38969	0.00275	0.00014	0.38969	3.22516	0.00698	0.00036	3.22516
0.43688	-0.00282	-0.00014	0.43687	3.26734	0.00565	0.00029	3.26734
0.48422	-0.0034	-0.00017	0.48422	3.30984	0.00608	0.00031	3.30984
0.53094	-0.00115	-0.00006	0.53094	3.35234	0.00662	0.00034	3.35234
0.57641	0.00009	0	0.57641	3.39469	0.004	0.0002	3.39469
0.62078	-0.00198	-0.0001	0.62078	3.43656	0.00273	0.00014	3.43656
0.66563	-0.00099	-0.00005	0.66563	3.47891	0.00261	0.00013	3.47891
0.71078	0.00014	0.00001	0.71078	3.52172	0.00318	0.00016	3.52172
0.75547	0.00066	0.00003	0.75547	3.56437	0.00467	0.00024	3.56437
0.79937	0.00069	0.00004	0.79938	3.60687	0.00236	0.00012	3.60687
0.84312	-0.00121	-0.00006	0.84312	3.64906	-0.00015	-0.00001	3.64906
0.88688	0.00152	0.00008	0.88688	3.69078	0.00479	0.00024	3.69078
0.93047	0.00333	0.00017	0.93047	3.7325	0.00503	0.00026	3.7325
0.97422	0.00187	0.0001	0.97422	3.77469	0.00489	0.00025	3.77469
1.01812	0.0026	0.00013	1.01812	3.81734	0.00815	0.00041	3.81734
1.06187	0.00149	0.00008	1.06187	3.86031	0.00697	0.00035	3.86031
1.10516	0.00208	0.00011	1.10516	3.90266	0.00455	0.00023	3.90266
1.14781	-0.0001	-0.00001	1.14781	3.945	0.00251	0.00013	3.945
1.19047	-0.00261	-0.00013	1.19047	3.9875	0.00291	0.00015	3.9875
1.2325	0.00046	0.00002	1.2325	4.03	0.00631	0.00032	4.03
1.27469	0.00267	0.00014	1.27469	4.07219	0.00399	0.0002	4.07219
1.3175	0.00157	0.00008	1.3175	4.115	0.00242	0.00012	4.115
1.36031	0.00509	0.00026	1.36031	4.15781	0.00503	0.00026	4.15781
1.40313	0.009	0.00046	1.40313	4.20016	0.00277	0.00014	4.20016
1.44562	0.00493	0.00025	1.44562	4.24234	0.005	0.00025	4.24234
1.48828	0.00314	0.00016	1.48828	4.28453	0.00616	0.00031	4.28453
1.53094	0.00655	0.00033	1.53094	4.32641	0.00267	0.00014	4.32641
1.57359	0.00414	0.00021	1.57359	4.36766	0.00363	0.00018	4.36766
1.61672	0.00263	0.00013	1.61672	4.40906	0.0021	0.00011	4.40906
1.65984	0.00343	0.00017	1.65984	4.45125	0.00284	0.00014	4.45125
1.70234	0.00114	0.00006	1.70234	4.49344	0.00546	0.00028	4.49344
1.74437	0.00069	0.00004	1.74437	4.53656	0.00547	0.00028	4.53656
1.78688	0.00203	0.0001	1.78688	4.58047	0.00671	0.00034	4.58047
1.82891	0.00378	0.00019	1.82891	4.62359	0.0039	0.0002	4.62359
1.87062	0.00239	0.00012	1.87062	4.66563	0.00052	0.00003	4.66563
1.9125	0.00064	0.00003	1.9125	4.70797	0.00085	0.00004	4.70797
1.955	0.00544	0.00028	1.955	4.75125	0.00335	0.00017	4.75125
1.99734	0.00325	0.00017	1.99734	4.79437	0.00621	0.00032	4.79437
2.03969	0.0006	0.00003	2.03969	4.83656	0.00445	0.00023	4.83656
2.08219	0.00377	0.00019	2.08219	4.87859	0.00092	0.00005	4.87859
2.125	-0.00004	0	2.125	4.92047	0.00251	0.00013	4.92047
2.16719	-0.0018	-0.00009	2.16719	4.96219	0.00367	0.00019	4.96219
2.20984	0.00142	0.00007	2.20984	5.00375	0.00475	0.00024	5.00375
2.25297	0.00419	0.00021	2.25297	5.04562	0.00406	0.00021	5.04562
2.29563	0.00792	0.0004	2.29563	5.08797	0.00456	0.00023	5.08797
2.33813	0.00469	0.00024	2.33813	5.13	0.00626	0.00032	5.13
2.38078	0.00535	0.00027	2.38078	5.17172	0.00599	0.00031	5.17172
2.42266	0.00628	0.00032	2.42266	5.21422	0.00781	0.0004	5.21422
2.46422	0.00093	0.00005	2.46422	5.25719	0.00851	0.00043	5.25719
2.50578	0.00219	0.00011	2.50578	5.30031	0.0072	0.00037	5.30031
2.54797	0.0039	0.0002	2.54797	5.34328	0.00426	0.00022	5.34328
2.59047	0.0035	0.00018	2.59047	5.38609	0.00006	0	5.38609
2.63281	0.00384	0.0002	2.63281	5.42891	0.00139	0.00007	5.42891
2.67516	0.00311	0.00016	2.67516	5.47141	0.0042	0.00021	5.47141
2.71766	0.00514	0.00026	2.71766	5.51375	0.0038	0.00019	5.51375

Extension (mm)	Load (N)	Compressive stress (MPa)	Compressive strain (mm/mm)
5.59688	0.00386	0.0002	5.59688
5.63828	0.00423	0.00022	5.63828
5.68047	0.00643	0.00033	5.68047
5.72281	0.00611	0.00031	5.72281
5.76516	0.00466	0.00024	5.76516
5.80734	0.0045	0.00023	5.80734
5.84984	0.00168	0.00009	5.84984
5.89234	0.0009	0.00005	5.89234
5.93469	0.00401	0.0002	5.93469
5.97719	0.00395	0.0002	5.97719
6.02031	0.00554	0.00028	6.02031
6.06297	0.00628	0.00032	6.06297
6.10531	0.00702	0.00036	6.10531
6.1475	0.00775	0.00039	6.1475
6.18969	0.0063	0.00032	6.18969
6.23156	0.00809	0.00041	6.23156
6.27375	0.00605	0.00031	6.27375
6.31594	0.00204	0.0001	6.31594
6.35813	0.00347	0.00018	6.35813
6.40047	0.00522	0.00027	6.40047
6.44297	0.00813	0.00041	6.44297
6.485	0.00788	0.0004	6.485
6.52688	0.00419	0.00021	6.52688
6.56922	0.00457	0.00023	6.56922
6.61234	0.00522	0.00027	6.61234
6.65547	0.00671	0.00034	6.65547
6.69812	0.00716	0.00036	6.69812
6.74031	0.00391	0.0002	6.74031
6.78281	0.00409	0.00021	6.78281
6.82453	0.00353	0.00018	6.82453
6.86594	0.00237	0.00012	6.86594
6.90766	0.00447	0.00023	6.90766
6.95	0.00675	0.00034	6.95
6.99234	0.00694	0.00035	6.99234
7.035	0.00691	0.00035	7.035
7.07781	0.00531	0.00027	7.07781
7.12047	0.00719	0.00037	7.12047
7.16297	0.00822	0.00042	7.16297
7.20563	0.00482	0.00025	7.20563
7.24844	0.00345	0.00018	7.24844
7.29109	0.00641	0.00033	7.29109
7.33328	0.00503	0.00026	7.33328
7.37547	0.00128	0.00007	7.37547
7.41781	0.00493	0.00025	7.41781
7.45984	0.00806	0.00041	7.45984
7.50156	0.00464	0.00024	7.50156
7.54406	0.00291	0.00015	7.54406
7.58625	0.00848	0.00043	7.58625
7.62844	0.01036	0.00053	7.62844
7.67063	0.00611	0.00031	7.67063
7.71266	0.00633	0.00032	7.71266
7.75438	0.008	0.00041	7.75438
7.79656	0.00319	0.00016	7.79656
7.83969	0.00171	0.00009	7.83969
7.88266	0.00442	0.00022	7.88266
7.92531	0.00529	0.00027	7.92531
7.9675	0.00469	0.00024	7.9675
8.01	0.00463	0.00024	8.01
8.05234	0.00793	0.0004	8.05234
8.09406	0.00959	0.00049	8.09406
8.13562	0.00661	0.00034	8.13562
8.17781	0.00826	0.00042	8.17781
8.22031	0.00739	0.00038	8.22031
8.26266	0.00381	0.00019	8.26266
8.305	0.0051	0.00026	8.305

Extension (mm)	Load (N)	Compressive stress (MPa)	Compressive strain (mm/mm)
8.39016	0.00715	0.00036	8.39016
8.43219	0.00833	0.00042	8.43219
8.47453	0.00445	0.00023	8.47453
8.51719	0.00572	0.00029	8.51719
8.55969	0.00685	0.00035	8.55969
8.6025	0.0069	0.00035	8.6025
8.645	0.00833	0.00042	8.645
8.68703	0.00476	0.00024	8.68703
8.72828	0.00166	0.00008	8.72828
8.76984	-0.00024	-0.00001	8.76984
8.8125	0.0001	0.00001	8.8125
8.855	0.00576	0.00029	8.855
8.89719	0.00638	0.00032	8.89719
8.93953	0.00503	0.00026	8.93953
8.98234	0.0081	0.00041	8.98234
9.02516	0.00997	0.00051	9.02516
9.0675	0.01	0.00051	9.0675
9.10984	0.00896	0.00046	9.10984
9.1525	0.00824	0.00042	9.1525
9.19531	0.00644	0.00033	9.19531
9.23766	0.00415	0.00021	9.23766
9.28	0.00343	0.00017	9.28
9.32187	0.00459	0.00023	9.32187
9.36344	0.00767	0.00039	9.36344
9.40531	0.00853	0.00043	9.40531
9.44766	0.00827	0.00042	9.44766
9.49	0.00784	0.0004	9.49
9.53234	0.00806	0.00041	9.53234
9.57516	0.00923	0.00047	9.57516
9.61797	0.00904	0.00046	9.61797
9.66031	0.00768	0.00039	9.66031
9.70266	0.00732	0.00037	9.70266
9.74547	0.00555	0.00028	9.74547
9.78844	0.00539	0.00027	9.78844
9.83078	0.0074	0.00038	9.83078
9.87297	0.00657	0.00033	9.87297
9.91516	0.00457	0.00023	9.91516
9.95672	0.00505	0.00026	9.95672
9.99828	0.00635	0.0004	9.99828
10.04031	0.44832	0.02283	10.04031
10.08281	1.13186	0.05765	10.08281
10.12516	2.07156	0.1055	10.12516
10.1675	3.17536	0.16172	10.1675
10.21031	4.37688	0.22291	10.21031
10.25297	5.63598	0.28704	10.25297
10.29547	6.81618	0.34715	10.29547
10.33813	7.65347	0.38979	10.33813
10.38094	8.16077	0.41562	10.38094
10.42359	8.47268	0.43151	10.42359
10.46594	8.86638	0.45159	10.46594
10.50797	9.60629	0.48924	10.50797
10.54984	10.63737	0.54176	10.54984
10.59125	11.87639	0.60486	10.59125
10.63281	13.25089	0.67486	10.63281
10.675	14.72268	0.74982	10.675
10.71734	16.26825	0.82854	10.71734
10.75969	17.86912	0.91007	10.75969
10.80219	19.51544	0.99391	10.80219
10.84516	21.2065	1.08004	10.84516
10.88797	22.94672	1.16867	10.88797
10.93031	24.72732	1.25935	10.93031
10.97281	26.54093	1.35172	10.97281
11.01547	28.39317	1.44605	11.01547
11.05781	30.28424	1.54236	11.05781
11.09984	32.21847	1.64087	11.09984

Extension (mm)	Load (N)	Compressive stress (MPa)	Compressive strain (mm/mm)
11.18375	36.27646	1.84754	11.18375
11.22547	38.4143	1.95642	11.22547
11.26734	40.6481	2.07019	11.26734
11.30984	42.97743	2.18882	11.30984
11.3525	45.42378	2.31341	11.3525
11.39469	48.00034	2.44464	11.39469
11.43703	50.68847	2.58154	11.43703
11.47969	53.49343	2.7244	11.47969
11.52234	56.44195	2.87456	11.52234
11.56469	59.52526	3.0316	11.56469
11.60719	62.72189	3.1944	11.60719
11.64984	66.06515	3.36467	11.64985
11.69281	69.59782	3.54459	11.69281
11.73531	73.33073	3.7347	11.73531
11.7775	77.27135	3.9354	11.7775
11.81922	81.39272	4.1453	11.81922
11.86047	85.69207	4.36426	11.86047
11.90219	90.18945	4.59331	11.90219
11.94453	94.97472	4.83702	11.94453
11.98672	100.11778	5.09896	11.98672
12.02875	105.63795	5.3801	12.02875
12.07141	111.54954	5.68117	12.07141
12.11438	117.8905	6.00411	12.11437
12.15687	124.70668	6.35126	12.15688
12.19906	131.9967	6.72254	12.19906
12.24156	139.74664	7.11724	12.24156
12.28422	148.03667	7.53945	12.28422
12.32656	156.9035	7.99103	12.32656
12.36891	166.30673	8.46993	12.36891
12.41141	176.27115	8.97742	12.41141
12.45281	186.85536	9.51647	12.45281
12.49391	198.00252	10.08419	12.49391
12.53563	209.71548	10.68072	12.53563
12.57797	222.19504	11.3163	12.57797
12.61984	235.61417	11.99973	12.61984
12.66187	249.93517	12.72909	12.66187
12.70406	265.24774	13.50896	12.70406
12.74656	281.70694	14.34722	12.74656
12.78906	299.42722	15.2497	12.78906
12.83125	318.42993	16.2175	12.83125
12.87359	338.69714	17.2497	12.87359
12.91594	360.28778	18.34931	12.91594
12.95813	383.27441	19.52001	12.95813
13	407.7056	20.76427	13
13.04187	433.50879	22.07842	13.04188
13.07484	455.0961	23.17785	13.07484

Table D.12 PBS-Soaked Scaffolds Specimen 4 Raw Compression Data

Extension (mm)	Load (N)	Compressive stress (MPa)	Compressive strain (mm/mm)	Extension (mm)	Load (N)	Compressive stress (MPa)	Compressive strain (mm/mm)
0	0.00371	0.00019	0	2.71703	0.00398	0.0002	0.54341
0.00281	0.00307	0.00016	0.00056	2.75953	0.00337	0.00017	0.55191
0.02375	0.0198	0.00101	0.00475	2.80234	0.00434	0.00022	0.56047
0.06563	0.05808	0.00296	0.01313	2.84469	0.00542	0.00028	0.56894
0.11156	0.08096	0.00412	0.02231	2.88687	0.00421	0.00021	0.57737
0.15328	0.06476	0.0033	0.03066	2.92969	0.00315	0.00016	0.58594
0.19609	0.03664	0.00187	0.03922	2.97234	0.00338	0.00017	0.59447
0.24484	0.02355	0.0012	0.04897	3.01469	0.0045	0.00023	0.60294
0.29531	0.0209	0.00106	0.05906	3.05672	0.00562	0.00029	0.61134
0.34391	0.01528	0.00078	0.06878	3.09828	0.0062	0.00032	0.61966
0.39094	0.00543	0.00028	0.07819	3.14	0.00651	0.00033	0.628
0.43812	-0.00126	-0.00006	0.08762	3.1825	0.00672	0.00034	0.6365
0.48547	-0.0014	-0.00007	0.09709	3.225	0.0062	0.00032	0.645
0.53219	-0.00136	-0.00007	0.10644	3.26734	0.00589	0.0003	0.65347
0.57734	-0.00131	-0.00007	0.11547	3.30969	0.00616	0.00031	0.66194
0.62156	-0.00095	-0.00005	0.12431	3.35219	0.0079	0.0004	0.67044
0.66625	0.00127	0.00006	0.13325	3.39438	0.00637	0.00032	0.67888
0.71141	0.00406	0.00021	0.14228	3.43641	0.00334	0.00017	0.68728
0.75594	0.00479	0.00024	0.15119	3.47875	0.00344	0.00018	0.69575
0.79984	0.00219	0.00011	0.15997	3.52172	0.00593	0.0003	0.70434
0.84359	0.00181	0.00009	0.16872	3.56406	0.00643	0.00033	0.71281
0.8875	0.00332	0.00017	0.1775	3.60594	0.0052	0.00026	0.72119
0.93094	0.00412	0.00021	0.18619	3.64813	0.00388	0.0002	0.72963
0.97438	0.00259	0.00013	0.19488	3.69094	0.00402	0.0002	0.73819
1.01844	0.00288	0.00015	0.20369	3.73344	0.0046	0.00023	0.74669
1.06219	0.00338	0.00017	0.21244	3.77531	0.00771	0.00039	0.75506
1.10531	0.00244	0.00012	0.22106	3.8175	0.01041	0.00053	0.7635
1.14797	0.00108	0.00005	0.22959	3.86	0.0093	0.00047	0.772
1.19047	0.00101	0.00005	0.23809	3.90234	0.00587	0.0003	0.78047
1.2325	0.00206	0.00011	0.2465	3.94484	0.00501	0.00025	0.78897
1.27484	0.00119	0.00006	0.25497	3.98719	0.00636	0.00032	0.79744
1.3175	0.00097	0.00005	0.2635	4.02969	0.00721	0.00037	0.80594
1.36016	0.00476	0.00024	0.27203	4.07219	0.00656	0.00033	0.81444
1.4025	0.00755	0.00038	0.2805	4.115	0.00603	0.00031	0.823
1.44516	0.00543	0.00028	0.28903	4.1575	0.00572	0.00029	0.8315
1.48828	0.00272	0.00014	0.29766	4.19984	0.00598	0.0003	0.83997
1.53109	0.00315	0.00016	0.30622	4.24203	0.00725	0.00037	0.84841
1.57375	0.00557	0.00028	0.31475	4.28375	0.00777	0.0004	0.85675
1.61688	0.00598	0.0003	0.32338	4.325	0.00743	0.00038	0.865
1.65984	0.00647	0.00033	0.33197	4.36672	0.00682	0.00035	0.87334
1.7025	0.00528	0.00027	0.3405	4.40969	0.00761	0.00039	0.88194
1.74469	0.00273	0.00014	0.34894	4.45281	0.00926	0.00047	0.89056
1.78672	0.00102	0.00005	0.35734	4.49516	0.00914	0.00047	0.89903
1.82844	0.00055	0.00003	0.36569	4.53719	0.00742	0.00038	0.90744
1.86984	0.00193	0.0001	0.37397	4.58	0.00562	0.00029	0.916
1.91187	0.00558	0.00028	0.38237	4.62328	0.00575	0.00029	0.92466
1.95453	0.00918	0.00047	0.39091	4.66578	0.00569	0.00029	0.93316
1.99703	0.00982	0.0005	0.39941	4.70797	0.00296	0.00015	0.94159
2.03922	0.00887	0.00045	0.40784	4.75078	0.00262	0.00013	0.95016
2.08219	0.00842	0.00043	0.41644	4.79359	0.00492	0.00025	0.95872
2.12531	0.00766	0.00039	0.42506	4.83594	0.00527	0.00027	0.96719
2.16797	0.00559	0.00028	0.43359	4.87828	0.00481	0.00025	0.97566
2.21031	0.00291	0.00015	0.44206	4.92016	0.00502	0.00026	0.98403
2.25313	0.00124	0.00006	0.45063	4.96141	0.00686	0.00035	0.99228
2.29578	0.0012	0.00006	0.45916	5.00219	0.00644	0.00033	1.00044
2.33813	0.00187	0.0001	0.46763	5.04437	0.00666	0.00034	1.00888
2.38031	0.00381	0.00019	0.47606	5.0875	0.01054	0.00054	1.0175
2.42234	0.00541	0.00028	0.48447	5.13047	0.00997	0.00051	1.02609
2.46406	0.00497	0.00025	0.49281	5.17281	0.00571	0.00029	1.03456
2.50563	0.00519	0.00026	0.50113	5.21547	0.00219	0.00011	1.04309
2.5475	0.00643	0.00033	0.5095	5.25813	0.00363	0.00019	1.05163
2.58984	0.00623	0.00032	0.51797	5.30062	0.00489	0.00025	1.06012
2.6325	0.0068	0.00035	0.5265	5.34297	0.0037	0.00019	1.06859
2.67484	0.00551	0.00028	0.53497	5.38578	0.00381	0.00019	1.07716

Extension (mm)	Load (N)	Compressive stress (MPa)	Compressive strain (mm/mm)
5.47109	0.00587	0.0003	1.09422
5.51312	0.00609	0.00031	1.10263
5.555	0.00587	0.0003	1.111
5.59656	0.00595	0.0003	1.11931
5.63797	0.00531	0.00027	1.12759
5.67984	0.00672	0.00034	1.13597
5.72203	0.00795	0.0004	1.14441
5.76438	0.0089	0.00045	1.15288
5.80641	0.00844	0.00043	1.16128
5.84938	0.0069	0.00035	1.16988
5.89281	0.00771	0.00039	1.17856
5.93547	0.00865	0.00044	1.18709
5.97766	0.00616	0.00031	1.19553
6.02016	0.00375	0.00019	1.20403
6.06297	0.00462	0.00024	1.21259
6.10531	0.00662	0.00034	1.22106
6.1475	0.00573	0.00029	1.2295
6.18984	0.00404	0.00021	1.23797
6.23156	0.0061	0.00031	1.24631
6.27344	0.00854	0.00043	1.25469
6.31578	0.00867	0.00044	1.26316
6.35797	0.00758	0.00039	1.27159
6.4	0.00681	0.00035	1.28
6.44203	0.0063	0.00032	1.28841
6.48391	0.00578	0.00029	1.29678
6.52609	0.00658	0.00034	1.30522
6.56891	0.00832	0.00042	1.31378
6.6125	0.00873	0.00044	1.3225
6.65547	0.00741	0.00038	1.33109
6.69797	0.00506	0.00026	1.33959
6.74031	0.00465	0.00024	1.34806
6.78266	0.00569	0.00029	1.35653
6.82453	0.00562	0.00029	1.36491
6.86594	0.00521	0.00027	1.37319
6.90781	0.00589	0.0003	1.38156
6.95031	0.00667	0.00034	1.39006
6.9925	0.00647	0.00033	1.3985
7.03469	0.00607	0.00031	1.40694
7.0775	0.00746	0.00038	1.4155
7.12031	0.00766	0.00039	1.42406
7.16281	0.00746	0.00038	1.43256
7.20531	0.00736	0.00037	1.44106
7.24813	0.00843	0.00043	1.44963
7.29094	0.00744	0.00038	1.45819
7.33328	0.00281	0.00014	1.46666
7.37531	0.0019	0.0001	1.47506
7.41766	0.0034	0.00017	1.48353
7.45969	0.00385	0.0002	1.49194
7.50141	0.00511	0.00026	1.50028
7.54344	0.0062	0.00032	1.50869
7.58563	0.00668	0.00034	1.51713
7.62781	0.00597	0.0003	1.52556
7.67031	0.00762	0.00039	1.53406
7.71266	0.00991	0.0005	1.54253
7.75453	0.00766	0.00039	1.55091
7.79672	0.00494	0.00025	1.55934
7.83969	0.0049	0.00025	1.56794
7.88266	0.00564	0.00029	1.57653
7.92531	0.00581	0.0003	1.58506
7.9675	0.00447	0.00023	1.5935
8.01	0.00483	0.00025	1.602
8.05234	0.00563	0.00029	1.61047
8.09391	0.0044	0.00022	1.61878
8.13516	0.00323	0.00016	1.62703

Extension (mm)	Load (N)	Compressive stress (MPa)	Compressive strain (mm/mm)
8.17734	0.00532	0.00027	1.63547
8.22	0.00955	0.00049	1.644
8.2625	0.00848	0.00043	1.6525
8.30484	0.00355	0.00018	1.66097
8.34734	0.00518	0.00026	1.66947
8.39	0.00858	0.00044	1.678
8.43219	0.0071	0.00036	1.68644
8.47437	0.00593	0.0003	1.69488
8.51703	0.00734	0.00037	1.70341
8.55969	0.00789	0.0004	1.71194
8.60203	0.00696	0.00035	1.72041
8.64437	0.00684	0.00035	1.72888
8.68656	0.00685	0.00035	1.73731
8.72844	0.00477	0.00024	1.74569
8.77047	0.00366	0.00019	1.75409
8.8125	0.0045	0.00023	1.7625
8.85484	0.00614	0.00031	1.77097
8.89703	0.00662	0.00034	1.77941
8.93953	0.00691	0.00035	1.78791
8.98234	0.00781	0.0004	1.79647
9.025	0.00691	0.00035	1.805
9.06734	0.00597	0.0003	1.81347
9.10984	0.00632	0.00032	1.82197
9.1525	0.00802	0.00041	1.8305
9.19531	0.00973	0.0005	1.83906
9.2375	0.00943	0.00048	1.8475
9.27984	0.00825	0.00042	1.85597
9.32172	0.00771	0.00039	1.86434
9.36328	0.00782	0.0004	1.87266
9.405	0.00904	0.00046	1.881
9.4475	0.00938	0.00048	1.8895
9.49	0.00939	0.00048	1.898
9.53234	0.00899	0.00046	1.90647
9.575	0.00667	0.00034	1.915
9.61781	0.0064	0.00033	1.92356
9.66031	0.00743	0.00038	1.93206
9.70281	0.00683	0.00035	1.94056
9.74562	0.00518	0.00026	1.94912
9.78859	0.00581	0.0003	1.95772
9.83094	0.00665	0.00034	1.96619
9.87297	0.00579	0.00029	1.97459
9.915	0.00683	0.00035	1.983
9.95656	0.00924	0.00047	1.99131
9.99813	0.00824	0.00042	1.99963
10.04016	0.00656	0.00033	2.00803
10.08266	0.00688	0.00035	2.01653
10.12516	0.0091	0.00046	2.02503
10.1675	0.01041	0.00053	2.0335
10.21	0.01014	0.00052	2.042
10.25266	0.01184	0.0006	2.05053
10.29547	0.02322	0.00118	2.05909
10.33813	0.05366	0.00273	2.06763
10.38078	0.1094	0.00557	2.07616
10.42359	0.20549	0.01047	2.08472
10.46609	0.35293	0.01797	2.09322
10.50813	0.55303	0.02817	2.10162
10.54984	0.80156	0.04082	2.10997
10.59125	1.08824	0.05542	2.11825
10.63281	1.40841	0.07173	2.12656
10.67516	1.76402	0.08984	2.13503
10.71766	2.16002	0.11001	2.14353
10.75984	2.60252	0.13255	2.15197
10.80234	3.09444	0.1576	2.16047
10.84516	3.64382	0.18558	2.16903

Extension (mm)	Load (N)	Compressive stress (MPa)	Compressive strain (mm/mm)
10.84516	3.64382	0.18558	2.16903
10.88797	4.26099	0.21701	2.17759
10.93016	4.95567	0.25239	2.18603
10.9725	5.73307	0.29198	2.1945
11.01531	6.60011	0.33614	2.20306
11.05781	7.50258	0.3821	2.21156
11.09984	8.21063	0.41816	2.21997
11.14203	8.66602	0.44136	2.22841
11.18422	8.98211	0.45746	2.23684
11.22609	9.2991	0.4736	2.24522
11.26781	9.92897	0.50568	2.25356
11.31016	10.91099	0.55569	2.26203
11.3525	12.1878	0.62072	2.2705
11.39469	13.71009	0.69825	2.27894
11.43719	15.43442	0.78607	2.28744
11.48016	17.34896	0.88358	2.29603
11.52281	19.45444	0.99081	2.30456
11.56516	21.75485	1.10797	2.31303
11.60766	24.27113	1.23612	2.32153
11.65016	27.03672	1.37697	2.33003
11.69266	30.07842	1.53188	2.33853
11.73484	33.43922	1.70305	2.34697
11.77703	37.20161	1.89466	2.35541
11.81891	41.42402	2.10971	2.36378
11.86016	46.12899	2.34933	2.37203
11.90188	51.33019	2.61423	2.38038
11.94406	57.06573	2.90633	2.38881
11.98656	63.39763	3.22881	2.39731
12.02891	70.38905	3.58488	2.40578
12.07141	78.05219	3.97517	2.41428
12.11375	86.3261	4.39655	2.42275
12.15594	95.13129	4.845	2.43119
12.19828	104.34448	5.31422	2.43966
12.24125	113.85289	5.79848	2.44825
12.28422	123.62232	6.29603	2.45684
12.32672	133.58549	6.80345	2.46534
12.36859	143.63147	7.31509	2.47372
12.41078	153.71046	7.82841	2.48216
12.45266	163.93785	8.34929	2.49053
12.49391	174.45532	8.88494	2.49878
12.53563	185.34853	9.43972	2.50713
12.57766	196.77641	10.02174	2.51553
12.61969	208.85832	10.63707	2.52394
12.66188	221.51285	11.28156	2.53238
12.70422	234.72112	11.95425	2.54084
12.74672	248.57175	12.65965	2.54934
12.78906	263.1947	13.4044	2.55781
12.83156	278.72021	14.1951	2.56631
12.87391	295.27011	15.03798	2.57478
12.91656	312.95831	15.93884	2.58331
12.95906	331.87704	16.90236	2.59181
13.00109	352.19495	17.93714	2.60022
13.04281	373.97482	19.04638	2.60856
13.08406	397.19388	20.22892	2.61681
13.12516	422.03552	21.49409	2.62503
13.16672	448.65393	22.84976	2.63334
13.17516	454.21698	23.13308	2.63503

Table D.13 Dry Scaffolds Specimen 1 Raw Compression Data

Extension (mm)	Load (N)	Compressive stress (MPa)	Compressive strain (mm/mm)	Extension (mm)	Load (N)	Compressive stress (MPa)	Compressive strain (mm/mm)
0	-0.00138	-0.00007	0	2.71781	0.00103	0.00005	0.54356
0.00219	-0.00041	-0.00002	0.00044	2.76047	-0.00108	-0.00006	0.55209
0.01531	0.00873	0.00044	0.00306	2.80312	-0.00226	-0.00012	0.56062
0.04875	0.03581	0.00182	0.00975	2.84563	-0.00149	-0.00008	0.56913
0.09266	0.06436	0.00328	0.01853	2.88781	-0.00174	-0.00009	0.57756
0.13766	0.06823	0.00348	0.02753	2.93016	-0.00193	-0.0001	0.58603
0.18359	0.0512	0.00261	0.03672	2.9725	-0.00176	-0.00009	0.5945
0.23281	0.03404	0.00173	0.04656	3.01484	-0.00156	-0.00008	0.60297
0.28375	0.02221	0.00113	0.05675	3.05672	-0.00193	-0.0001	0.61134
0.33375	0.01077	0.00055	0.06675	3.09813	-0.00224	-0.00011	0.61963
0.38266	0.00124	0.00006	0.07653	3.13953	-0.00144	-0.00007	0.62791
0.43109	-0.00517	-0.00026	0.08622	3.18203	0.00202	0.0001	0.63641
0.47891	-0.00605	-0.00031	0.09578	3.22469	0.00284	0.00014	0.64494
0.52609	-0.00598	-0.0003	0.10522	3.26734	0.00078	0.00004	0.65347
0.57219	-0.00678	-0.00035	0.11444	3.31	0.00174	0.00009	0.662
0.61734	-0.00769	-0.00039	0.12347	3.3525	0.00276	0.00014	0.6705
0.6625	-0.00632	-0.00032	0.1325	3.39469	0.00033	0.00002	0.67894
0.70797	-0.00219	-0.00011	0.14159	3.43672	-0.00093	-0.00005	0.68734
0.75313	0.00076	0.00004	0.15063	3.47922	-0.0011	-0.00006	0.69584
0.7975	-0.00074	-0.00004	0.1595	3.52219	-0.00214	-0.00011	0.70444
0.84188	-0.00168	-0.00009	0.16838	3.565	-0.00418	-0.00021	0.713
0.88578	-0.00138	-0.00007	0.17716	3.6075	-0.00462	-0.00024	0.7215
0.92953	-0.00267	-0.00014	0.18591	3.64969	-0.00313	-0.00016	0.72994
0.97344	-0.00216	-0.00011	0.19469	3.69156	-0.00329	-0.00017	0.73831
1.01766	-0.00184	-0.00009	0.20353	3.73328	-0.00372	-0.00019	0.74666
1.06156	-0.00245	-0.00012	0.21231	3.77531	-0.00225	-0.00011	0.75506
1.10484	-0.00452	-0.00023	0.22097	3.8175	0.00193	0.0001	0.7635
1.14766	-0.00456	-0.00023	0.22953	3.85969	0.00435	0.00022	0.77194
1.19016	-0.00186	-0.00009	0.23803	3.90156	0.00236	0.00012	0.78031
1.23219	-0.00118	-0.00006	0.24644	3.94391	0.00064	0.00003	0.78878
1.27453	-0.0024	-0.00012	0.25491	3.98656	0	0	0.79731
1.31734	-0.00194	-0.0001	0.26347	4.02938	-0.00146	-0.00007	0.80588
1.36016	-0.00039	-0.00005	0.27203	4.07219	-0.00121	-0.00006	0.81444
1.40266	-0.00009	0	0.28053	4.11516	0.00017	0.00001	0.82303
1.44547	0.00034	0.00002	0.28909	4.15797	0.00127	0.00006	0.83159
1.48828	0.00147	0.00007	0.29766	4.20031	-0.00025	-0.00001	0.84006
1.53125	0.00209	0.00011	0.30625	4.2425	-0.00123	-0.00006	0.8485
1.57406	0.00145	0.00007	0.31481	4.285	-0.00087	-0.00004	0.857
1.61688	0.00089	0.00005	0.32338	4.32688	-0.00174	-0.00009	0.86538
1.66	0.00171	0.00009	0.332	4.36828	-0.00247	-0.00013	0.87366
1.70281	0.00301	0.00015	0.34056	4.41016	-0.00273	-0.00014	0.88203
1.74516	0.00198	0.0001	0.34903	4.45281	-0.00054	-0.00003	0.89056
1.78719	-0.00169	-0.00009	0.35744	4.49516	0.001	0.00005	0.89903
1.82906	-0.00407	-0.00021	0.36581	4.53734	-0.00049	-0.00003	0.90747
1.87062	-0.00302	-0.00015	0.37412	4.58	0.00184	0.00009	0.916
1.91266	-0.00144	-0.00007	0.38253	4.6225	0.00469	0.00024	0.9245
1.955	-0.00046	-0.00002	0.391	4.66469	0.00291	0.00015	0.93294
1.99719	0.00175	0.00009	0.39944	4.70719	-0.00002	0	0.94144
2.03969	0.0036	0.00018	0.40794	4.75031	-0.00098	-0.00005	0.95006
2.08234	0.00214	0.00011	0.41647	4.79359	-0.00015	-0.00001	0.95872
2.12516	0.00094	0.00005	0.42503	4.83625	-0.00032	-0.00005	0.96725
2.16781	0.00223	0.00011	0.43356	4.87844	-0.00158	-0.00008	0.97569
2.21031	0.0011	0.00006	0.44206	4.92063	-0.00043	-0.00002	0.98413
2.25328	-0.00143	-0.00007	0.45066	4.96234	-0.00012	-0.00001	0.99247
2.29578	-0.00282	-0.00014	0.45916	5.00375	-0.00013	-0.00001	1.00075
2.33781	-0.00351	-0.00018	0.46756	5.04547	0.00046	0.00002	1.00909
2.38016	-0.00266	-0.00014	0.47603	5.08797	0.00274	0.00014	1.01759
2.42234	-0.00128	-0.00007	0.48447	5.13031	0.00312	0.00016	1.02606
2.46406	0.00078	0.00004	0.49281	5.1725	-0.00262	-0.00013	1.0345
2.50563	0.00031	0.00002	0.50113	5.21516	-0.00694	-0.00035	1.04303
2.54766	-0.00022	-0.00001	0.50953	5.25781	-0.00429	-0.00022	1.05156
2.59016	0.00118	0.00006	0.51803	5.30031	0.00152	0.00008	1.06006
2.63266	0.00214	0.00011	0.52653	5.34266	0.00494	0.00025	1.06853
2.67531	0.00267	0.00014	0.53506	5.38547	0.00416	0.00021	1.07709

Extension (mm)	Load (N)	Compressive stress (MPa)	Compressive strain (mm/mm)
5.42844	0.00237	0.00012	1.08569
5.47094	-0.00306	-0.00016	1.09419
5.51312	-0.00871	-0.00044	1.10263
5.55531	-0.0083	-0.00042	1.1106
5.59688	-0.00415	-0.00021	1.11937
5.63828	-0.00057	-0.00003	1.12766
5.68031	0.0012	0.00006	1.13606
5.72297	0.00306	0.00016	1.14459
5.76531	0.00542	0.00028	1.15306
5.8075	0.00398	0.0002	1.1615
5.85	0.00107	0.00005	1.17
5.89281	-0.0018	-0.00009	1.17856
5.93531	-0.0042	-0.00021	1.18706
5.97766	-0.00556	-0.00028	1.19553
6.02047	-0.00281	-0.00014	1.20409
6.06313	0.00234	0.00012	1.21263
6.10547	0.00257	0.00013	1.22109
6.1475	-0.00031	-0.00002	1.2295
6.18969	-0.00139	-0.00007	1.23794
6.23156	-0.00076	-0.00004	1.24631
6.27359	-0.00071	-0.00004	1.25472
6.31578	0.00029	0.00001	1.26316
6.35828	0.00073	0.00004	1.27166
6.40063	0.00023	0.00001	1.28013
6.44281	0.0005	0.00003	1.28856
6.48484	-0.00103	-0.00005	1.29697
6.52688	-0.00242	-0.00012	1.30537
6.56953	-0.0038	-0.00019	1.31391
6.6125	-0.00245	-0.00012	1.3225
6.65531	-0.00139	-0.00007	1.33106
6.69797	0.00098	0.00005	1.33959
6.74016	0.00466	0.00024	1.34803
6.7825	0.00668	0.00034	1.3565
6.82406	0.00367	0.00019	1.36481
6.86578	-0.00112	-0.00006	1.37316
6.90813	-0.00335	-0.00017	1.38163
6.95063	-0.00465	-0.00024	1.39013
6.99281	-0.00217	-0.00011	1.39856
7.03516	0.00156	0.00008	1.40703
7.07812	0.00331	0.00017	1.41562
7.12094	0.00315	0.00016	1.42419
7.16328	0.00114	0.00006	1.43266
7.20578	-0.00101	-0.00005	1.44116
7.24859	-0.00074	-0.00004	1.44972
7.29141	0.00039	0.00002	1.45828
7.33359	0.00112	0.00006	1.46672
7.37578	-0.00169	-0.00009	1.47516
7.41813	-0.00189	-0.0001	1.48363
7.46016	0.00065	0.00003	1.49203
7.50172	0.00375	0.00019	1.50034
7.54406	0.00759	0.00039	1.50881
7.58641	0.00782	0.0004	1.51728
7.62844	0.00477	0.00024	1.52569
7.67063	0.00298	0.00015	1.53413
7.71266	0.001	0.00005	1.54253
7.75453	-0.0031	-0.00016	1.55091
7.79688	-0.00445	-0.00023	1.55938
7.84	-0.00241	-0.00012	1.568
7.88297	0.00042	0.00002	1.57659
7.92562	0.00119	0.00006	1.58512
7.96797	0.00096	0.00005	1.59359
8.01047	0.00248	0.00013	1.60209
8.05266	0.00355	0.00018	1.61053
8.09422	0.00236	0.00012	1.61884

Extension (mm)	Load (N)	Compressive stress (MPa)	Compressive strain (mm/mm)
8.13578	0.00097	0.00005	1.62716
8.17797	0.00252	0.00013	1.63559
8.22031	0.0029	0.00015	1.64406
8.2625	0.00175	0.00009	1.6525
8.30516	0.0022	0.00011	1.66103
8.34781	0.00175	0.00009	1.66956
8.39031	-0.00049	-0.00003	1.67806
8.4325	-0.00256	-0.00013	1.6865
8.475	-0.00119	-0.00006	1.695
8.5175	0.00042	0.00002	1.7035
8.56	-0.00098	-0.00005	1.712
8.6025	-0.00227	-0.00012	1.7205
8.64484	-0.00203	-0.0001	1.72897
8.68688	-0.00121	-0.00006	1.73738
8.72859	-0.00035	-0.00002	1.74572
8.77031	0.0015	0.00008	1.75406
8.8125	0.00362	0.00018	1.7625
8.855	0.00426	0.00022	1.771
8.89734	0.00132	0.00007	1.77947
8.94	-0.0018	-0.00009	1.788
8.98266	-0.00325	-0.00017	1.79653
9.02547	-0.00205	-0.0001	1.80509
9.06797	-0.00253	-0.00013	1.81359
9.11031	-0.00392	-0.0002	1.82206
9.15297	-0.00148	-0.00008	1.83059
9.19563	0.00035	0.00002	1.83913
9.23797	0.00094	0.00005	1.84759
9.28	-0.00027	-0.00001	1.856
9.32172	-0.00054	-0.00003	1.86434
9.36328	-0.0003	-0.00002	1.87266
9.40516	0.00109	0.00006	1.88103
9.4475	0.00364	0.00019	1.8895
9.49	0.00402	0.0002	1.898
9.5325	0.00154	0.00008	1.9065
9.57531	-0.00024	-0.00001	1.91506
9.61812	-0.00063	-0.00003	1.92362
9.66062	-0.00174	-0.00009	1.93212
9.70297	-0.00316	-0.00016	1.94059
9.74578	-0.00251	-0.00013	1.94916
9.78875	-0.0004	-0.00002	1.95775
9.83125	-0.00143	-0.00007	1.96625
9.87344	-0.00377	-0.00019	1.97469
9.91547	-0.00326	-0.00017	1.98309
9.95703	-0.0001	0	1.99141
9.99859	0.00135	0.00007	1.99972
10.04062	0.00129	0.00007	2.00812
10.08297	0.00118	0.00006	2.01659
10.12547	0.00197	0.0001	2.02509
10.16766	0.00186	0.00009	2.03353
10.21031	0.00016	0.00001	2.04206
10.25313	-0.00026	-0.00001	2.05063
10.29578	-0.00006	0	2.05916
10.33844	0.00063	0.00003	2.06769
10.38125	0.06104	0.00311	2.07625
10.42406	0.30455	0.01551	2.08481
10.46625	0.8193	0.04173	2.09325
10.50828	1.67287	0.0852	2.10166
10.55016	2.88188	0.14677	2.11003
10.59188	4.38977	0.22357	2.11838
10.63328	5.89882	0.30042	2.12666
10.67516	7.02508	0.35778	2.13503
10.71766	7.79742	0.39712	2.14353
10.76016	8.38463	0.42703	2.15203
10.8025	9.19912	0.46851	2.1605

Extension (mm)	Load (N)	Compressive stress (MPa)	Compressive strain (mm/mm)
10.12547	0.00197	0.0001	2.02509
10.16766	0.00186	0.00009	2.03353
10.21031	0.00016	0.00001	2.04206
10.25313	-0.00026	-0.00001	2.05063
10.29578	-0.00006	0	2.05916
10.33844	0.00063	0.00003	2.06769
10.38125	0.06104	0.00311	2.07625
10.42406	0.30455	0.01551	2.08481
10.46625	0.8193	0.04173	2.09325
10.50828	1.67287	0.0852	2.10166
10.55016	2.88188	0.14677	2.11003
10.59188	4.38977	0.22357	2.11838
10.63328	5.89882	0.30042	2.12666
10.67516	7.02508	0.35778	2.13503
10.71766	7.79742	0.39712	2.14353
10.76016	8.38463	0.42703	2.15203
10.8025	9.1912	0.46851	2.1605
10.84531	10.39145	0.52923	2.16906
10.88797	11.93097	0.60764	2.17759
10.93047	13.7487	0.70022	2.18609
10.97312	15.76809	0.80306	2.19462
11.01562	17.93523	0.91343	2.20312
11.05781	20.22678	1.03014	2.21156
11.1	22.60886	1.15146	2.22
11.14219	25.07319	1.27697	2.22844
11.18406	27.62283	1.40682	2.23681
11.22578	30.27775	1.54203	2.24516
11.26766	33.07073	1.68428	2.25353
11.31016	36.07095	1.83708	2.26203
11.35266	39.33642	2.00339	2.27053
11.39469	42.87661	2.18369	2.27894
11.43719	46.66188	2.37647	2.28744
11.48	50.65111	2.57964	2.296
11.52266	54.81323	2.79161	2.30453
11.56469	59.09145	3.0095	2.31294
11.60719	63.45862	3.23192	2.32144
11.64969	67.95165	3.46075	2.32994
11.69203	72.57052	3.69599	2.33841
11.73438	77.30328	3.93702	2.34687
11.77687	82.20102	4.18646	2.35537
11.81875	87.29398	4.44585	2.36375
11.86016	92.5655	4.71432	2.37203
11.90188	98.00878	4.99155	2.38038
11.94438	103.71505	5.28216	2.38888
11.98703	109.77592	5.59084	2.39741
12.02922	116.16549	5.91626	2.40584
12.07172	122.83036	6.2557	2.41434
12.11438	129.79039	6.61017	2.42287
12.15672	137.08701	6.98178	2.43134
12.19891	144.6761	7.36829	2.43978
12.24141	152.53009	7.76829	2.44828
12.28422	160.76268	8.18758	2.45684
12.32656	169.40448	8.6277	2.46531
12.36844	178.39946	9.08581	2.47369
12.41062	187.7343	9.56123	2.48212
12.45234	197.53149	10.0602	2.49047
12.49375	207.86183	10.58632	2.49875
12.53563	218.79324	11.14305	2.50713
12.57781	230.55698	11.74217	2.51556
12.62	243.3231	12.39234	2.524
12.66219	257.06174	13.09205	2.53244
12.70438	271.78055	13.84167	2.54087
12.74672	287.48749	14.64162	2.54934
12.78891	304.29517	15.49763	2.55778
12.83125	322.25668	16.4124	2.56625
12.87375	341.49084	17.39198	2.57475
12.91609	362.17172	18.44525	2.58322
12.95828	384.35797	19.57519	2.59166
13.00016	408.07974	20.78333	2.60003
13.04203	433.314	22.0685	2.60841
13.07484	454.61847	23.15353	2.61497
13.12516	422.03552	21.49409	2.62503
13.16672	448.65393	22.84976	2.63334
13.17516	454.21698	23.13308	2.63503

Table D.14 Dry Scaffolds Specimen 2 Raw Compression Data

Extension (mm)	Load (N)	Compressive stress (MPa)	Compressive strain (mm/mm)	Extension (mm)	Load (N)	Compressive stress (MPa)	Compressive strain (mm/mm)
0	0.0004	0.00002	0	2.71766	0.00104	0.00005	0.54353
0.00266	0.00132	0.00007	0.00053	2.76016	0.00335	0.00017	0.55203
0.02266	0.0166	0.00085	0.00453	2.80281	0.00323	0.00016	0.56056
0.06406	0.05415	0.00276	0.01281	2.84531	0.00135	0.00007	0.56906
0.11	0.07811	0.00398	0.022	2.8875	0.00126	0.00006	0.5775
0.15156	0.06313	0.00322	0.03031	2.92969	0.00255	0.00013	0.58594
0.19422	0.03427	0.00175	0.03884	2.97203	0.0027	0.00014	0.59441
0.24266	0.02214	0.00113	0.04853	3.01469	0.00017	0.00001	0.60294
0.29328	0.02069	0.00105	0.05866	3.05656	-0.00094	-0.00005	0.61131
0.34203	0.01211	0.00062	0.06841	3.09828	-0.00008	0	0.61966
0.38938	-0.00012	-0.00001	0.07788	3.14031	0.00056	0.00003	0.62806
0.43656	-0.00484	-0.00025	0.08731	3.18297	0.00236	0.00012	0.63659
0.48422	-0.00178	-0.00009	0.09684	3.22547	0.00381	0.00019	0.64509
0.53125	-0.00178	-0.00009	0.10625	3.26766	0.0026	0.00013	0.65353
0.57641	-0.00632	-0.00032	0.11528	3.31	0.00064	0.00003	0.662
0.62047	-0.00697	-0.00035	0.12409	3.3525	0.00076	0.00004	0.6705
0.66516	-0.00261	-0.00013	0.13303	3.39453	0.00216	0.00011	0.67891
0.71031	0.0001	0	0.14206	3.43672	0.00306	0.00016	0.68734
0.75516	0.002	0.0001	0.15103	3.47953	0.00168	0.00009	0.69591
0.79922	0.00103	0.00005	0.15984	3.52234	0.00083	0.00004	0.70447
0.84312	-0.0008	-0.00004	0.16862	3.56516	-0.00099	-0.00005	0.71303
0.88672	-0.00274	-0.00014	0.17734	3.60766	-0.00277	-0.00014	0.72153
0.93031	-0.00283	-0.00014	0.18606	3.64984	-0.00446	-0.00023	0.72997
0.97422	-0.00082	-0.00004	0.19484	3.69156	-0.00363	-0.00018	0.73831
1.01844	0.00032	0.00002	0.20369	3.73312	-0.00228	-0.00012	0.74663
1.06203	-0.00034	-0.00002	0.21241	3.77484	-0.00105	-0.00005	0.75497
1.10516	-0.00199	-0.0001	0.22103	3.81687	0.00197	0.0001	0.76337
1.14813	-0.00152	-0.00008	0.22963	3.85938	0.00492	0.00025	0.77188
1.19063	0.00004	0	0.23813	3.90219	0.00738	0.00038	0.78044
1.23281	0.00013	0.00001	0.24656	3.945	0.00704	0.00036	0.789
1.27531	-0.00048	-0.00002	0.25506	3.98734	0.00387	0.0002	0.79747
1.31813	-0.00169	-0.00009	0.26362	4.02953	0.00245	0.00012	0.80591
1.36094	-0.00115	-0.00006	0.27219	4.07219	0.00293	0.00015	0.81444
1.40344	-0.00057	-0.00003	0.28069	4.11484	0.00326	0.00017	0.82297
1.44594	-0.00081	-0.00004	0.28919	4.15734	0.00247	0.00013	0.83147
1.48875	-0.00035	-0.00002	0.29775	4.2	0.00211	0.00011	0.84
1.53156	-0.00072	-0.00004	0.30631	4.2425	0.00223	0.00011	0.8485
1.57422	-0.00194	-0.0001	0.31484	4.285	-0.00071	-0.00004	0.857
1.61703	-0.00011	-0.00001	0.32341	4.32688	-0.00249	-0.00013	0.86538
1.65984	0.00303	0.00015	0.33197	4.36828	-0.00018	-0.00001	0.87366
1.7025	0.00338	0.00017	0.3405	4.41016	0.00156	0.00008	0.88203
1.74469	0.00289	0.00015	0.34894	4.45234	0.00179	0.00009	0.89047
1.78703	0.00236	0.00012	0.35741	4.49438	0.00158	0.00008	0.89888
1.82906	0.00183	0.00009	0.36581	4.53688	0.0032	0.00016	0.90738
1.87078	-0.00076	-0.00004	0.37416	4.57969	0.00552	0.00028	0.91594
1.91266	-0.00015	-0.00001	0.38253	4.62281	0.00597	0.0003	0.92456
1.955	0.00239	0.00012	0.391	4.66563	0.00618	0.00031	0.93313
1.9975	0.00362	0.00018	0.3995	4.70844	0.00346	0.00018	0.94169
2.03969	0.00148	0.00008	0.40794	4.75125	0.00122	0.00006	0.95025
2.08203	-0.00018	-0.00001	0.41641	4.79391	0.00055	0.00003	0.95878
2.12469	0.00134	0.00007	0.42494	4.83625	0.00003	0	0.96725
2.1675	0.00229	0.00012	0.4335	4.87844	0.00085	0.00004	0.97569
2.21031	0.00221	0.00011	0.44206	4.92063	0.00099	0.00005	0.98413
2.25328	0.00301	0.00015	0.45066	4.96219	-0.00006	0	0.99244
2.29594	0.00281	0.00014	0.45919	5.00359	-0.00069	-0.00004	1.00072
2.33844	0.00046	0.00002	0.46769	5.04547	0.00031	0.00002	1.00909
2.38078	-0.00088	-0.00004	0.47616	5.08797	0.00303	0.00015	1.01759
2.42281	-0.00084	-0.00004	0.48456	5.13063	0.00371	0.00019	1.02613
2.46438	-0.00031	-0.00002	0.49288	5.17297	0.00326	0.00017	1.03459
2.50609	-0.00037	-0.00002	0.50122	5.21516	0.00252	0.00013	1.04303
2.54797	-0.00022	-0.00001	0.50959	5.25766	0.00029	0.00002	1.05153
2.59047	0.00053	0.00003	0.51809	5.30031	0.00044	0.00002	1.06006
2.63281	0.00126	0.00006	0.52656	5.34297	0.00162	0.00008	1.06859
2.67516	0.0017	0.00009	0.53503	5.38609	0.0023	0.00012	1.07722

Extension (mm)	Load (N)	Compressive stress (MPa)	Compressive strain (mm/mm)	Extension (mm)	Load (N)	Compressive stress (MPa)	Compressive strain (mm/mm)
5.42891	0.00268	0.00014	1.08578	8.13547	0.00182	0.00009	1.62709
5.47125	0.00046	0.00002	1.09425	8.17766	0.00084	0.00004	1.63553
5.51344	-0.00003	0	1.10269	8.22031	0.00217	0.00011	1.64406
5.55531	-0.00063	-0.00003	1.11106	8.26266	0.00427	0.00022	1.65253
5.59688	-0.002	-0.0001	1.11937	8.305	0.00381	0.00019	1.661
5.63828	-0.00057	-0.00003	1.12766	8.3475	0.00322	0.00016	1.6695
5.68031	0.00176	0.00009	1.13606	8.39	0.0028	0.00014	1.678
5.72281	0.00205	0.0001	1.14456	8.43234	0.00273	0.00014	1.68647
5.76516	0.00105	0.00005	1.15303	8.47453	0.0036	0.00018	1.69491
5.8075	0.00115	0.00006	1.1615	8.51734	0.00441	0.00022	1.70347
5.85	0.00246	0.00013	1.17	8.56016	0.00467	0.00024	1.71203
5.89266	0.00304	0.00015	1.17853	8.6025	0.00368	0.00019	1.7205
5.93531	0.00235	0.00012	1.18706	8.64484	0.00163	0.00009	1.72897
5.97813	0.00167	0.00009	1.19563	8.68719	-0.0003	-0.00002	1.73744
6.02063	0.00199	0.0001	1.20413	8.72891	-0.00041	-0.00002	1.74578
6.06297	0.00289	0.00015	1.21259	8.77063	0.00026	0.00001	1.75412
6.10547	0.00317	0.00016	1.22109	8.81281	0.00136	0.00007	1.76256
6.14781	0.003	0.00015	1.22956	8.85516	0.00159	0.00008	1.77103
6.19016	0.00176	0.00009	1.23803	8.8975	0.00256	0.00013	1.7795
6.23172	0.00071	0.00004	1.24634	8.93984	0.00413	0.00021	1.78797
6.27359	0.00058	0.00003	1.25472	8.98266	0.00379	0.00019	1.79653
6.31578	0.00082	0.00004	1.26316	9.02547	0.00411	0.00021	1.80509
6.35813	0.00312	0.00016	1.27163	9.06781	0.0041	0.00021	1.81356
6.40047	0.00037	0.00019	1.28009	9.11016	0.00338	0.00017	1.82203
6.44266	0.00258	0.00013	1.28853	9.15297	0.00307	0.00016	1.83059
6.48453	0.00301	0.00015	1.29691	9.19547	0.00332	0.00017	1.83909
6.52672	0.00334	0.00017	1.30534	9.23766	0.00622	0.00032	1.84753
6.56938	0.00449	0.00023	1.31388	9.28	0.00595	0.0003	1.856
6.6125	0.00508	0.00026	1.3225	9.32219	0.00355	0.00018	1.86444
6.65562	0.0046	0.00023	1.33113	9.36375	0.00197	0.0001	1.87275
6.69812	0.00221	0.00011	1.33963	9.40563	0.00247	0.00013	1.88113
6.74047	-0.00088	-0.00004	1.34809	9.44781	0.0037	0.00019	1.88956
6.78281	0.00075	0.00004	1.35656	9.49031	0.00386	0.0002	1.89806
6.82469	0.00261	0.00013	1.36494	9.53266	0.00415	0.00021	1.90653
6.86625	0.00087	0.00004	1.37325	9.57531	0.00435	0.00022	1.91506
6.90813	0.00039	0.00002	1.38163	9.61797	0.00326	0.00017	1.92359
6.95078	0.00331	0.00017	1.39016	9.66047	0.00341	0.00017	1.93209
6.99312	0.00655	0.00033	1.39863	9.70297	0.00456	0.00023	1.94059
7.03531	0.00484	0.00025	1.40706	9.74578	0.00583	0.0003	1.94916
7.07797	0.00291	0.00015	1.41559	9.78875	0.00489	0.00025	1.95775
7.12078	0.00435	0.00022	1.42416	9.83125	0.00199	0.0001	1.96625
7.16344	0.00366	0.00019	1.43269	9.87328	0.00068	0.00003	1.97466
7.20609	0.0021	0.00011	1.44122	9.91531	0.00115	0.00006	1.98306
7.24875	0.00164	0.00008	1.44975	9.95703	0.00209	0.00011	1.99141
7.29125	0.00199	0.0001	1.45825	9.99859	0.00254	0.00013	1.99972
7.33359	0.00204	0.0001	1.46672	10.04047	0.00421	0.00021	2.00809
7.37578	-0.00015	-0.00001	1.47516	10.08313	0.00631	0.00032	2.01662
7.41797	-0.00143	-0.00007	1.48359	10.12562	0.00567	0.00029	2.02513
7.45984	-0.00116	-0.00006	1.49197	10.16797	0.00381	0.00019	2.03359
7.50141	-0.00014	-0.00001	1.50028	10.21047	0.0056	0.00028	2.04209
7.54359	0.00232	0.00012	1.50872	10.25328	0.00618	0.00031	2.05066
7.58594	0.00502	0.00026	1.51719	10.29594	0.0038	0.00019	2.05919
7.62813	0.00609	0.00031	1.52562	10.33875	0.00158	0.00008	2.06775
7.67063	0.00526	0.00027	1.53413	10.38141	0.00171	0.00009	2.07628
7.71313	0.00441	0.00022	1.54263	10.42391	0.00225	0.00011	2.08478
7.75547	0.00374	0.00019	1.55109	10.46641	0.00193	0.0001	2.09328
7.7975	0.00268	0.00014	1.5595	10.50853	0.00406	0.00021	2.10172
7.84	0.0011	0.00006	1.568	10.55031	0.00418	0.00021	2.11006
7.88312	0.00049	0.00002	1.57662	10.59188	0.00185	0.00009	2.11838
7.92578	0.00078	0.00004	1.58516	10.63328	0.00243	0.00012	2.12666
7.96797	0.00098	0.00005	1.59359	10.67531	0.00519	0.00026	2.13506
8.01031	0.00063	0.00003	1.60206	10.71781	0.03464	0.00176	2.14356
8.0525	0.00142	0.00007	1.6105	10.76016	0.22603	0.01151	2.15203
8.09406	0.00306	0.00016	1.61881	10.80281	0.71468	0.0364	2.16056

Extension (mm)	Load (N)	Compressive stress (MPa)	Compressive strain (mm/mm)
10.84562	1.58653	0.0808	2.16913
10.88844	2.80112	0.14266	2.17769
10.93062	4.31485	0.21975	2.18613
10.97297	5.96397	0.30374	2.19459
11.01578	7.27882	0.37071	2.20316
11.05828	8.18394	0.4168	2.21166
11.10031	8.79383	0.44787	2.22006
11.14234	9.47725	0.48267	2.22847
11.18437	10.59932	0.53982	2.23688
11.22609	12.17302	0.61997	2.24522
11.26797	14.09433	0.71782	2.25359
11.31047	16.23116	0.82665	2.26209
11.35297	18.47513	0.94093	2.27059
11.39516	20.80408	1.05954	2.27903
11.4375	23.22751	1.18297	2.2875
11.48016	25.77348	1.31263	2.29603
11.52266	28.46136	1.44953	2.30453
11.565	31.30739	1.59447	2.313
11.60766	34.34226	1.74904	2.32153
11.65047	37.58517	1.9142	2.33009
11.69297	41.02451	2.08936	2.33859
11.73516	44.62528	2.27275	2.34703
11.77734	48.43493	2.46677	2.35547
11.81938	52.53782	2.67573	2.36387
11.86063	56.93398	2.89962	2.37213
11.90234	61.56123	3.13529	2.38047
11.94453	66.41525	3.3825	2.38891
11.98719	71.57847	3.64546	2.39744
12.02953	77.1149	3.92743	2.40591
12.07219	83.08215	4.23134	2.41444
12.115	89.50249	4.55832	2.423
12.15719	96.44513	4.91191	2.43144
12.19922	103.88535	5.29084	2.43984
12.24187	111.83197	5.69556	2.44837
12.28453	120.37619	6.13071	2.45691
12.32687	129.47144	6.59393	2.46537
12.36906	138.98889	7.07865	2.47381
12.41125	148.95959	7.58645	2.48225
12.45297	159.50981	8.12377	2.49059
12.49422	170.70563	8.69397	2.49884
12.53563	182.56931	9.29818	2.50713
12.57781	195.23376	9.94317	2.51556
12.62	208.89072	10.63872	2.524
12.66172	223.50333	11.38293	2.53234
12.70391	239.0289	12.17364	2.54078
12.74625	255.61121	13.01817	2.54925
12.78875	273.38184	13.92322	2.55775
12.83125	292.37604	14.89059	2.56625
12.87359	312.61771	15.92149	2.57472
12.91609	334.18463	17.01988	2.58322
12.95813	357.14807	18.1894	2.59162
12.99984	381.58044	19.43373	2.59997
13.04141	407.45776	20.75165	2.60828
13.08281	434.80969	22.14468	2.61656
13.1075	452.0434	23.02238	2.6215
13.16672	448.65393	22.84976	2.63334
13.17516	454.21698	23.13308	2.63503

Table D.15 Dry Scaffolds Specimen 3 Raw Compression Data

Extension (mm)	Load (N)	Compressive stress (MPa)	Compressive strain (mm/mm)	Extension (mm)	Load (N)	Compressive stress (MPa)	Compressive strain (mm/mm)
0	0.00349	0.00018	0	2.71766	0.00611	0.00031	0.54353
0.00281	0.0049	0.00025	0.00056	2.76047	0.00502	0.00026	0.55209
0.02391	0.02062	0.00105	0.00478	2.80297	0.0036	0.00018	0.56059
0.06578	0.05735	0.00292	0.01316	2.84516	0.00305	0.00016	0.56903
0.11172	0.08143	0.00415	0.02234	2.8875	0.00393	0.0002	0.5775
0.15328	0.06731	0.00343	0.03066	2.93031	0.00483	0.00025	0.58606
0.19625	0.03766	0.00192	0.03925	2.97266	0.00548	0.00028	0.59453
0.24484	0.0231	0.00118	0.04897	3.01484	0.00381	0.00019	0.60297
0.29516	0.02079	0.00106	0.05903	3.05672	0.00333	0.00017	0.61134
0.34375	0.01458	0.00074	0.06875	3.09813	0.00394	0.0002	0.61963
0.39078	0.00419	0.00021	0.07816	3.13984	0.0039	0.0002	0.62797
0.43797	-0.00128	-0.00006	0.08759	3.18219	0.00492	0.00025	0.63644
0.485	-0.00041	-0.00002	0.097	3.22469	0.00441	0.00022	0.64434
0.53156	-0.00032	-0.00002	0.10631	3.26703	0.00434	0.00022	0.65341
0.57688	-0.00225	-0.00011	0.11538	3.30938	0.0058	0.0003	0.66188
0.62141	-0.00294	-0.00015	0.12428	3.35203	0.00612	0.00031	0.67041
0.66609	0.00017	0.00001	0.13322	3.39406	0.0045	0.00023	0.67981
0.71109	0.00411	0.00021	0.14222	3.43578	0.00359	0.00018	0.68716
0.75578	0.00441	0.00022	0.15116	3.47828	0.00469	0.00024	0.69566
0.79984	0.00135	0.00007	0.15997	3.52156	0.00591	0.0003	0.70431
0.84359	0.00258	0.00013	0.16872	3.56422	0.00566	0.00029	0.71284
0.88719	0.00492	0.00025	0.17744	3.60656	0.00612	0.00031	0.72131
0.93062	0.00305	0.00016	0.18612	3.64906	0.00677	0.00034	0.72981
0.97438	0.00252	0.00013	0.19488	3.69141	0.00578	0.00029	0.73828
1.01844	0.00309	0.00016	0.20369	3.73344	0.00411	0.00021	0.74669
1.06203	0.00211	0.00011	0.21241	3.77531	0.00392	0.0002	0.75506
1.10516	0.00011	0.00001	0.22103	3.81766	0.00468	0.00024	0.76353
1.14812	0.00035	0.00002	0.22962	3.86	0.00454	0.00023	0.772
1.19062	0.00307	0.00016	0.23812	3.90219	0.00608	0.00031	0.78044
1.23281	0.00311	0.00016	0.24656	3.94469	0.0061	0.00031	0.78894
1.27484	0.00158	0.00008	0.25497	3.98719	0.00495	0.00025	0.79744
1.31766	0.00316	0.00016	0.26353	4.02969	0.00468	0.00024	0.80594
1.36031	0.00618	0.00031	0.27206	4.07203	0.00489	0.00025	0.81441
1.40266	0.00728	0.00037	0.28053	4.11453	0.00721	0.00037	0.82291
1.44547	0.00717	0.00037	0.28909	4.15734	0.00804	0.00041	0.83147
1.48828	0.00736	0.00037	0.29766	4.19984	0.007	0.00036	0.83997
1.53109	0.00521	0.00027	0.30622	4.24219	0.00682	0.00035	0.84844
1.57375	0.00173	0.00009	0.31475	4.28453	0.00673	0.00034	0.85691
1.61656	0.00143	0.00007	0.32331	4.32625	0.00625	0.00032	0.86525
1.65953	0.0035	0.00018	0.33191	4.3675	0.00504	0.00026	0.8735
1.70234	0.00528	0.00027	0.34047	4.40938	0.00421	0.00021	0.88188
1.74453	0.00513	0.00026	0.34891	4.45219	0.00606	0.00031	0.89044
1.78672	0.00468	0.00024	0.35734	4.495	0.00734	0.00037	0.899
1.82891	0.00507	0.00026	0.36578	4.53734	0.00673	0.00034	0.90747
1.87063	0.00504	0.00026	0.37413	4.58	0.00625	0.00032	0.916
1.91234	0.00381	0.00019	0.38247	4.62281	0.00617	0.00031	0.92456
1.95453	0.0037	0.00019	0.39091	4.66531	0.00496	0.00025	0.93306
1.99703	0.00529	0.00027	0.39941	4.70766	0.00396	0.0002	0.94153
2.03922	0.0055	0.00028	0.40784	4.75062	0.00674	0.00034	0.95012
2.08188	0.00354	0.00018	0.41638	4.79359	0.00876	0.00045	0.95872
2.12469	0.00507	0.00026	0.42494	4.83578	0.00744	0.00038	0.96716
2.1675	0.00723	0.00037	0.4335	4.87797	0.00809	0.00041	0.97559
2.21016	0.00624	0.00032	0.44203	4.91984	0.00845	0.00043	0.98397
2.25297	0.00312	0.00016	0.45059	4.96156	0.00523	0.00027	0.99231
2.29562	0.00184	0.00009	0.45913	5.00313	0.00344	0.00018	1.00063
2.33781	0.00364	0.00019	0.46756	5.04516	0.0056	0.00029	1.00903
2.38016	0.00431	0.00022	0.47603	5.08734	0.00773	0.00039	1.01747
2.42234	0.004	0.0002	0.48447	5.12953	0.00703	0.00036	1.02591
2.46406	0.00496	0.00025	0.49281	5.17203	0.00648	0.00033	1.03441
2.50547	0.00515	0.00026	0.50109	5.215	0.00757	0.00039	1.043
2.54734	0.00502	0.00026	0.50947	5.25828	0.00921	0.00047	1.05166
2.58969	0.00527	0.00027	0.51794	5.30094	0.00848	0.00043	1.06019
2.63219	0.00674	0.00034	0.52644	5.34312	0.00676	0.00034	1.06862
2.67469	0.00744	0.00038	0.53494	5.38594	0.00589	0.0003	1.07719

Extension (mm)	Load (N)	Compressive stress (MPa)	Compressive strain (mm/mm)	Extension (mm)	Load (N)	Compressive stress (MPa)	Compressive strain (mm/mm)
5.42875	0.00626	0.00032	1.08575	8.13516	0.00427	0.00022	1.62703
5.47109	0.0042	0.00021	1.09422	8.17734	0.00762	0.00039	1.63547
5.51328	0.00287	0.00015	1.10266	8.21984	0.00971	0.00049	1.64397
5.555	0.0034	0.00017	1.111	8.26203	0.00889	0.00045	1.65241
5.59625	0.00529	0.00027	1.11925	8.30438	0.00871	0.00044	1.66088
5.63766	0.00556	0.00028	1.12753	8.34719	0.00859	0.00044	1.66944
5.67969	0.00585	0.0003	1.13594	8.38984	0.00748	0.00038	1.67797
5.72219	0.00738	0.00038	1.14444	8.43203	0.006	0.00031	1.68641
5.76453	0.00749	0.00038	1.15291	8.47437	0.00697	0.00036	1.69488
5.80703	0.00687	0.00035	1.16141	8.51703	0.00731	0.00037	1.70341
5.84953	0.00727	0.00037	1.16991	8.55969	0.00607	0.00031	1.71194
5.89203	0.0081	0.00041	1.17841	8.60203	0.00638	0.00033	1.72041
5.93453	0.0058	0.0003	1.18691	8.64437	0.00668	0.00034	1.72888
5.97766	0.0032	0.00016	1.19553	8.68656	0.00596	0.0003	1.73731
6.02062	0.00497	0.00025	1.20412	8.72828	0.00563	0.00029	1.74566
6.06313	0.00706	0.00036	1.21263	8.77016	0.00683	0.00035	1.75403
6.10531	0.00546	0.00028	1.22106	8.81234	0.00834	0.00042	1.76247
6.1475	0.00254	0.00013	1.2295	8.85484	0.00874	0.00044	1.77097
6.18953	0.00266	0.00014	1.23791	8.89734	0.00877	0.00045	1.77947
6.23141	0.0034	0.00017	1.24628	8.93984	0.01017	0.00052	1.78797
6.27344	0.00259	0.00013	1.25469	8.98234	0.0107	0.00054	1.79647
6.31578	0.00305	0.00016	1.26316	9.025	0.00961	0.00049	1.805
6.35797	0.00482	0.00025	1.27159	9.06719	0.00703	0.00036	1.81344
6.40016	0.00687	0.00035	1.28003	9.10953	0.00748	0.00038	1.82191
6.44266	0.00793	0.0004	1.28853	9.1525	0.00895	0.00046	1.8305
6.48438	0.00759	0.00039	1.29688	9.19531	0.00776	0.0004	1.83906
6.52625	0.00676	0.00034	1.30525	9.23766	0.00701	0.00036	1.84753
6.56906	0.00777	0.0004	1.31381	9.27984	0.00701	0.00036	1.85597
6.61203	0.00741	0.00038	1.32241	9.32187	0.00675	0.00034	1.86437
6.655	0.00695	0.00035	1.331	9.36344	0.00542	0.00028	1.87289
6.6975	0.00706	0.00036	1.3395	9.40531	0.00652	0.00033	1.88106
6.74031	0.00753	0.00038	1.34806	9.4475	0.01003	0.00051	1.8895
6.78281	0.00689	0.00035	1.35656	9.48984	0.01086	0.00055	1.89797
6.82469	0.00622	0.00032	1.36494	9.53219	0.00827	0.00042	1.90644
6.86609	0.00678	0.00035	1.37322	9.57484	0.00646	0.00033	1.91497
6.90797	0.00761	0.00039	1.38159	9.61781	0.00936	0.00048	1.92356
6.95047	0.00824	0.00042	1.39009	9.66047	0.01094	0.00056	1.93209
6.99266	0.00928	0.00047	1.39853	9.70266	0.00951	0.00048	1.94053
7.03484	0.01081	0.00055	1.40697	9.74547	0.00873	0.00044	1.94909
7.0775	0.00879	0.00045	1.4155	9.78844	0.00915	0.00047	1.95769
7.12047	0.00634	0.00032	1.42409	9.83078	0.0074	0.00038	1.96616
7.16297	0.00603	0.00031	1.43259	9.87281	0.00534	0.00027	1.97466
7.20547	0.00623	0.00032	1.44109	9.91484	0.00694	0.00035	1.98297
7.24828	0.00663	0.00034	1.44966	9.95656	0.00834	0.00042	1.99131
7.29109	0.00686	0.00035	1.45822	9.99813	0.00813	0.00041	1.99963
7.33328	0.00788	0.0004	1.46666	10.04016	0.00914	0.00047	2.00803
7.37547	0.00535	0.00027	1.47509	10.08266	0.01075	0.00055	2.01653
7.41781	0.00333	0.00017	1.48356	10.12516	0.01265	0.00064	2.02503
7.45953	0.00494	0.00025	1.49191	10.16766	0.04938	0.00251	2.03353
7.50094	0.00574	0.00029	1.50019	10.21031	0.19726	0.01005	2.04206
7.54297	0.00706	0.00036	1.50859	10.25297	0.49889	0.02541	2.05059
7.58578	0.00866	0.00044	1.51716	10.29547	0.95366	0.04857	2.05909
7.62813	0.00833	0.00042	1.52562	10.33813	1.52765	0.0778	2.06763
7.67047	0.00728	0.00037	1.53409	10.38078	2.19395	0.11174	2.07616
7.7125	0.0068	0.00035	1.5425	10.42359	2.90843	0.14813	2.08472
7.75484	0.00701	0.00036	1.55097	10.46594	3.66994	0.18691	2.09319
7.79719	0.00723	0.00037	1.55944	10.50813	4.51327	0.22986	2.10162
7.84	0.00703	0.00036	1.568	10.54984	5.51541	0.2809	2.10997
7.88281	0.0073	0.00037	1.57656	10.59141	6.69626	0.34104	2.11828
7.92547	0.00636	0.00035	1.58509	10.63328	7.88149	0.4014	2.12666
7.96797	0.00736	0.00037	1.59359	10.67562	8.84217	0.45033	2.13512
8.01047	0.00862	0.00044	1.60209	10.71797	9.57255	0.48753	2.14359
8.05234	0.00685	0.00035	1.61047	10.75984	10.12072	0.51544	2.15197
8.09375	0.00463	0.00024	1.61875	10.80219	10.69228	0.54455	2.16044

Extension (mm)	Load (N)	Compressive stress (MPa)	Compressive strain (mm/mm)
10.84531	11.56652	0.58908	2.16906
10.88781	12.7691	0.65032	2.17756
10.93	14.21677	0.72405	2.186
10.9725	15.81088	0.80524	2.1945
11.01531	17.4944	0.89098	2.20306
11.05766	19.25548	0.98067	2.21153
11.09969	21.09995	1.07461	2.21994
11.14172	23.03618	1.17322	2.22834
11.18375	25.0706	1.27683	2.23675
11.22547	27.20315	1.38545	2.24509
11.26734	29.43281	1.499	2.25347
11.30969	31.77008	1.61804	2.26194
11.35203	34.23186	1.74341	2.27041
11.39422	36.83514	1.876	2.27884
11.43688	39.60259	2.01694	2.28738
11.47984	42.55877	2.1675	2.29597
11.5225	45.72979	2.329	2.3045
11.56469	49.10007	2.50065	2.31294
11.60734	52.65464	2.68168	2.32147
11.65016	56.42234	2.87357	2.33003
11.69281	60.41324	3.07682	2.33856
11.735	64.61469	3.2908	2.347
11.77688	69.02387	3.51536	2.35538
11.81859	73.63483	3.75019	2.36372
11.86	78.4874	3.99733	2.372
11.90156	83.58681	4.25704	2.38031
11.94391	88.96931	4.53117	2.38878
11.98641	94.69003	4.82252	2.39728
12.02859	100.73645	5.13047	2.40572
12.07109	107.10078	5.4546	2.41422
12.11391	113.80087	5.79583	2.42278
12.15672	120.91165	6.15798	2.43134
12.19906	128.44466	6.54163	2.43981
12.24172	136.35413	6.94446	2.44834
12.28453	144.69849	7.36943	2.45691
12.32672	153.49159	7.81726	2.46534
12.36859	162.66373	8.2844	2.47372
12.41094	172.26712	8.77349	2.48219
12.4525	182.45827	9.29252	2.4905
12.49359	193.29327	9.84435	2.49872
12.53516	204.78305	10.42951	2.50703
12.57734	217.11099	11.05737	2.51547
12.61938	230.43979	11.7362	2.52387
12.66156	244.71819	12.46339	2.53231
12.70391	259.93341	13.2383	2.54078
12.74641	276.22092	14.06782	2.54928
12.78891	293.73895	14.96	2.55778
12.83109	312.55463	15.91828	2.56622
12.87313	332.65372	16.94191	2.57463
12.91563	354.07156	18.03272	2.58313
12.95781	376.92587	19.19668	2.59156
12.99984	401.33389	20.43977	2.59997
13.04188	427.34116	21.76431	2.60838
13.08297	455.00189	23.17306	2.61659

Table D.16 Dry Scaffolds Specimen 4 Raw Compression Data

Extension (mm)	Load (N)	Compressive stress (MPa)	Compressive strain (mm/mm)	Extension (mm)	Load (N)	Compressive stress (MPa)	Compressive strain (mm/mm)
0	0.00114	0.00006	0	2.71766	0.00631	0.00032	0.54353
0.00281	0.00339	0.00017	0.00056	2.76031	0.00391	0.0002	0.55206
0.02375	0.02039	0.00104	0.00475	2.80266	0.00448	0.00023	0.56053
0.06578	0.05596	0.00285	0.01316	2.84516	0.00434	0.00022	0.56903
0.11172	0.07851	0.004	0.02234	2.88766	0.00207	0.00011	0.57753
0.15313	0.0633	0.00322	0.03063	2.93	0.00407	0.00021	0.586
0.19609	0.03469	0.00177	0.03922	2.97234	0.00512	0.00026	0.59447
0.24484	0.02388	0.00122	0.04897	3.01453	0.00085	0.00004	0.60291
0.29531	0.02417	0.00123	0.05906	3.05641	-0.00039	-0.00002	0.61128
0.34375	0.01474	0.00075	0.06875	3.09797	0.00249	0.00013	0.61959
0.39094	0.00337	0.00017	0.07819	3.13969	0.00351	0.00018	0.62794
0.43797	-0.00201	-0.0001	0.08759	3.18234	0.00356	0.00018	0.63647
0.48516	-0.002	-0.0001	0.09703	3.22463	0.00525	0.00027	0.64494
0.53172	-0.00231	-0.00012	0.10634	3.26688	0.0065	0.00033	0.65338
0.57688	-0.0054	-0.00028	0.11538	3.30922	0.00288	0.00015	0.66184
0.62141	-0.00417	-0.00021	0.12428	3.35187	0.00227	0.00012	0.67037
0.66625	-0.00057	-0.00003	0.13325	3.39422	0.00556	0.00028	0.67884
0.71125	0.00023	0.00001	0.14225	3.43609	0.00562	0.00029	0.68722
0.75563	0.00216	0.00011	0.15112	3.47859	0.00311	0.00016	0.69572
0.79969	0.00272	0.00014	0.15994	3.52141	0.0025	0.00013	0.70428
0.84375	0.00374	0.00019	0.16875	3.56437	0.00425	0.00022	0.71288
0.88734	0.00356	0.00018	0.17747	3.60734	0.00468	0.00024	0.72147
0.93078	0.00172	0.00009	0.18616	3.64969	0.00314	0.00016	0.72994
0.97453	0.00178	0.00009	0.19491	3.69172	0.00375	0.00019	0.73834
1.01859	0.00244	0.00012	0.20372	3.73328	0.0023	0.00012	0.74666
1.06234	-0.00015	-0.00001	0.21247	3.77531	0.00069	0.00004	0.75506
1.10531	-0.00192	-0.0001	0.22106	3.8175	0.00381	0.00019	0.7635
1.14797	-0.00244	-0.00012	0.22959	3.85984	0.00675	0.00034	0.77197
1.19047	-0.0017	-0.00009	0.23809	3.90203	0.00498	0.00025	0.78041
1.23266	-0.00091	-0.00005	0.24653	3.94438	0.00465	0.00024	0.78888
1.275	0.0012	0.00006	0.255	3.98688	0.00458	0.00023	0.79738
1.31766	0.00328	0.00017	0.26353	4.02906	0.00182	0.00009	0.80581
1.36031	0.00473	0.00024	0.27206	4.07156	0.00259	0.00013	0.81431
1.40266	0.00541	0.00028	0.28053	4.11453	0.00695	0.00035	0.82291
1.44547	0.00681	0.00035	0.28909	4.1575	0.0076	0.00039	0.8315
1.48844	0.00824	0.00042	0.29769	4.19969	0.00473	0.00024	0.83994
1.53109	0.00601	0.00031	0.30622	4.24156	0.00303	0.00015	0.84831
1.57375	0.00375	0.00019	0.31475	4.28359	0.00177	0.00009	0.85672
1.61656	0.00271	0.00014	0.32331	4.32594	0.00282	0.00014	0.86519
1.65906	0.00192	0.0001	0.33181	4.36812	0.00517	0.00026	0.87363
1.70203	0.00316	0.00016	0.34041	4.41031	0.00612	0.00031	0.88206
1.74453	0.00292	0.00015	0.34891	4.45266	0.00524	0.00027	0.89053
1.78672	0.00197	0.0001	0.35734	4.495	0.00497	0.00025	0.899
1.82844	-0.00047	-0.00002	0.36569	4.53734	0.00482	0.00025	0.90747
1.87016	-0.00165	-0.00008	0.37403	4.58031	0.00497	0.00025	0.91606
1.91234	0.00146	0.00007	0.38247	4.62313	0.00469	0.00024	0.92463
1.95469	0.00579	0.00029	0.39094	4.66531	0.00443	0.00023	0.93306
1.99703	0.00695	0.00035	0.39941	4.70766	0.00436	0.00022	0.94153
2.03953	0.00562	0.00029	0.40791	4.75031	0.00314	0.00016	0.95006
2.08234	0.00447	0.00023	0.41647	4.79328	0.00249	0.00013	0.95866
2.12531	0.00456	0.00023	0.42506	4.83594	0.00463	0.00024	0.96719
2.16766	0.00349	0.00018	0.43353	4.87828	0.00461	0.00023	0.97566
2.21016	0.00161	0.00008	0.44203	4.91969	0.00255	0.00013	0.98394
2.25328	0.0033	0.00017	0.45066	4.96078	0.00017	0.00001	0.99216
2.29594	0.00363	0.00018	0.45919	5.0025	0.00089	0.00005	1.0005
2.33813	0.00139	0.00007	0.46763	5.04531	0.00425	0.00022	1.00906
2.38016	-0.00018	-0.00001	0.47603	5.08828	0.00616	0.00031	1.01766
2.42219	0.00185	0.00009	0.48444	5.13047	0.00484	0.00025	1.02609
2.46375	0.00229	0.00012	0.49275	5.1725	0.00454	0.00023	1.0345
2.505	0.0006	0.00003	0.501	5.215	0.004	0.0002	1.043
2.54719	0.00078	0.00004	0.50944	5.25766	0.00304	0.00015	1.05153
2.58984	0.00231	0.00012	0.51797	5.30047	0.00341	0.00017	1.06009
2.63234	0.00485	0.00025	0.52647	5.34312	0.00427	0.00022	1.06862
2.675	0.00499	0.00025	0.535	5.38594	0.00482	0.00025	1.07719

Extension (mm)	Load (N)	Compressive stress (MPa)	Compressive strain (mm/mm)
5.42859	0.005	0.00025	1.08572
5.47109	0.00273	0.00014	1.09422
5.51328	0.00304	0.00016	1.10266
5.55516	0.00384	0.0002	1.11103
5.59641	0.0033	0.00017	1.11928
5.63734	0.00397	0.0002	1.12747
5.67938	0.00681	0.00035	1.13588
5.72203	0.00726	0.00037	1.14441
5.76438	0.00624	0.00032	1.15288
5.80703	0.0052	0.00026	1.16141
5.85	0.00692	0.00035	1.17
5.89281	0.00543	0.00028	1.17856
5.93516	0.00199	0.0001	1.18703
5.97766	0.00551	0.00028	1.19553
6.02047	0.00514	0.00026	1.20409
6.06297	0.00362	0.00018	1.21259
6.10531	0.00585	0.0003	1.22106
6.14766	0.00552	0.00028	1.22953
6.18969	0.00167	0.00009	1.23794
6.23141	0.00178	0.00009	1.24628
6.27328	0.00459	0.00023	1.25466
6.31562	0.00544	0.00028	1.26312
6.35766	0.00486	0.00025	1.27153
6.39984	0.00587	0.0003	1.27997
6.44219	0.00491	0.00025	1.28844
6.48422	0.00215	0.00011	1.29684
6.52641	0.00458	0.00023	1.30528
6.56922	0.00759	0.00039	1.31384
6.6125	0.00706	0.00036	1.3225
6.65578	0.00675	0.00034	1.33116
6.69828	0.00524	0.00027	1.33966
6.74047	0.00303	0.00015	1.34809
6.78266	0.00512	0.00026	1.35653
6.82437	0.00579	0.0003	1.36487
6.86578	0.0046	0.00023	1.37316
6.90766	0.00494	0.00025	1.38153
6.95	0.00536	0.00027	1.39
6.99234	0.00813	0.00041	1.39847
7.03484	0.00767	0.00039	1.40697
7.07766	0.00512	0.00026	1.41553
7.12031	0.00606	0.00031	1.42406
7.16297	0.00466	0.00024	1.43259
7.20547	0.00149	0.00008	1.44109
7.24828	0.00342	0.00017	1.44966
7.29078	0.0058	0.0003	1.45816
7.33297	0.00493	0.00025	1.46659
7.37531	0.0033	0.00017	1.47506
7.41766	0.00409	0.00021	1.48353
7.45969	0.00715	0.00036	1.49194
7.50156	0.0068	0.00035	1.50031
7.54375	0.00614	0.00031	1.50875
7.58625	0.00827	0.00042	1.51725
7.62859	0.00831	0.00042	1.52572
7.67078	0.00637	0.00032	1.53416
7.71281	0.00483	0.00025	1.54256
7.75484	0.00529	0.00027	1.55097
7.79703	0.00727	0.00037	1.55941
7.83969	0.00787	0.0004	1.56794
7.88266	0.00533	0.00027	1.57653
7.92531	0.00397	0.0002	1.58506
7.9675	0.00396	0.0002	1.5935
8.00984	0.00449	0.00023	1.60197
8.05203	0.00466	0.00024	1.61041
8.09375	0.00354	0.00018	1.61875

Extension (mm)	Load (N)	Compressive stress (MPa)	Compressive strain (mm/mm)
8.13516	0.00422	0.00021	1.62703
8.17719	0.00507	0.00026	1.63544
8.21953	0.00485	0.00025	1.64391
8.26203	0.00716	0.00036	1.65241
8.30469	0.00748	0.00038	1.66094
8.3475	0.00561	0.00029	1.6695
8.39	0.00359	0.00018	1.678
8.43234	0.0039	0.0002	1.68647
8.47453	0.00443	0.00023	1.69491
8.51719	0.0044	0.00022	1.70344
8.55953	0.00422	0.00021	1.71191
8.60203	0.0048	0.00024	1.72041
8.64453	0.00305	0.00016	1.72891
8.68656	0.00161	0.00008	1.73731
8.72828	0.0025	0.00013	1.74586
8.77031	0.00398	0.0002	1.75406
8.8125	0.00399	0.0002	1.7625
8.85484	0.00495	0.00025	1.77097
8.89688	0.00669	0.00034	1.77938
8.93922	0.00654	0.00033	1.78784
8.98203	0.0073	0.00037	1.79641
9.025	0.0079	0.0004	1.805
9.0675	0.00709	0.00036	1.8135
9.11016	0.00298	0.00015	1.82203
9.15281	0.00281	0.00014	1.83056
9.19547	0.0034	0.00017	1.83909
9.23781	0.00243	0.00012	1.84756
9.27984	0.00328	0.00017	1.85597
9.32156	0.00545	0.00028	1.86431
9.36297	0.00327	0.00017	1.87259
9.40484	0.00383	0.0002	1.88097
9.44719	0.00802	0.00041	1.88944
9.48953	0.0092	0.00047	1.89791
9.53219	0.00891	0.00045	1.90644
9.575	0.00854	0.00043	1.915
9.61781	0.00797	0.00041	1.92356
9.66016	0.00559	0.00028	1.93203
9.70266	0.00547	0.00028	1.94053
9.74547	0.00796	0.00041	1.94909
9.78828	0.00671	0.00034	1.95766
9.83078	0.0055	0.00028	1.96616
9.87297	0.00586	0.0003	1.97459
9.91484	0.00608	0.00031	1.98297
9.95656	0.00611	0.00031	1.99131
9.99828	0.00493	0.00025	1.99966
10.04016	0.00649	0.00033	2.00803
10.08266	0.00595	0.0003	2.01653
10.12516	0.0057	0.00029	2.02503
10.16766	0.04644	0.00237	2.03353
10.21016	0.18831	0.00959	2.04203
10.25281	0.56149	0.0286	2.05056
10.29531	1.27573	0.06497	2.05906
10.33813	2.36879	0.12064	2.06763
10.38094	3.80982	0.19403	2.07619
10.42344	5.5096	0.2806	2.08469
10.46578	7.13662	0.36346	2.09316
10.50813	8.331	0.42429	2.10162
10.54984	9.1208	0.46452	2.10997
10.59141	9.64498	0.49121	2.11828
10.63281	10.35119	0.52718	2.12656
10.675	11.46769	0.58404	2.135
10.71734	12.94135	0.6591	2.14347
10.75953	14.74544	0.75098	2.15191
10.80188	16.8089	0.85607	2.16038

Extension (mm)	Load (N)	Compressive stress (MPa)	Compressive strain (mm/mm)
10.84484	19.02025	0.96869	2.16897
10.8875	21.30664	1.08514	2.1775
10.92969	23.63795	1.20387	2.18594
10.97234	25.9896	1.32364	2.19447
11.01516	28.39837	1.44632	2.20303
11.05766	30.88005	1.57271	2.21153
11.09953	33.44511	1.70335	2.21991
11.14156	36.11368	1.83925	2.22831
11.18359	38.89737	1.98103	2.23672
11.22547	41.79602	2.12865	2.24509
11.26734	44.80234	2.28176	2.25347
11.30953	47.9259	2.44085	2.26191
11.35203	51.21958	2.60859	2.27041
11.39406	54.70134	2.78592	2.27881
11.43656	58.36162	2.97233	2.28731
11.47938	62.21656	3.16866	2.29588
11.52203	66.28561	3.3759	2.30441
11.56437	70.54805	3.59298	2.31288
11.60687	74.98784	3.8191	2.32137
11.64953	79.62549	4.05529	2.32991
11.69203	84.46833	4.30194	2.33841
11.73438	89.50186	4.55829	2.34687
11.77672	94.72953	4.82454	2.35534
11.81859	100.14928	5.10056	2.36372
11.86	105.76311	5.38647	2.372
11.90156	111.5918	5.68332	2.38031
11.94391	117.7119	5.99502	2.38878
11.98609	124.14478	6.32264	2.39722
12.02813	130.87589	6.66545	2.40563
12.07094	137.91554	7.02398	2.41419
12.11391	145.31133	7.40064	2.42278
12.15656	153.12538	7.79861	2.43131
12.19875	161.29836	8.21486	2.43975
12.24125	169.79974	8.64783	2.44825
12.28406	178.78223	9.1053	2.45681
12.32625	188.31354	9.59073	2.46525
12.36828	198.35661	10.10222	2.47366
12.41047	208.91579	10.63999	2.48209
12.45203	220.08673	11.20893	2.49041
12.49328	231.9142	11.81129	2.49866
12.535	244.40761	12.44758	2.507
12.57719	257.74649	13.12692	2.51544
12.61922	272.10654	13.85827	2.52384
12.66125	287.43784	14.63909	2.53225
12.70359	303.74167	15.46944	2.54072
12.74594	321.15527	16.3563	2.54919
12.78797	339.82367	17.30708	2.55759
12.83031	359.83475	18.32623	2.56606
12.87297	381.34155	19.42157	2.57459
12.91563	404.52728	20.60241	2.58313
12.95781	429.36453	21.86736	2.59156
12.99109	450.37894	22.93761	2.59822

APPENDIX E: STEP-BY-STEP PROTOCOL

Scaffold Fabrication

1. Ultra Epsom medium grain premium salt was milled in a 550mL Eisco Labs porcelain mortar and pestle
2. Sifted salt through American Educational screen sieves set and collected the salt particles between mesh sizes 60 and 230 in a plastic tupperware
3. Milled Resomer ester-terminated 85 lactide: 15 glycolide PLGA with a molecular weight of 190,000-240,000 g/mol in a 550mL Eisco Labs porcelain mortar and pestle
4. Sifted PLGA through American Educational screen sieves set and collected the salt particles between mesh sizes 60 and 230 in a separate plastic tupperware
5. Used a scale to measure out 0.8g of salt and 0.2g of PLGA and vortexed the powders together in a 10mL conical
6. Carefully poured the gram of salt and PLGA powder into a 5mm Type KB Precision die
7. Pressed the salt and PLGA firmly within the die using a 1kN press
8. Removed the pressed pellet from the die and placed it on the gas foaming chamber scaffold shelf. Six pressed pellets went on the shelf at a time
9. Sealed the gas foaming chamber and connected the quick-disconnect tubing and the pressure transducer
10. Making sure the release valve was closed, the 800psi carbon dioxide tank was opened, flooding the gas foaming chamber with carbon dioxide gas
11. Waited 22 hours
12. Connected the National Instruments USB-6002 Multifunction I/O device (DAQ) to a laptop with the National Instruments LabView program created for this project
13. Within the LabView program, set the output voltage range from 2V to 2V, filled in the name of the person running the experiment along with the date, selected a .csv file to export to, and set the current output voltage to 0V
14. Connected the Electronic Positioning System on the Valworx Electric Actuated Stainless Ball Valve to a wall outlet
15. Set the current output voltage to 1.5V
16. Ran the LabView program
17. Disconnected the gas foaming chamber and removed the gas foamed scaffolds from the gas foaming chamber
18. Let the scaffolds soak in deionized water for 24 hours, leaving behind a porous PLGA scaffold

SEM Images of Scaffolds

1. Scaffolds for imaging were placed in a Denton Vacuum Desk IV
2. The pressure in the Denton Vacuum Desk IV was lowered to 100mTorr and the scaffolds were gold sputtered for 60s
3. The pressure in the Denton Vacuum Desk IV was returned to ambient conditions
4. One scaffold was placed onto a locking mechanism in a JEOL JSM-6390 Scanning Electron Microscope (SEM) and the door to the SEM was shut
5. The pressure inside the SEM was lowered to 50 μ Torr
6. The high-voltage cathode in the SEM was turned on, producing an image in the JEOL JSM-6390 software
7. Four pictures were taken of each scaffold: one at 30x magnification centered on the scaffold, one at 100x magnification centered on the scaffold, one at 100x magnification directly to the 100x magnification centered image, and one at 100x magnification directly to the right of the 100x magnification centered image
8. Scalar measurements of pore sizes over 30 μ m were taken of the 100x magnification photos inside the software
9. The 100x magnification images were filtered out using the color threshold settings in Figure 3.7 in Fiji ImageJ. This filter was selected and the number of pixels filtered out was measured
10. An ANOVA was run between the number of filtered pixels between the two scaffold fabrication methods using JMP 12

Cell Culture

1. The biological safety cabinet cell culture was to be performed in was thoroughly cleaned following aseptic procedures
2. 15mL of Cell Applications, Inc. human osteoblast growth medium were pipetted into a T-75 flask
3. 1mL of Cell Applications, Inc. adult human osteoblasts were thawed until only a small pellet of ice remained in a water bath kept at 37°C and then pipetted into the T-75 flask
4. The flask of osteoblasts was rocked back and forth gently to evenly distribute the osteoblasts on the bottom surface of the flask and placed in a humidified incubator maintained at 37°C with 5% carbon dioxide
5. Every other day, the growth medium was aspirated out, the flask washed with 5mL of Dulbecco's Phosphate-Buffered Saline (dPBS), and 15mL of growth media were pipetted back into the flask until 60% confluency was reached
6. Once 60% confluency was reached, the growth medium was aspirated out, the flask washed with 15mL of Dulbecco's Phosphate-Buffered Saline (dPBS), and 30mL of growth media were pipetted back into the flask until 80% confluency was reached

7. Once 80% confluency was reached, the T-75 flask was ready to be expanded
8. For each flask being passed, 2mL of trypsin, 5mL of trypsin inhibitor, 15mL of dPBS, and 8mL of human osteoblast growth medium were placed in the water bath for 15 minutes then sprayed with 70% IPA and brought inside the biological safety cabinet
9. Twenty-five mL of growth medium for each flask being passed to was also placed in the water bath for 15 minutes then sprayed with 70% IPA and brought inside the biological safety cabinet
10. The necessary number of new flasks were placed inside the biological safety cabinet
11. A flask containing osteoblasts had the growth medium aspirated out and was washed in 15mL of dPBS
12. Two mL of trypsin were pipetted into the flask containing osteoblasts and the flask was rocked back and forth until it was deemed that the osteoblasts had sufficiently separated from the bottom of the flask
13. Five mL of trypsin inhibitor and enough human osteoblast growth medium were added to the flask such that 5mL of the total contents of the flask could be passed to each new flask necessary
14. Another 25mL of human osteoblast growth medium were then added to each new flask, and the new flasks were placed into the incubator
15. Growth medium was changed every day until 80% confluency was reached
16. Passage ratios were followed according to Figure 3.11

Cell Freezing

1. Each time a flask needed to be frozen down, a cryovial per flask was obtained and labeled
2. A flask containing osteoblasts had the growth medium aspirated out and was washed in 15mL of dPBS
3. Two mL of trypsin were pipetted into the flask containing osteoblasts and the flask was rocked back and forth until it was deemed that the osteoblasts had sufficiently separated from the bottom of the flask
4. Five mL of trypsin inhibitor and 8mL of growth medium were added to the flask
5. The cell suspension was placed in a 50mL conical and placed in a centrifuge opposite another 50mL conical with 15mL of water
6. The conical was centrifuged in an International Equipment Company model CL CLINICAL centrifuge for 4 minutes at 2,000rpm
7. One mL of freezing medium containing 80% human osteoblast growth medium, 10% dimethyl sulfoxide (DMSO), and 10% fetal bovine serum (FBS) was made per cryovial plus one mL extra
8. The supernatant in the centrifuged conical was aspirated out
9. The pellet of osteoblasts was resuspended in 1mL of freezing medium and mixed gently inside the pipette

10. The freezing medium with osteoblasts was pipetted into a cryovial
11. The cryovials were placed inside a ThermoScientific Mr. Frosty freezing container and left in a -80°C freezer for 24 hours before being transferred to a liquid nitrogen Dewar for long term storage

Cell Counting

1. Each time cells per volume had to be counted, a flask containing osteoblasts had the growth medium aspirated out, was washed in 15mL of dPBS, and had 2mL of trypsin added to it which was gently rocked back and forth until the osteoblasts had sufficiently separated from the flask
2. Five mL of trypsin neutralizing solution was added to the flask
3. A micropipette was used to collect 100µL of the cell suspension which was added to a 2mL collection tube
4. Outside of the biological safety cabinet, 100µL of Trypan Blue was pipetted into the same collection tube and mixed within the micropipette tip
5. The 200µL of Trypan Blue-stained osteoblast suspension was pipetted into a BRAND hemocytometer
6. The hemocytometer was placed under an optical microscope and live (transparent) and dead (blue) cells were counted
7. Reverse calculations were performed to estimate how many viable cells were in the original flask of cells

Growth of Osteoblasts on Scaffolds

1. Once the scaffolds had all been fabricated, 8 of the 9 vials of frozen osteoblasts were plated again following the same steps as the original plating procedure
2. When it was determined the 8 flasks of osteoblasts were one day away from reaching 80% confluency, 25 scaffolds were soaked in 70% ethanol for 10 minutes and washed in dPBS. Then the scaffolds were placed in a 48-well plate, and 1mL of either Cell Applications, Inc. Human Osteoblast Differentiation Medium (ODM), or dPBS in 21 of those wells according to Figure 3.13
3. The 48-well plate was placed in the incubator for 24 hours
4. Following the cell counting procedure, the number of osteoblasts in the flasks were estimated and the volume of ODM needed to create a ratio of one million osteoblasts per 0.2mL was determined
5. The osteoblasts were centrifuged at 2,000rpm for 4 minutes in a 50mL conical, the supernatant was aspirated out, and the necessary amount of ODM was pipetted into the conical
6. The 48-well plate was removed from the incubator, the ODM and dPBS in the wells were aspirated out, and 0.2mL of the ODM with osteoblasts were deposited onto 7 of the

scaffolds 10 times each, being careful about creating bubbles or letting one's arm cross the well plate.

7. The 48-well plate was placed in the incubator for 2 hours
8. The 48-well plate was removed from the incubator and 0.8mL of ODM were added to the 7 osteoblast-containing wells, and 1mL of either ODM or dPBS were added to the rest of the wells according to Figure 3.13
9. ODM and dPBS were changed every 48 hours for what was supposed to be 10 days (terminated at day 6 due to contamination)

Compression Testing

1. A Bluehill 3 program that ran compression tests that terminate at either 450N or when the compression platens get too close together was created to export a .csv file with maximum load, Young's modulus, and the ultimate compressive yield of each scaffold, and the raw data of load over extension
2. The scaffolds were removed from the 48-well plate with tweezers and dried on a paper towel for 10 minutes
3. One scaffold at a time was placed in the center of the bottom compression platen of an Instron 3342 single-column tensile/compression testing machine and the Bluehill 3 program was set to run
4. When testing the scaffolds soaked in ODM or dPBS, the bottom platen would be with a Kimwipe
5. Once all tests were run, the exported data was saved to a flashdrive

Staining

1. On the same day of compression testing, the 9 scaffolds to be stained were washed in their wells with dPBS twice
2. The scaffolds were then left to sit in 70% ethanol for 10 minutes, and then the ethanol was aspirated out
3. Each scaffold was placed in a cryosectioning mold top down that was then filled halfway with optimum cutting temperature gel (OCT gel)
4. Using tweezers, each mold was submerged in liquid nitrogen inside a portable Dewar until the OCT gel was frozen
5. The frozen OCT gel blocks were then stored in a -18°C freezer for 48 hours
6. One at a time an OCT gel block was removed from its mold and glued to a metal die with more OCT gel, which was then placed on a shelf inside a ThermoScientific Cryotome FSE cryostat
7. Once the new OCT gel was also frozen, the die was placed in the main apparatus of the cryostat and a cryostat blade was placed in its holder

8. The cryostat was set to take 60 μ m sections and the blade was moved up against the surface of the OCT gel block such that the blade was parallel to the surface
9. The handle on the cryostat was spun to start taking sections of the OCT gel block
10. Quality sections of the OCT gel block (as in full slices containing the scaffold) were added to a VECTABOND-treated microscope slide by moving the surface of the slide up to the section on the blade and allowing the cryosection to readily adhere to the slide
11. Every once in a while, the blade had to be cleaned with 70% IPA and dried to allow quality sections to be taken again
12. Once 8 slides (intended to be 9 slides but one OCT gel block failed to produce quality cryosections) with 5 quality cryosections were created, a 200mL 1% Alizarin Red S (Sigma Aldrich Model # MFCD00013049) solution was created in a glass staining jar under a fume hood
13. The 8 slides were placed in a staining tray and submerged in the Alizarin Red S solution for 4 minutes
14. The tray was pulled out of the solution and excess Alizarin Red S was shaken off
15. The tray was then briefly dipped (~1s) 20 times in 200mL of acetone, then 20 times in 200mL of a 1:1 solution of acetone and xylene, and then 20 times in 200mL of pure xylene under a fume hood
16. The tray was placed on a folded paper towel in the fume hood and the acetone and xylene were properly disposed of in their corresponding waste containers
17. Images were taken of the stained slides with an Olympus CKX41 inverted microscope with the software QCapture Pro 6 at 4x magnification
18. Five images were taken of each slide, where the images were positioned to capture the most Alizarin Red S staining present in each cryosection and saved to a USB
19. The images were filtered out using the color threshold settings in Figure 3.17 in Fiji ImageJ. This filter was selected and the number of pixels filtered out was measured
20. An ANOVA and a Tukey's post-hoc test were run between the number of filtered pixels between the ODM-soaked scaffolds with osteoblasts, the ODM-soaked scaffolds without osteoblasts, and the dPBS-soaked using JMP 12