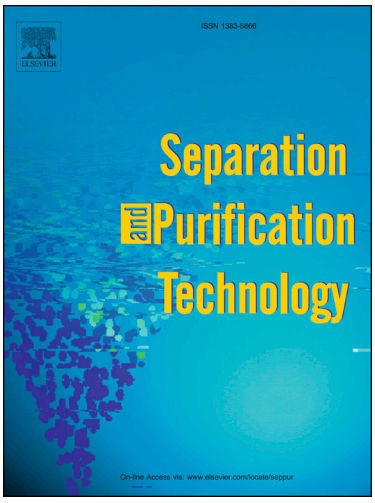

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Analysis of the effect of vortex on the flow field of a cylindrical cyclone separator

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Abstract

This study presents a new method to analyze the vortex of cyclone separator by using the vortex identification of *Q* criterion. The Phase Doppler Particle Analyzer (PDPA) is used to measure the flow, and the numerical simulation is done by using the Reynolds stress model (RSM). In addition, a new conception of iso-vortex surface according to *Q* criterion is proposed for identifying the vortex structure. Since the model is validated by agreement between the numerical results and experimental data, and then is used to analyze the flow field. The results show that the tendency of the vortex structure is intuitive according to the new iso-vortex surface. Equivalent diameter of the iso-vortex surface is large in the upper region of the cylinder and decreases along the axis downward. The carrier energy of vortex decay gradually. In the process, vortex develops rapidly, even ruptures. Meanwhile, the vorticity magnitude has a sudden change near *r*/R=0.93, and then vorticity magnitude rises up sharply. The vortex line of relative stable region is almost circular distribution, while the vortex line is complex at the upper region of cylinder, which has a hierarchical trend. The trend of the vortex center deviating from the geometric center firstly increases, reaches a peak value, and then reduces gradually. The axial position of peak value increases with the increase of velocity. Furthermore, the vortex structure can be appropriately adjusted to improve the flow instability, which is highly significant.

Key words: Cyclone separator; Vortex; *Q* criterion; Iso-vortex surface; Vorticity magnitude

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