Syndiotactic Polystyrene (92S11)

Theoretically, there are three structural forms of polystyrene that can be prepared from styrene monomer: atactic (phenyl rings randomly oriented about the polymer chain), syndiotactic (phenyl rings on alternating sides about the polymer chain), and isotactic (phenyl rings all on one side of the polymer chain).

Atactic polystyrene was first developed and introduced in the 1930s by a number of companies including BASF in Germany and Dow in the United States. This amorphous polymer is the familiar polystyrene of commerce. While the other physical forms of polystyrene were theorized, their actual synthesis proved difficult. This changed in the 1980s with advances in olefin polymerization catalysts, specifically metallocene-based catalysts.

Syndiotactic polystyrene (SPS) is a new form of polystyrene polymer first synthesized in 1985 according to the claims of Idemitsu. The material is particularly interesting in that it offers the potential of overcoming one of amorphous polystyrene's primary deficiencies - a low heat distortion temperature. SPS had been expected to be crystalline in nature, due to its highly regular structure. Tests performed on the polymer have indicated that this is in fact true. The high degree of crystallinity gives the polymer an important feature - a melting point of 270^{o}C, which is in the range of commonly used engineering polymers such as nylon or polyacetal.

Since the first synthesis, considerable work has been performed to perfect the catalyst system, a metallocene catalyst similar to those used in the polyolefins. The work has been performed largely by Idemitsu, which holds a number of composition of matter patents. In 1988 Idemitsu formed an alliance with Dow to jointly develop the material and to begin market introduction in their respective home countries.

This Chem Systems' report discusses the commercial synthesis chemistry of SPS, estimates its cost of production, compares its physical properties versus atactic polystyrene and other engineering polymers, and suggests potential end-use markets based on cost/performance parameters.

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