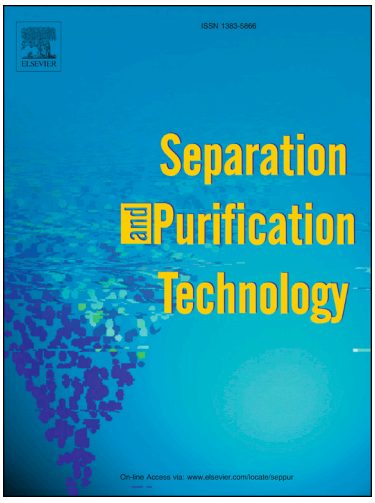

Simulation on performance of a demulsification and dewatering device with coupling double fields: swirl centrifugal field and high-voltage electric field

Haifeng Gong, Bao Yu, Fei Dai, Ye Peng, Jiaru Shao

PII: S1383-5866(18)30820-7
DOI: https://doi.org/10.1016/j.seppur.2018.06.049
Reference: SEPPUR 14703

To appear in: *Separation and Purification Technology*

Received Date: 12 March 2018
Revised Date: 11 June 2018
Accepted Date: 18 June 2018

Please cite this article as: H. Gong, B. Yu, F. Dai, Y. Peng, J. Shao, Simulation on performance of a demulsification and dewatering device with coupling double fields: swirl centrifugal field and high-voltage electric field, *Separation and Purification Technology* (2018), doi: https://doi.org/10.1016/j.seppur.2018.06.049

Simulation on performance of a demulsification and dewatering device with coupling double fields: swirl centrifugal field and high-voltage electric field

Haifeng Gong [a, b], Bao Yu [b,*], Fei Dai [b], Ye Peng [a], Jiaru Shao [b]

[a] *Engineering Research Centre for Waster Oil Recovery Technology and Equipment of Ministry of Education, Chongqing Technology and Business University, Chongqing 400067, China*

[b] *School of Mechanical Engineering, Chongqing University of Technology, Chongqing 400054, China*

Abstract: Demulsification and dewatering of emulsion oil are common in petroleum and chemical industries. For waste lubricating oil, as a common W/O emulsion, with high water content and complex construction, the multi-field coupling or integration technology can satisfactorily accomplish oil and water separation which cannot be realized by using a single technological method. A coupling device integrated swirl centrifugal and high-voltage electric fields are proposed. Water-droplet coalescence in emulsified oil under the high-voltage electric field can enlarge the droplet size, and the swirl centrifugal field can rapidly and efficiently achieve water-droplet separated from emulsified oil. In this study, the performance of the coupling device was investigated by using numerical simulation and experimental methods. The numerical results were in agreement with the values obtained by experimental methods. And the numerical results show that the dewatering and deoiling rates of overflow and outflow orifices increased by 4.5% and 6.2%, respectively, when voltage amplitude 10 kV increases to 11 kV. Moreover, when inlet velocity increased from 8 m·s^{-1} to 12 m·s^{-1}, the separation efficiency gradually decreased. In conclusion, the results demonstrate that the double-field coupling device has a greatly performance at 11 kV and 8 m·s^{-1}.

Keywords: numerical simulation; coupling device; performance; double-field

1 Introduction

With the development of industrial technologies, the consumption of lubricating oil increases yearly in the mechanical, transportation, and chemical engineering fields, thereby producing a considerable amount of waste lubricating oil, which has considerable significance for environmental protection and alleviating energy shortage by using certain methods to effectively dispose of waste oil [1, 2]. Demulsification and dewatering of emulsion oil are important technological links in the treatment process [3]. Several treatment methods are currently available, such as chemical, centrifugation, dissolved air flotation, electro-flotation, membrane process, ultrafiltration, electric, and biological demulsification [4-6]. Owing to the cost, energy, and time consumption of each method, the future development trend lies in the combination of two or more methods to efficiently achieve separation process and improve treatment results [7]. Therefore, a coupling device integrated swirl centrifugal and high-voltage electric fields are proposed [8]. The structure diagram of the coupling device is shown in Fig. 1. The bi-cone type hydrocyclone is used as the body structure of the coupling device. The overflow pipe is connected to the positive pole of the high voltage source, and the swirl chamber wall of the coupling device is connected to the

* Corresponding author.
E-mall address: baoyu_1994@163.com (B.Yu).