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Separation-and-Recovery Technology for Organic Waste Liquid with a High **Concentration of Inorganic Particles**

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ABSTRACT

The environmentally friendly and resourceful utilization of organic waste liquid is one of the frontiers of environmental engineering. With the increasing demand for chemicals, the problem of organic waste liquid with a high concentration of inorganic pollutants in the processing of petroleum, coal, and natural gas is becoming more serious. In this study, the high-speed self-rotation and flipping of particles in a three-dimensional cyclonic turbulent field was examined using a synchronous high-speed camera technique; the self-rotation speed was found to reach 2000–6000 rad s^{-1} . Based on these findings, a cyclonic gas-stripping method for the removal of organic matter from the pores of particles was invented. A technological process was developed to recover organic matter from waste liquid by cyclonic gas stripping and classifying inorganic particles by means of airflow acceleration classification. A demonstration device was built in Sinopec's first ebullated-bed hydro-treatment unit for residual oil. Compared with the T-STAR fixed-bed gas-stripping technology designed in the United States, the maximum liquid-removal efficiency of the catalyst particles in this new process is 44.9% greater at the same temperature, and the time required to realize 95% liquid-removal efficiency is decreased from 1956.5 s to 8.4 s. In addition, we achieved the classification and reuse of the catalyst particles contained in waste liquid according to their activity. A proposal to use this new technology was put forward regarding the control of organic waste liquid and the classification recovery of inorganic particles in an ebullated-bed hydro-treatment process for residual oil with a processing capacity of 2×10^6 t $\cdot a^{-1}$. It is estimated that the use of this new technology will lead to the recovery of $3100 \text{ t} \cdot \text{a}^{-1}$ of diesel fuel and 647 t $\cdot \text{a}^{-1}$ of high-activity catalyst; in addition, it will reduce the consumption of fresh catalyst by 518 t a^{-1} . The direct economic benefits of this process will be as high as 37.28 million CNY per year.

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