FUNCTIONAL PRODUCTS INC.

Innovative Chemistry for Lubricants

Technical Note

Mechanisms of Polymer Gelation

Functional Products Inc.

When cooled, a viscosity index improver may solidify at temperatures higher than the freezing point of the diluents because most viscosity improvers are copolymer solutions containing different segments of various levels of solubility. These segments form a network in the solution and prevent the fluid from flowing. This gel condition is acceptable and may be reversed by increasing the temperature.

However, when the copolymers are amorphous or crystalline, a gel may form at room temperature in the solution of copolymers in oil:

- Certain blocks of amorphous copolymers are less soluble in oil. Some amorphous copolymers form rigid domains when cooled from high solubilizing temperature and physical cross-linking of these domains yields a continuous three-dimensional network resulting in gelation. Examples of such amorphous copolymers include styrene-butadiene-styrene and styrene-isoprene-styrene copolymers.

- Semi-crystalline copolymers in oil display the same gelation mechanism as amorphous copolymers. Less soluble crystalline blocks form a three-dimensional network when cooled to room temperature. An example of a semi-crystalline copolymer is an ethylene-propylene copolymer with an ethylene content of greater than 65%.