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The Synthesis and Characterization of Polyether-Modified Polysiloxane Phosphate

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Abstract	In order to combine the properties of phosphate surfactants and silicone surfactants, the polyether-modified polysiloxane phosphate (PPSP) was prepared. Firstly, the intermediate was synthesized through the hydrosilylation of hydricpolysiloxane and alkyl polyether. Then the polyether-modified polysiloxane phosphate was prepared through the phosphorylation reaction of intermediate and P2O5. The optimum condition of the phosphorylation reaction was the reaction temperature was 80 ° C, reaction time was 3.5h and molar ratio of -OH: P2O5 was 3.0:1.0. The molecular structure of phosphate was characterized by FTIR and 31P-NMR. The components and their capabilities were also studied. The CMC of PPSP was 0.58g/L and the surface tension related was 25.78mN/m, but the foaming power of PPSP is relatively low.
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The Synthesis and Characterization of Polyether-modified Polysiloxane Phosphate

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Abstract: In order to combine the properties of phosphate surfactants and silicone surfactants, the polyether-modified polysiloxane phosphate (PPSP) was prepared. Firstly, the intermediate was synthesized through the hydrosilylation of hydricpolysiloxane and alkyl polyether. Then the polyether-modified polysiloxane phosphate was prepared through the phosphorylation reaction of intermediate and P₂O₅. The optimum condition of the phosphorylation reaction was the reaction temperature was 80°C, reaction time was 3.5h and molar ratio of -OH: P₂O₅ was 3.0:1.0. The molecular structure of phosphate was characterized by FTIR and ³¹P-NMR. The components and their capabilities were also studied. The CMC of PPSP was 0.58g/L and the surface tension related was 25.78mN/m, but the foaming power of PPSP is relatively low.

Introduction

Phosphate ester is prepared by esterification reactions of phosphating reagent and substances containing hydroxyl groups. The detailed reactions are different for different phosphating reagents, such as PCl₃, POCl₃, phosphoric acid, polyphosphoric acid and P₂O₅. Because of low equipment investment and common raw materials, P₂O₅ is commonly used for phosphation in the industrial production. Polyether-modified polysiloxane phosphate (PPSP) is a kind of novel anion silicone surfactant and it is widely used in daily chemical, textile, leather and paper making, because it not only has the properties of hydrophilicity, low surface tension, good softness and lubrication, but has special properties such as low irritation and easy biodegradability which are similar with that of phosphate surfactants [1-2]. There are two ways to prepare this kind of surfactant [3], one is to phosphorylate the polyether-modified polysiloxane (PPS), the other is to phosphorylate the allylterminated polyether firstly, then to form the product through hydrosilylation reaction with hydricpolysiloxane (HS). After phosphating reaction, PPSP takes on excellent antistatic property. The reason is that ionize phosphate side group is introduced into the molecular structure [4-5].

In the study, PPS intermediate was prepared through platinum catalyzed hydrosilylation of hydric-polysiloxane and allylpolyether. The PPSP was prepared through the phosphorylation of PPS. At last, the surface properties, foaming capacity and the structure characterization of PPSP were also studied.

Experimental

Synthesis of PPS

HS was added in a three-mouth flask and the temperature was increased to 80-90°C. Then chloroplatinic acid dissolved in isopropanol was added with nitrogen flowing in. The reaction was kept for 4-5h. During this time, allylpolyether was dropwise added. Then light yellow transparent PPS liquid was obtained after removing the low-boiling residue by low pressure and cooling. The hydroxyl value of PPS was determined according to method provided in previous paper [6].

Phosphating reaction

The PPSP is the mixture of monoester (MAP), diester (DAP) and tialkyl phosphate (TAP). The reaction scheme is shown in Fig.1.

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