solidifying in the presence of activators at high temperatures. Chemical composition of cindery waste shows that the major part of ash consists of aluminium, silica, potassium and ferrum oxides. The content of ferrum oxides makes ash valuable raw material for ferrous and nonferrous industries and for an agricultural sector, where it used as an inorganic fertilizer.

References

1. Vlasova V.V. Production engineering of complex extraction of valuable components from cindery waste of Irkutsk state district power station. Dissertation… PhD.– Irkutsk, 2005.– 182 p.
2. Vinogradov B.N., Vysotskaya O.B. Methods of ash quality assessments / Solid fuel chemistry, 1990.– №4.– P.139–143.

Mathematical model developing of heat exchanger block in low temperature separation scheme

N.V. Popova
Scientific supervisor – Associate Professor, E.A. Kuzmenko
Linguistic advisor – English instructor, I.E. Rymanova

National Research Tomsk Polytechnic University
Russia, 634050, Tomsk, 30 Lenin Avenue, natalies.popova@gmail.com

At the present time one of the most urgent and perspective problem in industry is gas fuel production. It is associated with number of factors, and the main one is gradual depletion of world oil reserves. According to the British Petroleum data at the year 2013 end Russia is known to be the second world leader on natural gas deposit (16,8 %). High-quality gas treating is to be a complex and demanding challenge, which includes using of modern technologies and equipment, that meet the requirements and standards of gas quality.

As a rule, gas produced from wells contains dropping liquid, consequently, gas has to be drained preliminary. Essential technology for gas dehydration is a low temperature separation technology. Purpose of this technology involves the droplets capture by reducing the gas temperature to approximately –30 °C. Reduction of temperature is achieved through the effects of isenthalpic (using ejector units or choke valves) and isentropic (using turbo-expanders) gas expansion. Also it is possible to apply recuperative heat exchangers.

This work is devoted to the mathematical model developing for calculation of heat exchanger block in a low temperature separation scheme.

Technological scheme provides cooling of raw gas fluid before the second and third separation stages with the counter current flow of the cooled gas after the third separation stage [3]. For forecasting gas treatment results, taking into account the thermodinamically affordable values of separators inlet temperatures, it is necessary to calculate a closed technological circuit with the heat exchanger block.

Process modeling is based on the equation of heat balance and the main heat-transfer equation with the impact of heat transfer agent compositions on the thermo-physical properties [1]. One should pay attention to the fact that fluid massflow in the apparatus is constant

The heat balance equation involves multiplication of mass flo , heat capacity and temperature difference of gas. Heat capacity of real gases can be calculated according to the rule of additivity, as the gas contains about 17 components including a C6+ fraction. Also, calculation of heat capacity should be provided with special pressure correction factor ΔC_p due to sufficiently high values of pressure in separators (5.5 MPa and 13.9 MPa). At this rate, heat capacity of each component was counted using the Rid empirical equation [2]:

$$Cp_i = (A_i + B_i T + C_i T^2 + D_i T^3)\,4.1887$$

Where A_i, B_i, C_i, D_i are empirical coefficients obtained by experimental methods.

The values of the obtained outlet temperatures in one of the heat exchangers are provided in the table below.

Table 1. Values of fluid outlet temperatures in the heat exchanger 1

Hot gas fluid		Cold gas fluid	
experimental T_{outlet}, °C	calculated T_{outlet}, °C	experimental T_{outlet}, °C	calculated T_{outlet}, °C
2.62	2.95	5.31	5.06

According to the obtained results it is possible to make conclusion that developed mathematical model can be used in calculation of fluid properties in critical conditions of low temperature separation technology and heat processes in a closed technological scheme.

References

1. Ivanchina E.D., Abramin A.L., Block calculation principle of chemical engineering systems.– Tomsk: TPU, 2004.
2. Rid R., Prausnitz J., Sherwood T. The properties of gases and liquids.– L.: Chem-

istry, 1982.– P.592.
3. Vasilyev G.G., Gulkov A.N., Zemenkov U.D. Exploitation of equipment and objects of gas production. Book 1.– M.: Infra-Engineering, 2008.– P.608.

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

A.Yu. Pronevich
Scientific supervisor – Assistant lecturer, N.S. Belinskaya

National Research Tomsk Polytechnic University
Russia, 634050, Tomsk, 30 Lenin Avenue, pau08@mail.ru

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