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Introduction

The chain reactions of small molecules called monomers result in macromolecular substances depending on their molar mass which are called oligomers or high polymers. The utility of the properties of polymeric materials depends on

- molecular characteristics of comprising macromolecules;
- arrangement of macromolecules in the system;
- nature and amount of additives—may be low or high molecular substances in liquid or solid state.

These polymers and additives are together called plastics. The primary molecular characteristics of plastics are molar mass, chemical structure (composition) and physical architecture [1]. Plastics are the world's fastest growing family for good reason, namely

- their economy and performance;
- their easy processing.

Surface structures and behavior of plastics affect many crucial properties which include friction, abrasion, wetting, adhesion, penetration and adsorption phenomena. These properties greatly control engineering and surface and are of utmost importance in processing and applications. They also govern transport properties, hence, additives play an important role [1].

Plastics are high molecular weight and have a wide range of mechanical and physical properties. Modern plastics have been seen in a very large range of commercial applications in both industrial as well as consumer products. Plastics have properties such as low density, high strength to weight ratio, good barrier resistance, and readiness to manufacture using a range of processes [2]. However, plastics are intrinsically difficult to process.

Many plastics would simply be of limited use without additives. For successful plastics processing and products, additives are frequently used for a variety of reasons. Numerous products are routinely fabricated with processing technology. This is made possible by the addition of additives to plastics to manufacture commercial-type products. Additives are often combined with plastics through dispersal.

Additives can be defined as a chemical substance which can be put into the polymer in a form in which it is effective, and which will remain long enough to be able to exert its influencing action in processing and the end products life. It is useful to examine solubility in determining additive compatibility. A completely insoluble additive is unlikely to be effective, and therefore solubility is the most important factor in additive compatibility [3].

Additives play an important leading role in the conversion of plastics into products. They enable a cost effective fabrication of mass products such as profile, pipe, and molded products. Plastics and additives are primarily used in melt-mixing procedures to influence processing by injection molding, thermoforming, extrusion, etc.

Additives are chemical compounds used to enhance the life and properties of plastics. They are not chemically bonded, but mechanically dispersed in polymers [4]. The additives used by the plastics industry are sometimes chemically complex compared to the common solvents. Some of them are polymorphous materials. The performance of additives is strongly affected during processing by their thermal history [5].

Plastics tend to undergo degradation during their processing and service life [6]. However, the stability of the plastics depends upon its structure, method of manufacture, and catalyst residues

left behind after the polymerization. The use of additives is dependent on the application and nature of the plastics. Additives can improve the plastics processing conditions by modifying a wide range of characteristics. Since most processing technologies in the modern plastics industry involve hot melt flow, the influence of additives on the rheological properties of molten plastics is of great importance from both the scientific and engineering point of view [7]. However, plastics additives have been hindered by a lack of fundamental understanding.

Customarily additives are added to plastics after polymerization in a step involving mechanical mixing. Therefore, plastics usually contain several additives which are included in the formulation to impart certain desired properties either during processing or subsequently. The effectiveness of additives depends primarily on their ability to interfere with the chemistry either by virtue of chemical reaction or by physical processes. The inherent efficiency of many modern additives is that they are capable of being introduced into the polymer in a form which is active, and can remain in the polymer long enough for their potential effect to be realized.

With technological progress, the introduction of additives to plastics has been based on a matter of trial and error experimentation [8]. The understanding and testing of plastics additives could also be useful during processing as well as end products in service. An accurate and rapid determination of additives is essential for the grading of the product. Methods such as ultraviolet and infrared spectroscopic determination of the samples are routinely used for quality control. However, such methods are not very helpful when additives such as antioxidant and UV stabilizers, or two antioxidants with overlapping frequencies in UV and IR spectrum, are present in the plastics [9].

The need for more powerful analytical techniques has grown exponentially over the last decade to meet the high complexity of polymers and additives. The increased demand for specific required information has become ever more evident in order to achieve the desired level of accuracy and reliability of analytical data. The analysis of plastics and additives requires the combination of powerful separation techniques with sensitive detection [10].

From the laboratory bench tests, performance tests on additives, and practical application in the industry, there appears to be a wide field of utilization in applications where improvements in properties are either mandatory or desirable. Additives with pronounced

chemical properties combined with physical parameters such as appearance, melting or boiling point, etc., are a valuable addition to plastics for processing and improving physical and chemical properties. However, a rapid and accurate method of determining these additives in plastics is needed to control their application in the manufacturing process and in research operations.

1.1 Summary

- Additives are simple chemical compounds, sometimes chemically complex.
- Without the addition of additives, plastics processing is very difficult.
- Additives disperse in plastics and are not chemically bonded. Hence, additives in plastics are mostly a physical mixture.
- Additives are added in small concentrations.
- Additives influence the rheological properties of the plastics melt during processing.

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