



Рис. 4 – Зависимость параметров рабочего процесса от нагрузки на двигатель 6S70MC-C (модель AVL Boost)

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## MOTOR FUEL BY HYDROGENATION TECHNOLOGY

Most of the motor fuel is produced at refineries, but its alternative production is beginning to develop more and more. Many countries are conducting research to create a new technology for the production of motor fuel, gas and raw materials for the chemical industry. The basis of this technology is coal, oil shale and oil sands, the reserves of which far exceed the oil reserves. Motor fuel, the raw materials for the

production of which are solid combustible minerals (brown and hard coal, sapropel) and natural gas (methane), are now produced on a limited scale. Further expansion of synthetic fuel production is constrained by its high cost, which significantly exceeds the cost of natural oil fuel.

Hydrogenation is a universal method of processing solid combustible minerals into liquid products and gas. Hydrogenation technology in comparison with other processing methods is low-operational and low-waste. It can be carried out on high-power installations. Hydrogenation is a combination of thermal destruction reactions with hydrogenation (hydrogen addition) [1].

The thermal efficiency of coal hydrogenation is significantly higher than other processing methods. It reaches 56 % in comparison with 40...45 % at gasification of coal and synthesis from gas on GTL technology (Gas to Liquid).

By varying the pressure, temperature, duration and type of catalyst, different types of motor fuel (gasoline or diesel fuel), raw materials for the chemical industry (phenols and aromatic hydrocarbons) can be obtained from the same coal.

Oil products volume in the hydrogenation of solid combustible minerals is for:

- brown coal from 55 to 80 % of the mass.;
- hard coal from 70 (young coal) to 85 % of the mass. (anthracite);
- sapropel (balkhashin) up to 90...95 % of the mass.

In the 1930s and 1940s, destructive hydrogenation of coal became industrially widespread in some countries that did not have their own oil reserves. In Germany, 15 hydrogenation plants have been built to process 6 million tons of coal per year. During the processing of coal at these plants, the volume of motor fuel reached 55, gaseous hydrocarbons 30 %, water up to 10 %, and the unreacted residue was about 5 % of the organic mass of coal. The multi-stage scheme made it possible to process almost any hydrocarbon feedstock. However, the large number of levels of processing significantly complicated and increased the cost of the process [1].

In recent years, Germany, England, Russia and other countries have been conducting intensive research to improve coal hydrogenation technology in order to reduce hydrogen pressure and intensify the process. For example, the experimental production of ST-5 for coal processing 5 tons/day was built [2]. The processing process is carried out in two stages:

- first, coal or other solid combustible minerals are expanded with heavy oils to form a paste, and then subjected to hydrogenation at a pressure of 25...70 MPa in the presence of an iron-molybdenum catalyst at a temperature of 400 °C;
- the resulting petroleum product is distilled, and fractions with a boiling point above 325 °C are again subjected to hydrogenation.

Depending on the conditions of the process, the products of processing can be only gasoline or gasoline and diesel fuel. The octane number by the motor method of synthetic gasolines is 69,5, which should be increased. Production of 1 ton of synthetic fuel requires 3...6 tons of coal, so motor fuel is 1,5...2,0 times more expensive than petroleum gasoline and is not yet widely used.

Recently, there is a growing interest in the process of «thermal dissolution» of coal. Dissolution is carried out in various organic substances at atmospheric or elevated pressure. The maximum solubility is characterized by a mixture of tetralin,

phenol and naphthalene in the ratio (1:1:1). The amount of substances that go into solution largely depends on the nature of solid combustible minerals, the properties of the solvent and the process parameters. The volume of the extract increases with increasing boiling point of the solvent and when working under pressure (in some cases, the process is carried out under hydrogen pressure). The optimum temperature is the critical boiling point of the solvent, which is for most solid combustible minerals in the range of 380...450 °C at a pressure of 2...15 MPa and a process duration of 20...60 minutes.

Synthetic motor fuels do not contain or contain a small amount of primary harmful substances. Emissions of toxic components in the exhaust gases of internal combustion engines are much lower compared to traditional petroleum fuels. This solves the environmental problems of using motor fuels [3].

### **Literature**

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### **ОСОБЛИВОСТІ ЗДІЙСНЕННЯ РОБОЧОГО ЦИКЛУ В ДВИГУНАХ ІЗ ЗОВНІШНІМ ПІДВОДОМ ТЕПЛОТИ**

Експлуатація на автомобільному транспорті пневматичного двигуна у якості основної силової установки, або як допоміжного у складі комбінованої енергоустановки, ускладнюється малим запасом енергії енергоносія – стисненого повітря і його від'ємними температурами при розширенні [1]. Для покращення техніко-економічних показників енергетичної установки можна застосовувати підігрів стисненого повітря, яке подається в циліндри.

Підігрів можна реалізувати як за допомогою нагрівачів (наприклад, [2,3]), так і реалізувавши конструкцію двигуна із зовнішнім підводом теплоти