

EFFECT OF SYNTHESIS GAS SUPPLY ON ENGINE PERFORMANCE

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Annotation. Reactors operating in an aqueous solution of coal dust were manufactured and tested. Of the options tested on the road on the Cobalt car, the 4th option was chosen, that is, the option of adding synthesis gas from the AndMI-2 reactor to a conventional gasoline-air mixture, since it increased engine power by 4, 09%, fuel consumption was reduced by 26.02%, the amount of CO in the exhaust gases was reduced by 2.15 times and the amount of CN in the exhaust gases was reduced by 3.93 times.

Keywords: fuel, reactor, dielectric vessel, electrolyzer, electrode, water, catalyst, coal, carbon, hydrogen, oxygen, synthesis gas, gasoline-air mixture, engine power, gasoline consumption, carbon monoxide, unburned hydrocarbon.

Currently, there are many environmental problems in the world, from the extinction of certain species of plants and animals to the extinction of the human race.

The main problem of humanity is that how people treat nature will determine their lives and the lives of future generations. Environmental pollution is a problem that seriously harms human health. Planet Earth is a home for all people, so they should take care of it.

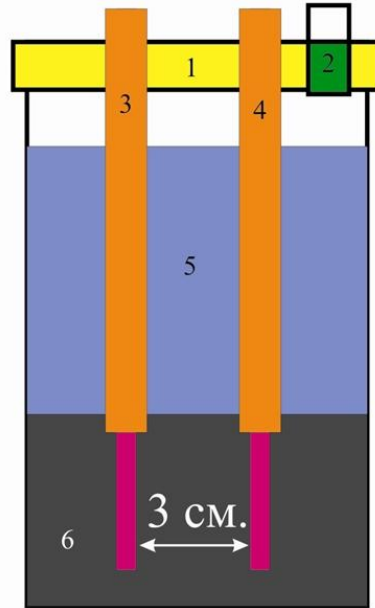
One of the many problems associated with environmental pollution is traffic flows in large cities. For example, in October 2022, the city of Tashkent took first place among the world's major cities in terms of air pollution. According to the IQAir portal, the concentration of PM-2.5 particles, the most harmful for humans, was 212 $\mu\text{g}/\text{m}^3$, which corresponded to the "very harmful" level according to the classification of the International Health Organization and was 42.4 times higher than the established standards.

The effect of motor transport on nature is air pollution with exhaust gases. In recent years, there has been a tendency to increase the share of such pollutants among all other wastes. If this trend continues, in 50 years this current "relative heaven" on Earth will end and hell will begin. Therefore, it is necessary to eliminate such trends and problems that seriously threaten the Earth.

The Law of the Republic of Uzbekistan dated 22.05.2019 "On the use of renewable energy sources" was adopted [1].

In the Andijan region, projects aimed at the development of this sector are increasingly being put into practice. One such project is a reactor for the production of synthesis gas, which can be used in internal combustion engines of vehicles and boiler rooms of buildings.

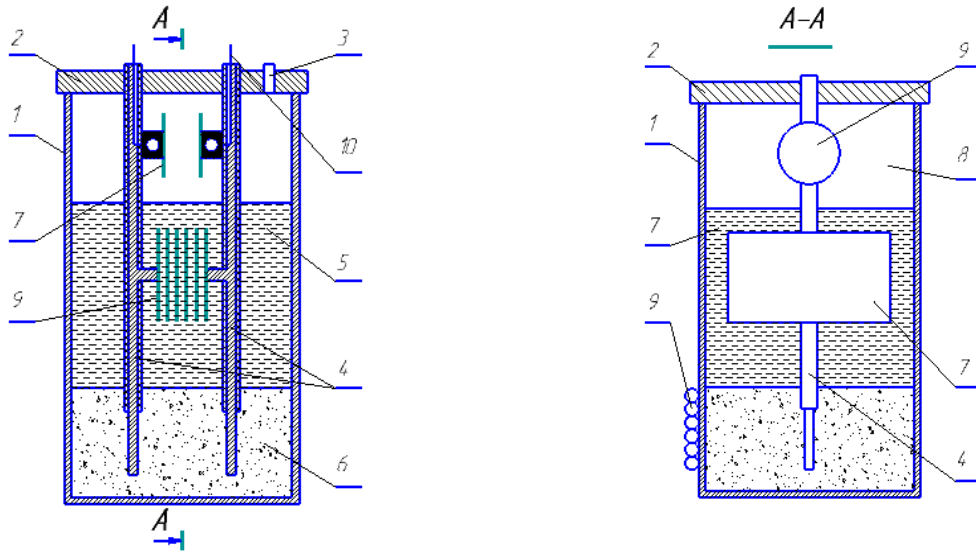
The Russian inventor Rys A.'s "Universal Fuel Reactor for Cars and Homes" was adopted as a prototype for this project, in which water 5 and crushed coal or graphite 6 and 2 electrodes 3,4 are placed in a dielectric container (Fig. 1). The container is closed with a hermetic cover 1, and a tube 2 and a filter are placed in it for the release of synthesis gas [2].



Picture 1. "Universal Fuel Reactor for Car and Home" by Rys A.

The disadvantage of such a reactor is the large energy consumption used for the operation of the reactor and the low flammability of the gas leaving the reactor. To overcome these shortcomings, Rys A. the length of the reactor was extended, a plate electrolyzer was installed in the aqueous medium, and pulsed high-voltage electrodes were placed in the gaseous medium. Also, in this AndMI-1 reactor, a crucible was placed on the surface of the dielectric vessel (Fig. 2). The electrolyzer, placed in an aqueous environment, was also connected in parallel to the power source, as were the electrodes.

The reactor consists of the following parts: 1- dielectric container; 2- the lid of the container; 3- filter; 4- electrodes; 5- aqueous environment; 6- coal environment; 7- electrolyzer; 8- gaseous environment; 9- electrodes working at high voltage; 10- high voltage wire [8,9].



Picture 2. AndMI-1 reactor

The reactor works as follows: coal powder or any liquefied hydrocarbon (for example, processed motor oil) is placed in the dielectric vessel 1 and water is poured over it. A catalyst (for example, baking soda, alkali, table salt, etc.) is added to the water. The cover 2 of the container 1 is closed and electricity is connected to the electrodes 4 (12, 24, 36 V constant current). A high-temperature (50000C) plasma arc is formed between electrodes 4 and carbon gases (SO and SO₂) are released.

The aqueous medium 5 above the coal medium 6 also boils, and hydrogen and oxygen gases are released from it. The electrolyzer 7 installed in the aqueous environment 5 ensures that more hydrogen and oxygen gases are released in the boiling water.

Electrolyzer 7 is connected to electrodes 4 in parallel with electricity (12, 24, 36 V direct current or 220 V alternating current). Plates of the electrolyzer 7 are placed in series through gaskets. Only their outermost plates are connected to electrodes 4. As a result, one side of each plate is positive and the other side is negative. The number of plates is selected depending on the voltage of electricity, for example, when connected to a constant current of 12 V, 6, at 24 V - 12, at 36 V - 18, etc. If the electrode 4 is connected to a constant current of 220 V, the number of plates will be even more [10-12].

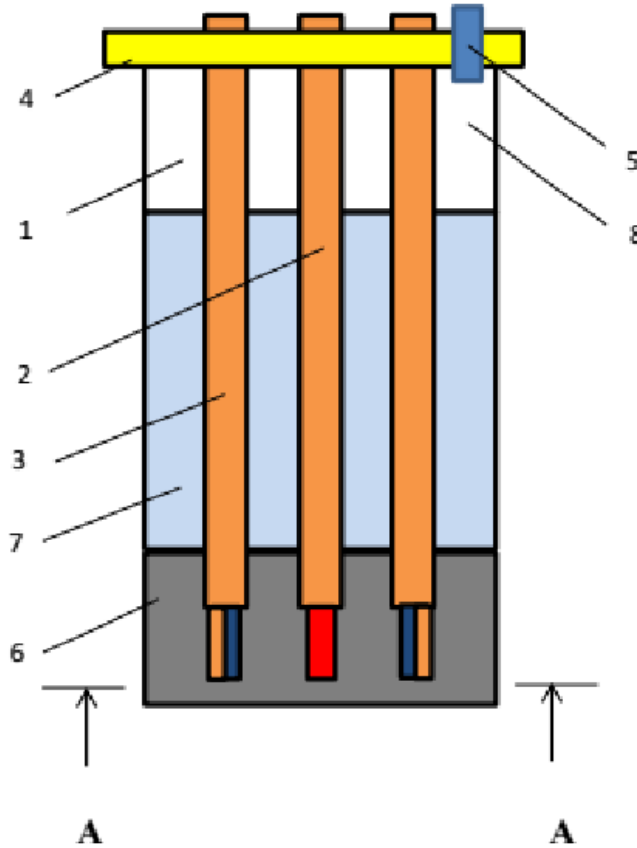
In gaseous environment 8, carbon, hydrogen and oxygen gases are added to form synthesis gas. Electrodes 9 operating at high voltage are installed in the gaseous environment 8, and pulsed electric current of about 30 kV is supplied to them through high-voltage wires 10, and as a result, the synthesis gas changes to the state of ionized gas, and is sent to the consumer, for example, to the internal combustion engine through the filter 3 on the lid of the container 1.

Electricity is also generated from the plasma generated in the coal medium 6. To use this energy, a copper wire is wrapped around the water container 1 and a coil 11 is formed. In this case, the ends of the wire of the coil are connected to the electrolyzer 8. In another option, this wire is connected to high voltage electrodes 9. Also, a magnet is placed on the surface of the filter 3 placed on the cover 2 of the vessel 1, and with its help, the ionization of the outgoing gas is further increased.

In order to further reduce the consumption of energy used for the operation of the reactor and to increase the flammability of the synthesis gas leaving the reactor, the positive electrode was placed in the center of the vessel, and the negative electrodes were placed in a circle around it (Fig. 3). The electrodes are made of insulated wires, in which the insulation of the lower part of the positive electrode placed in the

carbon medium is exposed 3-4 cm long, and the insulation of the negative electrodes placed in the carbon medium along the circumference - only the part facing the center is exposed 3-4 cm long.

The reactor consists of the following parts: 1- dielectric case; 2- central positive electrode; 3- negative electrodes placed around the circle; 4- cover; 5- filter; 6- coal environment; 7- aqueous environment; 8- gaseous environment.



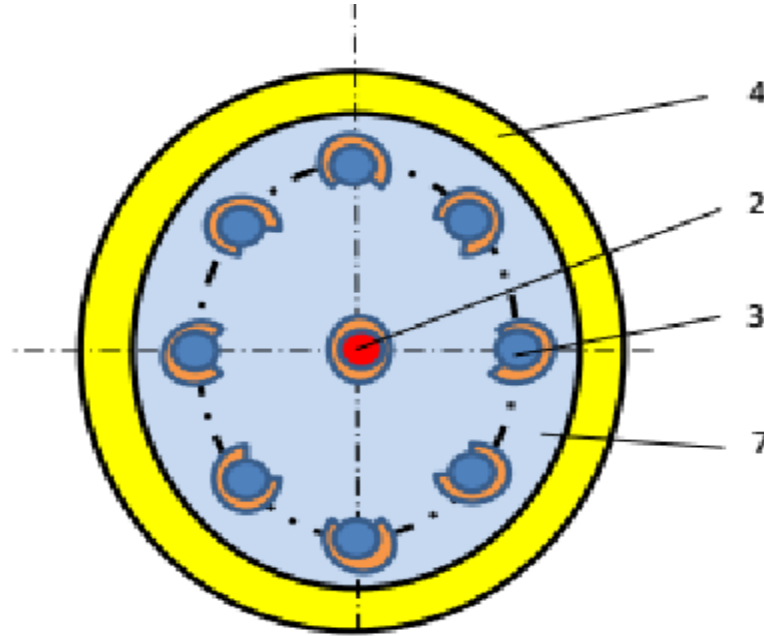


Figure 3. AndMI-2 reactor

The reactor works as follows [13-15]:

Coal powder or any crushed hydrocarbon (for example, processed motor oil is poured into the dielectric container 1) and water is poured over it. A catalyst (for example, baking soda, alkali, table salt, etc.) is added to the water. The lid 4 of the container 1 is closed and the central positive electrode 2 and the negative electrode 3 arranged around the circle are connected to electricity (12, 24, 36, or 220 V constant current). A high-temperature (50,000C) plasma arc is formed between the electrodes 4, and carbon gases (SO and SO₂) are released from the coal medium 6, oxygen from the positive electrode 2, and hydrogen gases from the negative electrode 3.

The watery medium 7 above the coal medium 6 boils and from the electrolyzer placed in it, i.e. from the positive electrode 2, oxygen and hydrogen gases are released from the negative electrode 3.

In the gas environment 8, carbon, hydrogen and oxygen gases are added, synthesis gas is formed, and it is sent to the consumer, for example, to the internal combustion engine through the filter 5 in the cover 4 of the tank 1.

These reactors were built and tested in a vehicle in laboratory and on-road tests. In the tests, the following fuel-air mixtures sent to the cylinders of the car engine were checked (Fig. 4):

- Normal gasoline-air mixture (control);
- Control + Rys A. reactor synthesis gas;
- Control + AndMI-1 reactor synthesis gas
- Control + AndMI-2 reactor synthesis gas



Figure 4. Test device

As can be seen from the test results (table 1), when the engine of the experimental "Cobalt" car operated in a normal gasoline-air mixture (control), the power of the engine was 74.35 kW, and the fuel consumption was 6.88 l/h. when Rys A.'s synthesis gas was added to the gasoline-air mixture (option 2), the power of the engine increased to 75.55 kW, and gasoline consumption decreased to 6.16 l/h [16,17]. When using AndMI-1 reactor synthesis gas (option 3) added to the usual gasoline-air mixture, the power of the engine increased to 76.87 kW, and gasoline consumption decreased to 5.75 l/h. In the next option 4, when the engine was used with gasoline-air+ AndMI-1 reactor adding synthesis gas, the power of the engine increased to 77.39 kW, and gasoline consumption decreased to 5.09 l/h. In this case, the main reason for the increase in power of the engine and the decrease in gasoline consumption in options 2, 3 and 4 was that the cylinders were filled with additional combustible gas in exchange for the addition of synthetic gases to the usual gasoline-air mixture.

Table 1.

Indicators of the engine in the transmission of synthetic gases

No	Types of fuel-air mixture	Quantity of revolutions of the crankshaft, rpm	Engine power, kW km/h	Fuel consumption , l/100 km	CO in exhaust, amount, %	CN in exhaust gas, amount, %
1.	Normal gasoline-air mixture (Control)	2300	74,35	6,88	4,06	5,15
2.	Control + Rys A. reactor synthesis gas	2300	75,55	6,16	2,28	3,22

3.	Control + AndMI-1 reactor synthesis gas	2300	76,87	5,75	2,05	2,83
4.	Control + AndMI-2 reactor synthesis gas	2300	77,39	5,09	1,89	1,31

The amount of carbon monoxide in the exhaust gases was 4.06% and the amount of unburned hydrocarbons CN was 5.15% when the engine was running in a normal gasoline-air mixture (control). 2.28; 2.05; 1.89% and CN amount 3.22; 2.83; was 1.31% [18-20].

In conclusion, from the options tested on the road in the "Kobalt" car, the 4th option, that is, the option of adding synthesis gas from the AndMI-2 reactor to the usual gasoline-air mixture, was chosen, because it increased the engine power by 4.09%, fuel consumption by 26.02%. decreased by , the amount of CO in the exhaust gases decreased by 2.15 times, and the amount of CN in the exhaust gases decreased by 3.93 times.

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