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ABSTRACT

Currently, the world's most prestigious chemical and technological scientific institutes are constantly working on the development of the most effective technological methods of obtaining environmentally friendly synthetic fuel. As a result of which reactions, the best quality and clean synthetic fuel can be obtained, and the issue of bringing such technology to the industrial scale is the most urgent task for chemists-technologists-engineers looking for synthetic fuel issues.

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Introduction

Synthetic fuel is a hydrocarbon fuel obtained as a result of the processing of the original material, which differs from conventional fuel in the production process, that is, before processing, it has properties that are not suitable for the consumer.

As a rule, this term refers to liquid fuel obtained from solid (coal, sawdust, shale) or gaseous fuel. The term "synthetic fuel" has many different meanings and can refer to different types of fuel. The International Energy Agency traditionally defines "synthetic fuel" as any liquid fuel derived from coal or natural gas.

The history of the production of synthetic fuels initially developed in two different directions. The first of these is called alternative fuel sources, and from the beginning this direction was considered as an alternative fuel, replacing liquid hydrocarbons. His goal was, for example, to rid vehicles of internal combustion engines and replace them with an alternative engine and a suitable cheap fuel. Attempts to obtain such fuel have been going on almost since those times (since the 1910s). In fact, the first examples of internal combustion engines did not run on liquid hydrocarbons derived from petroleum, but on the contrary, they ran on coal dust or alcohol. Both of these fuels lag far behind liquid hydrocarbons in terms of efficiency. Researchers working in this direction can still be found today. The second direction in the production of synthetic fuel is hydrogen energy. Of course, many people have heard about it. What if hydrogen grids were pulled out and hydrogen was used as a fuel, just like natural gas grids in cities! This would be a huge achievement in terms of both energy efficiency and the environment. At first glance, hydrogen is an ideal fuel. First, it is the most common element in



the universe, and secondly, when it is burned, a large amount of energy is released without releasing any harmful gases and water is formed. Humanity has recognized the advantages of hydrogen energy for a long time, but is in no hurry to use it on a large industrial scale. Perhaps, in the future, hydrogen energy will have a strong place in the world energy market. However, so far there are no significant promising results in this regard. On the contrary, hydrogen energy cannot compete with liquid hydrocarbon energy. In addition, both of these approaches to the production of synthetic alternative fuels have their own shortcomings. Hydrogen can be transported in gaseous, liquid and solid (bonded) form. But hydrogen gas is very expensive to transport because of its low density. For this reason, worldwide developments are ongoing to improve the cost-effectiveness and safety of hydrogen transportation. For example, it is possible to increase the pressure in the pipeline system, transport hydrogen in a liquefied state, use gas carriers, railway and car tanks.

For example, the main element of hydrogen energy - hydrogen gas - is an extremely explosive substance. The explosion risk of hydrogen is 10,000 (ten thousand!) times higher than that of regular gasoline. Alternative fuel types, such as alcohols, vegetable oils, or their mixtures, have a very low energy content, which is called biofuel. Moreover, the energy efficiency of biofuels from different sources is never the same. Petroleum liquid hydrocarbons are the complete opposite of this. In particular, it is possible to obtain the same gasoline as a result of the processing of oil extracted from any part of the earth's surface. However, it is impossible to obtain exactly the same biofuel from different types of oils and alcohols. This will destroy the possibility of standardization of the fuel obtained from them, even if it is decided to use such fuels with low energy capacity in cars. That is, a car that runs on a type of alcohol or oil must always be filled with only this type of fuel. The fact that the types of alcohols and oils are very diverse, and their sources are limited in different geographical areas of the earth, does not allow this. So far, neither of these two approaches to creating alternative fuel sources that can replace liquid hydrocarbons has been more effective than petroleum liquid hydrocarbons.

Despite this, efforts to create alternative fuel sources continue to this day, and experts do not tire of coming up with new alternative options for energy supply. In particular, directions such as trying to use electricity directly, or storing the generated electricity in huge lithium-ion batteries, and then using such batteries as an energy source, are ways to create alternative fuel sources. is a clear example of modern trends. Most people have probably heard about electric cars, or Tesla, a car that runs on battery power in recent years. I would like to mention that Tesla-mobile, or electric cars, is not the first attempt to design and mass-produce a vehicle based on an electric battery. This is the third such attempt in the last 120 years.

Let's go back to synthetic fuel. By "synthetic fuel" we mean a fuel that can completely replace petroleum-derived fuels (mainly gasoline), but is not itself made from petroleum. In this case, even if the component liquid hydrocarbons of oil are obtained from anything other than oil, it will be a synthetic fuel. That is, for example, if gasoline is obtained not from oil, but from wood or coal, then that gasoline is a synthetic fuel.

When media representatives talk about attempts to obtain synthetic fuel in a scientific institution, they usually use the words "innovation", "modern technology". Unfortunately, it is somewhat inappropriate for media representatives to use such expressions in relation to

synthetic fuel technologies. After all, as mentioned above, attempts to obtain synthetic fuel and technologies in this regard have been around for more than a hundred years. Most of these technologies have been damaged and failed mainly due to their extraordinary complexity, which means that they are not economically viable. It is much easier and cheaper to extract oil from the bottom of the ocean, then bring it to the shore, process it in a factory, and get gasoline. But now, at the beginning of the 21st century, it seems that new directions have been opened, which are more technologically and economically effective, in terms of getting fuel not from oil, but from other sources. In this regard, coal, firewood (wood) and gas are considered as the main synthetic fuel raw materials.

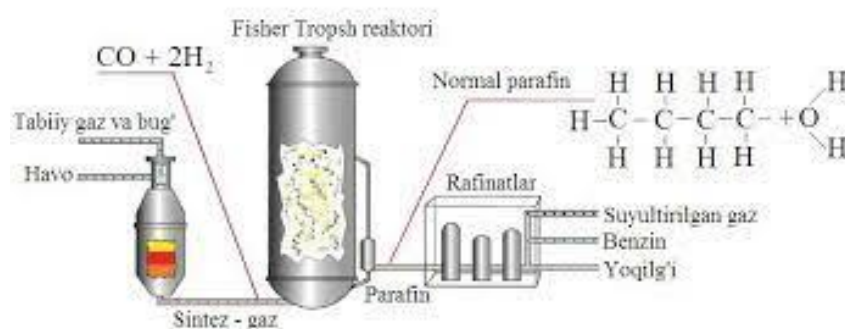


Figure 1. Technological scheme of the Fischer-Tropsch fusion process reactor

A legitimate question arises: if the composition of liquid hydrocarbons obtained from oil and synthetic hydrocarbons is the same, then what determines the advantage and high quality of synthetic hydrocarbons? Let's share the details: first of all, petroleum products always contain additional impurities, such as sulfur, some metals and other toxic substances. It is not possible to completely clean oil from such impurities during the refining process. Currently, oil refineries spend a lot of effort to clean oil from these impurities. Accordingly, the degree of refining of oil determines the quality of gasoline obtained from it. Depending on the degree of purity, the standard price of the obtained gasoline will be different. That's why there are grades of gasoline like 80, 92, 95, or Euro-5, Euro-6 and other standards of oil. But even then, a certain amount of sulfur remains in the oil. This means a poisonous gas, a bad smell, is released into the air.

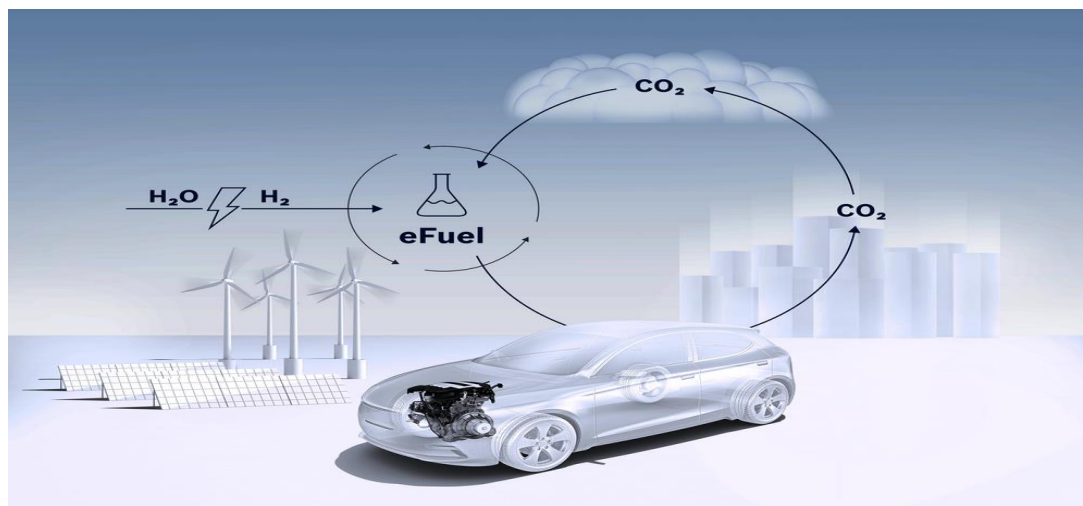




Figure 2. Distribution of synthetic liquid fuels in the atmosphere

The biggest advantage of synthetic fuels based on synthetic hydrocarbons is their effect on the human body. That is, synthetic fuel does not have any negative effects on humans (of course, this still needs to be proven). The fact is that hydrocarbons themselves are very diverse and, in the language of chemists, there are types such as linear, branched, cyclic, and aromatic. Accordingly, hydrocarbons belonging to different groups have very similar fuel properties, but their other physical properties, such as smell, viscosity, effects on the human body, are completely different. This is a very important point. If gasoline from oil gets into a person's stomach, it will definitely be poisoned. And synthetic gasoline is a neutral substance, it does not contain various toxic substances, tars, aromatics, so it does not poison a person. This is a very important point.

For this reason, when we talk about the problems that synthetic fuel should solve, first of all, we need to take into account the improvement of the environmental condition in cities, especially large megalopolises. As a result, the amount of toxic substances released into the environment should be drastically reduced. In this case, it is possible to imagine the growth of the world economy as a result of the loss of energy dependence on oil. As raw materials for the production of synthetic fuel, it is possible to use gas, which is the cleanest source of carbon, or coal, firewood, and even the processing of waste collected daily in the city.

Currently, the world's most prestigious chemical and technological scientific institutes are constantly working on the development of the most effective technological methods of obtaining environmentally friendly synthetic fuel. As a result of which reactions, the best quality and clean synthetic fuel can be obtained, and the issue of bringing such technology to the industrial scale is the most urgent task for chemists-technologists-engineers looking for synthetic fuel issues. As I said above, there are certain advances in this direction, and we hope that in the coming years, the synthetic fuel industry will overtake the oil industry and begin to provide mankind with environmentally friendly and cheap fuel sources.

In conclusion, the biggest advantage of synthetic fuels based on synthetic hydrocarbons is their effect on the human body. That is, synthetic fuel does not have any negative effects on humans (of course, these still needs to be proven). If gasoline from oil gets into a person's stomach, it will definitely be poisoned. And synthetic gasoline is a neutral substance, it does not contain various toxic substances, tars, aromatics, so it does not poison a person. This is a very important point. In this regard, the work that is being done now will create a lighter lifestyle and improve the living of mankind.

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