

## ▶ PLASTICIZERS

Many synthetic resins and cellulose derivatives are obtained in the white powdery form or horny tough materials. In these forms their plastic properties are reduced and they do not flow appreciably under the action of heat and pressure; hence can not be processed. Due to these reasons, the applications of these plastic are very limited.

If some plasticizers are added in these plastic materials, their properties can be modified into the workable form.

Plasticizers are high boiling liquid. In some rare cases, it is solid with low volatility, used to toughen and flexibilize a plastic base or to soften it at workable temperatures. The plasticizers are used to develop the ease of fabrication, and to produce the resilient elastic characteristics.

A plasticizer is added when cellulose derivatives and vinyl resins are used in moulding, casting, extrusion or as lacquers. The plasticisers produce flexibility, elasticity and impact strength therefore, they have become an integral part of the resin mixture. Inclusion of **plasticizers** tends to lower Tg and increase polymer flexibility. Plasticizers are generally small molecules that are chemically similar to the polymer and create gaps between polymer chains for greater mobility and reduced interchain interactions. A good example of the action of plasticizers is related to polyvinyl chlorides or PVCs. A uPVC or unplasticized polyvinyl chloride is used for things such as pipes. A pipe has no plasticizers in it because it needs to remain strong and heat resistant.

Plasticized PVC is used for clothing for a flexible quality. Plasticizers are also put in some types of cling film to make the polymer more flexible.

### Properties of Plasticizers

The important characteristics of plasticizers are as :

- (a) Plasticizers are non-volatile solvents. They have the essential properties of high boiling point and low volatility. These properties are important because if the plasticizer evaporates from a plastic or a film then it will revert to its original brittle condition.
- (b) The boiling point of the plasticizers should be above 300°C.
- (c) In general, the plasticizers must be chemically inert, fast to light, resistant to moisture, non-toxic and non-fuming.
- (d) The plastic materials should not contain any smell or taste, because these are also used for packing food materials or beverages.
- (d) Plasticizers should possess basic characteristics, such as, it should be compatible with the polymer, impart flexibility, show permanent retention and be water insoluble and stable in its presence.

### Important Plasticizers

Some important plasticizers are discussed below :

(1) **Camphor** : At present, camphor is produced synthetically from  $\alpha$ -pinene, which is a constituent of turpentine oil. Earlier, it was obtained exclusively from the camphor tree.

Camphor is a transparent, colourless material with a characteristic odour. Its melting point is 175°C and boiling point is 209°C. Its specific gravity is 0.92. For the production of celluloid, camphor is extensively used as a plasticizer. It is also used in explosives and for pharmaceutical purposes.

**(2) Triphenyl Phosphate :** Triphenyl phosphate is the plasticizer which is used in cellulose acetate films and sheets and forms clear and tough products.

Triphenyl phosphate is compatible with oils and resins and is soluble in organic solvents. It is available in white flakes, and contains low melting point (M.P. 45°C) and boiling point 390°C. It has low volatility and is resistant to moisture. Its solubility in water is only 0.001% at 25°C.

**(3) Dibutyl Phthalate :** Dibutyl phthalate is a commonly used plasticizer for almost all plastics. Its formula is  $C_4H_9OOC.C_6H_4.COOC_4H_9[O]$ . Dibutyl phthalate is found in clear liquid form. Its boiling point is 340°C and freezing point is -35°C. It is fast to light and is non-toxic in nature. Its specific gravity is 1.05 at 20°C and solubility in water is only 0.001% at 25°C. It is miscible with all organic solvents and oils. When it is mixed with cellulose acetate, cellulose nitrate, and poly (vinyl chloride), gives tough and clear products.

**(4) Tricresyl Phosphate :** Since tricresyl phosphate is a toxic plasticizer, even then it is the most suitable plasticizer for poly (vinyl chloride). However, care has to be exercised in the use of tricresyl phosphate. It is high boiling liquid, has low volatility, and its specific gravity is 1.18 at 20°C. It freezes at -35°C and its loss on evaporation is negligible. It is almost insoluble in water and is moisture resistant. It is non-inflammable and confers fire resistant properties to polymers. It is compatible with most of the synthetic resins.

**(5) Dimethyl Phthalate :** Dimethyl phthalate is a clear liquid. Its formula is  $CH_3OOC.C_6H_4.COOC_3(O)$ . It is widely used as an additive in cellulose acetate for which it is a good solvent. It is volatile in nature, and is fast to light and is non-toxic.

It is used in the preparation of cellulose acetate dopes, lacquers, and films.

The specific gravity of dimethyl phthalate is 1.20 at 20°C, and boiling point is 285°C. Its solubility in water is 0.3%. It is soluble in many organic solvents. The dimethyl phthalate is compatible with most of the plastic resins and oils.

## ▶ ANTIOXIDANTS

The polymeric materials can easily be deteriorated by oxidative degradation, thermal degradation and photo degradation, and therefore, leading to ageing, weathering and fatigue. The compounds which counteract and oppose these effects are known as additives, such as antioxidants.

A large number of antioxidants have been developed. A few of antioxidants are discussed here in brief manner :

**(a) Chain Breaking Antioxidants :** There are various antioxidants, which work on chain breaking mechanism, and is known as electron donor mechanism as :

