

## **Epoxy Resins Update (92S10)**

Epoxy resins form a family of thermosetting resins known for their excellent mechanical and electrical properties, dimensional stability, resistance to high temperatures and numerous chemicals, and their strong adhesion to a variety of materials such as glass, metal, and fibers.

Epoxy resins can be cured by a variety of curing agents including amines, amides, amidoamines, anhydrides, Lewis acids and bases, aminoplasts, phenoplasts, and organometallic catalysts. This diverse curing chemistry allows formulation of a wide variety of epoxy based systems which can be tailored to meet end-use application, performance, and environmental compliance demands.

Currently, much research and development work is geared towards designing new epoxy resins, diluents, and curing agents which allow formulation of zero or low VOC systems. As a result of these efforts the market is shifting away from traditional low solids formulations to more environmentally friendly systems such as waterborne, powder coatings, 100% reactive systems, high solids, and radiation cured coatings and adhesives. This trend is certain to continue and the challenge to raw material manufacturers and formulators is to continue to develop environmentally compliant, cost-effective materials and systems without sacrificing the excellent final properties that epoxies have traditionally delivered.

The **Epoxy Resins Update** report reviews epoxy resin synthesis, curing chemistries and formulations and estimates cost of production for bisphenol A based epoxy resins (DGEBA). The cost of production for the final DGEBA product is determined by starting with the basic building blocks, benzene and propylene, and working forward through cumene, phenol and acetone, bisphenol A and epichlorohydrin.

The successful formulation of epoxy based system requires a good working knowledge of not only the chemistry of epoxy/curing agent blends but also an understanding of the end-use application and property demands. To assist formulators, additives are commonly used in conjunction with epoxy resins and curing agents. These additives or modifiers include solvents (reactive and/or nonreactive), fillers, pigments, flexibilizers, and tougheners.

The major markets for epoxy resins are protective coatings, adhesives, molding, casting

and tooling components, and reinforced plastics. Other markets include building and construction and civil engineering applications.

Global demand for epoxy resins is concentrated in three regions of the world: Western Europe, the United States, and Japan, with triregional demand estimated to be 540,000 metric tons in 1993. Epoxy resin markets are mature and overall growth in demand is expected to mirror growth in economic activity.

Global capacity for epoxy resin capacity is estimated at just over one million metric tons. Three producers, Ciba, Dow, and Shell, the "Big 3," account for over 70 percent of global capacity and tend to dominate the global market. **Epoxy Resins Update** segments the supply/demand outlook on a triregional basis.