Integration Strategies of Hydrogen Network in a Refinery Based On Operational Optimization of Hydrotreating Units

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Integration strategies of hydrogen network in a refinery based on operational optimization of hydrotreating units☆

Le Wu[1], **Xiaoqiang** Liang[1], **Lixia** Kang[1], **Yongzhong** Liu[1,2,]*

[1] Department of Chemical Engineering, Xi'an Jiaotong University, Xi'an, Shaanxi, 710049, P. R. China

[2] Key Laboratory of Thermo-Fluid Science and Engineering, Ministry of Education, Xi'an, Shaanxi, 710049, P. R. China

Abstract: Inferior crude oil and fuel oil upgrading lead to escalating increase of hydrogen consumption in refineries. It is imperative to reduce the hydrogen consumption for energy-saving operations of refineries. An integration strategy of hydrogen network and an operational optimization model of hydrotreating (HDT) units are proposed based on the characteristics of reaction kinetics of HDT units. By solving the proposed model, the operating conditions of HDT units are optimized, and the parameters of hydrogen sinks are determined by coupling hydrodesulfurization (HDS), hydrodenitrification (HDN) and aromatic hydrogenation (HDA) kinetics. An example case of a refinery with annual processing capacity of eight million tons is adopted to demonstrate the feasibility of the proposed optimization strategies and the model. Results show that HDS, HDN and HDA reactions are the major source of hydrogen consumption in the refinery. The total hydrogen consumption can be reduced by 18.9% by applying conventional hydrogen network optimization model. When the hydrogen network is optimized after the operational optimization of HDT units is performed, the hydrogen consumption is reduced by 28.2%. When the benefit of the fuel gas recovery is further considered, the total annual cost of hydrogen network can be reduced by 3.21×10^7 CNY·y^{-1}, decreased by 11.9%. Therefore, the operational optimization of the HDT units in refineries should be imposed to determine the parameters of hydrogen sinks base on the characteristics of reaction kinetics of the hydrogenation processes before the optimization of the hydrogen network is performed through the

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* To whom correspondence should be addressed.