Article

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

Hualin Wang, Pengbo Fu, Jianping Li, Yuan Huang, Ying Zhao, Lai Jiang, Xiangchen Fang, Tao Yang, Zhaohui Huang, Cheng Huang

PII: S2095-8099(17)30813-5
DOI: https://doi.org/10.1016/j.eng.2018.05.014
Reference: ENG 79

To appear in: *Engineering*

Received Date: 12 December 2017
Revised Date: 2 March 2018
Accepted Date: 15 May 2018

Please cite this article as: H. Wang, P. Fu, J. Li, Y. Huang, Y. Zhao, L. Jiang, X. Fang, T. Yang, Z. Huang, C. Huang, Separation-and-Recovery Technology for Organic Waste Liquid with a High Concentration of Inorganic Particles, *Engineering* (2018), doi: https://doi.org/10.1016/j.eng.2018.05.014

Engineering 4 (2018) xxx-xxx

Research
Green Industrial Processes—Article

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

Hualin Wang [a,*], Pengbo Fu [a], Jianping Li [a], Yuan Huang [a], Ying Zhao [b], Lai Jiang [c], Xiangchen Fang [d], Tao Yang [d], Zhaohui Huang [e], Cheng Huang [e]

[a] *National Engineering Laboratory for Industrial Wastewater Treatment, East China University of Science and Technology, Shanghai 200237, China*
[b] *Sinopec Luoyang Petrochemical Engineering Corporation, Luoyang 471003, China*
[c] *Sinopec Jinling Petrochemical Corporation, Nanjing 210033, China*
[d] *Sinopec Dalian (Fushun) Research Institute of Petroleum and Petrochemicals, Fushun 113001, China*
[e] *Sinopec Zhenhai Refining and Chemical Company, Ningbo 315207, China*

* Corresponding author.
E-mail address: wanghl@ecust.edu.cn

ARTICLE INFO
Article history:
Received 2 December 2017
Revised 2 March 2018
Accepted 15 March 2018
Available online

Keywords:
Organic waste liquid
Inorganic particles
Cyclonic gas stripping
Particle self-rotation
Airflow acceleration classification

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·a^{-1}. It is estimated that the use of this new technology will lead to the recovery of 3100 t·a^{-1} of diesel fuel and 647 t·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.