

Course Name: Canning Technology and Value Addition in Seafood

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Canning Technology and Value Addition- Containers and their Properties - Part 1

Hello everybody, welcome to the third session of Sea Food Canning Technology. In the previous sessions, we have already discussed to explain the Canning Technology, we had to divide it into three concepts like the actual concept, the container and the process. In the initial sessions, we have discussed regarding the concept. In this session, we will be dealing with the container and especially the containers used for canning and their property. What will be an ideal container for canning? There are different properties assigned for a material to be qualified as a good or ideal container for Canning Technology. The foremost property or the one of the premium properties that we are looking for is basically the physical strength.

The container should be basically strong enough to protect the contents as well as to survive the handling and transportation. That is one of the key features that the material should possess so that it will qualify as an ideal container for canning. Next, after the physical strength, it should be light enough for easy and economic handling. The weight of the container by the use of that particular material is going to ultimately decide the transportation costs and the product costs, etc.

It should be light enough. It should be like any other good packaging material, it should be impervious to air, moisture, dust and microbes once it is sealed. Usually, most of the products are properly packed inside a particular container or a packaging film. But in most cases, these containers are not 100% barriers, like they may be permeable to different kinds of matters or different kinds of materials such as moisture, some of the materials can be permeable to lights, different kinds of gas permeabilities are there. These kinds of permeabilities are challenges for the seafood processing industry, because eventually once the food is packed and sent for shelf life or shelf storage, these kinds of permeability can ultimately affect the quality of the food over the period of time.

Since, the canned products or the products prepared using Canning Technology are supposed to be stored at the room temperature, the permeability of the container is very important. It should be impervious to all that air, moisture and such elements so that the food inside the container can be preserved under the room temperature for a quite long time. That is one quality that we are looking for. The appearance of the container or the appearance of the material is also one of the key features because the appearance should

be pleasing and sanitary because one of the key features which should be possessed by consumer products is that, once in the shelf or the commercial area or the marketing area or the shop once it is displayed on the shelf, that it should attract the consumers to buy it. So, the surface should be sanitary and hygienic enough so that it should give a sanitary feel for the consumer. So, that sanitary and clean feel is one of the importance. It should be pleasing and sanitary in appearance. That is one quality that we are looking. And also, it should not be harmful or it should not import any toxicity into the contents. So that particular property is called migration.

So, the material that is used for preparing the particular packaging that is going to be used for canning should not impart any additional constituents into the food. For example, in the case of many plastic packaging materials, these are having a lot of chemical constituents which, over the period of time, may leak into the food and make the food toxic or unacceptable for human consumption. That is one of the properties that we should be aware about because it should not have any migratory properties. That is one of the features that we are looking for.

It should withstand the pressure and temperature of thermal processing. As we know, thermal processing is a severe process. It is basically thermal sterilization. Especially in the case of canning, we are subjecting the food package to high temperatures up to the level of 121.1 degree Celsius and also up to 15 to 20 PSI of pressure. These are the two extreme conditions which we are going to make the containers exposed to. All this material should be used for such containers so that the container should withstand the process. It should not break or it should not burst after the actual processing is done. That is one of the properties. Also at the same time, it should be inexpensive to discard after use. Discarding the food packaging is one of the important challenges that is being currently faced by the food industry. Especially the plastic packaging, after opening the container and after consuming the product, what is left is the plastic packaging material, which if not properly recycled or properly handled, it can be released into the environment and can cause the different types of plastic pollution issues. It should not happen in the case of canning. That property also should be inherent to the material that we are going to use for canning. It should be inexpensive at the same time and it should be discarded friendly. It should be easily recycled and reusable. That is one of the properties.

Finally, one of the most important properties that the material should be capable of hermetic sealing using high speed machines. So, sealing property, different kinds of sealing methods are there which we will be discussing eventually. But the ability to close the container airtight is one of the key features that we are looking for canning. It should be sealable using machines so that the process should be entirely automated.

The machines can be involved and the sealing should be perfect otherwise the

productivity will be reduced. If you seal it only manually, that will significantly reduce the rate of production. These are the key features that we are actually looking into a container, an ideal container which could be used for canning. If we try to generally classify different types of containers that could be used for thermal processing, it could be classified into three categories. That is rigid container, semi-rigid containers and flexible containers.

So, in the case of rigid containers, there are two materials that is popularly used. One is glass jar or glass containers and metal cans, so metal containers. In the case of metal cans, there are three major types of metals that is currently being used for making cans. One is Tin Free Steel cans or in short form we call it as TFS and another is the old tin cans it has been used for Canning Technology since its inception. Tin cans, tin free steel cans and then aluminium cans; these are the metal materials that is used for can making.

In the case of flexible pouches or flexible containers, it is the retort pouch that is very frequently used for canning purposes. In the case of retort pouch, it is basically a multi laminate pouch. In the retort pouch, there are two types of varieties that we found. One is opaque retort pouches and other one is see-through retort pouch and that is one category. Another category is semi-rigid containers.

Semi-rigid containers, it comes under this particular category. Two types of materials are usually used. One is thermoformed trays that is high impact polystyrene or such kind of material. HPP or High Impact Polypropylene, like different kinds of specialized polymers, are used for and it is thermally formed into different trays or containers. Such containers are called thermoformed trays.

Thermoformed trays are one kind of containers used and another one is tetra pack. Tetra pack is basically used in aseptic Canning Technology. It is one of the different processes of pasteurization. The tetra-pack contains different layers of papers, aluminium foil and plastic. This is basically the classification of different kinds of containers that could be used for Canning Technology.

Glass is one of the primitives or one of the primary materials used when the Canning Technology was developed. You may remember in the previous session; we discussed about the historical development of Canning Technology. In that in the 1800s or the late 1800s, it was the Nicholas Appert who invented the Canning Technology. He actually used the glass jars for developing the technology. So, glass jars are particularly the first material or it may be considered as the first packaging material that is used while developing canning tools.

Still glass jars are used widely throughout the world, especially now the application is limited in the case of home canning purposes. What is glass means, glass is basically it is

a non-crystalline amorphous solid and basically the pure form of glass or the basic material or more than 70% of the glass is silicon dioxide or silica or it is also known as quartz sand. Based on the quality of the Silica or Silicon dioxide, the quality of the glass jar is considered. Also termed as fused quartz or fused silica because we are using a thermal fusing technology to make it into an amorphous solid. Basically, Silicon dioxide is the purest form of glass.

The properties that we are looking in the case of glass containers is that it should be highly resistant to thermal top. In the case of thermal processing, it is one of the key features that we looked. So, the glass will withstand the thermal processing. So basically, thermal processing is actually involved with different alternative cycles of expansion and contraction. So, the material is going to expand when it is heated and it is going to contract when it is cooled or shrink when it is cooled.

Since the normal glass is very brittle, if it is subjected to this kind of expansion and contraction, there is higher chance that it may break. So that should be avoided. The material that we are going to use for glass containers, especially for thermal processing, should be able to withstand thermal shock. So, for different kinds of purposes it can be used. Such materials are generally used for lab purposes and also there are different kind of glasses materials which are used for optical fibres which is resistant to thermal shock. And also, certain glasses are there which have high melting point. These glasses with high melting points are used in halogen lamps and especially in space crabs also high melting point glasses are used because it should withstand high temperatures. It should not melt under normal temperatures.

There are different kinds additives that we add in the process of glass making other than silicon dioxide. For example, soda lime is one material. This is Sodium carbonate with the chemical formula Na_2CO_3 . It is one of the premium material or one of the fine materials that is used but the drawback of silica soda lime is basically it has low melting temperature. so, it is used in the case of normal glassware that we use in day-to-day purposes or day to day life. Soda lime is added at different concentrations. Sodium oxide or lime can be added, Calcium oxide can be added, then a little bit amount of Magnesia, Alumina.

All these materials are added to prepare this particular soda lime and 75% of the glass will be basically silica. Along with silica, other materials like soda lime and magnesia, alumina etc. are added to prepare this particular kind of glass material with lower melting point. And also, another type of glass is borosilicate which is basically 5 to 15% of Boron trioxide B_2O_3 is added. The main property of this borosilicate glass is basically it has high thermal resistance. Especially the lab glassware and also the glass used for thermal processing is basically made with borosilicate that is one material. Another material is Alumina silicate where 5 to 10% of Aluminium oxide is added or alumina is added. They

are thermally resistant but it is very difficult to melt. They are having very high melting point. So, that is why they are popularly used in the preparation of fiberglass.

The alumina or Aluminium silicate is basically used in the preparation of a fiberglass material. Borosilicate is used for the preparation of thermal tolerant glass material. For example, glasswares and canning jars and also soda lime is used for other kind of general use or general glass material. There are certain popular glass jar sizes that is used for canning like 32 oz which is called quart and 16 oz which is called pint and 8 oz half pint and 4 oz which is quarter pint. These are the basic size groups of glass jar that is used for Canning Technology. 32 oz will be around, in the case of ml, 1 liter; 946 ml like 473 ml like different kinds of quantities are there. These are the general glass jar sizes that is used for canning. These 4 sizes 32 oz 16 oz 8 oz and 4 oz that was about glass containers. Now the next category in the case of rigid containers is metal cans.

Metal cans are the most widely used material for canning. If you see like you the market of the canning product, these are the largest number of materials. Now, slowly, the flexible packaging is catching up. But historically the metal cans were the maximum use for the production of canned products. What are the advantages of metal cans? Metal cans are basically 100% recyclable and can be recycled infinitely with no loss of quality. It is infinitely recyclable. The advantage of metal cans whatever be the metal that we use, whether it may be tin coated steel or tin free steel or aluminium cans; all these metal cans can be almost 100% recyclable. Once prepare a metal container that metal can, after the use of the food product, can be recycled and made into further different cans without compromising the quality of the container. That is one of the very important properties of metal containers. The metal cans are most recycled food and beverage containers in the world. That is one of the characteristics of the metal can because of this property.

Also, cans have the highest scrap value because it is economical for recycling. Because of this highest scrap value, it will subsidize the collection and recycling of other materials. Basically, the metal containers are actually supporting the recycling industry as it has a very good scrap value. Because of the metal containers only, the recycling industry is surviving because if you see the other materials like semi-rigid containers or plastics or paper, they have very minimum scrap value. The recycling industry cannot survive only by recycling plastic containers because plastic containers cannot be infinitely used as food containers as one recycles is insufficient to be reused for food purposes.

It has to be reused for non-food purposes and as the recycling increases the usage also very narrows down. That is one of the drawbacks of other kind of material. But in the case of metal cans what happens is that, without compromising the quality, even after recycling also it can be used for preparation of food can. That is one of the advantages.

Also, cans are recycled to a well established and efficient infrastructure because metal recycling is a very established infrastructure currently in the industry. That is also an advantage.

Also, cans can be recycled and returned to a store shelf as new can in just 60 days because the time period required for recycling is very short compared to other materials. Within 60 days, a can can be recycled and brought as a new can into the store. That is one of the important properties of metal containers. Cans are highly stackable and have high cubic efficiency making them cost effective for transportation because the stackability of the metal containers are very important because unlike the plastic containers, it is rigid.

By design, most of the cans are cylindrical in shape. Why most of the cans are cylindrical, not made into other shapes; are because cylindrical shape will support a greater number of cans per square meter area. That is why cylinder is one of the efficient materials when in the case of packaging. So, in a given square meter area, a greater number of cans can be stacked, can be palleted or can be arranged, can be organized if it is in cylinder shape. Compared to other metal containers, since most of the food cans are in cylinder shape, more containers can be packed for the surface area and also, small area more cans mean more containers can be transported and also the advantages are metal cans are lightweight because the thickness of the metal container walls can be minimized. In most of the beverage cans the thickness is very minimum, like the thickness of the any beverage can wall is almost similar to the human hair thickness. It is thin as human hair. Even though the thickness is very less, it will not compromise the physical strength. That is the advantage. Using minimum material, we can produce maximum containers with maximum physical strength. That is one of the advantages; cans are lightweight, they are unbreakable, they are physically strong and provide superior protection to the product. That is also very important.

Why metal cans are very important to the thermal processing process is that they can go through the heating and cooling cycle very fast because of the conduction or the thermal transfer. Since the metals are very good conductors, what happens is that it can go through this heating and cooling cycles very fast. So, basically the processing is very fast. If you consider some general facts that we already discussed that 100% of the metal cans are infinitely recyclable. That is one of the key features and cans are the number one recycle beverage containers in the world because, 69% of the beverage containers are recycled.

That is one of the higher point and aluminium cans, especially 95% of aluminum cans are recyclable. Whatever the aluminum cans we find it because we need not produce more metal so more metal aluminum cans because 95% of the cans are coming as new containers so that also reduces the stress on the manufacturing industry. Another feature of the metal containers other than 100% recyclability is that these metal containers; the

steel and aluminum metals are particularly easy to collect from waste because they are highly distinguishable then even in a very multi or composite waste we can use a magnet or similar kinds of identification technologies can be used and even from a mixed waste comparatively easy to collect and segregate this kind of materials. That is one of the properties and it has been already we discussed that around 70% of aluminum cans and around 68% of steel cans are recycled throughout the world that means around 75% of aluminum and around 80 to 90% of the steel which is ever produced in the world is still in the use. So, it particularly decreases the pressure and the utilization of different kinds of metal producing sources like iron ore. Different kinds of ore that we use for preparing different kinds of metals.

So, this kind of recyclability is very important and we also discussed that within the short period of time the time span of recyclability of metal containers are very short it is around 60 days and also, we discuss about high scrap value in the case of scrap value it is around 8 times than Poly Ethylene Terephthalate which is the most common packaging material or plastic packaging material that is used throughout the world and is called PET or Poly Ethylene Terephthalate. So, the metals have 8 times more scrap value than PET and also 4 times than paper and also you know that glass basically does not have any scrap value because it had been melted, we want to recycle the glass you cannot make as such we had to melt it and again complete recycle the process. Glass is basically very difficult to recycle. So, that is why the glass does not have any scrap value. In the case of scrap value also, metals on a higher note and also this high recycling capacity or this recycling reduces energy of metal production. 70% of energy required for metal production is reduced because of the recyclability. Almost 95% of energy reduction in the production of aluminium. In the case of steel, we use iron ore as the basic material and in the case of aluminium we use bauxite. This kind of recyclable capacity of these both metals will reduce pressure over the metallic ore resources of the world. Thank you.