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Calculation of optimal ratios between temperature and hydrogen containing gas consumption in the catalytic dewaxing process by using the mathematical model

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One of the most fast-evolving processes of advanced petroleum refining is the catalytic hydrodewaxing process. The feedstock for the process is a mixture of atmospheric gasoil and straight-run diesel fraction. The process is aimed to produce winter grade and arctic diesel fuel which meet the Euro-5 standard for diesel fuel quality.

The technology of the process includes several stages. Firstly, the mixture of atmospheric gasoil and diesel fraction is hydrotreated. After that it is undergone hydrocracking and hydroisomerization on dual functional Ni-containing catalyst. Then the product obtained in the reaction section is stabilized and rectified to produce end products, such as stable gasoline, which is further processed at catalytic reforming unit; components for trade diesel fuel production; and residue, that is used as fuel oil for industrial plant needs.

The purpose of the hydrodewaxing process is to convert long chain n-paraffins (from 10 to 27 carbon atoms) into short chain iso-paraffins (from 5 to 9 carbon atoms) in order to produce winter grade and arctic diesel fuel. Low temperature characteristics of diesel fuel depend on concentration of long chain n-paraffins [1]. As lower concentration of long chain paraffins is than lower cloud point and freezing temperature are.

In the hydrodewaxing process it is crucial to maintain the excess of hydrogen in circulating gas as fresh hydrogen injected simultaneously with the feed is intensively consumed in chemical reactions of hydrocracking. The hydrogen circulation rate is as higher as heavier the feed is and higher conversion degree is as well as lighter obtained products are.

The hydrogen consumption significantly influences the exploitation expenses as well. For these reasons optimal hydrogen containing gas maintenance depending on the feedstock flow rate is vital in order to achieve cost-effectiveness and resource efficiency of the plant

To estimate the optimal ratio between operating temperature and hydrogen containing gas consumption depending on the feedstock flow rate the mathematical model [2] was developed and effectively applied.

Figure 1 provides the ratios between hydrogen containing gas consumption and temperature which ensure maintaining the long chain normal paraffins concentration at the level of 9 wt%. for six values of feedstock consumption.

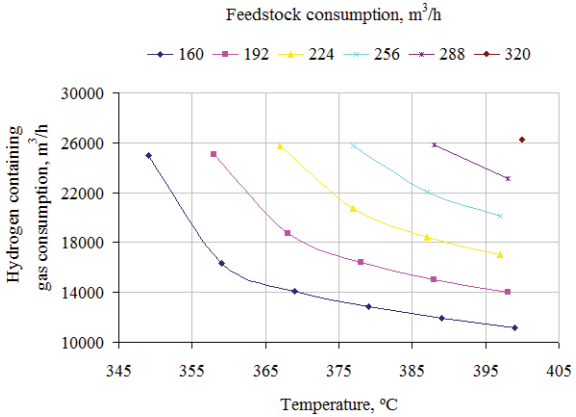

Fig. 1. *The temperature and hydrogen containing gas consumption required to maintain n-paraffins C_{10}–C_{27} concentration at the level 9 wt % depending on feedstock consumption*

So, the higher the temperature in the reactor is the lower hydrogen containing gas consumption is required to obtain the product that meets desired low temperature characteristics.

The process should be operated at optimal ratio between temperature and hydrogen containing gas consumption depending on feedstock consumption to safe resource of the plant.

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