Course Name: Canning Technology and Value Addition in Seafood
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Canning Technology and Value Addition: Containers and their Properties - Part 3

Hello everybody. Welcome to the third session of Seafood Canning Technology. The next important part in the case of the preparation of the containers is basically the containers, as we discussed, it is made with different kinds of metals; different layers of metal. But an exposed metal cannot come with contact with food materials. So, some kind of coatings need to be provided over that metal layers. There are different kinds of protective and decorative coatings are used in canning technology.

Generally, it is known as lacquering. The purpose of such kind of coatings or lacquerings are they protect the metal from the contents. When anything come in contact with metals there is a chance that either the metal ions may interact with the components within the food or within the enclosed contents or either the content can interact with the metal. So, either of this can happen. This kind of coatings or lacquerings protect the metal from the contents. And also, they avoid contamination of the product by metal ions from the container. So, either way there is a protection from metal to the food or food to the metal. And also, they facilitate manufacture. The coating will basically make the metal surface more workable and flexible all those properties and so and also that sanitary appearance is actually given by different kinds of coatings.

So, they basically facilitate the manufacture of the metal containers and also they provide a basis for decoration and product identification because the printable surface of the metal is actually coated with a particular kind of coating or lacquering. So that the printing and various kinds of designs the brand names etc. can be properly exhibited over the surface. Also, they form a barrier to external corrosion and aberration. External corrosion or aberration means the external part of the metals especially is exposed to external elements such as moisture, oxygen etc. since the metal tend to react with oxygen and other gases. So different kinds of metal oxides can form and this may eventually result in corrosion of the metal. These kinds of coatings tend to protect such activities. They form a barrier to external corrosion and aberration also. These are the basic functions of the coatings.

As we discussed there are basically two types of coating. One is called as internal or food contact coatings and one is external or non-food contact or decorative coating. These are the two types of coatings that are generally applied over the can surface. In the

case of internal coatings their sole purpose is to protect the food from the metal; protection of the contents from the metal. Most of the metal is basically steel and iron.

Iron basically picks up in beer or discoloration of some kind of dark colored fruits such as plums and strawberries due to metal contact. Metal contact can actually convert the contents into different kinds of forms or when the food come in contact with the metal contents they can alter the basic nature of the food like color, taste, etc. So, these kinds of internal lacquers protect from such things to happen. And also, protection from the contents of the can. Example - acidic soft drinks which may corrode the uncoated metal or some fish, meats and soups or which may cause sulfur staining.

The foods are basically classified based on pH like high acid foods or low acid foods or sulfur containing foods. If the metal is exposed to acidic components of the food, there is a high chance that the acidic nature of the food can corrode the material. That is one part of the issue. And another one is that certain food contains different components such as sulfur. That the sulfur which is contained within the food can interact with the iron and the certain sulfur blackenings.

Different undesired kinds of discoloration may happen to the food. So, the metal and the food have to be protected from these kinds of changes. That is the basic function of the internal or food contact lacquers or coatings. Then what is the purpose of external or non-food contact or decorative coatings? That is basically the protection from the environment. For example, atmospheric corrosion etc. because of the oxygen. They provide a decorative surface, labelling and consumer information. That is one purpose and also, they influence of the article during filling operations. For example, beverage cans can only be filled with an external decoration because no internal coating can be provided in the case of beverage cans. What provides in these kinds of external coatings is that they provide the necessary friction or mobility to pass through the filling head.

Different kinds of mechanical procedures are there. These kinds of coatings will make the container more suitable or more movable; like flexible to move through those procedures. As we discussed, the coatings or the lacquers added are either to protect the metal or the food from interaction between each other or to protect the metal from the outside elements. Basic food lacquers are made with resin. Also, the resin or the component will be supported by a drying oil complex because the oil-resin cross linking can happen and form a uniform layer and there is going to be different kinds of additives also such as, different kinds of dryers or accelerators are added plasticizers, dyes, pigments etc. are also added. And also there will be a solvent to mix all these components together like either an alcohol or water base. These are the basic ingredients or basic components of a normal food lacquer coating. The resins can be of two types; either natural or synthetic resins. The natural resin called as oleoresins. Oleoresins are basically

plant origin resins and synthetic resins are basically liquid monomers or plastic.

Different types of plastic based liquid monomers are used for synthetic resins. Most common resins that we use are epoxy resins or thermosetting polymers. But currently, the main problem with epoxy resins is the presence of bisphenol A or BPA which is having lot of carcinogenic and other health effects. Currently, this epoxy resins are the industries trying to replace with other kinds of resins rather than epoxy resins because of the presence of BPA. So, there is also epoxy phenolic which is the most common kinds of resins used.

It is basically there is a phenolic other than the epoxy component there is going to be phenolic plus an aldehyde component. So currently the studies are concentrating on replacing all these epoxy components but this is one of the most common kinds of material used to prepare the liquids currently because of various properties. And also, why means, tin and aluminium, they react with food that we already discussed that metals react with food. So, this kind of protective coatings is an essential. Earlier, different kinds of methods were used like China wood oil or the natural resins were used.

Now, it is basically epoxy or other similar kind of synthetic resins. It is basically the resins or these lacquers are applied prior to can fabrication along with heat or UV radiation or UV treatment. So, to set the resins, the resins are applied on the metal sheets and either they are heat treated or UV treated so that it forms a normal coating and basically it is thermosetting material. So, it will when we apply heat or UV light they will set into a normal coating. Then also oleoresins because they are most using is means oleoresins are cheap other than cheap means it is oleoresins have a limitation like it has less workability compared to epoxy resins.

So, the most common epoxy that we use is epoxy chlorohydrin or ECH. Different kinds of materials that we use has different kinds of properties. For example, oleoresin that we already told that it is cheaper but it has a barrier and workability issues are there. But epoxy resins have properties like flavor retaining property, chemical resistance property, mechanical properties. So that is why epoxy resins are widely used. And also, epoxy phenolic resins are specifically used. They are basically universal resins. So, they can be used for both acid and sulfur resistance. Both acid foods as well as sulfur containing foods it can be used. And epoxy amino resins are also there.

It is also universal but it is mostly used in beer and other kinds of beverage cans. And also, different kinds of thermoplastic like polypropylene, polyamide like composite films are used or polyethylene terephthalate (PET) films are used. So, different kinds of thermoplastics are also used as a coating other than this kind of oleoresins, epoxy resins, epoxy phenolic resins or epoxy amino resins. So, can coatings be applied to metal and after the application it is followed by a thermal treatment or a thermal curing or different

kinds of UV treatment is also made or it is also called as UV curing and also it is known as a stowing method. A uniform dried film has to be formed on the metal.

So, most coatings are applied as a wet film. And the major constituents in a can coating as applied to the metal includes the different kinds of resins are there, different kinds of cross-linking materials, additives, solvents as we discussed. Different kinds of application methodologies are also there for applying these lacquers. Lacquers can be applied in different kinds of methods such as electrophoretic lacquers; similar to electrolytic metal coating, different kinds of electrolytic method are also used for depositing lacquers over the metal surface. Such methodology is known as electrophoretic lacquering methodology.

And also there is a dip applied lacquers metal sheet is dipped in a lacquer layer. They are called as dip applied lacquers and also brush lacquers are there; where the lacquers are applied using a brush over the metal surface and also there are spray lacquers. Normal spraying is used to uniformly distribute the lacquering material over the metal surface. There are also different kinds of trade terminologies used for different kinds of lacquering. For example, oleoresins are a combination of resin and oil.

In the case of fruits and vegetables, the metal or the material the oleoresin that we use is called R enamel. So, R stands for the regular kind of thing. Regular enamels are basically acid resistant kinds of enamel. So, in the case of fruits and vegetable cans R enamel resins can be used. And also, the case of corn; Corn was one of the major foods that was canned initially. The vegetable material that is canned initially in a wide range. But the corn is also having Sulphur components are there or sulphides are present in corn. The issue with sulphides or sulphur components is that it will react with iron and form iron sulphide or iron blackening. So, such in the case of corn it was basically the C enamels were used.

The C enamel means corn enamel. The enamel that is used or the lacquer that is used for corns contain zinc oxide. Because what happens is that zinc oxide will react with sulphur and form sulphur and zinc complexes will form. Instead of iron sulphur the zinc sulphide will form. Which is white in colour and that kind of blackening issues will not be there. It is called sulphur containing enamels or corn enamels. It is called C enamel. There are basically two kinds of enamels. One is acid resistant enamel that is regular or R enamel. And then there is sulphur resistant enamel or C enamel. C stands for corn and this enamel was developed for canned corns. The different kinds of this lacquers have different colors as well.

Epoxy phenolic is characteristic with a golden color. Basically, lacquers will have its own different kinds of colors. Golden color is the standard color for epoxy phenolic lacquers. Color is basically is an indication of effectiveness of coating. We need to know that whether the lacquer has been properly applied. Giving a particular pigmentation or color

to the lacquer you can make sure that the application of the lacquer is uniform whether the lacquer is applied or not. For such purposes different pigmentation is given to the lacquers. In such certain cans there are also white surface, white coatings are also provided. Those white surfaces are basically made with titanium dioxide. The titanium dioxide is used to give that white coloration to the lacquer.

Immersion coating can be given or different kinds of coating that is spray coating, different kinds of coating methods are there. Any kind of coating methods can be used for application of this lacquer. Once the lacquer is set that is why they are called thermosetting oleoresins. So once the dry film is set so the component, the dry film weight can be expressed in different methodology like different values are there. So, there will be oleoresins means up to 4 to 10 gram per meter square oleoresins will has to be there and for example if we are using vinyl, it is around 2 to 7 grams per meter square and if you are using a phenolic component, it is generally between 2 to 5 gram per meter square and if you are using epoxy component 3 to 5 grams per meter square.

This will be the dry film weight if you use different kinds of lacquers. This will eventually determine that how much lacquer has to be applied. In the case of lacquering, initially the original can coatings were based on oleoresin products made by fusing natural gums and resins and blending them with drying oil such as linseed or tung oil (Chinese wood oil). Initially the natural kind of oil combinations were used. Especially for internal coating, we already discussed that epoxy phenolic acrylic coating is there, phenolic vinyl resin, oleoresin grooves are used.

Different kinds of materials are used as the internal coating component of the lacquers and main problem is BPA bisphenol A to reduce the health risk associated with the bisphenol A which is associated with epoxy materials. So now the research is mostly going on replacing such materials. So different metal can coatings are there, different kinds of coating types are there. So according to the property and the material that is we have used to prepare that particular material the application and other properties etc will vary. So, the main can coating types are one the most common is as we discussed it is epoxy phenolic and the properties of epoxy phenolic is basically that is a high molecular weight epoxy resins cross linked with phenolic resolved resins.

That is what the mixture is all about and it provides good flexibility and very good packed resistance for aggressive acid products. So, it is basically for acid resistance lacquers. That is why it is most widely used coating and it is also the color is universal golden coating for three piece and shallow drawn cans. Then another one is epoxy amine or epoxy acrylate. It is also a high molecular weight epoxy racines which is cross linked with amino or acrylate resins and it is also it is mainly employed now in waterborne coatings.

It is also a universal lacquer for beer and beverage cans and basically it can be used in the side seam strip in high solid forms for welded cans. And another important one is epoxy anhydride which is it is also a high molecular epoxy resins cross linked with anhydride hardness. It also has good fabricability with stands beading very good chemical resistance. So, it is basically used as an internal white coating for three-piece cans and ends.

And another one is vinyl organosol or PVC. Basically, it is PVC or polyvinyl chloride dispersed in an appropriate solvent and stabilized with low molecular weight epoxy racines or ESBO. It is mainly used in drawn cans and easy open ends also and it is often used over epoxy phenolic base coat. And another material that can coating uses thermoset polyester. The polyester racines are cross linked with phenolic or amino racines.

It may contain low molecular weight epoxy racines. It is very good chemical resistance, good fabricability and withstands beading. Its application is mainly as an internal and external coating for two piece and three-piece cans and ends for meat, fish and vegetables. Another important coating material is thermoplastic polymer coating. It is basically extrusion coated or laminated film of polypropylene, polyester or polyamide or combination thereof. It is mainly used in shallow drawn cans and easy open and standard ends.

Another main coating material is phenolic material which is very low cost. It is having poor flexibility but it has also good resistance particularly for aggressive foods. It is mainly used in drums and pails where flexibility is not a critical factor. So, in that condition phenolic can be used.

And another one is oleoresins. It is a naturally occurring oils and fatty acids with synthetic modification. It is a general purpose, golden color, inexpensive coating. Once very common but now very limited use. So, as we discussed different purposes there. One is decorative coatings and one is corrosion resistance coatings or protective coatings.

Corrosion resistance is one of the major physical properties that we are looking for in the case of a external or decorative coating. And there are particularly different kinds of cans are prepared or different kinds of materials are there. For example, the Toyo Seikan Co. Limited, the Japanese company has developed a TULC can or is called Toyo Ultimate can which is having a lowest of the carbon emission that is a new kind of can that has been introduced. Low carbon emission is there in that particular can manufacturing process. It is basically a steel sheet with polyester laminate on both sides. So, what happens is that it is manufactured using dry forming method. No lubricant is needed. So, the steel sheet comes with polyester laminate on both sides. At the time of the

manufacturing itself, the sheet is coated with polyester on both sides. That eventually results in less carbon emissions for that particular can. That is called a TULC can. So, that is the new kind of canning systems are being made. Since it is coated with polyester the bisphenol, risk is not there. Such kind of interventions or inventions are being introduced right now. And for this decorative purposes, different kinds of printing methodologies are used.

There is basically lithography offset printing. Lithography offset printing is basically printing on flat surfaces using the color code CMYK that is basically cyan, magenta, yellow, black etc. That is what the flat surface printing methodology is used. Mainly printing is done using plastics. It is basically an engraved cylinder printing methodology and also there is lithography curved offset printing, letterpress printing. These are different kinds of printing methodologies that is used in the case of cans.

In the case of 3-piece cans, mainly it is using lithography offset printing. But in the case of 2-piece cans, different kinds of methods like letterpress, curved offset printing, lithography curved offset printing, gravure printing etc. are used. So, different kinds of printing methods are there to print above the decorative coatings of the container. So, basic decorative coatings will have a white base coat and which is overprint varnish is also applied in the case of decorative coating.