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Optimization of a crude distillation unit using a combination of wavelet neural network and line-up competition algorithm

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Abstract: the modeling and optimization of an industrial-scale crude distillation unit (CDU) is addressed. The main specifications and base conditions of CDU are taken from a crude oil refinery in Wuhan, China. For modeling of a complicated CDU, an improved wavelet neural network (WNN) is presented to model the complicated CDU, in which novel parametric updating laws is developed to precisely capture the characteristics of CDU. To address CDU in an economically optimal manner, an economic optimization algorithm under prescribed constraints is presented. By using a combination of WNN-based optimization model and line-up competition algorithm (LCA), the superior performance of the proposed approach is verified. Compared with the base operating condition, it is validated that the increments of products including kerosene and diesel are up to 20% at least by increasing less than 5% duties of intermediate coolers such as second pump-around (PA2) and third pump-around (PA3).

Keywords: crude oil distillation; wavelet neural network; line-up competition algorithm; optimization

1 INTRODUCTION

Distillation of crude oil is regarded to be one of the most fundamental process in petroleum refining and petrochemical industries, where the crude oil is separated into different products each with specific boiling range. In response to the highly competitive market and stringent environmental laws, improving the operation level of crude oil distillation unit (CDU) is essential. In fact, the optimization of CDU system is beneficial to simultaneously achieve well-controlled and stable system, high production rate and product quality as well as low operation cost for the economic consideration. Therefore, the engineering design, control strategy and process optimization of a CDU has been paid attention to improve product efficiency and quality assurance in petroleum industry in recent years [1].

As one of the most complicated operations in the field of chemical separation processes, the operation input and output variables amongst the CDU are highly interacted, which undoubtedly increase the difficulty in

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