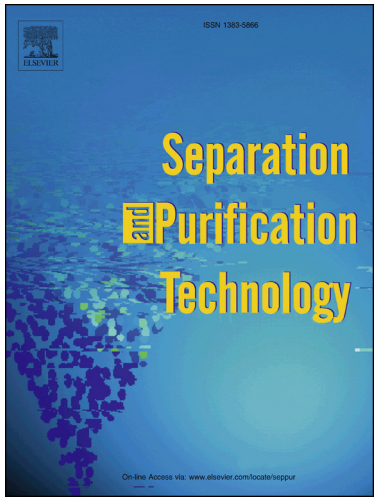

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High-speed particle rotation for coating oil removal by hydrocyclone

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Abstract: Hydrocyclone not only achieves centrifugal separation of solids and liquids but also purifies oil-coated particles through rotational shear flow, resulting in high-speed particle rotation. This study develops a method to detect microsphere rotation assisted by microfluidic and high-speed imaging techniques. The developed method is applied to investigate the intensification mechanism of particle rotation on de-oiling oil-coated particles by using hydrocyclone. Results show that the microspheres exhibit high rotation speed of more than 1000 rad/s when translating near the wall. The conical structure and inlet flow rate of hydrocyclone significantly affect the magnitude and distribution of rotation speed in the equipment. An experiment on de-oiling real oil-coated spent catalysts verifies the de-oiling intensification of the hydrocyclone, with the de-oiling efficiency being promoted by a minimum of 12.87% based on stirred hydrothermal tank. The de-oiling intensification mechanism is attributed to the strong resultant centrifugal force, whose direction periodically changes because of particle rotation and revolution. Overall, this study provides guidance for the design of washing hydrocyclones for oil-coated particles.

Keywords: Particle rotation; Oil-coated particle; Hydrocyclone; Swirling shear flow; Solid/liquid separation

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