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IMPORTANT PHYSICAL AND TECHNICAL MEANS OF HYDROGEN TRANSPORT

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Currently, the task of providing the energy supply of mankind through the achievements of science is one of the most urgent problems. One of the ways to solve this problem is the use of hydrogen energy. Hydrogen energy involves the use of hydrogen and/or hydrogen-containing compounds to produce energy for all practical purposes with high energy efficiency, environmental and social benefits, as well as economic competitiveness. In each period of the energy revolution, one can observe large innovative programs that had a great impact on human life. In the 21st century, humanity is at the beginning of a new energy frontier, and it can be overcome by the next series of undefined innovations. It is known from history that scientists are the main source of innovative ideas and revolutionary solutions in the field of energy. It is difficult to imagine future energy without alternative energy, and in this sense, the greatest hopes can be attributed to hydrogen energy.

The scientific and technical directions of the concept of hydrogen energy were created in the 70s of the last century. In this direction, replacing organic fuel with a new energy carrier-hydrogen in all areas of their application, only water is produced during combustion and there are almost no harmful waste [1]. The world is currently experimenting with the efficient use of hydrogen energy in all areas, including energy production, storage and distribution: electricity, heating and cooling for buildings and households are organized by hydrogen energy; industry; hydrogen energy is used in transport and in the production of various raw materials, and there are many such applications. Energy efficiency and sustainability form the basis of the transition from the current fossil fuel-based economy to an economy based on renewable sustainable fuel cycles based on high-efficiency engineering and energy technology choices. Currently, advanced technological options for hydrogen production and the methods and prospects of its application in the main energy sectors to fully realize the use of hydrogen energy technologies are widely discussed by experts. An unexpected opportunity to find and harvest natural hydrogen on Earth, once thought to be non-existent, has been revealed and analyzed to understand possible geological interpretations to guide future operations of the sustainable and perennial fuel. Most experts and scientists note that the hydrogen industry is expected to form the basis of the future globalized economy. In this, hydrogen replaces the current coal, oil and natural gas. According to various forecasts, this situation will begin to form by 2040.[2]

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One of the reasons that hindered the development of hydrogen technologies in the 20th century was that the technology for its production became very expensive. However, as a result of the use of high technologies, these processes are becoming cheaper, and another important aspect is that it is an environmentally friendly product. Therefore, today, the importance of hydrogen is incomparable even in the implementation of the obligations of the countries in the fight against climate change. Attention is being paid to hydrogen as a solution to the problem of supplying energy to buildings, transport networks, and industry in the face of a rapidly growing population. The main task in the coming decades is to form a completely new industry and market of hydrogen technologies. This requires the development of environmentally friendly "green" hydrogen production, storage in large volumes and transportation over thousands of kilometers through pipelines and tankers, as well as the development of a system for use in energy, transport, industry and households.

In recent years, many studies have been conducted in the world on the effective use of alternative energy. In particular, the use and improvement of hydrogen energy is one of the most important and urgent issues in the focus of attention of scientists. In the last two centuries, methods of using energy from substances such as oil and gas, fuel and nuclear energy for the benefit of mankind have been discovered and are being used in practice. However, these methods of energy production, which are widely used today, increase the demand for new types of energy due to the depletion of mineral resources, environmental pollution, and economic efficiency. Hydrogen energy has many advantages and is currently the most optimal solution for meeting energy needs. Therefore, a lot of work has been done in this field recently.

In its free state and under normal conditions, hydrogen is a colorless, odorless and tasteless gas. The density of hydrogen compared to air is 1/14. Hydrogen can react with other substances, such as oxygen in water, carbon in methane, and organic compounds. Because hydrogen is so chemically active, it rarely exists as an unbound element. Hydrogen sold to the liquid state occupies 1/700 of the gas state. Hydrogen has the highest binding energy of 120.7 GJ/t per unit mass when combined with oxygen. The small molecular mass and ability to generate high energy are the basis for using hydrogen as a fuel for rockets and as an energy source for spaceships. Also, when hydrogen is used, hot gases are not produced, and the quality of water in nature is not affected by this.[3] The chemical element hydrogen was discovered in 1766 by the British scientist Henry Cavendish. In 1800, the method of obtaining hydrogen from water with the help of electricity was discovered, and in the middle of the 19th century, an electrochemical device designed to obtain electricity using hydrogen without combustion was created. In the first half of the 20th century, experimental devices for obtaining hydrogen from methane were launched. Today, hydrogen gas is produced mainly from hydrocarbons in the amount of 55-65 million tons per year. Hydrogen is

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mainly used in oil refining and in the production of ammonia and methanol in the chemical industry. Currently, only 1-2% of the total volume of hydrogen is used in energy. A global transformation process related to the reduction of environmental emissions is taking place in the world energy sector. In the 21st century, the program is undergoing a renaissance — the US DOE Hydrogen and Fuel Cells Program receives financial resources in the amount of 120 million US dollars annually[8]. The US Department of Energy passed the "Comprehensive National Energy Strategy" (On the Future of Hydrogen) Act. The law established that fuel cells should be recognized as key elements in the development of hydrogen energy technologies and adopted a multi-year research plan proposed by the US Department of Energy. The only state of the island of Hawaii is also implementing its own hydrogen program and intends to export hydrogen and hydrogen energy carriers in the future. Apart from the United States, these industries are developing most rapidly in Canada, Japan and other developed countries. Along with large-scale researches, active work on the commercialization of hydrogen energy is being carried out here. In 2017, the Fuel Cells and Hydrogen Joint Undertaking (FCH JU) program began to be implemented in the European Union. According to him, until 2023, 1.8 billion will be spent on the development of hydrogen technologies. euro is spent[5].

In Uzbekistan, solar and wind energy have great prospects, but one of the most important reasons preventing their development is the dependence of these energy sources on changes in weather conditions and day-night changes. Wind power generators work only when the wind speed is higher than 5-6 m/s, and in the regions of Uzbekistan with high wind potential, they provide energy for an average of 3200-4300 hours a year, and the duration of the year is 8760 hours. Solar photoelectric power plants work only during the day, when there are no clouds and little clouds, and they provide energy for an average of 1500-2200 hours a year in the regions of Uzbekistan with high solar potential. At night, during cloudy or windless periods, the amount of energy produced by variable renewable energy sources decreases, and this decrease is required to be compensated by other sources. For this purpose, the use of thermal power plant blocks and chemical accumulators leads to a noticeable increase in the cost of each kilowatt of electricity supplied [5]. When there is a large amount of energy from variable renewable energy sources, it is possible to obtain hydrogen at the expense of excess energy, store it for a certain period of time and use it as a compensating source in the event of energy shortage. The main consumer of hydrogen is the chemical industry (hydrogen is mainly used in the production of ammonia and methanol), as well as the petrochemical industry. During oil refining, various oil products are cleaned of sulfur compounds with its help. In power generation, hydrogen is used to cool high-power turbogenerators. In ferrous and non-ferrous metallurgy, hydrogen is used to obtain pure metals that can be recovered from oxides. In particular, high-purity

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hydrogen is necessary for the production of chemically pure copper, tungsten and molybdenum. In the radio engineering industry, hydrogen is used in the production of semiconductor equipment. The combustion temperature of hydrogen in oxygen is about 3000 degrees, and it can be produced up to 4000 degrees in special burners [6]. For this reason, hydrogen is used to weld refractory metals. Liquid hydrogen is also used as rocket fuel. It should be noted that in recent years, the problem of global warming has arisen before the world community. According to some estimates, another 2 degrees increase in the global average temperature will lead to an irreversible increase in temperature and kill all life on the planet.

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