Detecting Errors in Generating a Certificate of Analysis

A Senior Project

presented to

the Faculty of the Dairy Science Department

California Polytechnic State University, San Luis Obispo

In Partial Fulfillment

of the Requirements for the Degree

Bachelor of Dairy Science

by

Breanne Harlan

March, 2013

Acknowledgement

I wish to express my greatest gratitude to my manager, Rosa Chen, and supervisor, Jay Hill at Kraft Foods for their support, encouragement, and passion to help me complete this project to my best ability. I would also like to thank Dr. Rafael Jimenez and Dr. Bruce Golden for their help to complete the writing portion of this project. I would also like to acknowledge the lab technician, Martin Kaltov at Kraft Foods, Albany, MN and members of the quality management team at the corporate site of Kraft Foods Group, Inc. for advice on my project I appreciate the love and support of my parents for allowing me to attend California Polytechnic University, San Luis Obispo and be a part of the Dairy Science Department. I am proud and honored to receive the hands on experiences of applying my education to the industry practices used in my internship.

Abstract

Many companies rely on a Certificate of Analysis (COA) to accompany the delivery of their product or material. The COA, required by law, prevents customers from questioning whether a product is safe and ensures manufacturers confirm every product tested passes the Food and Drug Administration's required specifications. Previous to this project, Kraft Foods Springfield copied their test results for each product from their data warehouse software, called Systems, Applications, and Products onto a Word document to create a COA. This was a systematic approach to detect the possible occurrences of error and reduce the time spent on generating a COA. When Kraft Foods Springfield shipped their processed cheese or cream cheese products to a customer, they attached a Certificate of Analysis document. A minimum of forty product codes was gathered, along with documentation of every customer that purchased each product. The Salt, Fat, Moisture, pH, Aerobic Plate Count, Coliform, and Yeast and Mold tests performed on every product determined the characteristic codes, or Master Inspection Characteristics for each material or product produced. This project created a profile to request a COA through the SAP program and reduced the opportunities for error in copying and pasting the results from SAP onto a Word document, creating a more efficient workplace. The objective of this project was to identify and implement the best practice to efficiently create a COA.

Key Words: Certificate of Analysis, SAP, processed cheese

Table of Contents

List of Figures

List of Tables

Introduction

Kraft Foods assigned this project to reduce the opportunities of error in copying and pasting the results from the Systems, Applications, and Products, also known as SAP, system onto a Word document. SAP is a business intelligence ERP (Enterprise Resource Planning) data warehouse software. This project eliminated the use of a Word document for creating a Certificate of Analysis (COA). The COA documents the quality or purity of the material or product. Companies and suppliers use COA documents to affirm that the given quality data is correct for a certain product. The COA document is also a requirement by the Food and Drug Administration (FDA). Previous to this project, Kraft Foods Springfield, a processed cheese plant, copied their test results for each product from their quality software, called SAP, onto a Word document to create a Certificate of Analysis. This brought me to detect the possible occurrences of error and reduce the time spent on generating a Certificate of Analysis. The ultimate goal of this project was to find an efficient way to create an outbound COA for Springfield Underground, a cheese storage facility for Kraft Foods Springfield, to send the COA with the product.

Literature Review

Systems, Applications, and Products (SAP) Data Processing

Systems, Applications, and Products, also known as SAP, is a business intelligence ERP (Enterprise Resource Planning) data warehouse software. According to Nelson (2002), business processes throughout companies are managed using a common database and shared reporting capacity. Catalyst, Inc. (Newtown, PA, USA) is an SAP services company that specializes in implementing ERP software that requires methods of management for the supply chain and distribution. Catalyst, Inc. helps companies integrate their distribution networks with retail, manufacturing, and quality testing for consumer goods. The quality department uses the Catalyst, Inc. service of SAP for logging and monitoring product specifications.

In a food manufacturing setting SAP software manages all-inclusive data from ingredients entering the plant, creating parameters of product test targets, recording test results, product release, as well as shipping. This software also makes traceability of products, ingredients, and supplies very easily accessible. The SAP program integrates business processes across the board, rather than utilizing separate processes for each department or area (Soliman *et al.*, 1998). SAP, although difficult to convert from multiple systems, proves to be a much more efficient software environment that provides access for any computer connected to the network.

SAP, originally developed and marketed in Germany in the late 1980's, has recently spread outside the German borders to replace other core data processing programs (Martin *et al.*, 2000). Many food-processing companies I have interviewed with and spoken about SAP, are just now in the process of converting their separate systems to SAP. SAP has lately become the hot topic for food processors; however, the software has not been exclusive for food-processing companies. Mary Sumner (1999) discusses companies that are using SAP and the problems they have encountered in operating the system. Some of these companies include Monsanto, Anheuser Busch, Boeing, Ralston Purina, and Emerson Electric. Kraft Foods Group, Inc. (Northfield, IL) investigated SAP integration for the company in 2010 (Hannon, 2012) and has enabled the company's employees to take 500 million rows of data and trend or graph the data in just a few seconds. Justifications for implementing SAP for Kraft Foods Group, Inc. were the need to integrate multiple software systems to an all-inclusive data system, improving efficiency, data integration, and saving money for the future.

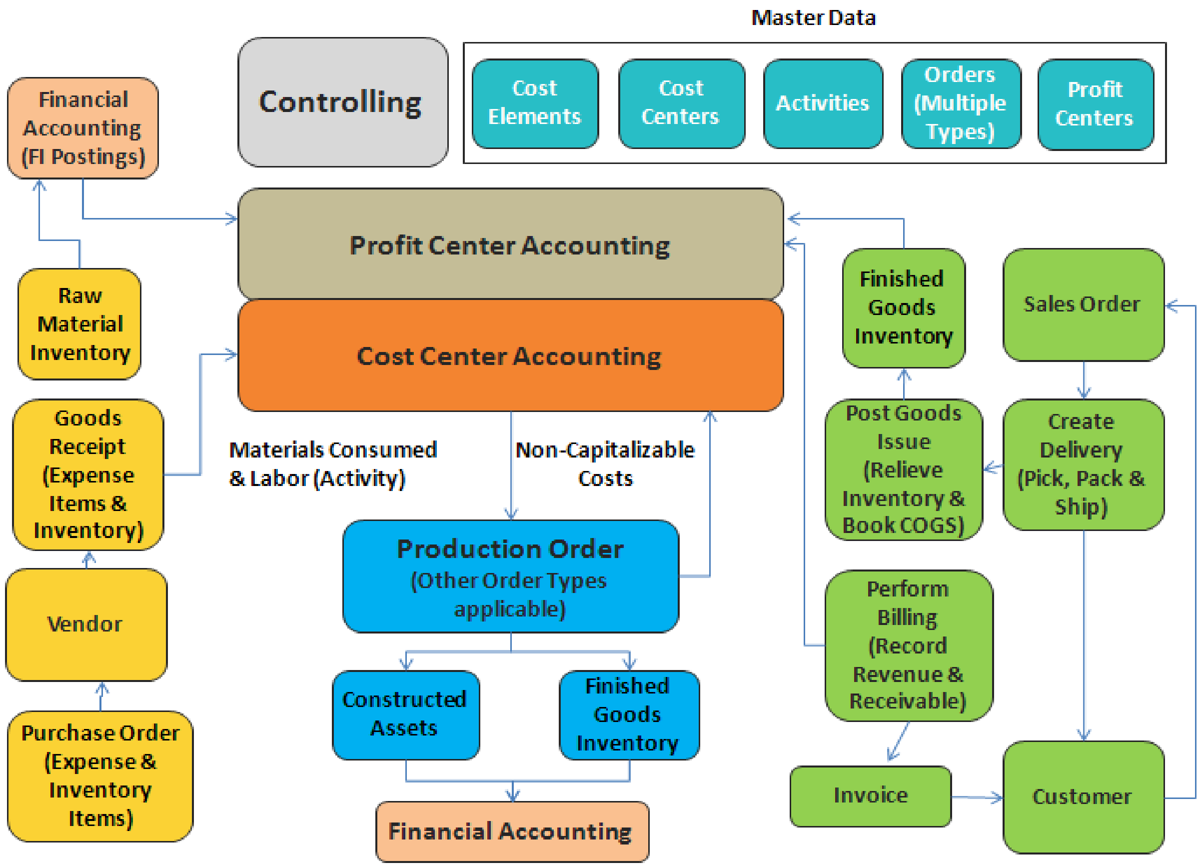


Figure 1. Areas of the SAP program.

Adapted from http://ktnptl1012.files.wordpress.com/2011/12/sap-financial-accounting1.png

Certificate of Analysis (COA)

Many companies rely on a Certificate of Analysis (COA) report from their supplier to accompany their delivery of product, material, or ingredient. A COA is a document issued by a supplier that verifies and attests to the quality or purity of the material or product (Brown, 2008). This document is required to be sent to the customer before the customer's product arrives at their facility (Grocery, 2008). The COA shows evidence that the manufacturer carried out the quality assurance testing. The COA also confirms that the product results were within the stated specifications and acts as an intervention step to prevent highly contaminated products from entering the customer's facility (Bucknavage *et al.*, 2011). Although the Food and Drug Administration only recommends using COAs, some processors identify receiving product as a Critical Control Point (CCP) to "mandate that a COA be received for every lot delivered" (Stier *et al.*, 2010). A CCP falls under the HACCP (Hazard Analysis Critical Control Point) program, a science-based system, which ensures food safety hazard measures are being controlled to result in products safe for consumption. According to Dan Creininl (2005), a writer for Food Quality Magazine, COAs "hold the key to improving quality and productivity." The document prevents customers from questioning a safe product and encourages companies to confirm that every product falls within the specifications, for not only microbiological testing, but also chemistry testing.

Many companies also require from the supplier a "continuing guarantee, which typically is a general agreement that all product shipped to the customer will meet all local, state, and federal requirements, in addition to meeting the customer standards," as stated by Dan Zaura (2005), a writer for Food Quality Magazine. Grading for flavor, melt diameters, and appearance is also conducted, but not required to be on the COA, unless the customer requests for the grading results as well.

The supplier will ensure that the COA provides analytical data for specific elements of the product that may be associated with specific biological, chemical, and physical hazards (Peariso, 2005). The FDA's Code for Federal Regulations, Code 21 states that the customer must make certain that the tests and examinations used to determine if the specifications are met, are appropriate, scientifically valid methods (FDA, 2012). The analytical methods and specifications required on the COA include: visual inspection, organoleptic inspection, chemistry analysis, microbiological analysis, and other scientifically valid methods that may be necessary (Kailasapathy, 2008). For the visual inspection, milk should be free from any extraneous matter that may include machine parts, plastic, packaging particles, insects, or dust, while organoleptic analysis includes smell, appearance, and taste (Kailasapathy, 2008). On the other hand, the chemistry analysis methods of acidity, fat, protein, and moisture are important to the properties and functioning of the product. Microbial analysis is most important for determining the amount of microorganisms in the milk.

At the Springfield, MO plant for Kraft Foods Group, Inc., their analytical methods of the COA can be divided into two sections: the compositional analysis and the microbiological quality analysis. The compositional analysis consists of the methods that test for fat, moisture, protein, and pH, whereas the microbiological analysis is composed of salt, aerobic plate count (APC), and coliforms. The components required to include in a COA is shown in Table 1.

Table 1. The Components Required to Include in a COA

Header	"Certificate of Analysis"
	Name, Address, Phone Number of Supplier
	Name, Address, Phone Number of Manufacturer
	Name of Raw Material or Finished Product
	Category of material; ex: ingredient, finished product
Body	Lot Number and/or Batch Number
	Date of Manufacture
	Product Code or Number
	Expiration Date of Material (if applicable)
	Test Results
	Specifications for each test
	Re-test Data (if applicable)
	Test Names; ex: Fat, on a dry basis
Footer	Certificate of Compliance (quality statement)
	Stability Statement (if applicable); ex: store at 55°F
	Printed Name and Signature of Analysts and Approver
	Page Number

Standard of Identity for Processed Cheese

According to the Standard of Identity (FDA, 2012), processed cheese is defined as the food prepared by comminuting and mixing, with the addition of heat, one or more cheeses of the same or different varieties for the manufacturing with an emulsifying agent into a homogenous plastic mass. Processed cheese is the result of blending several different natural cheeses with emulsifiers, extra salt, and food coloring. There are optional ingredients and emulsifiers that may be added as well. Processed cheese must be heated for no less than thirty seconds at a temperature no less than 150°F (FDA, 2012). This time and temperature is crucial for the pasteurization of the cheese mixture, as well as the reduction of potential pathogens. The moisture content is required to be less than one percent more than the natural cheese, but has to be less than the required 43% (FDA, 2012). In addition, the fat content should be no less than 20%. Optional ingredients of processed cheese foods may include: cream, milk, skim milk, buttermilk, cheese whey solids, anhydrous milk fat, and skim milk cheese (FDA, 2012). The FDA requires that the pH not be adjusted below 5.0 with the use of vinegar, acetic acid, lactic acid, citric acid, and phosphoric acid (Frye *et al.*, 2008). The Standard of Identity sets the majority of the parameters for each component and microbiological analysis included in the COA. Typical composition of various process cheeses is shown in Table 2.

Table 2. Typical Composition of Various Process Cheeses

Product	Water (%)	Fat (%)	Protein (%)	Lactose (%)	Ash (%)
American process cheese	39.2	31.2	22.1	1.6	5.8
American process cheese slices	43.1	24.5	19.7	8.3	4.4
American process cheese spread	47.6	21.2	16.4	8.7	6.0
Swiss process cheese	42.3	25.0	24.9	2.1	5.8
Swiss process cheese food	43.7	24.1	21.9	4.5	5.8

Adapted from Kailasapathy, 2008.

Compositional Analysis

Milk is one of the only food products that contain all the necessary components and nutrients to survive. In the quality assurance laboratories, or off-site laboratories, for dairy processing facilities analytical methods are implemented to measure the content of water (moisture), fat, protein, and acidity (pH) for every batch and every product produced.

As stated previously, the moisture content is defined by Standard of Identity to not exceed more than 43% for pasteurized process cheese and cold pack cheese, no more than 44% for pasteurized process cheese food, and between 44 and 60% moisture for pasteurized process cheese spread (Chandan, 2008). Moisture is included in the COA, one reason being that moisture is defined in the standard of identity. Another reason includes an excess or shortage of water content in the processed cheese product. During the manufacture of processed cheese, water is added to create a smooth and stable emulsion (Marcos, 1993). The addition of water is necessary to achieve the smooth and soft texture of the processed cheese as well as improve the meltability of the product (Gupta & Reuter, 1993). According to Siew Kim Lee (Lee *et al.*, 2004), "water helps in dissolving the calcium chelating salts, hydrating the proteins and dispersing the components." Water is also added to reduce the cost of the product; however, the FDA places a maximum limit on the water content to prevent companies from increasing too much profit. When moisture content is too high, problems due to high addition of water or too much condensate from steam occur, which may cause the cheese mass to remain thin in body, block cheese will not firm up, or the processed cheese will adhere to its foil packaging (Meyer, 1973). However, low moisture content or water added all in one lot can cause a thick, heavy and "pudding-like texture, the texture remains too long to be suitable for cheese spreads and does not cream up enough, block cheese is too firm, or it is possible that the processed cheese body is not homogenous and instead grainy and fatty (Meyer, 1973). Water is useful in decreasing the hardness or firmness of processed cheese (Zuber *et al.*, 1987); however, with high moisture content there is always a problem with microbiological growth. All microorganisms require an abundant supply of water to grow. Water activity is the amount of water available for use, furthermore, the survival of bacteria, yeasts, and molds remain constant at a_w values between 0.069 and 0.83 (Mugnier *et al.*, 1985). Therefore, moisture analysis is one of the most important quality control criteria for finished product goods.

The fat content of processed cheese is defined in the Standard of Identity, as stated above to be not less than 50% fat in dry matter for pasteurized processed cheese, a minimum of 41% fat in dry matter for pasteurized processed cheese food, no less than 20% fat content in pasteurized process cheese spreads, and the fat content in dry matter is not less than 47% in most cold pack cheeses, except Swiss (not less than 43%) and Gruyere (not less than 45%) (FDA, 2012). Milk fat exists in small globules as an emulsion that is surrounded by a phospholipid bilayer of milk components, such as protein and phospholipids. This absorbable membrane stabilizes the fat in a water-in-oil emulsion, preventing the fat from separating. According to Kasipathy Kailasapathy (2008), "milk fat is important in cheese making because it is directly related to the yield of cheese, used to establish the price of milk paid to the farmer, contributes to the flavor of cheese and to the body characteristics of cheeses." Although, fat contributes to the previously stated characteristics, the additives and optional ingredients of processed cheese do no change the fat content, therefore, a product out of specification for fat depends on the fat content of the raw materials. Fat is important to include in the COA because fat has defined specifications in the Standard of Identity for process cheese and it contributes to the texture, flavor, and body that consumers love.

Although the protein content is not defined in the Standard of Identity for process cheese, whole milk contains approximately 3.2% protein (Chandan, 2008). Protein exists in milk as partly in colloidal suspension and partly in solution. Proteins, consisting of both whey and casein, are amino acids that determine the function and structure of the entire suspension in milk. The caseins are separated into four groups, α_{s1}-casein, (β+γ)-casein, α_{s2}-casein, and κ-casein (Kannan, 2012). The individual caseins differ in molecular weight, amino acid composition or sequence, sensitivity to calcium ions, and the physical properties of charge distribution that are separated into individual components by ion-exchange chromatography and electrophoresis. The phosphate groups influence the structure of caseins, initiating binding to calcium through ionic bonds and begin polymerization of the micelle particles (Rook, 1977) that is key to micelle formation. On the other hand, another reaction with protein involves the destabilization of the protein micelle. Sometimes the destabilization of the micelle is desirable, such as the formation of a gel when the pH is reduced, or when κ-casein undergoes proteolysis. Acidification may also be used to fractionate the milk proteins (Kailasapathy, 2008). However, in other cases, the destabilization of the protein micelle is not desirable, such as the aggregation of casein that occurs during the thickening stage of UHT-treated milks and concentrated milks (Kailasapathy, 2008). Changes in the colloidal suspension of the protein can change the texture. Over creaming may cause the body of the cheese to fall apart or break. This colloidal change may result in processed cheese that showed good spreadability after packaging; however, over time the product becomes hard and brittle, removing the water and showing leakage (Meyer, 1973). Protein is important for not only the nutritional value, but also for the consumers who use their product in baking or other ingredients. The structure of the protein plays an important role in the overall structure of the product.

The degree of acidity is measured by pH and plays an important role in processed cheese because the addition of salt affects the acidity or alkalinity of the product. The FDA defines acidity in the Standard of Identity for processed cheese to be no less than 5.0. Professor Bartosz Solowiej (2007), Department of Milk Technology and Hydrocolloids, Agricultural University, Lublin, conducted an experiment to analyze the effect of pH on the rheological properties, as well as meltability. Solowiej observed a trend with a decrease in pH, or increase in acidity, caused a hard and crumbly texture in the processed cheese. However, higher pH processed cheeses are elastic and almost lack structure and rigidity. Because the higher pH caused the texture of the processed cheese to be elastic, the meltability also increased (Solowiej, 2007). All processed cheeses are made within a narrow pH range of 5.2-6.0 (Solowiej, 2007). In addition to the trend in pH, Solowiej found the addition of whey products caused the process cheese products to increase in viscosity and hardness. Along with moisture, pH is also important for the development of high quality cheese. Acidity is crucial in cheese production, because each step is determined by the development of acid (Kailasapathy, 2008). The pH of milk is highly dependent on temperature; furthermore, the pH tends to decrease with increasing temperature. This plays a role in reducing the amount of microorganisms in the product.

Microorganisms thrive in a fairly weak acidic and weak basic environment with a pH ranging from 6.6 to 7.5, making it difficult to control the microbial load of milk and milk products when the pH of raw milk is 6.7 (Tetra Pak, 2003). Therefore, microorganisms can be controlled through pasteurization with high temperatures for a short amount of time. However, if the pH is too high, or above the limit for processed cheese, block cheese will not form its shape and firm up and will stick to the foil packaging (Meyer, 1973). On the other hand, if the pH is too low or the product is too sour, the texture of the cheese may become rough, grainy, and non-homogenous, or even too firm, and after packaging, the good product after time becomes hard and brittle (Meyer, 1973). Process cheese with a bitter or slightly bitter flavor is caused by a low pH value, or even the “presence of sulphuric acid produced by the use of sodium sulphite as a preservative (Meyer, 1973). It is crucial to remain within the clarified pH for not only flavor and functionality, but also reducing the number of microorganisms.

Microbiological Analysis

Erna Melanie DuBois describes milk as “nature’s perfect food,” (DuPuis, 2002) as one liter of milk provides the consumer with a full serving of fat, phosphorus, and riboflavin, a half serving of protein, and one-third serving of thiamine, ascorbic acid and Vitamin A, as well as other vitamins and minerals (Zottola *et al.*, 1993). However, milk is used as a vector for food borne diseases because it can easily become contaminated as milk’s environment provides perfect conditions for growth of microorganisms.

Much of the microorganisms grown in food products have similar patterns and conditions of growth. The growth of microorganisms depends on the availability of carbohydrates and food, acidity and pH, time for growth, temperature, presence of oxygen, and the amount of moisture. These variables can be summed up in a useful acronym, FATTOM, to remember these conditions and patterns of growth. This acronym stands for Food, Acidity, Time, Temperature, Oxygen, and Moisture and was a very helpful study tool for microbiology and dairy processing classes. According to Tetra Pak Solutions (Tetra Pak, 2003), “Micro-organisms occur most abundantly where they find food, moisture, and a temperature suitable for growth. The nutrients available in food products determine the growth of microorganisms. Protein-rich foods, such as milk, can be hazardous because microorganisms thrive on this food source. Processed cheese will have a higher prevalence of food borne pathogens than pasteurized milk products because cheese is a concentrated product (White, 1998). Since the conditions of milk favor the growth of microorganisms, it is inevitable to have a microbial population in a product, not to say that the population cannot be reduced. But, the occurrence of food borne pathogens can be fairly remote if manufacturing procedures and good manufacturing practices. Methods and tests used in the quality laboratories at manufacturing sites test the quality of the product as well as the level of contamination.

The dairy processing industry most commonly uses Coliform Count, Standard Plate Count (SPC), and yeast and mold tests to confirm the product falls with in the FDA's required specifications and is of good quality to ensure the product is safe to sell for consumption.

Coliform bacteria are broadly used as an indicator organism for pasteurization because coliforms are destroyed at the on set of pasteurization. Many bacteria in different generas are in the coliform group; however, the most prevalent in raw milk are *Enterobacter, Escherichia, Citrobacter,* and *Klebsiella* (Richter, 2001). Furthermore, the presence of coliform bacteria often indicates fecal contamination; nonetheless, coliforms can also indicate contamination from the soil and contaminated water. The Coliform Count lab method detects the amount of coliform bacteria in the product; a further analysis test can confirm what type of coliform bacteria is present.

In the Grade "A" Pasteurized Milk Ordinance (PMO), the FDA requires every dairy product not to exceed ten coliforms per milliliter (FDA, 2011), and cheese made from pasteurized milk should contain no traces of coliform bacteria (Khayat *et al.*, 1988). A high coliform count can indicate two main issues. The first may be improper practices of pasteurization, including not fulfilling the requirement of 161°F for fifteen seconds for High Temperature Short Time (HTST) pasteurization. The second may include contamination post-pasteurization often a result of unsanitary product lines. Moreover, the Coliform Count is crucial for determining product safety and is required in every COA.

The standard plate count (SPC) method, also known as aerobic plate count or total viable count, is the most common method used in dairy processing for estimating bacterial populations in dairy products. This method, incubated at 32° ± 1°C for 48 ± 3 hours (Houghtby *et al.*, 1993), estimates the total aerobic population of microorganisms in most types of dairy products for determining sources of contamination and the quality of the finished product (Laird, 2004) and is the referenced method in the PMO for evaluating the quality of both raw and pasteurized milk. The PMO also defines a bacterial limit for SPC as not to exceed more than 200,000 colony-forming units (CFUs) per milliliter (FDA, 2011).

Normally, the shelf life of pasteurized milk is entirely dependent on the quality of raw milk. Furthermore, the shelf life can be drastically reduced with post pasteurization. Tetra Pak Solutions (Tetra Pak, 2003) states that ordinary pasteurized milk should have a shelf life of 8-10 days if stored at 5-7°C in a sealed package. Almost all tests are designed to predict shelf life, as they are based on the detection of psychotropic bacteria. These microorganisms usually cause a majority of problems with shelf life. There is no test that perfectly determines shelf life; however the SPC method in conjunction with the preliminary incubation (PI) count is recommended (White, 1998).

Dairy processors, including Kraft Foods Group, Inc. often use the Petrifilm™ aerobic count (PAC) procedure, an alternative method of the expensive traditional standard plate count, for rapid detection of microorganisms. This procedure, developed by 3M™, advanced the manual process of traditional SPC methods. The PAC method, incubated at 32°C ± 1°C for 48 ± 3 hours (Houghtby *et al.*, 1993), utilizes a ready-made culture medium composed in plastic films and contains indicator dye built in a grid (Houghtby *et al.*, 1993) for accurate and prompt identification of the number of colonies present. A survey, conducted at University of Sao Paulo, Brazil, concluded that there is no significant difference between the traditional agar methods. According to 3M™'s website (3M, 2013), a survey of 274 processing plants that converted to Petrifilm™ plates from traditional agar methods found an average labor savings of 45% and an average technician efficiency of 80%. These two surveys provided manufacturers with assurance for efficiency in time and relative ease of use. This procedure is also applied in the dairy microbiological course at universities, such as California Polytechnic University in San Luis Obispo.

Although the SPC method is widely used and referenced in the PMO, the method does not give a complete picture of what types of bacteria or potential pathogens may grow in the product to determine completely the issues in sanitary practices. Therefore, a follow up test, PI count, of milk in combined with SPC will show more conclusive data of the bacterial content in the dairy product. Despite its shortcomings, the standard plate count, or aerobic plate count, remains a standard reference for estimating aerobic bacterial populations for many regulatory programs, including the FDA's PMO, and is compared to many new methods.

Fungi are a group of microorganisms that are found throughout nature in plants and animals and are divided into yeasts and molds. Differentiating between yeasts and molds can be difficult because of their manner in reproduction (Walstra *et al.,* 2006). Yeasts are single cell organisms used in most alcoholic and bread fermentations; however, yeasts are very undesirable in dairy products. Molds consist of "threadlike strands of cells called hyphae" (Tetra Pak, 2003) and reproduce asexually as well as by spores. The spores are very resistant to heat treatment and are small and light enough to be spread by air movements. Both yeasts and molds are common for causing spoilage in dairy products (Schmidt, 2008); therefore, yeasts and molds are helpful in estimating the end of shelf life (Deibel *et al.*, 2008). According to László Varga (2007), "through microbiological activity alone, approximately one-fourth of the world's food supply is lost." This is a shocking number and gives reason why biologists are constantly trying to develop methods for reducing, if not eliminating, the microbial population.

Materials and Methods

Initial Model

When Kraft Foods Springfield ships a product to a customer, they attach a COA document. Kraft Foods in Springfield, MO integrated their software to SAP in 2009, therefore, much of the logistics and issues prior to my project were still being configured. Only one plant previous to Springfield had gone through the process of generating an outbound COA through SAP. All of the quality results from the microbiological and component tests performed in the lab, as well as from the product line, are displayed in the Catalyst, Inc. service of SAP. Before my project, the Quality department at the Springfield, MO plant manually created a COA by copying results from Catalyst SAP to a Microsoft® Word document. A template of a COA was created; however, this was not enough, as it created opportunities of error and an inefficient use of time. This process took about nine minutes to create a COA.

Diagnosis Process

I received direction for this project at the onset of my internship, on June 18, 2013. Having no background or knowledge on the SAP program, I initiated my first steps by consulting the IT (Information Technology) technician to gain some direction of where to begin.

On July, 25, 2012, I participated in a conference call with the Kraft Foods Quality Management Team at the corporate site to determine what was done in the past, including what methods worked and did not work in efficiently creating an outbound Certificate of Analysis.

After holding the conference calls with the Quality Management Team, I received a job aid, an instruction manual on how to proceed in developing an outbound COA through SAP.

While I was configuring the problems of being granted access for SAP and waiting on answers from the corporate quality team, I received training on each test in the quality laboratory at the Kraft Foods Springfield plant that was performed to incorporate into the COA. After receiving some background on SAP and the tests used on the COA, I spent my time diagnosing the job aid and seeking direction from the instructions.

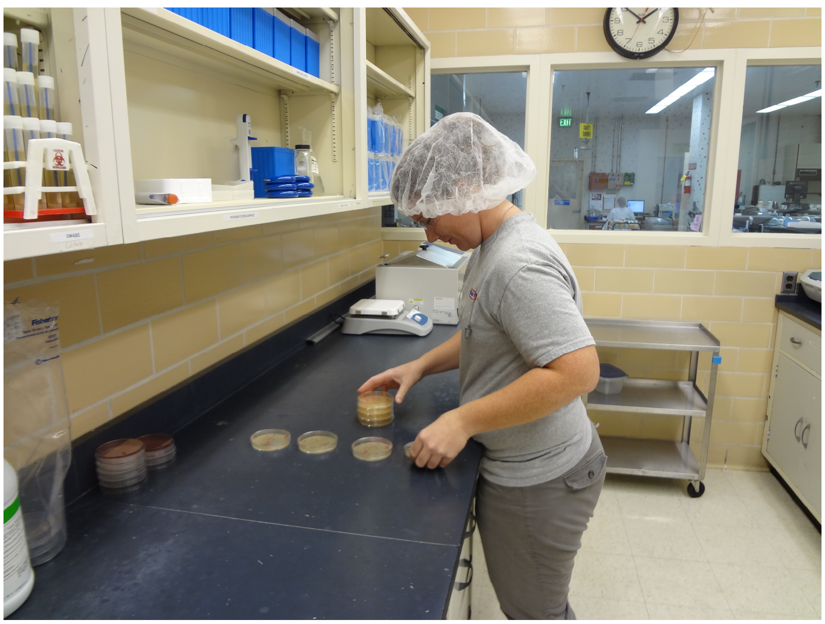


Figure 2. Training in the Microbiology laboratory.

The project required creating a certificate profile, which is the initial action in SAP for generating an outbound COA. This profile assigns the quality tests performed to each product produced in the plant and gives SAP a mode of action when generating a COA. Without a certificate profile, SAP would not be able to associate the test results with its products for a COA.

Validating Changes

After following the job aid from the corporate quality team, I identified commands in SAP that led me to each screen of creating a certificate profile.   The certificate profile required me to enter Master Inspection Characteristic (MIC) codes, which is the SAP term for the tests performed on each product, such as fat (on a dry basis). MICs are created in SAP to simplify the names of each test to a single code. MICs were determined by the material used for each salt, fat, moisture, pH, APC, yeast and mold, and coliform tests performed on every product. However, in the search bubble, there were multiple MIC codes for each test, and I was unable to determine which code to use for the certificate profile characteristics. For example, when adding a MIC for pH, I found five different code numbers with the same description. The correct MIC for each test was determined by consulting both the quality management team at the corporate office of Kraft Foods Group, Inc., as well as the lab technician at the Albany processing plant. The lab technician advised me to use the same MICs that he used, because the methods of each test at both Albany and Springfield are the same.

Results and Discussion

Initial Model

The previous process of using a template in Microsoft® Word to create a COA was chosen by the management at the Springfield processing plant because, at the time, SAP was just introduced. The template in Microsoft® Word was the easiest way to create a COA, when the SAP program was still being configured. My time as an intern gave the Springfield Quality department the opportunity to become more efficient in creating a COA.

Diagnosis Process

After meeting with the IT technician, I discovered that as an intern I was denied access to the program. The process of granting access took close to a week because I needed higher authoritative clearance to make changes to the profiles in the SAP program.

When I received the job aid from the quality management, I found that it was very vague. At the time I did not know where to find the product codes, MICs, as well as the customer codes, and I did not know the definition of these three items. The job aid did not give background on the product codes, MICs, or customer codes. The job aid also did not give reasoning or definitions for each step. Although, the job aid was ambiguous in some areas, the job aid provided commands to use when creating a certificate profile. Table 3 below refers to all of the codes used in my project.

Table 3. SAP Commands used to generate an outbound COA

Command	Definition
QC01	Create Certificate Profile
QC02	Change Certificate Profile
QC15	Create Certificate Profile Assignment
MSC2N	Update Batch
YMTIF_COA	Quality Certificate for Batch
QC17	Search for Customers in Certificate Profile Assignment
SP01	Spool Request

Validating Changes

After talking with employees in the processing plant, I was informed that another Kraft Foods plant, in Albany, MN, had completed this procedure of creating product profiles in SAP to request an outbound COA; however, the profile did not include the customer information. I initiated a conference call and live screen chat with the laboratory technician at the Albany plant with my manager, as well as my project supervisor. This conference call helped solve the problem of having too many MIC codes for each test. Though the technician at the Albany, MN processing plant did not need to enter profiles for every customer, he provided the command, "QC15" screen that inputted the customer data into the certificate profile.

A minimum of forty product codes, thirteen MICs were gathered, and over two hundred customer codes were gathered to input in the certificate profile for each product using the job aid generated by the corporate quality team. After multiple conference calls to the corporate quality team, the corporate job aid, and the laboratory technician at the Albany, MN processing plant, I reached a breaking point and was able to generate a COA. However, the COA only showed This project created a profile to request a COA through the SAP program. As a result of this project, generating the COA was done completely on the SAP program, instead of the previous method of copying results on the SAP program to a Word document.

Towards the end of my internship, I received the opportunity to travel to Northfield, IL and present my project to employees at the corporate office. Before my internship ended, I was not able to fully complete the generation of a COA. I encountered problems where only fat and moisture were appearing on the COA, and all of the other tests were missing. After I left Kraft Foods to go back to school, I handed the project over to my supervisor to complete. After staying in contact with my supervisor for questions I needed answered for this project, my supervisor discovered the problem of SAP only generating results from two tests. In the process of creating a certificate profile and entering product codes, MICs, and customer codes, four "Profile Characteristics Data" were created. These four profiles were interfering with each other's commands. My supervisor blocked all but one profile and made sure all but one of the characteristic profiles needed were entered and a complete COA was generated. In the end, the process of creating a COA completely through SAP only took about two minutes.

The project is not fully ready to be released to Springfield Underground so that the COA would be sent with the product.

Towards the end of my internship, Kraft Foods provided me, along with the other summer interns, the opportunity to travel to the corporate office in Northfield, IL and present my project and learning experiences to the Kraft Foods leadership group.

Figure 3. Project presentation at the corporate office.

At the end of my internship, I created my version of the corporate job aid, which included comments on why each step was performed. Appendix 1 and Appendix 2 refers to the job aids I created.

Conclusion

At the end of my internship, I was still having issues with SAP generating results from two tests (fat and moisture). However, after following through with my supervisor, I discovered that he was able to fix these issues. Kraft Foods' processed cheese plant in Springfield, MO was able to generate a complete COA as a result of this project. The process of creating a COA through SAP reduced the time spent on making a COA from nine minutes to two minutes. This project opened opportunities for the processing plant to gain efficiency in creating a COA, as well as reduce errors made to create a COA. This project is very important to processing plants across the world, as many food companies are converting their business systems to SAP. SAP is a universal program that applies to all industries; therefore, this project can be applied to any company that requires a COA for distribution of product.

References

3M. 2013. 3M petrifilm aerobic count plates. Accessed Feb. 24, 2013. http://solutions.3m.com/wps/portal/3M/en_US/Microbiology/FoodSafety/product-information/product-catalog/?PC_7_RJH9U523003DC023S7P92O3O87000000_nid=J5W756N61Vbe29BDXSBJ7Fgl.

Brown, P. 2008. Certificates of analysis. In Nutraceauticals World. Nov. 2008. Accessed Jan. 30, 2013. http://www.bcit.ca/files/appliedresearch/pdf/certificates_of_analysis_nov_08_nw.pdf.

Bucknavage, M. W., and C. N. Cutter. 2011. Food safety interventions: reducing risk from farm to table. Food Safety Magazine. Accessed Jan. 20, 2013. http://www.foodsafetymagazine.com/magazine-archive1/februarymarch-2011/food-safety-interventions-reducing-risk-from-farm-to-table/.

Chandan, R. C. 2008. Dairy processing and quality assurance: an overview. Pages 1-40 in Dairy Processing & Quality Assurance. R. C. Chandan, A. Kilara, and N. P. Shah, ed. Wiley-Blackwell, Ames, Iowa, USA.

Creininl, D. 2005. Certificates of analysis confirm control. Food Quality Magazine. Accessed Jan. 20, 2013. http://www.foodquality.com/details/article/878233/Certificates_of_Analysis_Confirm_Control.html

Diebel, C. T., and R. H. Diebel. 2008. Laboratory analysis of milk and dairy products. Pages 529-574 in Dairy Processing & Quality Assurance. R. C. Chandan, A. Kilara, and N. P. Shah, ed. Wiley-Blackwell, Ames, Iowa, USA.

DuPuis, E. M. 2002. Nature's Perfect Food: How Milk Became America's Drink. New York University, New York, New York, USA.

FDA. 2011. Grade "A" Pasteurized Milk Ordinance. Accessed Feb. 15, 2013. http://www.fda.gov/downloads/Food/FoodSafety/Product-SpecificInformation/MilkSafety/NationalConferenceonInterstateMilkShipmentsNCIMSModelDocuments/UCM291757.pdf

FDA. 2012. Code of Federal Regulations Title 21. Accessed Feb. 21, 2013. http://www.accessdata.fda.gov/scripts/cdrh/cfdocs/cfcfr/cfrsearch.cfm?fr=133.169.

Frye, C. P., and Arun Kilara. 2008. Regulations for product standards and labeling. Pages 145-168 in Dairy Processing & Quality Assurance. R. C. Chandan, A. Kilara, and N. P. Shah, ed. Wiley-Blackwell, Ames, Iowa, USA.

Grocery Manufacturer's Association. 2008. Food supply chain handbook. Accessed Feb. 23, 2013. http://www.gmaonline.org/downloads/technical-guidance-and-tools/GMA_SupplyChain2.pdf

Gupta, V. K., and W. Reuter. 1993. Firmness and melting quality of processed cheese foods with added whey protein concentrates. Lait, 73: 381-388.

Hannon, D. 2012. Kraft Foods' recipe for business intelligence success. *InsiderPROFILES*. April-June Issue.

Houghtby, G. A., L. J. Maturin, and E. K. Koenig. 1993. Microbiological count methods. Pages 213- 246 in Standard Methods for the Examination of Dairy Products. R. T. Marshall, ed. American Public Health Association, Washington, D.C., USA.

Kailasapathy, K. 2008. Chemical composition, physical, and functional properties of milk and milk ingredients. Pages 75-104 in Dairy Processing & Quality Assurance. R. C. Chandan, A. Kilara, and N. P. Shah, ed. Wiley-Blackwell, Ames, Iowa, USA.

Kannan, A., N. Hettiarachchy, K. Sato, and M. Marshall. 2012. Food proteins and peptides: structure-function relationship. Pages 49-93 in Food Proteins and Peptides: Chemistry, Functionality, Interactions, and Commercialization. Taylor & Francis Group, Boca Raton, FL, USA.

Khayat, F. A., J. C. Bruhn, and G.H. Richardson. 1988. A survey of coliforms and *Staphylococcus aureus* in cheese using impedimetric and plate count methods. J. Food Protect. 51:53-55.

Laird, D. T., S. A. Gambrel-Lenarz, F. M. Scher, T. E. Graham, and R. Reddy. 2004. Microbiological count methods. Pages 153-186 in Standard Methods for the Examination of Dairy Products. 17th ed. American Public Health Association, Washington, D.C., USA.

Lee, S. K., S. Anema, and H. Klostermeyer. 2004. The influence of moisture content on the rheological properties of processed cheese spreads. Int. J. Food Sci. Tech. doi: 10.1111/j.1365-2621.2004.00842.x.

Marcos, A. 1993. Water activity in cheese in relation to composition, stability, and safety. Pages 439-470 in Cheese: Chemistry, Physics, and Microbiology. P. F. Fox, ed. Chapman & Hall, London, UK.

Martin, I., and Y. Cheung. 2000. SAP and business process re-engineering. BPMJ. 6:113-121.

Meyer, A. 1973. Processed Cheese Manufacture. Food Trade Press Ltd., London, UK.

Mugnier, J., and G. Jung. 1985. Survival of bacteria and fungi in relation to water activity and the solvent properties of water in biopolymer gas. Appl. Environ. Microbiol. 50 (1): 108-114.

Nelson, R. 2002. The AMCIS 2002 workshops and panels V: teaching ERP and business processes using SAP software. Communications of the Associated Information Systems. Vol. 9, Article 24.

Peariso, D. 2005. From aseptic to zip pouch: basic packaging material & line control. Accessed Jan. 20, 2013. http://www.foodsafetymagazine.com/magazine-archive1/februarymarch-2005/from-aseptic-to-zip-pouch-basic-packaging-material-line-control/.

Phadungath, C. 2005. Casein micelle structure: a concise review. Songklanakarin J. Sci. Tech. 27 (1): 201-212.

Richter, R. L., and E. R. Vedamuthu. 2001. Milk and milk products. Pages 483-496 in Compendium of Methods for the Microbiological Examination of Foods. 4th ed. American Public Health Association, Washington, D.C., USA.

Schmidt, R. H. 2008. Microbiological considerations related to dairy processing. Pages 105-143 in Dairy Processing & Quality Assurance. R. C. Chandan, A. Kilara, and N. P. Shah, ed. Wiley-Blackwell, Ames, Iowa, USA.

Soliman, F., M. A. Youssef. 1998. The role of SAP software in business process re-engineering. Int. J. Oper. Prod. Man. 18: 886-895.

Solowiej, B. 2007. Effect of pH on rheological properties and meltability of processed cheese analogs with whey products. Pol. J. Food Nutr. Sci. 57: 125-128.

Stier, R. F., and J. G. Surak. 2010. Verification: making sure your food safety management system is working. Accessed Jan. 20, 2013. http://www.foodsafetymagazine.com/magazine-archive1/aprilmay-2010/verification-making-sure-your-food-safety-management-system-is-working/.

Sumner, M. 1999. Critical Success Factors in Enterprise Wide Information Management Systems Projects. Pages 297-303 in Proceedings of the 1999 ACM SIGCPR Conference on Computer Personnel Research. SIGCPR ’99. Jayesh Prasad, ed. ACM, New York, New York, USA.

Tetra Pak. 2003. Dairy Processing Handbook. 2nd ed.Tetra Pak Processing Systems, Lund, Sweden.

Varga, L. 2007. Microbiological quality of commercial dairy products. Communicating Current Research and Educational Topics and Trends in Applied Microbiol. pp. 487-494.

Walstra, P., J. T. M. Wouters, and T. J. Geurts. 2006. Dairy Science and Technology. Taylor & Francis Group, Boca Raton, FL, USA.

White, C. 1998. Testing milk and milk products. Pages 431-460 in Applied Dairy Microbiology. E. H. Marth and J. L. Steele, ed. Marcel Dekker, New York, New York, USA.

Zaura, Dan. 2005. Effective supplier: how well do you know your vendors. Accessed Jan. 20, 2013. http://www.foodquality.com/details/article/878265/Effective_Supplier_Programs.html?tzcheck=1.

Zottola, E. A., and L. B. Smith. 1993. Growth and survival of undesirable bacteria in cheese. Pages 471-492 in Cheese: Chemistry, Physics, and Microbiology. P. F. Fox, ed. Chapman & Hall, London, UK.

Zuber, F., D. Megard, and J. C. Cheftel. 1987. Continuous emulsification and gelation of dairy ingredients by HTST extrusion cooking: production of processed cheese. Int. J. Food Sci. Tech. 22 (6): 607-626.

Appendices

Appendix 1

Catalyst

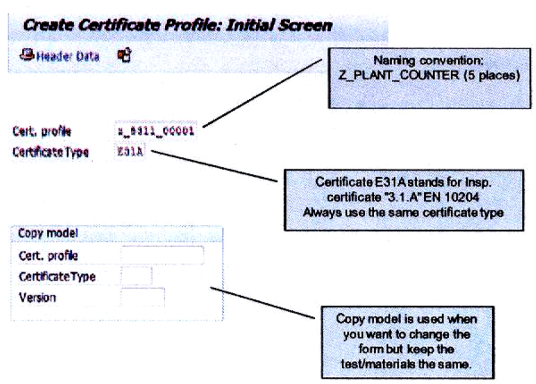
Global Business Services

Outbound COA
Quick Reference Guide

1

Catalyst

QC01
Create Certificate Profile Initial Screen

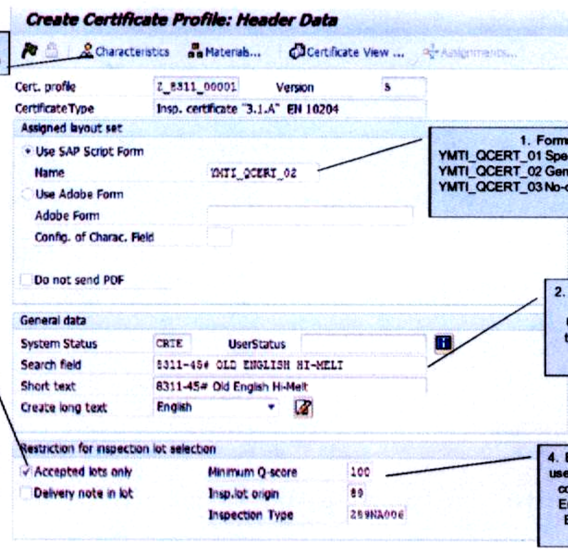


- After the profile is already created, if you use QC01 again, it will create another profile that you don't need…QC02 is the screen you use to change the profile

2

Catalyst

QC01
Create Certificate Profile Header Data Screen



5. Click next on Characteristics icon

1. Forms available:
YMTI_QCERT_01 Specific to Heinz
YMTI_QCERT_02 Generic COA
YMTI_QCERT_03 No-disclaimer/free text COA

2. Enter a meaningful Search field like Material description
Use the same text in the Short text, use this same search field every time

3. Make sure that this is marked unless user wants to include both Accepted and Rejected lots

4. Enter the Minimum Q-score to 100; if users want to include accepted lots with comments, this field can be set to 80
Enter the inspection lot origin as '89'
Enter Inspection Type 'Z89NA006'

3

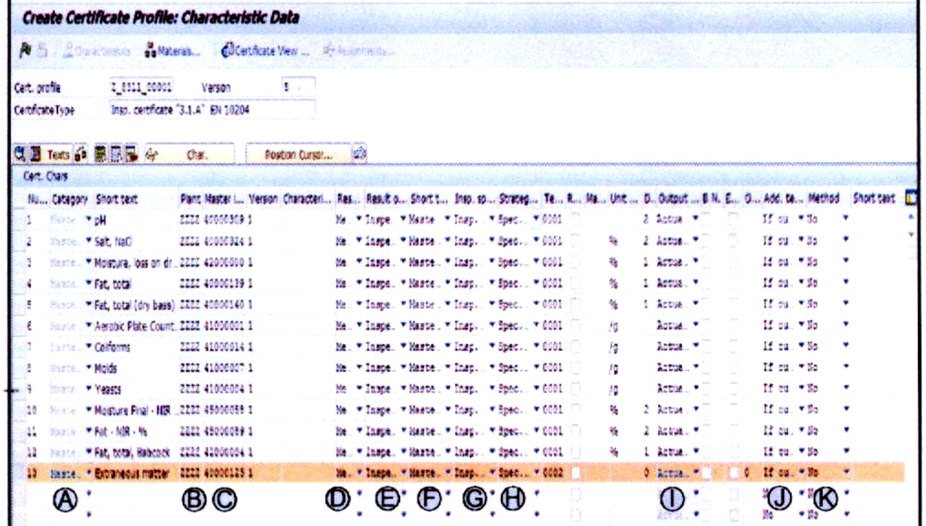
Catalyst

- Notes for the slide before:
  - Don't worry about the profile having the 8311-45# Old English Hi-Melt on the search field…because you enter the materials in the profile in the "Materials" tab, it will generate a COA for all of the materials…not just the OE Hi-Melt
  - Click on the Characteristics tab to proceed

4

Catalyst

QC01
Certificate Profile Characteristics Data Screen



Notes on this in next slide

5

Catalyst

Drop down menus for Characteristic Data

A. Master Inspection Characteristic

B. ZZZZ

C. Tests used..

Test Used for Profile	Master Iinspection Characteristic #
pH	40000309
Salt, NaCl	40000324
Mositure, loss on drying, NIR	42000000
Fat, total	40000139
Fat, total (dry basis)	40000140
Aerobic Plate Count/TVC	41000001
Coliforms	41000014
Molds	41000007
Yeasts	41000004
Moisture Final - NIR - %	45000058
Fat - NIR - %	45000089
Fat, total, Babcock	42000004
Extraneous Matter	40000125

D. Mean value of the sample/inspection point

E. Inspection Result

F. Master Inspection Characteristic

G. Insp. specifications from QM

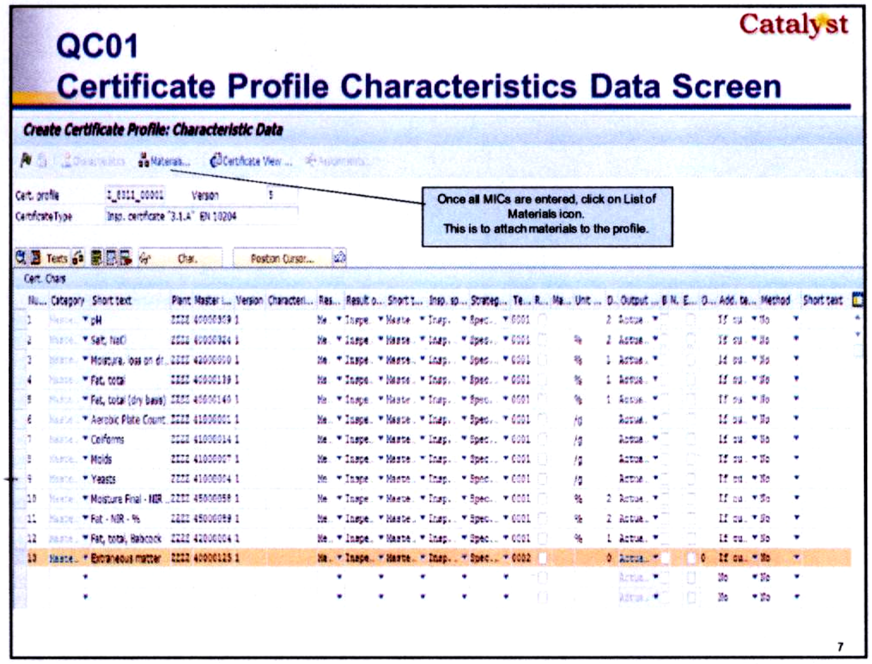
H. Spec. limits from insp. spec. or batch

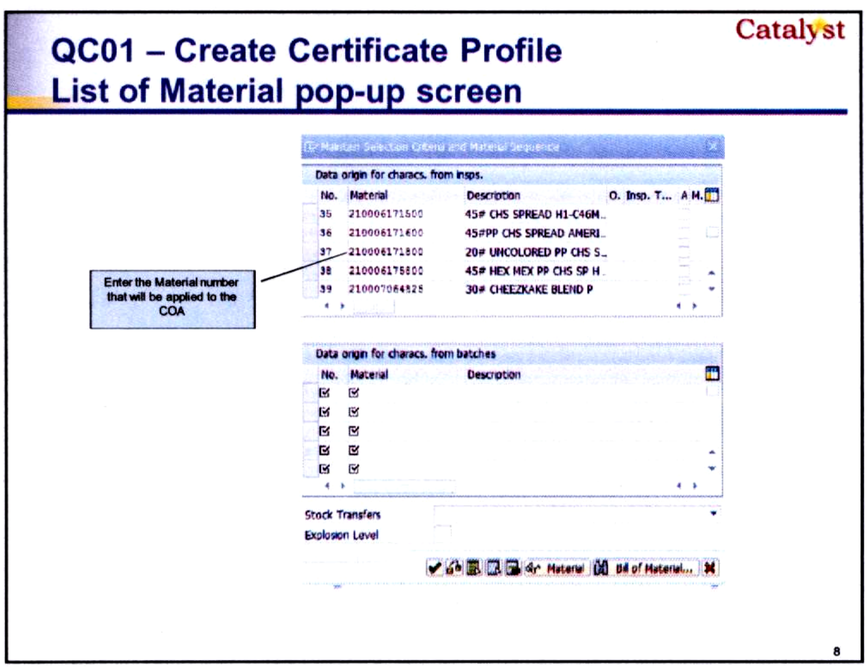
I. Actual value

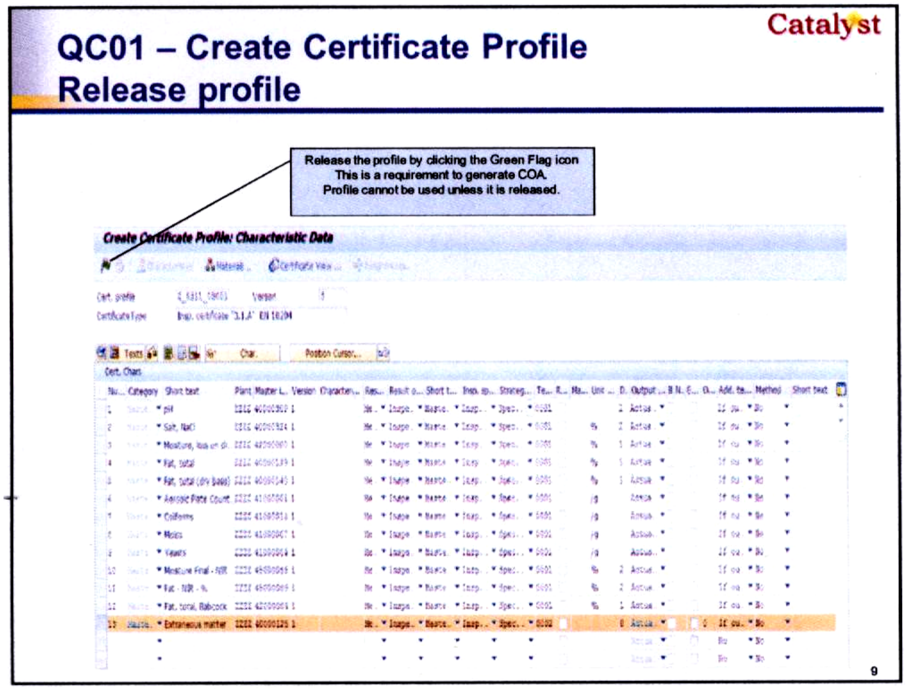
J. If outside of specification

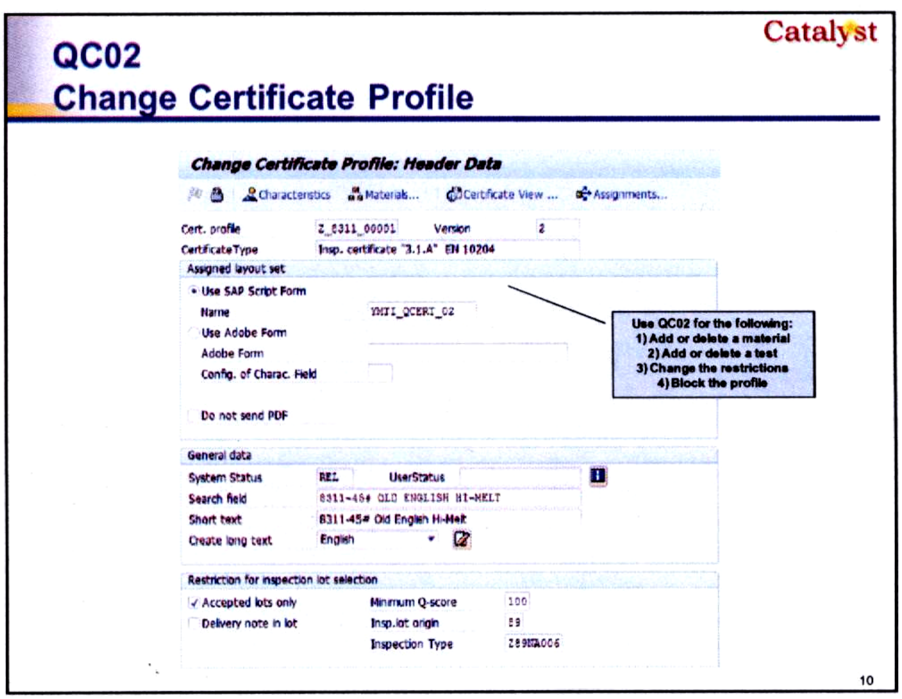
K. No

6


Catalyst
QC01
Certificate Profile Characteristics Data Screen
Create Certificate Profile: Characteristic Data
Once all MICs are entered, click on List of Materials icon.
This is to attach materials to the profile.
Cert. profile
Certificate Type
Version
Texts
Char.
Position Cursor...
Cert. Chars
Category
Short text
pH
Salt, NaCl
Fat, total
Aerobic Plate Count
Coliforms
Molds
Yeasts
Moisture Final - NIR
Fat - NIR - %
Fat, total, Babcock
Extraneous matter
Method
Short text
7

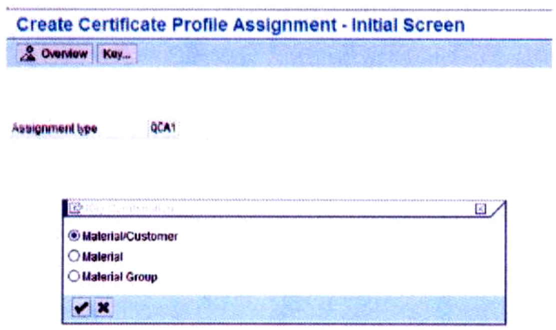

Catalyst
QC01 – Create Certificate Profile
List of Material pop-up screen
Data origin for characs. from insps.
No.
Material
Description
35 210006171500 45# CHS SPREAD H1-C46M..
36 210006171600 45#PP CHS SPREAD AMERI..
37 210006171800 20# UNCOLORED PP CHS S..
38 210006175800 45# HEX MEX PP CHS SP H..
39 210007064825 30# CHEEZKAKE BLEND P
Enter the Material number that will be applied to the COA
Data origin for characs. from batches
No.
Material
Description
Stock Transfers
Explosion Level
Material
Bill of Material...
8


QC01 – Create Certificate Profile
Release profile
Catalyst
Release the profile by clicking the Green Flag icon
This is a requirement to generate COA.
Profile cannot be used unless it is released.
Create Certificate Profile: Characteristic Data
9


QC02
Change Certificate Profile
Catalyst
Change Certificate Profile: Header Data
Characteristics
Materials...
Certificate View ...
Assignments...
Cert. profile
Z_8311_00001
Version
2
Certificate Type
Insp. certificate "3.1.A" EN 10204
Assigned layout set
Use SAP Script Form
Name
YMTI_QCERT_02
Use Adobe Form
Adobe Form
Config. of Charac. Field
Do not send PDF
General data
System Status
REL
UserStatus
Search field
8311-45# OLD ENGLISH HI-MELT
Short text
8311-45# Old English Hi-Melt
Create long text
English
Restriction for inspection lot selection
Accepted lots only
Minimum Q-score
100
Delivery note in lot
Insp.lot origin
89
Inspection Type
Use QC02 for the following:
1) Add or delete a material
2) Add or delete a test
3) Change the restrictions
4) Block the profile
10

Catalyst

QC15
Create Certificate Profile Assignment

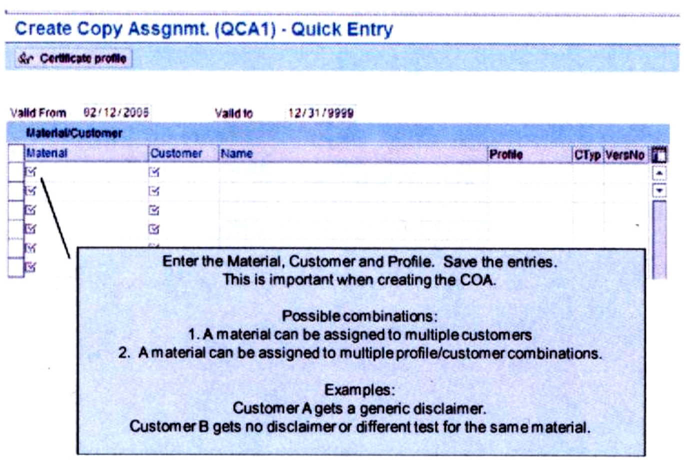


This is to assign the profile to the customers

11

Catalyst

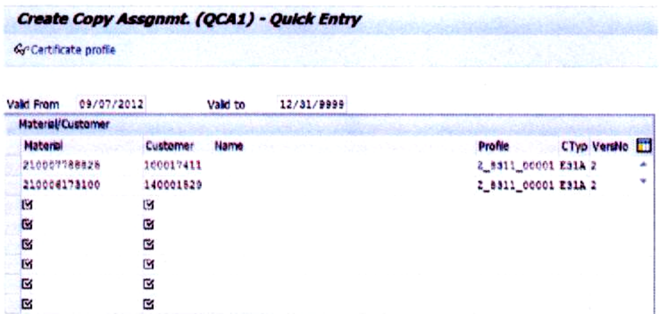
QC15
Create Certificate Profile Assignment, cont'd



12

Catalyst

QC15
Create Certificate Profile Assignment



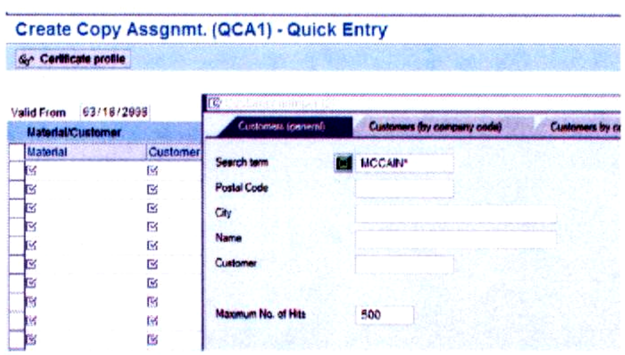
A profile assignment has to be created for every material a customer purchases…

- **you can look up the customer by clicking the bubble in the customer column and enter in the search field**
- **Click Save to assign the material and customers to the profile**

13

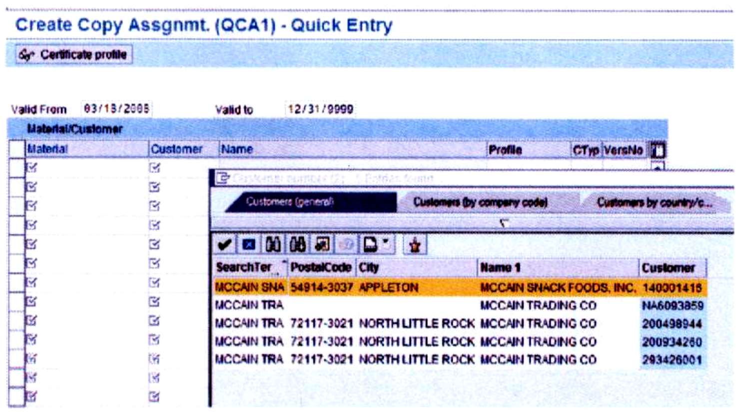
Catalyst

QC15
How to find customer

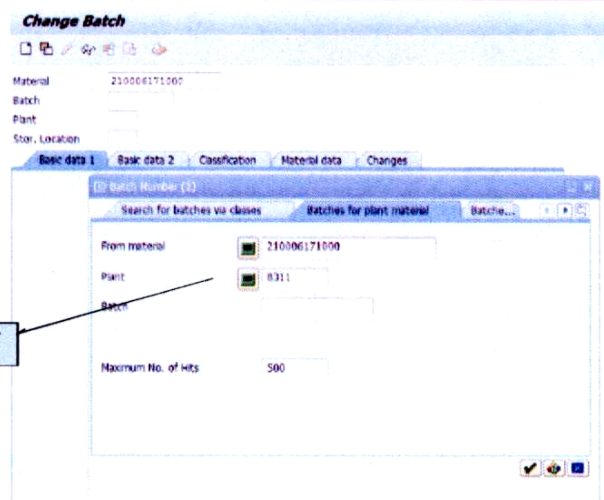


14

QC15
How to find customer, cont'd



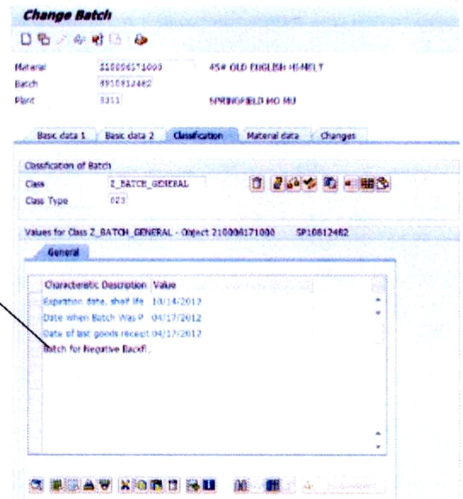
MSC2N - Update Batch



Search for the batch number under the selected material.

Catalyst

MSC2N - Update Batch



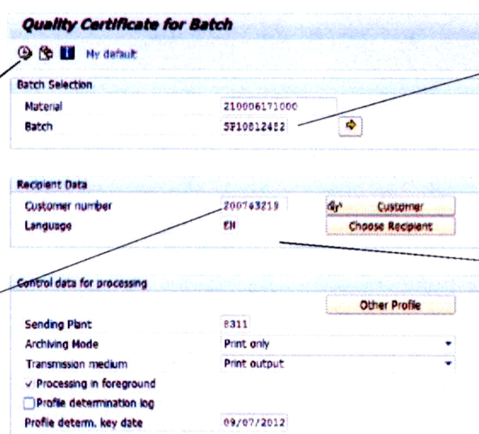
Ensure any data relating to the batch is updated: Expiration date, Date Produced, for example. This will be pulled into the COA.

17

Catalyst

Type in YMTIF_COA
Quality Certificate for Batch and hit enter

2. Once completed, click on Execute icon.



Click on the bubble to find the specific batch number for the material

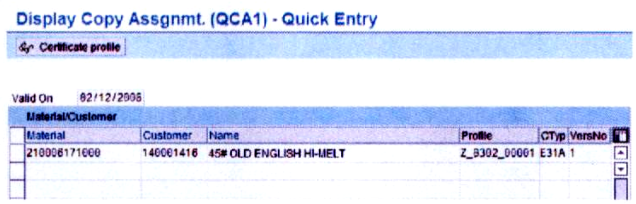
Look up customer in two ways: Excel Spreadsheet or follow the next screen

1. Enter the following:
Material
Batch
Customer number
Sending Plant

18

Create a new session under QC17 to search for customers

Catalyst



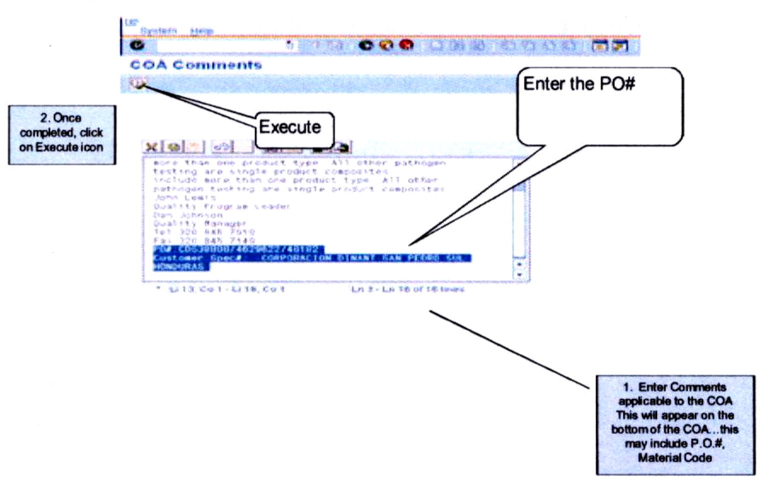
After creating the certificate profile assignment under screen QC15, QC17 will display the materials you input in.

- **You can search by customer or by material**
- **This was used to look up which materials were added to the customers, but it can be search vice-versa**
- **Copy the customer and paste into the customer info on the YMTIF_COA screen.**

19

YMTIF_COA
Pop-up screen

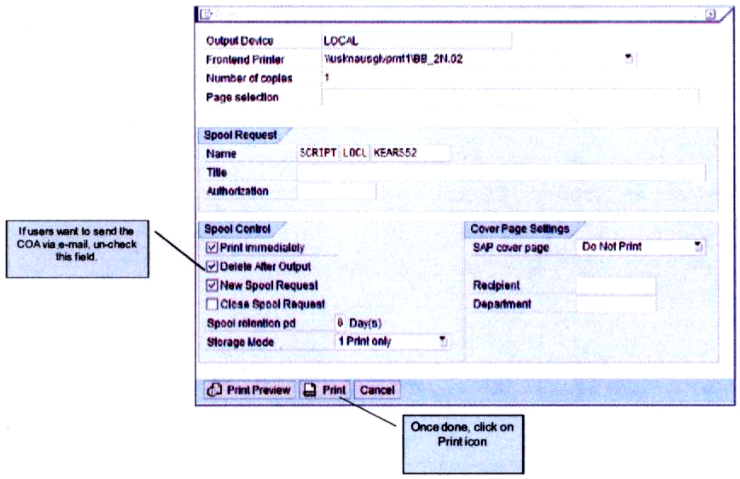
Catalyst



20

YMTIF_COA
Print pop-up screen

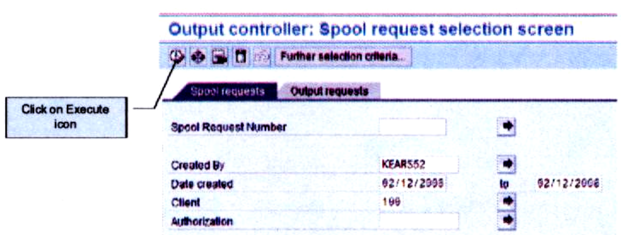
Catalyst



21

SP01
Initial screen

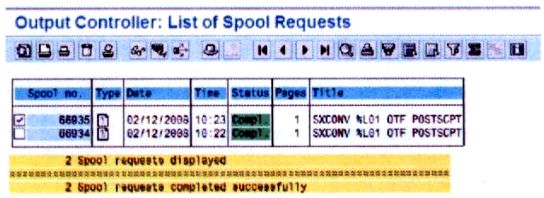
Catalyst



22

Catalyst

SP01
Main screen

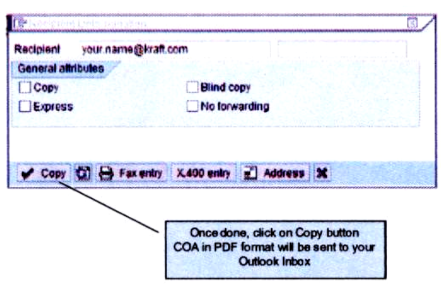


Go to the main menu: Spool Request -> Forward -> Send using SAP Office

23

Catalyst

SP01
SAP Office pop-up screen

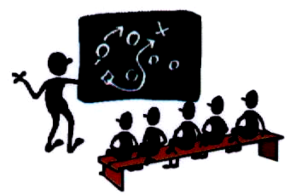


24

Catalyst

Demonstration

- Show the actual COA
- Take note of the Comment section
- Take note of the Digital Signature and Date
- Verify the COA is sent to Outlook Inbox



25

Catalyst

Global Business Services

Job Aid adjusted to Springfield's information by:

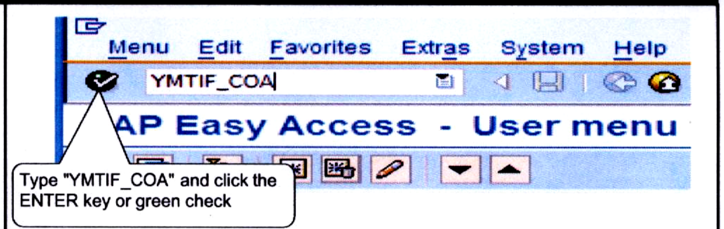
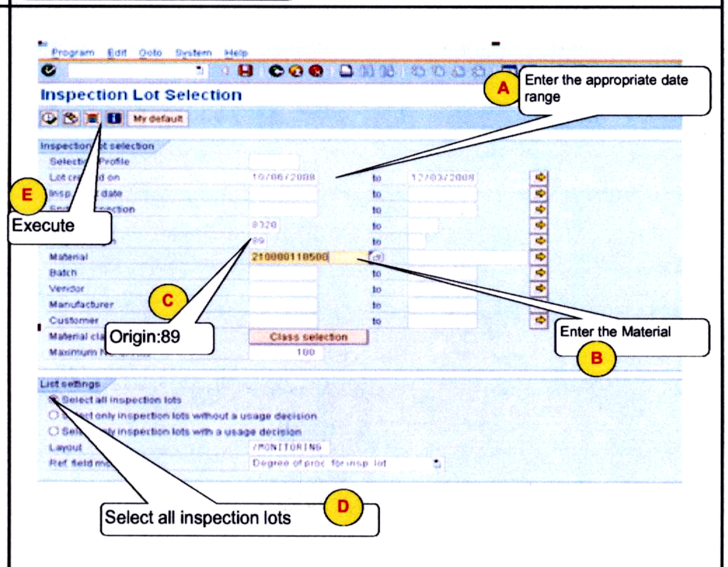
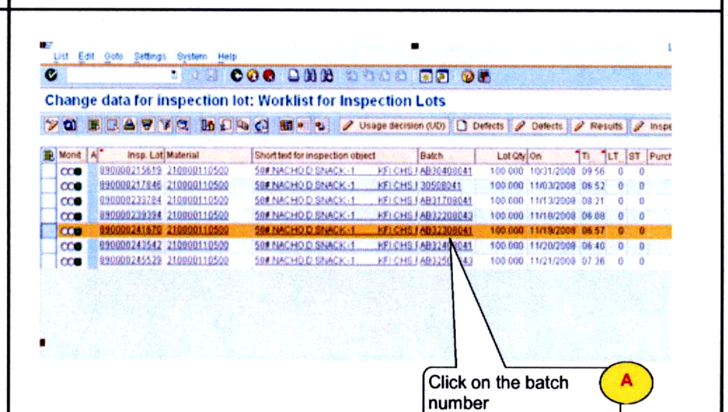
Breanne Harlan

2012 Summer Quality Manufacturing Intern

26

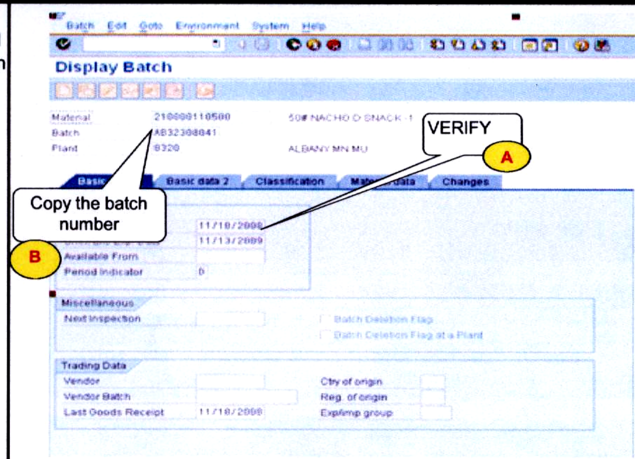
Appendix 2

Catalyst	PROCESS **CREATING A COA**	T-code: YMTIF_COA and SP01 Created by: Breanne M. Harlan Version: V1.1 Date: 9/7/2012

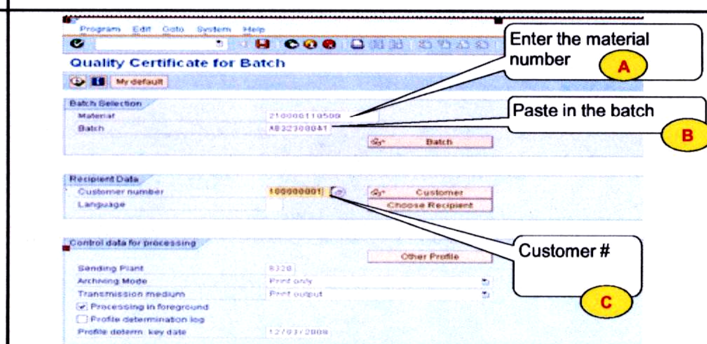
NO.	SUB	SEQUENCE OF OPERATION	JOB LAYOUT
1		Double Click YMTIF_COA in your favorites or type it in the transaction box	
		Open another session and go to transaction QA32 to look up the batch	
2	A	Enter the date range	
	B	Enter the material number	
	C	Origin: 89	
	D	Click on "SELECT ALL INSPECTION LOTS"	
	E	Execute	
3		Find the correct batch number	
	A	Click on the batch number	

Catalyst	PROCESS	T-code	YMTIF_COA and SP01
	CREATING A COA	Created by	Breanne M. Harlan
		Version	V1.1
		Date	9/7/2012

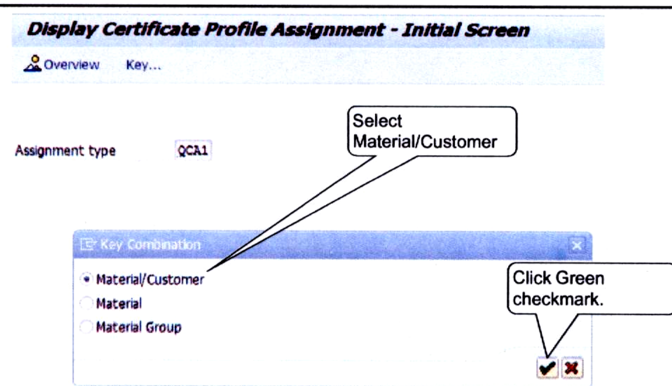
NO	SUB	SEQUENCE OF OPERATION	JOB LAYOUT
4	A	Verify the date on the bill of lading to the production date	
	B	Copy the batch number (Highlight and control c)	



NO	SUB	SEQUENCE OF OPERATION	JOB LAYOUT
5		**Go to YMTIF_COA**	
	A	Enter the material number	
	B	Paste in the batch number	
	C	Enter in the customer code, Look up in excel spreadsheet saved in O:/ or QC17.	

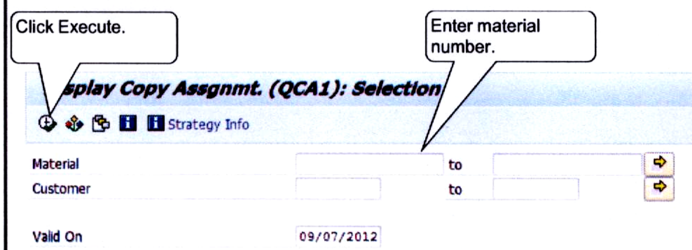
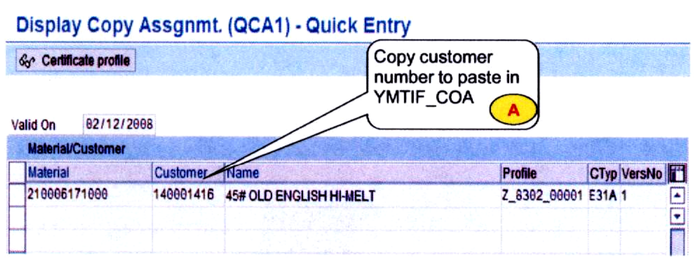
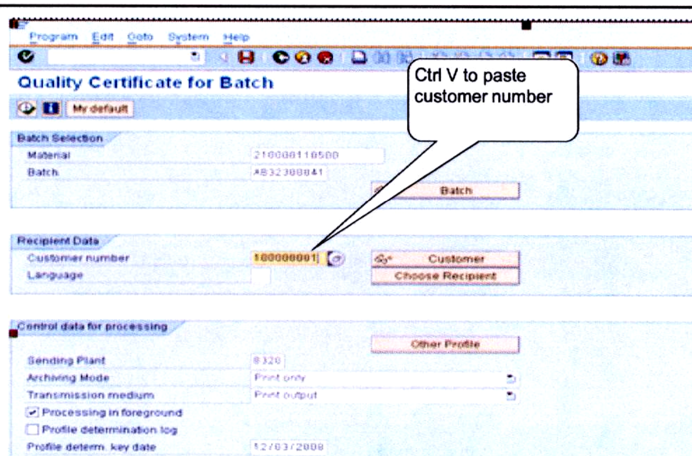


NO	SUB	SEQUENCE OF OPERATION	JOB LAYOUT
6	A	**Go to QC 17.**	
	B	Select Material/ Customer	
	C	Click on the Green Check Mark	

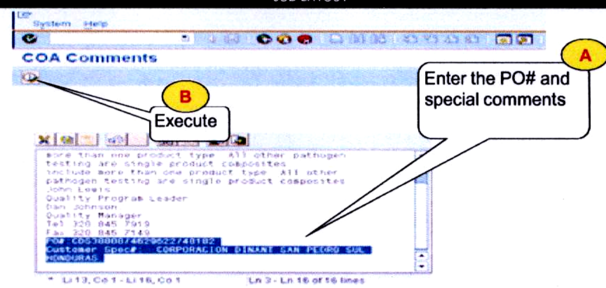
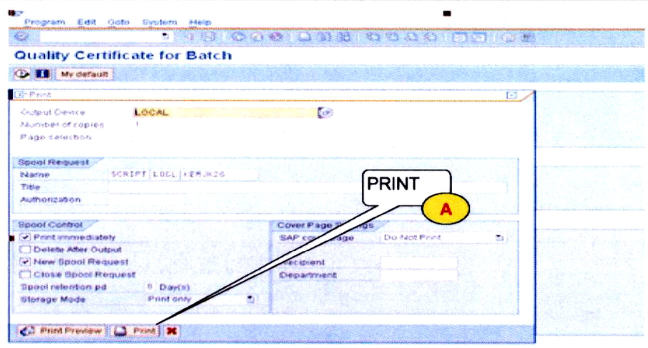
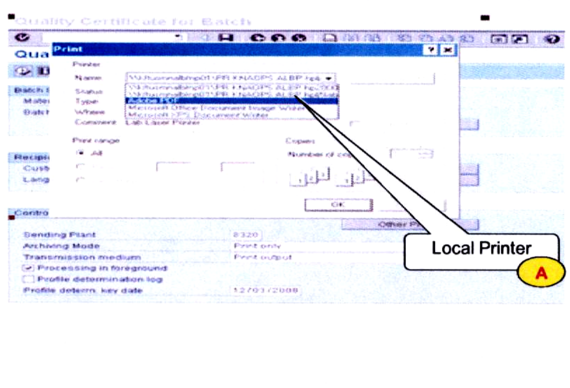


2 OF 5

PROCESS		
CREATING A COA	T-code	YMTIF_COA and SP01
	Created by	Breanne M. Harlan
	Version	V1.1
	Date	9/7/2012

NO.	SUB	SEQUENCE OF OPERATION	JOB LAYOUT
7	A	Enter in Material number.	
	B	Click Execute	
8	A	Copy Customer number by highlighting and pressing Ctrl C.	
9	A	Click on the customer number box.	
	B	Press Ctrl V to paste the customer number.	
	C	Hit Enter to continue to the next screen.	

Catalyst	PROCESS	T-code	YMTIF_COA and SP01
	CREATING A COA	Created by	Breanne M. Harlan
		Version	V1.1
		Date	9/7/2012

NO.	SUB	SEQUENCE OF OPERATION	JOB LAYOUT
10	A	Enter in the PO# and the customer spec #	
	B	Execute	
11	A	PRINT	
12	A	Choose a Local Printer.	

PROCESS		
CREATING A COA	T-code	YMTIF_COA and SP01
	Created by	Breanne M. Harlan
	Version	V1.1
	Date	9/7/2012

NO.	SUB	SEQUENCE OF OPERATION	JOB LAYOUT
13		**SP 01:** to email COA.	
	A	Double check date of COA request.	
	B	Execute.	
14	A	Check the request needed.	
	B	Go to the Main Menu at the top of the screen	
	C	Select Spool Request ->Forward->Send Using SAP Office.