

ENERGY PRODUCTION ON MARS AND MAJOR ENERGY CONSUMPTION ITEMS

Among the priority tasks on the way of Mars colonization is the stage of choosing the electrical energy generating methods.

Providing energy from the sun is a bad idea on Mars. The solar radiation flux on Mars is 2.5 times less than on Earth therefore solar panels are not an economically viable way to generate electricity. There are also dust storms on Mars, which reduce the amount of light received from the sky and can last from several weeks to several months. This means that if you want to get enough energy throughout the year, you have to increase the size of your solar installation, which significantly affects the cost. Moreover, even without dust storms, there is always a suspension of particles in the air, which will constantly settle on solar panels, reducing their efficiency.

The basic method of obtaining energy on Mars at the moment is radioisotope energy sources (RTG, RITEG) with a power of up to 500 W, used in the construction of satellites and mobile research rovers. These nuclear batteries convert the thermal energy released during the natural decay of radioactive isotopes (mainly ²³⁸Pu) into DC energy using a thermo-electric generator. This type of power supply is attractive for reasons of compactness and reliability. But its significant drawback is low output power and its gradual output power decrease after 30-80 years of operation.

Providing a safe installation for powering the base from a radioisotope battery with a capacity of 10 kW or more is not a trivial task. A real nuclear reactor of a standard design is more suitable for such capacities. The requirements for such a reactor are compactness and operational safety. In this direction, the design of a compact and, more importantly, a safe nuclear reactor has already been developed. This reactor project is named "Kilopower". NASA is currently planning to send five 10-kilowatt reactors of this design to Mars. This is enough to provide 40 kilowatts of electricity required to operate the Martian base, plus one spare reactor.

Next, let's discuss the consumption items of electrical energy by the Martian base. According to the priority, consumption items can be divided into basic and target ones. Basic expenditures include oxygen production, ventilation and pressure maintenance, water extraction and purification, thermoregulation, lighting, food production (in hydroponic installations), radio and satellite communications. Target items of expenditure include: drilling, construction and installation work, fuel production (mainly CH₄ methane), research work.

Next, basic energy consumption items such as oxygen production, water extraction and purification, space heating, have to be considered.

It is known that the atmosphere of Mars is rarefied and is 96% carbon dioxide CO₂. The water is in the state of ice in large accumulations under the surface layer of the soil. The average temperature is -63 °C.

Under such conditions, oxygen production can be realized in two ways of electrolysis:

- 1) the reaction of the splitting of the carbon dioxide molecule CO₂ into carbon monoxide CO and oxygen O;

- 2) the reaction of splitting water H₂O into hydrogen H₂ and oxygen O;

These electrolysis reactions are now being used on the International Space Station to produce breathable oxygen from water.

In addition to the extraction of water-containing ice, water can be generated from the reaction of reducing carbon dioxide CO₂ using hydrogen 4H₂ to methane CH₄ with the release of water 2H₂O (Sabatier reaction).

Thermoregulation of the station, or rather its heating, can be carried out using the thermal energy of a nuclear reactor, since on Earth the efficiency of heat transfer from the reactor is lower than on Mars when comparing the heat-conducting properties of the atmosphere of both planets.

On Mars, as it has been on Earth throughout recorded history, the prosperity and freedom of action of human population will be dependent, necessarily, on the availability of energy. As such, it is of central importance that the methods by which such energy is collected, generated, stored, converted, transmitted, and ultimately utilized, be thoroughly examined and analyzed, and the best be chosen.