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TECHNOLOGY OF PRODUCTION OF METHANOL-BASED FUEL CELLS AND ITS EFFICIENCY

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Annotation: This article presents thoughts and considerations about what methanol is. How it is obtained, current technology and efficiency of obtaining methanol, and in which fields it is used. These articles discuss the advantages, disadvantages, and efficiency of methanol fuel cell technology.
Keywords: methanol, methyl alcohol, methanol fuel elements,methanol economy, future fuel.

METANOL ASOSIDA YOQILG‘I ELEMENTLARI ISHLAB CHIQISH TEXNOLOGIYASI VA UNING SAMARADORLIGI

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Annotatsiya: Ushbu maqolada metanol nima.U qanday olinadi,hozirgi kunda metanol olish texnologiyasi va samaradorligi,qaysi sohalarda qo’llanilishi haqida fikr va mulohazalar keltirilgan.Metanol yoqilg‘i elementlari texnologiyasining afzalliklari,kamchiliklari, samaradorligi haqida fikr va mulohazalar yuritilgan.
Kalit so’zlar: metanol,metil alkogol,metanol yoqilg‘i elementlari,metanol iqtisodiyoti,kelajak yoqilg‘isi.
Аннотация: В этой статье представлены мнения и соображения о том, что такое метанол. Как его получают,современная технология получения метанола и его эффективность,в каких областях он используется.Размышлены о преимуществах, недостатках и эффективности технологии метанольных топливных элементов.
Ключевые слова: метанол, метиловый алкоголь,метанольные топливные элементы,экономика метанола,топливо будущего.

Introduction. Methanol (methyl alcohol, wood alcohol, carbinol, methyl hydrate, methyl hydroxide) - CH3OH, the simplest monohydric alcohol, a colorless toxic liquid. Methanol is the first representative of the homologous series of monohydric alcohols. At concentrations of 6.98-35.5% by volume, it forms explosive mixtures with air (flash point 8 ° C). Methanol is miscible with water and most organic solvents in any ratio. Methanol is the main raw material in the production of formaldehyde. It is added to gasoline as a solvent. It is

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widely used in the production of methyl methacrylate, methylamines, dimethyl terephthalate, methyl formate, methyl chloride, acetic acid, pharmaceuticals and other industries. Very toxic. When ingested, when inhaled, it poisons the body, and causes blindness. Therefore, it is necessary to periodically conduct medical examinations of workers working in areas where methanol is obtained or used. .The toxicity of this alcohol is much higher than that of ethyl, butyl and other alcohols. The lethal dose of methyl alcohol when ingested is 30 g, but severe poisoning with blindness can be caused by 5-10 g. The effects of its vapors are expressed as follows: irritation of the mucous membrane of the eyes; hypersensitivity to diseases of the upper respiratory tract and headaches; ringing in the ears; tremors; neuritis; visual impairment. Methyl alcohol can enter the body through intact skin. It can enter the body through breathing air saturated with its vapors through the skin, washing hands and wetting clothes. However, the most common and most dangerous way of poisoning with methanol is by swallowing the poison. The lethal dose of methanol when swallowed is 30 g. Cases of poisoning are known - with severe consequences, only 5-10 g of methanol. Methanol in the body has a serious effect on the nervous and cardiovascular systems. In particular, it actively affects the optic nerve and retina. As a result, one of the symptoms of methanol poisoning is lifelong blindness.

Accumulation in the body A distinctive feature of methanol is its rapid absorption from the gastrointestinal tract into the blood and slow excretion from the body. When ingested, methanol is excreted in urine and air within 7 days. In addition, methanol has cumulative properties - with repeated use of small doses, the poison accumulates in the body, creating a dangerous and lethal concentration. Due to these properties, chronic poisoning of a person is also possible.

Practical production of formaldehyde (participates in the synthesis of various plastics) and MTBE (high-octane additive to motor fuel); in the production of synthetic rubbers, acetic acid, methyl methacrylate, plastics, solvents, methylamines, dimethyl terephthalate, methyl formate, methyl chloride; taking medications; as an additive to motor gasolines; as a denaturing additive to ethyl alcohol intended for industrial use; recently used in methanol fuel cells; as an industrial solvent; methanol is a component of a number of antifreezes.

Methanol fuel cells (Direct Methanol Fuel Cells, DMFC) are a technology that generates electricity through the electrochemical reaction between methanol and oxygen. These fuel cells are similar to hydrogen-based fuel cells (PEMFC), but their main difference is that they use liquid methanol directly.

Principle of operation:

DMFC works according to the following basic processes:

1. Anode reaction: Methanol and water decompose on the electrode surface, producing protons (H^+), electrons (e^-) and carbon dioxide (CO_2):

$$CH3OH+H2O=CO2+6H+ +6e-$$

Advantages of MYE technology. Clean energy source: No combustion process, so fewer exhaust gases. Portable energy source: Can be produced in small quantities and fits into portable devices.

Easier to use than hydrogen fuel cells: Methanol is easier to store and transport because it is in liquid form.

Continuous power supply: Longer operating life than batteries and the ability to quickly “refuel” is possible.

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Disadvantages of MYE. Low efficiency: Lower efficiency than hydrogen fuel cells (PEMFC) (about 30-40%).

Carbon dioxide emissions: When methanol breaks down, CO_2 is produced, which is not entirely consistent with the goal of reducing harmful gases released into the atmosphere.

Catalyst cost: Requires expensive catalysts such as platinum.

Efficiency of MYE. Electrical efficiency: The overall efficiency of DMFCs is typically in the range of 30-40%, which is higher than diesel generators or internal combustion engines (ICEs), but lower than hydrogen fuel cells.

Energy efficiency: 1 kg of methanol can produce approximately 5.5 kWh of electricity.

Operating time: DMFCs can operate continuously for a long time, which is especially useful for laptops, drones, and portable power systems.

Applications. Portable devices: Laptops, phones, and other small electronic devices.

Vehicles: Can be used as a power source for electric vehicles and drones.

Military and offshore technologies: Used in areas where electricity is required for a long time.

Experiment and discussion section. Physicochemical properties of methanol

Chemical formula CH3OH

Molecular weight 32.04 g/mol

Melting temperature, °C minus 97.68

Density, g/cm3 0.791-0.792

The density and viscosity of methanol decrease with increasing temperature.

Table 1 below shows the density and viscosity of methanol as a function of temperature.

Table 1. Density and viscosity of methanol

Indicator name	negative 40 °C	negative 20 °C	0 °C	20 °C	40 °C	60 °C
density, g/cm^3	0,8470	0,8290	0,8100	0,7915	0,7740	0,7555
Viscosity, MPa C	1,750	1,160	0,817	0,597	0,450	0,350

Table 2. Boiling point of methanol versus pressure

Pressure, mm Hg	Temperature, °C	Pressure, MPa	Temperature, °C
1	negative 44,0	0,5	112,5
10	negative16,2	1,0	138,0
100	21,2	4,0	203,5
400	49,5	6,0	224,0

Table 3. Boiling point temperatures of aqueous methanol solutions

Molar fraction of methanol %	Boiling point temperature at 760 mm Hg, °C
0	100
5	92,8

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10	88,3
15	84,8
20	82
25	80,1
30	78,2
35	76,8
40	75,6
45	74,5
50	73,5
55	72,4
60	71,6
65	70,7
70	69,8
75	68,9
80	68
85	67,1
90	66,3

Technical methanol (hereinafter methanol, methyl alcohol) is one of the most important organic products and is the simplest representative of saturated monoatomic alcohols. In appearance, methanol is a colorless, transparent, volatile liquid without insoluble impurities, similar in smell and taste to ethyl alcohol. It is miscible with water in a transparent form.

Methanol is completely miscible with water and many organic liquids, but does not mix with aliphatic hydrocarbons. It absorbs water vapor, carbon dioxide and some other substances well.

Methanol is used as a semi-finished product in the chemical industry. Methanol is used in large quantities as a methylating agent in the production of formaldehyde, synthetic rubber, as well as in the production of such important products as dimethylterephthalate, methylamine, urotropine, methyl acrylate, pentaerythritol, hexamine.

Methanol is used as a solvent in the production of photographic film, amines, polyvinyl chloride, urea and ion-exchange resins, dyes and intermediates, and in the paint and varnish industry.

Methanol is used in large quantities to produce various chemicals, such as chlorophos, karbofos, methyl chloride and bromide, dimethyl sulfate, acetic acid, vinyl methyl ether, dimethylaniline, dimethylchlorothiophosphate, methyl mercaptan.

In the oil refining industry, methyl alcohol serves as a selective solvent for cleaning gasoline from mercaptans and as an azeotropic agent in the separation of toluene by rectification. In a mixture with ethylene glycol, methyl alcohol is used to obtain toluene from gasoline.

Methyl alcohol has a high octane number and can be used as an integral part of motor fuel.

In organic chemistry, methanol is used as a solvent.

Methanol is used in the gas industry to combat the formation of hydrates (due to its low freezing point and good solubility). In organic synthesis, methanol is used to produce

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formaldehyde, formalin, acetic acid, and a number of esters (for example, MTBE and DME), isoprene, etc.

Its largest amount is used in the production of formaldehyde, which is used to produce urea-formaldehyde and phenol-formaldehyde resins. A large amount of CH3OH is used in the paint industry to produce solvents in the production of varnishes. In addition, it is used as an additive to liquid fuels for internal combustion engines (limited due to hygroscopicity).

Due to its high octane number, which allows you to increase the compression ratio to 16, it increases the specific power of the engine; methanol is used to fuel racing motorcycles and cars. Methanol burns in air and, when oxidized, forms carbon (IV) oxide and water:

$$2CH_3OH + 3O_2\uparrow \rightarrow 2CO_2\uparrow + 4H_2O$$

To obtain biodiesel, vegetable oil is mixed with methanol at a temperature of 60 °C and normal pressure in the following proportions: 1 t of oil + 200 kg of methanol + potassium or sodium hydroxide.

In many countries, methanol is used as a denaturing additive to ethanol in the production of perfumes.

Note - the fire, explosion and toxicity characteristics of finished products, raw materials, intermediate products and production waste are given in Section 12 of the Basic Rules for Safe Operation of Production.

2.2 The by-product of the methanol extraction unit is isobutyl oil.

According to the physicochemical parameters, isobutyl oil must meet the requirements specified in Table 2.2.1.

Table 2.1.5

Indicator name	Rule
1	**2**
1 Mass fraction of water, %, max	43
2 Mass fraction of methanol, %, max	17
3 Mass fraction of ethanol, %, max	23
4 Mass fraction of propanol, %, max	11
5 Mass fraction of butanol, %, max	6
6 Mass fraction of isobutanol, %, max	0,8
7 Mass fraction of isopentanol, %, max	0,1

Conclusion. Methanol fuel cells are more convenient and safer than hydrogen fuel cells, but they are less efficient. They are considered one of the promising technologies, especially as portable power systems and alternative energy sources. In the future, the efficiency of MFCs can be improved by improving catalyst technology and reducing carbon dioxide emissions. The methanol economy is becoming increasingly important in the global energy market. It is increasingly used as an alternative to traditional fuels, especially in marine transport and industry. Green methanol, on the other hand, has the potential to become a carbon-neutral fuel in the future. For its sustainable development, it is important to reduce production costs and expand the methanol fuel infrastructure.

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