Studies on detergency of Poly (sodium α -hydroxyacrylate) and interaction between the polymer and oleic acid

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1. INTRODUCTION

Although various inorganic and organic builders have been used in detergent formulations and the mechanism of their building action in improving detergency performance of surfactants has been studied in many view points, the building action is probably not attributable to any single physical or chemical effect. Furthermore, there are few reports which investigate the detergency performance of the builders, especially polymer builders, even though they have been known to improve detergency performance. It is important to investigate the detergency performance of the substance as a builder.

In the previous work,[1] it has been reported that poly (sodium α - hydroxyacrylate) ; PHA has excellent detergency performance for artificially soiled cotton fabrics with multi-components. And now it is needed to investigate the effect of PHA on the removal of each soil component.

In this paper, we introduce DSC as a quantitative analysis method which is able to study detergency with PHA for oleic acid, which is one of the most common fatty acids found in the sebum of human body.

2. DIFFERENTIAL SCANNING CALORIMETRY (DSC)

Differential Scanning Calorimetry (DSC) is a thermoanalytical technique for monitoring the changes in physical or chemical properties of material as a function of temperature by detecting the heat changes associated with such processes. In DSC, the principle of the method is to compare the rate of heat flow to the sample and to an inert material which are heated or cooled at the same rate. Changes in the sample that are associated with absorption or evolution of heat cause a change in the differential heat flow which is then recorded as a peak. The area under the peak is directly proportional to the enthalpy change and its' direction indicate whether the thermal event is endothermic or exothermic. The method is only one of a family of related techniques the principal of which are DTA (differential thermal analysis), TG (thermalgravimetry) and DSC. DSC has long been applied for researching the properties of inorganics, organics and industrial processes. In food research, for example, DSC has been a popular tool for investigating the thermodynamic properties of components such as lipid, carbonates, proteins and water in food systems.[2] And also it has been used for researches of the structures and properties of mixture of water and oil and for thermal analysis of polymer.[3][4][5][6]

In detergency research, Yatagai in our laboratory has studied liquid crystalline of oily substances and sodium dodecyl sulfate (SDS) with DSC[7] and suggested DSC as a new method to examine for washing process of fibrous materials.[8]

3. EXPERIMENT AND RESULT

Effect of removal with PHA for oleic acid and their interaction were investigated by DSC. A filter papers were cut to be 0.5 cm in diameter, soiled with 2 μl of oleic acid and washed in a solution of PHA or SDS under various conditions of time, temperature and concentration. The amount of oleic acid left on the filter paper after washing under various conditions was measured by DSC. In other words, the effect of removal with PHA was investigated by DSC and compared to that with SDS.

Fig. 1 shows the change of peaks of oleic acid left on filter papers after washing with PHA solution at various temperatures. Two peaks in every curve observed near 13.3 ℃ and between 15 ℃ and 22 ℃. Peak P1 is original melting point of oleic acid and becomes broader and smaller with the increase of temperature. But a new peak P2 appears

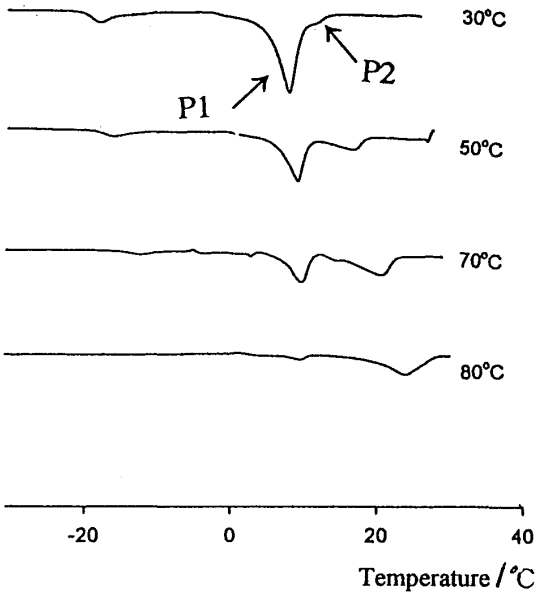

Fig. 1 Change of peak of residual oleic acid on the filter paper after washing with PHA solution at various temperatures and then dried.

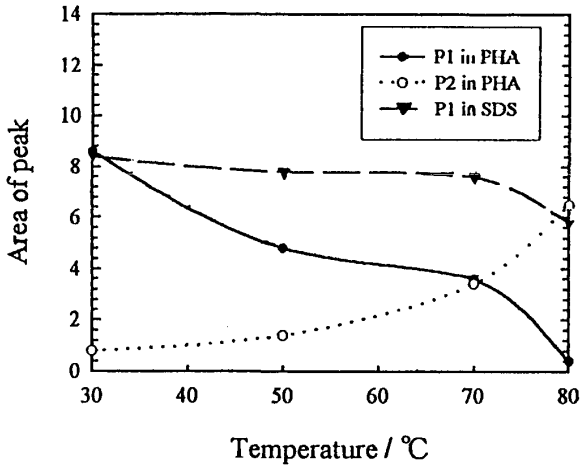

Fig. 2 Peak area of oleic acid and complexes of PHA and oleic acid left on the filter papers washed with 0.2% PHA or SDS solution for 10 min. and then dried.

near 16 ℃ after washing at the temperature of 30 ℃. P2 becomes bigger and shifts toward the higher temperature with the increase of washing temperature. This inclination was the same as those of change of peaks of oleic acid left on the fabrics washed with PHA solution under various conditions of concentration and time.

The values of peak area obtained from fig. 1 are plotted in fig. 2. The smaller the area of the peak, the larger the effect of removal of oleic acid. In the case of SDS, the peak area of oleic acid left became smaller with the increase of temperature. It is well known that temperature affects to the removal of oleic acid with surfactants in detergent solution. The area of peak P1 of oleic acid in the case of PHA solution became much smaller than that in SDS solution. It means that original oleic acid on the filet papers washed in PHA solution is much less than that in SDS solution on the equal basis of washing conditions. But area of a new peak P2 which is considered probably as a complex of PHA and oleic acid becomes bigger and bigger with the increase of temperature. It is very interesting to realize the existence and the change of a complex made on the washed filter paper by DSC observation, because these phenomena cannot be observed by other analysis methods such as Gas chromatography and Liquid chromatography.

In the present point, any conclusion is not yet obtained for the removal effect of PHA but it is certain that there are some interactions between PHA and oleic acid. In further work, we are going to investigate the removal effect of PHA under more various conditions and the interaction of PHA and oleic acid.

4. REFERENCE

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