***Food Sciences***

***Lecture 5 Food Processing Equipments***

**(a) Sanitary Design and Material of construction**

 Hygienic or sanitary design of food processing equipment is based on proper selection of material of construction and fabrication techniques.

 Chemical and biological properties also play an important role in designing of equipments in food industries.

 The major problem is corrosion and toxicity of food products due to corrosion.

 pH of food products should also be considered for material selection.

 Stainless steel is widely used for being corrosion resistant.

Three -A have set standard special features for design of equipment to ensure sanitary conditions. These are as follows:

Material, in general, should be 18-8 stainless steel, with a carbon content of not more than 0.12%, or equally corrosion-resistant material.

The gage of metal should be sufficient for various applications.

Product surfaces fabricated from sheets should have a No.4 finish or equivalent.

Square corners should be avoided. Minimum radii are often specified. For example a storage tank must have inside corners of 6.4mm for permanent attachments.

No threads should be in contact with food. Acme threads should be used.

Surfaces should be sopped to provide drainage.

Designs should permit interchangeability of parts.

**(b) Cleaning**

 Cleaning is an integral part of food processing operation.

 The process should ensure the microbiological safety of final products.

 After cleaning, the surface should be washed with hot water and left to dry.

Three –A standards for cleaning in place are as follows:

Using alkali or acid solutions appropriate for the product and equipment surface.

Providing a time of exposure of 10 to 60 min to remove substances without damage to the metal.

Utilizing a velocity of flow of 1.5m/s (1 to 3m/s).

Maintaining a slope of surface and tubing to provide for drainage (5 to 10mm/m).

Avoiding dead ends for flows.

Using connections and joints that are cleanable (welded joints, clamp-type joints, appropriate gaskets).

**(c) Controls:**

 Continuous processes are better than batch operation to save processing cost and for better uniformity.

 Quality control is greatly improved by computer control.

 Cheese plant uses process control computer to regulate process.

**(iii) Food transport:** It involves chemical engineers in designing refrigerated container, for transporting food products from the place of production to the consumers by rail and road carriers.

**(iv) Food preservation** It means preserving final food products for longer use and storage with the help of chemical additives, freezing, drying, inert gas blanketing etc. Preservation operation reduce or eliminate food spoilage.

**Food Additives**

Food additives improve nutritional compositions, flavor and storage stability in food products. It is used in small quantities. Food additives may be categorized with some of their examples. These are categorized according to functional and nutritional benefits provided to food rather than chemical identity of additives. Some of these are summarized as below. **Acidulants:**eg. adipic acid, citric acid, fumaric acid, lactic acid, malic acid, phosphoric acid,tartaric acid.

**Anticaking and free flow agents:**eg. Calcium silicate (CaSiO3), Calcium stearate (C36H70CO4),Magnesium silicate, Magnesium carbonate.

**Antifoaming agents:** eg. Polydimethylsiloxane

**Antioxidants:** eg. Butylatedhydroxyanisole (C11H16O2), Propyl gallate (C10H12O5), Ascorbic acid,Erythorbic acid

**Bulking agents:eg**. Polydextrose

**Coloring agents:** eg. Beet powder, caramel, saffron titanium dioxide and FDA certifiedchemicals

**Dietary fibres:** eg. Cellulose, hemicellulose, pentosans, pectins **Emulsifiers:** eg.Glycerol monostearate, succinylatedmonoglyceride, propylene glycolmonostearate, sodium stearoyl-2-lactylate, polyoxethylenesorbitan, monooleate, lecithin, sucrose esters.

**Enzymes:** eg.Amylase, glucoamylase, lactase, pectin methylesterase, lysozyme, lipase, tryipsin,glucose isomerase, glucose oxidase.

**Fat replacer:** eg.Protein, caprenin, caprylic acid.

**Firming agents:** eg. Calcium chloride, acidic aluminium salts. **Flavors:** eg.Essential oils, fruit juices, aroma chemicals.

**Flavor enhancers:** eg.Monosodium L-glutamate, ammonium glycyrrhizinate.

**Flour bleaching agents and bread improvers:** eg. Benzoyl peroxide

**Formulation aids :**eg.Starches, dextrins, maltodextrin, mineral oils.

**Fumigants:** eg.Propylene oxide, ethylene oxide.

**Gases:** eg. Nitrogen, carbon dioxide

**Humectants:** eg.Polyhydric alcohols.

**Leavening agents:** eg. Sodium bicarbonate

**Non – nutritive sweeteners:** eg.Aspartame, saccharin.

**Nutrient supplements:** eg.Riboflavin, niacin, iron.

**Preservatives :**eg.Benzoates, sorbates, propionates, sulfur dioxide, sulfites.

**Processing aids:** eg. Gelatin, lime

**Solvents:** eg.Ethanol, glycerin, propylene glycol.

**Stabilizers and thickeners:** eg. Gaur gum, carrageenan, cellulose.

**How is effective pasteurization and sterilization processing carried out?**

**Ans :**Heating alters the odor and taste of food and other chemical changes also takes place. Short time-high temperature treatment causes less deterioration than long-time low temperature processes. To provide adequate heat penetration using a short time treatment, agitated cookers are used. Agitation increases the rate of heat transfer from container to food product.

**How effectivelyis freezing processing carried out?**

**Ans:** For preservation of fresh food, food should be frozen very quickly (super cooled) and maintained at enough low temperature to prevent appreciable ice crystal formation. By this way, quality of food does not deteriorate and microorganisms do not increase to great extent. Generally slow freezing produces large ice crystals in the cells of the food which rupture the cells and cause a breakdown of the structure of the food and allows undesirable enzyme reactions even at a very low temperature (-18˚C).

**Why is vacuum evaporation preferred for juice concentration rather than evaporation at atmospheric pressure?**

**Ans:** Vacuum evaporation involves evaporation of water from fruit juices at lower pressures. It is well known that the boiling point of a liquid increases with increasing temperature and hence processing at higher temperature would damage heat sensitive biological compounds in the juice. Therefore, vacuum evaporation will contribute towards achieving the boiling point of juice at temperatures close to the room temperature and thereby safeguard the nutritional content of the fruit juices.

**What characterization methods are applicable for food process technologies ?**

**Ans:** Food chemistry and biotechnology related characterization methods need to be applied for the analysis of the concentration of various species contributing towards flavors and nutrition. Other than this, food process technologies also need to assess upon the toxicity of the processed food along with the maximum allowable shelf time, before the processed food is dangerous for human consumption.