Investigation of antifoaming activity of Pluronic type triblock copolymer.

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Introduction

Foam control is highly needed in most consumer and industrial products. For some applications, large volume of foam is needed but for other applications it has to be decreased. To supress foam formation, surfactants or antifoam agents are used. In Chemistry, If a small addition of antifoams results in a much reduced foam formation, it is considered as the most efficient foam control. In this study, a correlation between the antifoaming activity and structural properties of Pluronic type triblock copolymers was investigated to make it possible to design better copolymers with improved efficiency and better selection chain sizes suitable for specific applications. The effect of structural properties to the antifoaming activity was examined by characterizing and analysing various EO-PO triblock copolymers.The characterization was carried out by MALDI-TOF MS method.

Experimental

For the first part of the experiment,antifoaming activity was investigated, a graduated cylinder together with a pump was used for liquid circulation. The solution was sucked from the bottom of the cylinder and poured back at the top through a nozzle. As the solution circulated, dynamic foam was formed. The height of the foam was recorded every after 2min for 0.1M,0.075 M,0.05 M,0.035M,0.02M,0.01Mand 0.001M concentrations.All the experiments were carried out based on the standard measuring procedure of ASTM D1173-07.

During the characterization of copolymers, the measurements of polymers were challenging since the presence of numerous compounds overlaps, furthermore,there is a high accuracy criterion of the evaluation.However,some special data handling methods make it possible to determine detailed polymer quantities.

Results and discussion

In order to identify polymer property-structure relation,antifoaming activity was tested by measuring the height of the foam of different pluronics at different concentrations.
Table 1 shows the data obtained from triblock copolymer characterization.

	Mn	Mw	Mw/Mn	m%PO	m%EO
Pluronic 31R1	3483	3515	1.01	82.46	17.54
Pluronic RPE 3110	3394	3427	1.01	84.25	15.75
Pluronic RPE 1720	2081	2121	1.02	75.95	24.05
Pluronic 17R4	2797	2824	1.01	58.16	41.84
Pluronic RPE 1740	2412	2437	1.01	56.28	43.72

Table 1: Polymer quantities of different Pluronic.

Figure 1 represents the blank sample with zero concentration . As it can be seen, the foam height remained at 20.1cm for 1min,3min and 5min. However, for RPE 31R1,RPE 3110,RPE1720 and RPE1740 Pluronic (figure 2) a decrease in foam height at different concentrations can be observed, clearly suggesting that change in concentration has some positive effect in the antifoaming activity.

In Figure 2, some copolymers prove to have a good antifoaming activity i.eRPE 3110 with foam height almost at zero even at low concentrations.While other copolymers showed no antifoaming activity i.e RPE1740 with a constant foam height even at high concentration 0f 0.1M.

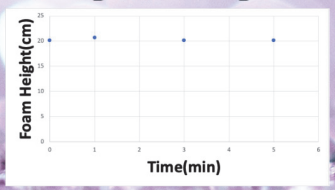

Figure 1: Dynamic foam height vs time for the BLANK sample.

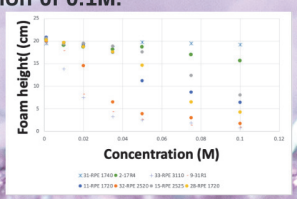

Figure 2: Dynamic foam height vs concentration for different pluronic.

Structural properties were investigated to see how they affect the antifoaming activity. For example,figure 3 explicitly shows that when ethylene oxide content increases, so does the foam height.

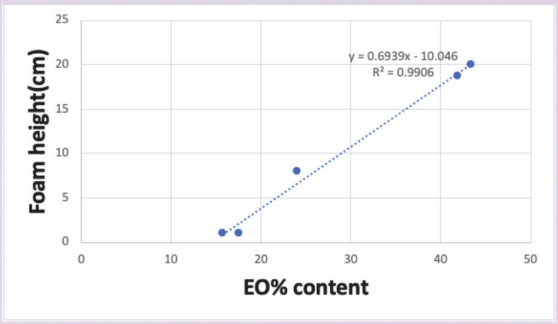

Figure 3: Foam height (at 0.1M,1min) vs ethylene oxide content for RPE 1720 31R1,RPE 3110,RPE 17R4 and RPE1740 Pluronic.

The absolute chain length of propylene oxide for different polymers was looked into.In order to investigate the effect of absolute chain length,same concentration of 0.1M and 1min for all five copolymers was selected.In figure 4,the deviation is quite apparent thus a weak correlation is observed.

Absolute chain length=mass% of PO*MW

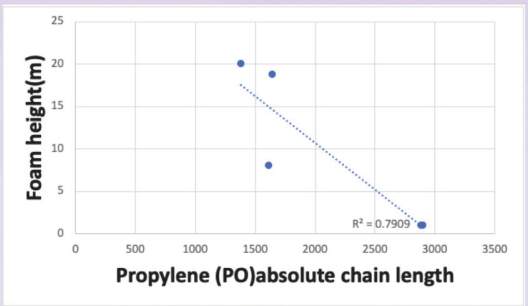

Figure 4: Absolute chain length vs foam height.

Polymers with high PO% content showed much reduced foam height (figure4). It can also be seen that even polymers with the same molecular weight do not have the same foam height,the EO% content present decreases the foam height.

Conclusion

Antifoaming activity was successfully investigated by measuring the foam height. Most of these copolymers have good antifoaming activity even at low concentrations while other pluronic showed constant foam height indicating poor to no antifomaing activity.

When the structure property was further analyzed,it was clear that compounds with low EO% content are good antifoaming. Polymers with higher absolute lengths are preferrable as antifomaing agents.

Acknowledgments

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