

Due to the new wave of studies of Gorevskoe deposit and Gorevskiy ore cluster, it's reasonable to have a fresh look on perspectives of this territory. The result of future field works is based on this knowledge: clear idea of genesis, ore mineralization and later transformation processes, the same way as tectonic conditions of the deposits. Detailed study of mineral and geochemical conditions as well as comparison with deposits in Canada, The USA and Australia indicates Gorevskoe as dedicated to SEDEX-type deposits. It is also shown by mineral and chemical regularities, geophysical survey and exploitation experience.

References

1. Distanov, E. Gand Kovalev, R.K.(1995) Kholodninskoe stratiphorm sulfidic-polymetallic deposit. Russian Geology and Geophysics, pp. 11.
2. Goodfellow, W.D., and Lydon, J.W., (2007), Sedimentary exhalative (SEDEX) deposits, in Goodfellow, W.D., ed., Mineral Deposits of Canada: A Synthesis of Major Deposit Types, District Metallogeny, the Evolution of Geological Provinces, and Exploration Methods: Geological Association of Canada, Mineral Deposits Division, Special Publication No. 5, p. 163-183.
3. Information-analytical center "Mineral", Lead, Zink, Moscow, 2015
4. Leach D.L., Taylor R.D., Fey D.L., Diehl S.F. and Saltus R.W. (2010) A deposit model for Mississippi Valley-type lead-zinc ores: Chapter A of mineral deposit models for resource assessment. US Geological Survey Scientific Investigations Report 2010–5070
5. Lobanov K. V. (2015) SEDEX-type deposits – the main source of Zn, Pb and Ag. Congress „Non-ferrous metals and minerals“, Krasnoyarsk.
6. Makarov, I.V.; Makarov, V.A., Kosolapov, A.I. and Shrainer, A.D. (2014) Unpublished report “Re-assessment of
7. Seltmann, R.; Soloviev, S.; Shatov, V.; Pirajno, F.; Naumov, E. and Cherkasov, S. (2010) Metallogeny of Siberia: tectonic, geologic and metallogenic settings of selected significant deposits. Australian Journal of Earth Sciences, 57, (655–706).
8. U.S. Geological Survey, Mineral Commodity Summaries (2015) Lead, Zink.

THERMAL CRACKING OF OIL

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Perhaps, oil is one of the most important mineral resources. When oil refining, mankind receives more than two thousand various products: gasoline, gas, clothes, household chemistry, cellophane, book-printing colors and etc. Oil industry continues to provide both domestic needs of the country and export. Russia remains one of the world's largest oil producers, consumers and exporters and keeps world market positions.

Motor gasoline is produced by thermal and catalytic cracking of petroleum. Basic gasoline requirements are evaporating capacities, antiknock rating and chemical stability. Evaporability is the capacity to change liquid to vapor state and should provide easy starting and quick engine warming-up. Antiknock rating depends on its chemical composition. Antiknock rating is caused by hydrocarbons, which become unstable and much faster. When air-fuel mixture compressing at high temperatures and pressures in cylinder, hydrocarbons are oxidized by atmospheric oxygen and form explosive compounds. The most detonating hydrocarbons are paraffinic hydrocarbons of normal structure. Paraffinic isohydrocarbons and aromatic hydrocarbons have high anti-knock properties. Naphthenes and unsaturated occupy an intermediate position. For antiknock property measurement, octane ratio is accepted. Octane ratio is percentage by isooctane volume in a standard heptane mix, which detonates with the same power as the test fuel in the engine [1].

There are two types of refinery: primary oil crude processing and cracking refinery. Cracking refinery is high temperature refinery, which results in changing petroleum structure and composition. When cracking refinery, light oil products such as gasoline, kerosene are produced. If petroleum and petroleum refinery products are heated above 360°C, hydrocarbons are chemically transformed that result in new products. Light oil product formation in thermal cracking can be explained by fact that, heavy hydrocarbon molecules are cracked into smaller molecules at high temperature conditions. The main reactions in thermal cracking are decomposition reactions resulting in the gasoline formation. Thermal cracking reactions and quality of products are influenced by the oil stock quality, temperature, duration and pressure of the cracking [3].

The speed of cracking refinery process can be accelerated by increasing of temperature as well as length of cracking. Both these factors are interchangeable. Application of high temperatures is advantageous because high octane gasoline obtained due to aromatic hydrocarbon formation at high temperature. On the other hand, when increasing cracking process severity, coke yield and gasification are increasing as well due to gasoline decomposition. Pressure is also of great importance in cracking process. Firstly, pressure effects secondary reactions in cracking (polymerization and condensation reactions are proceeding easier at high pressure). Secondly, due to pressure, gas formation decreases. As the final result, gasoline volume increases and the content of unsaturated hydrocarbons in its composition reduces. When cracking in vapor phase, pressure builds up in the system and reduces the amount of vapor stock and refinery products. This allows installing or increasing throughput capacity as well as improving cracking efficiency.

Visbreaking of heavy feedstock is meant for residue and tar conversion. (Working temperature is 470 – 480 C, pressure-40-45atm). When mild cracking of residue, a small amount of cracking gasoline (8-15%), gas diesel fractions

(80%), gas and coke are produced. Gas diesel fraction is raw material for deep cracking, so, normally, visbreaking is combined with deep cracking of heavy feedstock resulting in gas diesel fractions. Visbreaking of heavy tarry residue can also serve to reduce their viscosity and subsequent use as fuel oil.

High conversion cracking of kerosene-diesel fractions occurs in more severe conditions: at temperature of 500-510°C, pressure - 500 atm. During this process conducted with recycling of intermediate fractions, 50 per cent of cracking gasoline is produced. Currently, this type of cracking is gradually losing its relevance, as kerosene and diesel fractions of straight distillation find their direct applicability in a jet and diesel fuel.

High conversion cracking of light feedstock (thermal reforming) is carried out in more severe conditions (at temperature of 520-540°C, pressure 60-70 atm.) The raw materials are low-octane gasoline and naphtha of straight distillation. Process purpose is to obtain high-octane gasoline. At present, this type of cracking is almost not applied. Therefore, in petroleum refining the most common form of thermal cracking under pressure is residual cracking of heavy stock (residue, tar), combined with the subsequent high conversion cracking producing diesel fractions.

Coking process is to heat the heavy oil residues (tar of straight distillation, cracking residues) at atmospheric pressure and temperature of 400 – 500°C. As a result of decomposition reactions and hydrocarbon consolidation, gas, gasoline, kerosene-diesel fraction and coke are produced. The main products are coke and coking distillate.

Pyrolysis or oil pyrogenic decomposition occurs at a temperature of 680 – 750 C as well as at atmospheric pressure, i.e. in more severe conditions than coking process. Under such conditions, the petroleum feedstock is converted in more severe conditions with high gas yielding (50%) and aromatic hydrocarbon obtaining. The gas, produced during pyrolysis, is rich in unsaturated hydrocarbons, the most valuable of which is ethylene (18-28% content in gas). Pyrolysis gas is a valuable raw material for chemical processing.

Gasoline yield at single-pass cracking can be increased by deepening of cracking - accelerating of process time and temperature. During single distillate cracking, gas, 25 - 30% of gasoline, cracking residue and 50-60% of the intermediate fractions are obtained. The intermediate fraction partially consisting of unconverted materials and cracking products, may be applied for repeated cracking to obtain an additional amount of gasoline. This type of cracking, in which the intermediate fraction is continuously returned to the fresh feed mix for repeated cracking, called recycling cracking. Recycling cracking benefits are enormous. Only reforming (cracking of gasoline and naphtha fractions) is carried out without it [2].

The chemical composition of the cracking gasoline is substantially different from straight gasoline distillation of unsaturated hydrocarbons, aromatic and paraffinic isohydrocarbons. The presence of these hydrocarbons leads to higher anti-knock properties of cracking gasoline in comparison to straight distillation gasoline. Basically, straight distillation gasoline is composed of paraffins and naphthas, aromatic hydrocarbons in small amounts. The cracking gasoline contains 15-20 % of unsaturated hydrocarbons and aromatic hydrocarbons of 15-35%. The composition and properties of cracking-gasoline depend on the cracking process conditions, in which they are received. The lowest octane gasoline of visbreaking, as such cracking is mild and small amount of aromatic hydrocarbons are formed in it. High conversion cracking gasolines of distillate feedstock have an octane number of 65-70. Their composition is characterized by the presence of unsaturated, aromatic and branched paraffins. A disadvantage of the cracking gasoline is its instability during storage because of the high content of unsaturated hydrocarbons with dibond (alkadienes), prone to gum formation. Thus, thermal cracking of oil has already lost its capacities as a way of refining petroleum products, but, this method can be very useful for the refining industry, for introduction of new technologies and carrying out more detailed studies.

References

1. Parkhomenko V.E. Oil and gas refining technologies. Moscow: Gosoptechizdat, 1959. – 452p.
2. Pichugin A.P. Oil refining: straight distillation, thermal cracking, coking. Moscow: Gosoptechizdat, 1960. – 344 p.
3. Sakhanov A.N. Cracking in liquid phase Leningrad: Neftyanoye izdatekstvo, 1928. – 371 p.

ALLOWABLE AND CRITICAL RISKS OF THE ARCTIC DEVELOPMENT IN TERMS OF GLOBAL CLIMATE CHANGE

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The Arctic issues are becoming increasingly important in the current studies of global climate change. This is due to the fact that the Arctic region which is characterized by complex and rather specific climatic features (ice sheet) secures the balance of global climate system. As for the Arctic region itself, it should be noted that today it presents a vivid example of transforming climatic and environmental problems into economic and political ones. The specific geographical and climatic conditions of the Arctic present a challenge to economic activity in the region. In fact, it is these conditions that restrain geophysical exploration of the Arctic continental shelf. Besides, they make higher demand on communications-infrastructure availability, sustainable development of social systems, staff resources trained specifically to work under Arctic conditions, and, most significantly, programs aimed at preserving and protecting the Arctic environment and unique eco-systems. Therefore, development of the Arctic resources is always accompanied by a great number of various risks. Such a great concentration of risks in the Arctic region is due to different factors which can be conventionally divided into natural and technogenic ones. The natural factors involve geographical location of the