So according to the aim of the study the technology of gas emissions purification from sulfur dioxide with simultaneous separation of sulfonic acid and sulfoxides as reaction products has been developed [41, 42]. After absorption of 4.7m^3 gaseous sulfur dioxide (concentration of SO_2 in an aqueous solution of 0.4 mol/L), the aqueous solution of SO_2 was separated from the catalyst and analyzed. The analysis showed the presence of about 70% H_2SO_4 in the solution. The ratio of adsorbed toxic oxides per adsorbent A unit (mg/g) was used as the kinetic parameter of adsorption. In order to determine the quantitative dependences characterizing the rate of adsorption of SO_2 molecules by fly ash, experiments were performed on a laboratory installation with an adsorber. The conditions of selective oxidation of SO_2 (100%) were optimized. The optimum catalyst is tested on a vortex unit. The oxidation state of SO_2 was 93.5-94.0 %.

The catalyst created has been tested in the process of gases purification from SO_2 at a pilot vortex stirrer of design capacity 2 m^3/h on model gas mixtures SO_2-Ar with the content of SO_2 up to 1 % vol. The results have demonstrated that with gas feed speed of 10,000-15,000 h^{-1} degree of removal of SO_2 reaches 86.9-94.9 %.

Catalytic Cracking of Fuel Oil of the M-100 Brand from AGPP

The analysis shows that the investigated for cracking fuel oil of M-100 brand is low-sulfur (Table-4). According to the IR spectral analysis of the fractions of the initial fuel oil, gasoline, light gas oil and heavy residue after the conversion of fuel oil from AGPP, their composition, together with alkanes of normal structure, includes a significant amount of olefin and aromatic hydrocarbons. The presence of olefins is indicated by strong absorption bands at 3,080-3,050 cm^{-1} in the spectra of gasoline and two fractions of light gas oil, as well as a band of medium intensity for a heavy residue. Aromatic hydrocarbons are also concentrated in light fractions, since the intensity of the absorption bands at 1,700; 1,640 and 1,600-1,580 cm^{-1} decreases during the transition from gasoline to light gas oil (185-340°C), and in the spectra for the 340-350º C fraction and the heavy residue of the absorption bands at 3,150; 1,700 and 1,620 cm^{-1} are absent. However, the bulk of all fractions is composed of aliphatic hydrocarbons with absorption bands characteristic of deformation vibrations of these molecules at 1, 480-1, 380 cm^{-1} and 980-700cm^{-1} [43-46].

Table-4. Fractional composition and sulfur content in fuel oil from AGPP, grade M-100.

No	Fractional composition	Content, wt. %	
		hydrocarbon fractions	sulfur
1	initial fuel oil	100.0	0.7
2	gasoline	0.3	-
3	light gas oil	41.1	0.4
4	vacuum gas oil	18.4	1.3
5	heavy residue	39.3	0.7
6	losses	0.9	-

It has been established that the optimum in terms of the yield of light gas oil during cracking both in an inert atmosphere and in the presence of trace amounts of air is a catalyst based on fly ash from thermal power plants with the addition of the activated Tayzhuzgen zeolite.

According to X-ray diffraction analysis (Figure-3), the following components the composition of Tayzhuzgen zeolite are comprised (concentration, % intensity): Fe (49.939/739.15); Ca (1.715/9.16); Sr (0.270/1.98); Mn(0.129/1.81); Al (21.955/0.31); Si (23.114/0.98); Ti (1.903/20.87) and K (0.976/1.96).

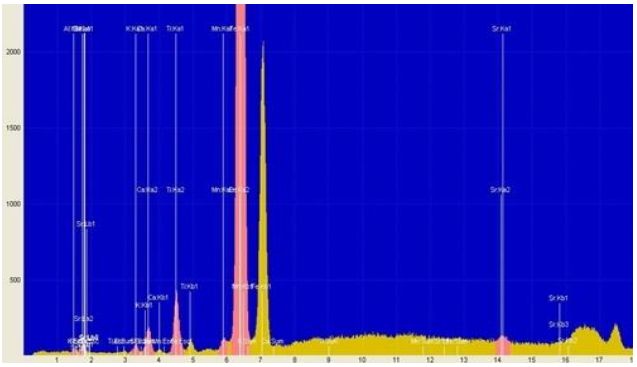

Figure-3. Image of diffraction analysis of natural zeolite from the Tayzhuzgen deposit (Kazakhstan).

On the optimal catalyst in the products of oxidative cracking of fuel oil, the fraction of light gas oil is the main part. Therefore, to elucidate the reaction mechanism, we set the task to determine the individual composition of the hydrocarbons included in this fraction. The results of gas chromatography-mass spectrometric analysis are presented in Table-5. As can be seen from the Table-5, the formation of C_7-C_{12} hydrocarbons occurs exclusively due to the symmetric decomposition of C_{14}-C_{24} paraffins, since the products of this reaction are the corresponding α-olefins and n-alkanes. Thus, as a result of cracking reactions of the M-100 fuel oil from AGPP, the resulting light gas oil contains a significant amount of α -olefins (Table-5), which are a scarce raw material for the production of synthetic additives and oils. It is known from the literature that the best synthetic oils that ensure the operation of equipment in cold climatic conditions are