Application of biosurfactant tea saponin in flotation separation for ternary plastic mixtures : statistical optimization and mechanism analysis

Yue Zhao[a], Fengrong Han[b], Izzeldin Ibrahim Mohamed Abdelaziz[b], Xinni Liu[b], Kamarul Hawari Ghazali[b], Puranjan Mishra[c]

[a] Shaanxi Key Laboratory of Disaster Monitoring & Mechanism Simulating, College of Geography and Environment, Baoji University of Arts and Sciences, Baoji, 721013, China

[b] Faculty of Electrical and Electronics Engineering, Universiti Malaysia Pahang, Pekan, 26600, Malaysia

[c] Faculty of Engineering and Technology, Universiti Malaysia Pahang, Kuantan, 26300, Malaysia

ABSTRACT

Plastics flotation is facilitated to the sustainable development and cleaner production of the industry. Biosurfactant tea saponin was first applied to a flotation process for ternary plastic mixtures so as to minimize the secondary pollution. Response surface methodology was utilized to optimize such process by considering variable interactions and multi-objects. Mechanism of wetting selectivity was clearly established with the assistance of interfacial free energy and characterization. Results showed that the tea saponin in cooperation with polyethylene glycol can be an eligible substitution of traditional reagents used in polyethylene, acrylonitrile-butadiene-styrene and thermoplastic rubber system. For multi-objective optimization of purity priority, the solution was predicted as polyethylene glycol concentration of 8.43 mg/L, tea saponin concentration of 50.00 mg/L, conditioning time of 7.36 min, air flow rate of 180.55 L/h and stirring intensity of 1179.72 rpm. The purity and recovery of polyethylene product could reach 98.31 and 95.18% in validation tests, respectively. For reverse optimization of recovery priority, the purity and recovery of polyethylene product were also satisfactory in validation tests with 90.36 and 99.36%, respectively. The essence of wetting selectivity is the hydrogen bond (O–H···π*) between specific plastics and tea saponin, providing a referential direction for the development of new targeted reagents.

KEYWORDS

Plastics; Flotation; Tea saponin; Response surface methodology; Wetting selectivity

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