Fig. 1. *Cobalt ferrite ($CoFe_2O_4$) obtained by sol-gel auto combustion method*

amount of ammonia was added to the solution in order to modify the pH value to about 7–8 [3]. Then solution was stirred on a magnetic stirrer heated for 1 hour. Continuously, after they were heated in a drying cabinet and at a temperature of 130–550 °C combustion occurred (Figure 1).

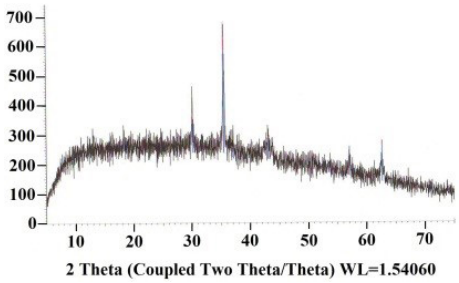

Fig. 1. *Diffractogram of cobalt ferrite obtained by sol-gel combustion method*

The specific surface area of the obtained powder was determined by low temperature nitrogen adsorption by the BET method and as a result showed 12 m^2/g. X-ray phase analysis of the product was carried out on a Phaser D2 automatic diffractometer (Bruker).

X-ray phase analysis showed that following the results of the synthesis by the sol-gel method both ferrite $CoFe_2O_4$ is formed and cobalt iron oxide ($Co_{0.745}Fe_{1.255}O_4$), ($Co_{0.255}Fe_{0.745}O_4$) (Figure 2).

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CALCULATION OF THE EQUIPMENT OF THE SEPARATION UNIT FOR THE PRODUCTS OF PROCESSING THE STRAIGHT-RUN DIESEL FRACTION ON A ZEOLITE CATALYST

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Product fractionation column is a part of almost every unit where catalytic processes are implemented.

At the first stage of work, the straight-run diesel fraction was processed on a zeolite catalyst in order to improve low-temperature properties. However, a product with a wide fractional composition was obtained, including gasoline, kerosene and diesel fractions.

In this connection, the aim of this work is to calculate the fractionation column for the products of processing the straight-run diesel fraction on a zeolite catalyst. The column provides separation into three narrow fractions: 1) the initial boiling point – 140 °C (gasoline fraction); 2) 140–240 °C (kerosene fraction); 3) 240 °C – end boiling point (diesel fraction).

Table 1. Characteristics of the technological flow

Characteristic	UM	Value
Density at 15 °C	g/cm^3	0.8254
Viscosity dynamic at 15 °C	cP	1.7074
Density at 20 °C	g/cm^3	0.8204
Viscosity dynamic at 20 °C	cP	1.4914
Fractional composition		
initial boiling point	°C	38
10 % vol.		90
20 % vol.		156
30 % vol.		187
40 % vol.		220
50 % vol.		250
60 % vol.		274
70 % vol.		299
80 % vol.		329
90 % vol.		335

Table 2. Characteristics of the fractionation column

Characteristic	UM	Value
Number of trays	items	73
Column diameter	mm	2800
Pressure in the column	kPa	350
Column top temperature	°C	155.5
Column bottom temperature	°C	354.5

The characteristics of the technological flow for the rectification column (a product of processing the straight-run diesel fraction on a zeolite catalyst) are presented in Table 1.

In the process of work, technological, thermal, constructive and mechanical calculations were made. Part of the calculations was carried out using the UniSim Design software [1]. In accordance with the calculations made, a project of a fractionation column with valve plates was developed. The characteristics of the column are presented in Table 2.

Table 3. Composition of the output products of the column in mass fractions

Fraction, °C	Initial boiling point – 140 °C	140–240 °C	240 °C – end boiling point
45	0.1167	0.0020	0.0000
59	0.1721	0.0038	0.0000
73	0.1099	0.0032	0.0000
87	0.1097	0.0043	0.0000
101	0.1072	0.0058	0.0000
115	0.1058	0.0086	0.0000
129	0.1008	0.0137	0.0000
143	0.0858	0.0249	0.0000
158	0.0614	0.0571	0.0000
172	0.0283	0.1123	0.0000
185	0.0022	0.1357	0.0011
199	0.0001	0.1148	0.0040
213	0.0000	0.1068	0.0120
227	0.0000	0.0849	0.0277
241	0.0000	0.0579	0.0476
255	0.0000	0.0432	0.0711
269	0.0000	0.0345	0.0864
283	0.0000	0.0285	0.0903
297	0.0000	0.0234	0.0846
311	0.0000	0.0200	0.0790
329	0.0000	0.0444	0.1871
335	0.0000	0.0360	0.1541
354	0.0000	0.0138	0.0615
366	0.0000	0.0102	0.0465
381	0.0000	0.0056	0.0260
395	0.0000	0.0045	0.0208

Considering the number of trays and the accepted inter-tray distance of 600 mm, the height of the column was 49 meters. The composition of the obtained products is presented in Table 3.

With the unit capacity of 100 m^3/h by feedstock, the yield of the gasoline fraction is – 9 m^3/h, kerosene fraction – 27 m^3/h, diesel fraction – 64 m^3/h.

References

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