FUNCTIONAL PRODUCTS INC.

Innovative Chemistry for Lubricants

Technical Note

Polymer Additives for Improvement of Water Spray-off in Lubricating Greases

Functional Products Inc.

Water resistance of grease is an important property for grease used where water exposure is expected. Water contamination of grease diminishes its lubrication performance, and may also lead to washout or loss of rust and corrosion protection. Polymer additives can be added to the grease formulation to improve water resistance. Usually the high molecular weight polymer used in lubricants significantly increases the viscosity of the base oil. However, some types of polymers can form a three dimensional network or interact with the network formed by soap thickener in grease. The polymer network entangles with the fibrous network constructed by soap thickener and forms flexible and reversible interpenetrating networks (IPNs) which can greatly improve the water resistance. Using a polymer with polar functional groups that can interact with the polar end of the soap molecules results in a polymer network that can interact with the soap thickener network. After mixing and cooling, the soap thickener forms a fiberous structure in the presence of the polymer network. These networks interpenetrate, as shown in Figure 1.

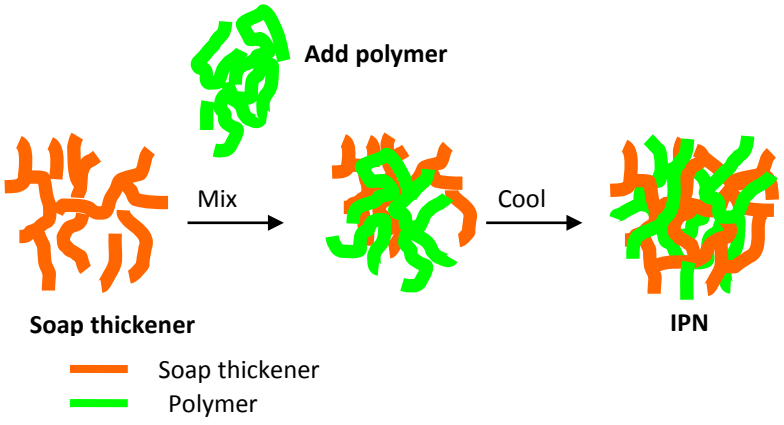

Figure 1: IPN formed by the polymer and soap thickener.

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In grease, this reversible polymer network can be formed in several ways (See figure 2):

1) Physical cross-linking via crystalline phase domains. For example: Semi-crystalline OCPs with high ethylene content have crystalline ethylene phase in the oil. The crystalline phase acts as physical cross-linking sites and the polymer forms a physical gel in the base oil.

2) Physical cross-linking via low oil solubility hard segments in a block copolymer. For example: SEBS block copolymer has styrene blocks with poor solubility in oil. The styrene blocks form hard micro-gel domains in grease, resulting in physical cross-linking of the polymer network.

3) Interaction between functionalized groups on polymer chains with soap thickeners. For example: Maleic anhydride groups in maleic anhydride grafted OCPs can react with basic groups during the soap making process or interact with the soap afterwards.

4) Physical cross-linking via long chain entanglement. For example: High molecular weight polymers including PIB and natural rubber improve both the tackiness of the grease and water resistance.

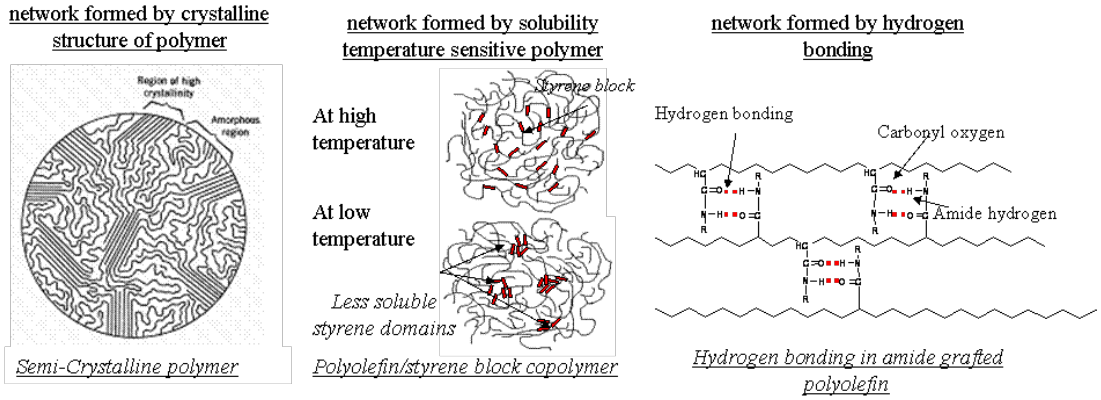

Figure 2: Illustration of polymer networks formed by different ways.

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