

heat carrier is a substance or a system of substances used as a medium for heating. As heat carriers for medium - and low-temperature processes in the chemical industry, hot air, hot water, saturated and superheated water vapor, flue gases, high-boiling organic compounds, solid granular materials (usually catalyst grains) are used.

Fuel energy during fuel combustion is used to produce heat and electricity in thermal power plants and special-purpose furnaces and makes up about 50% of the total energy balance used in the chemical industry.

Mechanical energy is used to perform such physical operations as grinding, centrifuging, moving materials, displacement, in the operation of various compressor machines, pumps and fans, etc.

Light energy is used in the form of irradiation to conduct photochemical synthesis processes, for example, in the production of hydrogen chloride, halogen alkanes, etc.

Chemical energy is realized in the work of chemical current sources of various devices and purposes.

Nuclear energy is used for conducting radiation-chemical processes (for example, in polymerization processes), energy production in nuclear power plants, for analysis, control and regulation of production processes.

Of all the energy consumed by the chemical industry, 40% is electric, 50% is thermal (in the form of heat carriers — steam and water) and 10% is fuel energy.

The main sources of energy are fossil fuels and products of their processing, water energy, biomass and nuclear fuel. To a much lesser extent, the energy of the wind, sun, tides, geothermal energy is used. The world reserves of the main types of fuel are estimated at $1.28 \cdot 10^{13}$ tons of CF (conditional fuel), including fossil coal $1.12 \cdot 10^{13}$ tons, oil $7.4 \cdot 10^{11}$ tons and natural gas $6.3 \cdot 10^{11}$ tons of CF (conditional fuel).

Energy production on the planet at present is $2.93 \cdot 10^{14}$ kW·h or $3.35 \cdot 10^7$ MW·year.

All energy resources are divided into *primary* and *secondary*, *renewable* and *non-renewable*, *fuel* and *non-fuel*.

Fuel energy resources are: coal, oil, natural gas, shale, tar sands, peat, biomass.

Non-fuel energy resources are: hydropower, wind, sun, earth, etc.

Secondary energy resources (SER) are the energy potential of final, by-products and intermediate products and wastes of chemical production used for power supply of units and installations. These include the thermal effects of exothermic reactions, the heat content of the process waste products, and the potential energy of compressed gases and liquids.

The most important source of energy is chemical fuel (fossil coals, peat, petroleum products, natural and technical gases), which make up 70% of the balance of energy resources of the chemical industry. The structure of chemical fuel consumption is as follows: gas 19.4%, solid fuel 30.9%, petroleum products 47.2%.

The calorie equivalent characterizes the energy value of a chemical fuel and represents the ratio of the net calorific value of a given fuel to the calorific value of *conventional fuel (CF)*, taken as 29,260 kJ:

$$\eta_c = Q^n / 29,260$$

CF (conventional fuel) is the amount of energy in kW·h obtained from the complete combustion of 1 kg or 1 m³ of fuel. This value is: for coal 8.0, natural gas 10.6, coke 7.2, fuel oil 15.4, reverse coke oven gas 4.8. For comparison, the same value for enriched uranium is $22.5 \cdot 10^6$.

The second place in terms of the energy contribution is occupied by *hydropower (HPP)* and *nuclear energy (NPP)*. The share of energy generated by hydropower plants is about 12%. NPPs represent the most promising source of energy, both electric and thermal.

Renewable energy sources are: