Packaging Matters: Is It Time to Move on?

Pamela Sanchez was deeply upset by the information she had just received. She was informed by a production supervisor that one of their canned products was returned by a distributor because it was bulging. So deep was her concern that she was frowning and staring into space, which was rare for her. Sanchez had reason to be concerned. This was the first time in her eight years at the company that she had encountered this problem. Bulging of any canned product is a serious matter and usually indicates there are leaks in the can or that bacteria have colonized inside and produced gas as a by-product.

Sanchez, a raw material quality analyst, was employed by one of the world's leading exporters of canned pineapple products, the Marion City, Philippines-based Del Valley Fruit Products. Sanchez was mainly responsible for ensuring that packaging materials such as tin sheets and corrugated cartons delivered by the company's certified suppliers were top quality. She knew the quality assurance department would be busy investigating the cause of the can's swollen state. She wondered whether there would be a need to change suppliers or the packaging material. So far, the supplier had been true to its claim that tin cans were superior packaging materials for food products.

Sanchez considered the tin assembly team's responsibility in this situation. If the team had made errors in the way they produced the tin cans (see **Exhibit 1**), heads would roll. She hoped none of the fruit processing workers had neglected hygiene procedures prior to packaging the product in tin cans.

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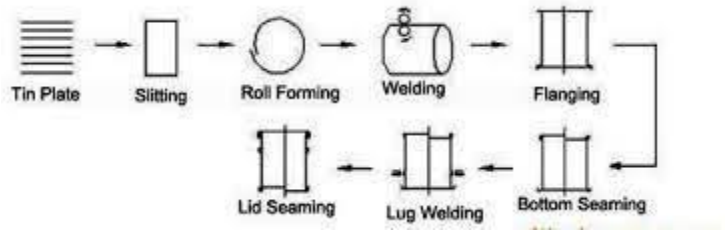
Exhibit 1

Tin Can Manufacturing Process



Source: Alibaba. "1-5L Round Can Production Line." Accessed 3 June 2016. <http://www.alibaba.com/product-detail/1-5L-Round-Tin-Can-Making_1290911036.html>.

She also wondered whether the distributor handled its canned products properly. A slight dent could produce very small holes that become entry points for microorganisms. The microorganisms could multiply inside the can and produce toxins. Sanchez felt a heavy burden on her shoulders, and her head started to ache as she thought about this problem. Food processing companies were always concerned about food safety because many things could go wrong on the production line and in distribution. Sanchez felt very protective of her company and its employees were like family to her. Competition in the canned pineapple product industry was stiff, and the company would not want anything to damage its sterling reputation. Sanchez rubbed her head and braced herself for the upcoming Hazard Analysis Critical Control Point[1] (HACCP) review.

Del Valley Fruit Products

Established in 1998 Del Valley Fruit Products had grown rapidly to become one of the Philippines' leading producers and exporters of canned pineapple products and had a vision of becoming a global brand for canned food. In 2006 the company was owned by a number of shareholders; the majority stockholder was Juan Santiago Bautista, who was also the company's CEO. Educated in the U.S., Bautista was a firm believer in building a successful business through production of healthy and high quality products. As CEO he acquired state-of-the-art equipment and ensured that the company complied with all the international certification standards and Good Manufacturing Practices (GMP). Del Valley only accepted suppliers who had International Standards Organization certification and were compliant with GMPs. Bautista also believed in the wisdom of finding the best people to work for the company. Employees were treated with care and given perks and privileges. Bonuses were awarded whenever the company attained or surpassed sales targets. These incentives drove employees like Pamela to do their best to ensure that Del Valley's products were top quality.

Tin Can History and Benefits

The tin can is one of the most popular food packaging options. It is a container made of tinplate. The invention for the tin can was prompted in 1795 by a cash prize offered by Napoleon Bonaparte for the development of a packaging material that would preserve food for the army and navy.[2] In 2016, many food companies preferred the tin can over other packaging materials because of its strength and superior quality. The shelf life for a product packaged in tin was two years or more. When properly manufactured,

the tin can protects stored food from oxygen, light, moisture, insects, rodents, and other contaminants (for example, harmful microorganisms, dust, dirt, and chemicals). Consumers enjoy the flexibility, food safety, and convenience of this packaging material. Canned products are easier to store, handle, and distribute.[3]

Nonetheless, tin cans can still be compromised. For example, if the tin cans are not properly manufactured, there could be microscopic leaks that can become entry points for contaminants. Also, if tin cans are not properly handled, they can become dented. Depending on the size of the dent and the way the can acquired the dent, very small openings can result. Another important consideration is how the content that goes inside the tin can is prepared. If the content is free from contaminants prior to introduction into the container, then it will stay that way as long as the tin can is free from any physical defects. If the content is already compromised, then the food quality might not be very good or, even worse, it will not be safe for human consumption.

Tinplate is described by Food and Agriculture Organization as a rigid and impermeable packaging material made from a thin sheet of low carbon steel coated with a thin layer of tin on both sides. Another way of producing it is by soaking sheets of mild steel into molten tin or by electro deposition of tin on the steel sheet. These processes result in tinplate with varying thickness of surface coating (with one side coated heavier than the other side). The tin can still corrode, but at a slower rate than steel when exposed to food material. The thickness of tinplate sheets may vary from 0.14 mm to 0.49 mm. The tinplate may be imprinted by lithography to provide suitable instructions or other information. Otherwise paper labels can be attached to the outer tinplate surface.[4]

The effectiveness of the tin coating is dependent on the thickness, uniformity, method of coat application, the composition of the steel base plate, and the type of food. To prevent the tin from affecting the taste of the food product, the side that comes in contact with the food may be lacquer coated.[5] Common organic coatings of Food and Drug Administration-approved materials and their uses are indicated in **Table 1.**

Table 1

Types of Tin Can Coatings

Coating	Typical uses	Type
Fruit Enamel	Dark-colored berries, cherries, and other fruits requiring protection from metallic salts	Oleoresinous
C-Enamel	Corn, peas, and other sulfur-bearing products	Oleoresinous w/ suspended zinc oxide
Citrus Enamel	Citrus products and concentrates	Modified oleoresinous
Beverage Can Enamel	Vegetable juices, red fruit juice, highly corrosive fruits, non-carbonated beverages	Double-coated w/ resinous base coat and vinyl top coat

Source: Food and Agriculture Organization. "Fruit and Vegetable Processing: Chapter 7. Packaging Materials." Accessed 6 May 2016. <http://www.fao.org/docrep/v5030e/v5030e0h.htm>.

Under normal conditions the presence of the tin coating provides a considerable degree of electrochemical protection against corrosion, despite the fact that in both types of tinplate the tin coating is discontinuous and minute areas of steel base plate are exposed. This can be observed in tin cans that exhibit rust. With prolonged exposure to humid conditions, corrosion may become a serious

problem. The coatings not only protect the metal from corrosion by food constituents, but also protect the foods from metal contamination, which can produce a host of color and flavor reactions depending upon the specific food. Particularly common are dark-colored sulfides of iron and tin produced in low acid foods that liberate sulfur compounds when heat processed, and bleaching of red plant pigments in contact with unprotected steel, tin, and aluminum.[6]

The Canned Pineapple Market

The Philippines is a top exporter of juice concentrates and pineapple juice[7] and its proximity to high growth countries like Korea, Singapore, and Hong Kong make pineapple product exportation a good business.

An increasing demand for pineapple products across the globe motivated food manufacturers to improve the quality of their products and ensure that quality was maintained until the product was consumed by customers. Thus, good packaging materials were of prime importance.

Sanchez and her team were considering alternative packaging materials that the company could use for its pineapple products since consumers were attuned to any news of a food packaging material error. Sanchez knew such a mishap could cut into the company's market share.

Packaging Materials

Packaging materials are very important for the safety and preservation of food products. They enable food products to be distributed across the globe safely. In general, packaging materials and containers are required to be non-toxic and compatible with the food. The material should be able to prevent moisture, odor, and gases from contaminating the contents. Moreover, the packaging materials should be able to cushion the contents from impact while allowing for ease of opening, easy disposal, and an attractive appearance at an affordable cost.[8]

Primary and Secondary Containers

Primary containers refer to natural coverings such as shells in nuts and eggs and peels in fruits. To enable mass transport of most agricultural food products, secondary containers such as boxes and metal containers may be required. This is true for products that are sold in their natural state. For processed products like fruit juices, dried milk, and sliced fruits, plastic or glass may be required as primary containers since the product's natural containers were removed or altered during processing. Secondary containers are used to add protection and make handling easier. Additionally, the secondary container greatly reduces the demand for protection that must be met by the primary container.[9]

Water vapor and other gases may affect the quality of the food product and must be avoided at all cost. For this reason, special provision for sealing may be required for primary containers. Since primary containers usually come in direct contact with food, serious consideration is given to the kind of material used to ensure food safety and maintain good quality. In essence, primary containers are scrutinized more than secondary containers.[10]

Hermetic Closure

Food quality is affected by the presence of microorganisms such as bacteria, yeast, molds, and intrusion of dust and gases. These can be prevented through the use of hermetic packaging. Hermetic closure serves as a barrier and maintains vacuum and pressure packaging.[11] Rigid metals and glass bottles

are common examples of hermetic containers when properly capped or closed. However, flexible packages are not truly hermetic for one or more of the following reasons.[12] First, thin flexible films are not completely impermeable to gas and water vapor. Second, the seals may be defective. Lastly, the thickness of aluminum foil and the flexing of packages and pouches are susceptible to minute pinholes due to creases.

Rigid aluminum containers can be made hermetic through the top-end double seam, which can be closed with regular tin sealing equipment even without forming the side seams or bottom-end seams. Tight lids with an inside ring of plastic or cork make glass containers impermeable to gas and water vapor. Since many glass containers are vacuum packed, their hermetic sealing is strengthened. Bottle caps are crimped to ensure tight contact with the bottle opening. Unfortunately, bottles often lose hermetic sealing more quickly than cans.[13]

Films and Foils

The thickness of films and foils dictates moisture and gas permeability and is indicative of their strength, elasticity, inflammability, and resistance to insect attack. Since they are non-rigid, their main function is to contain the product and protect it from contact with air or water vapor. Their capacity to protect against mechanical damage is limited, particularly when thin films are considered.[14]

Plastic Sheets

Dried fruit products are usually packed using plastic sheets such as polyethylene due to their flexibility, transparent quality, and resistance to low temperature. Dehydrated products need protection from moisture and polyethylene sheets offer that barrier although additional packaging materials may be needed to ensure that dried fruit products remain dry.[15]

Receptacles

This kind of packaging material has three categories. The first type of receptacle can be heat treated such as boxes, bottles, and bags that can be sterilized. The second type is those receptacles that do not require heat treatment such as boxes and bags that are used during processing of fruits and vegetables. Bags are usually made from polyethylene or cellophane when the products involved are dehydrated or are dried vegetables or fruits. The third type is called Criovac type, which requires heat treatment once the finished product is vacuum packed. [16]

Laminates

Food products need packaging materials that protect them from being exposed to water vapor, oxygen, and light.[17] Laminates can offer this protection, but must also possess burst strength and should not be susceptible to pin and crease holes. Combining layers of laminates or customizing the design for the best protection is an option. To create multilayers, processes are used such as the use of wet adhesive, dry bonding layers with thermoplastic adhesive or hot melt, and special extrusion techniques. Also, bonding the laminate to paper or metal foils may enhance the laminate's protective capacity.

Glass Containers

Glass containers are chemically inert, but the use of metal caps may expose the content to corrosion and unwanted chemical reactions. Glass containers can also break during transport thereby requiring additional packaging materials such as corrugated boxes and padding to prevent the materials from coming in contact with one another. The material should be thick enough to withstand thermal shock and impact breakage, but it cannot be too heavy to ensure ease of transport. Glass requires coating such as special waxes and silicones to lubricate the outside of the glass to prevent thermal shock and breakage during high-speed filling. Coatings also serve to minimize noise from glass to glass contact and to improve appearance. Instructions from manufacturers regarding filling temperature or cold storage

must be followed.[18] Glass manufacturers recommend that the temperature difference must not exceed 44° C (80°F) between the inside and outside surface of the glass in order to prevent thermal shock.[19]

Glass used for receptacles in fruit and vegetable processing has a carefully controlled mixture of sand, soda ash, limestone, and other materials made molten by heating the material to about 1,500° C (2,800° F).[20]

Jars for Sterilized/Pasteurized Canned Products

Jars may replace metal cans, taking into consideration, but offer both advantages and disadvantages. The advantages are 1) they do not react to food content; 2) they are transparent and can be manufactured in various shapes; and 3) they use cheap raw materials and are reusable. The disadvantages are 1) they are heavier than metal can of the same capacity; 2) they are fragile; and 3) they have lower thermal conductance and a limited resistance to thermal shocks.[21]

Receptacles in this category must assure a perfect hermeticity after their pasteurization/sterilization and cooling. This is achieved by the use of metallic (or glass) caps.[22]

Jars for Products without Heat Treatment

Marmalades, jellies, and jams use glass jars with non-hermetic closures of metal, glass, or rigid plastic caps. Jars with pneumatic closure (e.g. for marmalades and jams) can be hot filled hot and, therefore, are often sterile. Pneumatic closure also generally protects the food product from negative air impacts.[23]

Glass Bottles

Glass bottles are receptacles that are popularly used as packaging materials for finished products that need pasteurization such as tomato juice and food preserves. Metallic caps are used to hermetically close the containers. Corks and aluminum caps may also be used. [24]

Conclusion

During a meeting of all supervisors, Sanchez listened intently to Cynthia Santos, the company's quality assurance supervisor, as Santos outlined what needed to be done over the next few of days to determine the cause of bulging in the canned product. She emphasized the need to pinpoint which part of the production process needed scrutiny. Tony Amoncio, the head of the Tin Assembly Unit, was asked to submit a full report of the batches the unit produced that coincided with the lot number[i] of the product in question. Santos told the group that all units should review their HACCPs and check the records for anything unusual during the manufacturing of that batch. Lita Meliton, the quality analyst assigned to microbiology tests in the production area, was also asked to review her records. Carlos Lim, the distribution supervisor, was asked to look into the handling of the finished products. Everyone was to follow protocol and solve the mystery quickly.

Sanchez tapped her pen on her notebook and grimly considered the fate of the tin can as a packaging material. She wondered if the time had come to bid tin cans goodbye and welcome another type of packaging material. She exhaled a deep breath as the meeting was adjourned.

i A lot number is a code used by the manufacturer to record and trace when the product was manufactured.

Endnotes

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