

# METALLIC CONTAMINATION

• Some amount of the metal dissolve in milk and form metallic salts thereby, giving rise to a metallic taste to the milk. Some of the salts in milk have a catalytic action on the oxidation of milk fat resulting in the development of an oxidized flavour.

Factors which influence the degree of action by milk on the metal are:

- ✓ Temperature of milk
- ✓ Period of contact
- ✓ Cleanliness and polish of metal
- ✓ Amount of free air in milk
- ✓ Acidity of milk

## **SELECTION OF METALS FOR DAIRY EQUIPMENT**

**During the processing of milk the metallic surface will definitely come in contact milk.**

**It is necessary to take in to consideration this aspect while choosing the metals for designing various equipments with which milk will be in direct contact. It should be non-tainting, non-toxic, insoluble (in milk or its products), highly resistant to corrosion (by milk, cleaning and sanitizing agents etc.), easy to clean and keep bright, light yet strong, good agents of heat transfer, good in appearance throughout its use, low in cost, non-absorbent and durable.**

# CHARACTERISTICS OF DIFFERENT METALS AND THEIR ALLOYS USED FOR DAIRY EQUIPMENT

## Copper and its alloys:

- ✓ Used for the preparation of milk pails, coolers, vats, strainers, pipe fittings, milk pumps, pasteurizer coils, etc. Due to the action of milk it will cause taints in the milk or the dairy products. For preventing such effect the surface is coated with tin. Due to the action of milk on this metal a green corrosion product is formed (toxic for human consumption).
- ✓ Being a Soft metal, it is easy to work with this metal and could be used by having tin coating on the surface and this makes the metal more durable.
- ✓ Its high conductivity promotes rapid heat transfer and its cost is also reasonable.

## Aluminum and its alloys:

- ✓ Used in the preparation of milk cans, milk pails, linings for tanks and tankers, etc.
- ✓ Aluminum will not taint the milk and being a Soft metal and light weight, it is very easy to work with this metal.
- ✓ Aluminum alloyed or anodized makes it much more durable.
- ✓ The disadvantage of this metal is difficulty in cleaning due to its porosity, corrosion when alkaline dairy detergents and sanitizers are used.

## Low-carbon steel:

This low carbon steel is widely used for bodies of tanks, vats, bottle-washers, conveyors, etc.

## **Stainless steel:**

- This alloy of iron is most widely used for all milk/ dairy product contact surfaces. The pure iron taints milk/dairy product while stainless steel does not taint.
- Rusting caused to this metal in its pure state is slightly toxic.
- As this is a tough metal, it will presents problems in fabrication.
- Stainless steel is highly durable in the preparation of various dairy equipment.
- Advantages:
  1. Highly resistant to corrosion by common acids and alkalis
  2. Takes high polish and therefore easy to clean
  3. Corroded by brine and chlorine solution
  4. Welding has to be done to repair cracks etc

## **Tin:**

This metal is used mainly as coating for milk/dairy product contact surfaces of cans, vats, etc. It will not taint milk although quite soluble in it.

This metal is too soft to be used for any kind of equipment. Tin coating is not durable as it wears off readily by corrosion, abrasion, etc.

## **Nickel and its alloys:**

This metal is used as a coating for milk/dairy product contact surfaces of pasteurizing vats, coolers etc.

Used in freezing chamber of ice-cream freezers, cylinders and plungers of homogenizers, etc.

It has very slight effect on milk flavour although the most soluble in milk among dairy metals. It is mildly toxic.

**An alloy with iron makes it very tough and is quite difficult to handle during fabrication.**

**It is much more durable than tin coating, but it is more expensive.**

**Lactic acid causes corrosion of this metal however, it is not corroded by the alkaline washing powders.**

**Disadvantage: It is more costly when compared with the chromium and tin.**

## **Chromium and its alloys:**

**This very expensive metal is useful for the coating on various types of equipment. It is mostly used for the milk/dairy product contact surfaces. This metal is non-tainting and is resistant to corrosive action by acid and alkaline cleaners.**

## **CORROSION CONTROL**

**Corrosion cannot be entirely prevented in dairy equipment.**

**The following measures will help in preventing corrosion of stainless steel surface: keep the surface clean, permits surface to air dry and use cleaners and sanitizers in the lowest concentration and for the shortest duration.**

**Stainless steel used extensively in the dairy industry form an invisible film of chromium oxide forms on its surface when the stainless steel is dry and exposed to the atmosphere. This film protects the surface from corrosion. But upon breakage of film, the active metal gets exposed and corrode more easily.**

Equipment should be sanitized with chlorine solutions, preferably just before usage, so as to avoid prolonged contacts.

Milk utensils in villages are commonly made of earthenware, zinc plated or galvanized iron, brass or copper. In the normal milk, copper is bound with the fat as such this metal is not active chemically. Milk when comes in contact with copper, it will dissolve in milk and would exist in active form as copper ions. In the presence of direct sunlight and /or air the copper ions catalyze the hydrolysis of milk fat which an irreversible reaction resulting in off-flavor development. This flavor defect is more in high fat products. Copper salts formed due to the reaction of its ions with milk salts or lactic acid are greenish in colour, quite bitter to taste and is toxic.

**In normal milk iron is present in a chemically bound form. It is largely related to the fat globule membrane and the enzyme proteins. Similar to the copper, milk also dissolves iron when it comes in contact with it and will be forming free ions resulting in the development of off flavors and toxic compounds. Iron will also stain the product contact surface. A common practice prevailing when utensils, cans or buckets made of galvanized iron are to be used for handling milk and milk products, to coat the contact surface with zinc (Zinc plating) but upon long usage these vessels become defective due to wearing off the plating exposing the iron to be in contact with the milk directly.**

**Development of off flavours, discoloration of the products, corrosion of the vessels, formation of toxic compounds are some of the consequences when milk contact surface is made with these metals.**

**Stainless steel is an alloys containing chromium, manganese, silicon and nickel. The most satisfactory materials for the product surfaces is the stainless steel containing 18% chromium, 8% nickel in a low carbon steel. The processing equipment made with surfaces with this alloy are easily cleaned.**