IJDPP International Journal of Development and Public Policy
| e-ISSN: 2792-3991 | www.openaccessjournals.eu | Volume: 2 Issue: 3

Secondary Heat Energy Resources in the Industry of the Republic of Uzbekistan and Possibilities of Using Non-Traditional Energy Types

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Annotation: The article describes various technologies for the use of secondary energy resources, which is currently the most important promising direction of energy saving at enterprises and gives some notions about traditional-non-traditional energy. The use of secondary energy resources in Uzbekistan at ferrous metallurgy enterprises, in the chemical, petrochemical and pulp and paper industries is considered as a real possibility of energy saving.

Keywords: secondary energy resources (SER), combustible SER, gas, thermal load, energy saving.

Energy plays an important role in society. It allows increasing the capacity to meet the needs of different districts several times. The development of human civilization has always been closely linked to the amount and type of energy used. However, the current development of the national and global economy is leading to the overuse of energy resources and, consequently, their reduction. This, in turn, leads to resource shortages and environmental problems.

In this context, it is important for people, including schoolchildren, to develop an understanding of energy efficiency. In this process, physics has a special place among the general education sciences. People should also pay attention to the concept of sustainable development in Uzbekistan and the following issues:

- improving the environmental situation in the country;
- protection and improvement of the environment;
- land and water resources for future generations use wisely;
- Development of non-conventional and renewable energy sources.

At present, we consume energy mainly in the form of electricity and use a wide range of methods to obtain electricity.

Energy is the ability to produce work or some other action that changes the state of the acting subject. In a broad sense, this is a general measure of the various forms of motion of matter.

For modern society, the most relevant types of energy are electrical and thermal. Other varieties are mechanical, chemical, atomic, etc. - can be considered intermediate or auxiliary.

Thermal energy (heat, heat) - the energy of the chaotic movement of micro particles - is the primary energy of the energy conversion chain, and this chain ends with it. Thermal energy is used by man to provide the necessary conditions for his existence, to develop and improve society, to obtain electrical energy at thermal power plants, for the technological needs of production, for heating and hot water supply of residential and public buildings. Substances and systems, the energy potential of which is sufficient for subsequent purposeful use, can serve as energy sources.

ISSN 2792-3991 (online), Published under Volume: 2 Issue: 3 in March -2022
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The energy potential is a parameter that evaluates the possibility of using an energy source, expressed in units of energy - Joules or kilowatt-hours.

The most widely used in explaining traditional methods of obtaining energy are thermal power plants (nuclear plant). Thermal power plants include gas, coal, and oil-fired power plants, as well as nuclear power plants (nuclear plant) that generate heat in the presence of uranium nuclei. The operation of the first type of power plants is limited by the reduction of fuel reserves and the impact of combustion products on the environment. The resource of raw materials in the operation of nuclear power plants is almost unlimited.

When explaining non-traditional methods of obtaining electricity, it differs from traditional methods in that raw materials for energy resources are not limited, environmentally friendly and renewable. One of the best-studied and most widely used of these methods in recent years is solar panels and wind generators.

Much has been done in Uzbekistan in this area. For example, the Solar Physics Scientific Production Association is launching the production of solar batteries. At the initiative of the Ministry of Energy of Uzbekistan, wind generators are being imported from Denmark to Bekabad district of Fergana region. One of the most promising non-traditional methods for our Republic is bioenergy. To date, many designs of biogas plants have been developed. These devices perform two functions at once, producing biogas fuel and producing quality compost. The use of geothermal, volcanic energy will also need to address some of the environmental issues associated with the release of various gases.

Efficient devices for the rise of sea water and the use of wave energy have been developed and successfully used to supply low-power consumers.

No matter how natural and environmentally friendly non-traditional energy sources are, they may not fully meet energy needs. That is why nuclear energy is considered to be the main energy of the future. The first way to use nuclear energy is to discuss the fission energy of the uranium nucleus and its problems.

Energy resources are any sources of mechanical, chemical and physical energy.

Energy resources can be divided into:

- primary, the source of which is natural resources and natural phenomena;
- secondary, which includes intermediate products of coal enrichment and sorting; tar, fuel oil and other residual products of oil refining; chips, stumps, twigs during wood harvesting; combustible gases; heat of exhaust gases; combustible water from cooling systems; spent steam of power industrial plants.

Primary energy resources are divided into: - non-renewable or depleted (coal, oil, shale, natural gas, fuel);

- ✓ Non-renewable or exhaustible (coal, oil, shale, natural gas, fuel);
- ✓ Renewable (wood, hydropower, wind power, geothermal power, peat, fusion power);

Secondary (side) energy resources (SER) are energy carriers generated during production, which can be reused to generate energy outside the main technological process.

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About 90% of the currently used energy resources are non-renewable (coal, oil, natural gas, uranium, etc.) due to their high energy potential, relative availability and expediency of extraction; the rates of their extraction and consumption determine the energy policy.

The efficiency of the use of energy resources is determined by the degree of conversion of their energy potential into final products used or consumed final types of energy (mechanical energy of movement, heat for heating systems or technological needs, etc.), which is characterized by the efficiency of energy resources ηer:

$\eta er = \eta p \cdot \eta t \cdot \eta u$

Where ηp is the coefficient of production, extraction of a potential reserve of an energy resource (the ratio of the extracted to the total amount of the resource);

ηt- conversion factor (the ratio of the energy received to the total supplied by the energy resource);

ηu - is the energy utilization factor (the ratio of the energy used to the energy supplied to the consumer).

For oil η = 30…40%, for gas - 80%, coal - 40%. Modern furnace devices, when receiving thermal energy from chemical by burning fuels, make it possible to obtain ηt = 94…98%; when heat is transferred to the consumer through heat supply systems, ηp is reduced to 70 ... 80%. If, however, mechanical energy is obtained from the thermal energy of combustion products in order to generate electricity (at thermal power plants - thermal power plants), then ηt = 30 ... 40%; for an internal combustion engine ηt = 20…30%. The value of ηu depends on the type of a particular consumer and operating conditions (heating systems - 50%). On average, ηer = 36%.

The concept of secondary energy resources (SER) refers to the energy potential of products, waste, by-products and intermediate waste generated in technological installations (aggregates), which is not used in the unit itself, but can be partially or completely used for the power supply of other installations. The concept of "energy potential" means the presence of a certain reserve of energy (chemically bound heat, physical heat, potential energy of overpressure). The SER does not include the chemically bound heat of the products of fuel processing, gas-generating, coal-processing industries and those energy wastes that are used in the SER source unit itself (heat recovery).

According to the type of energy, SER are divided into three groups: fuel (burning), which means directly combustible waste products themselves that are not suitable for further technological processing (blast furnace gas, exhaust gas from soot furnaces, absorption gas in the production of monomers for synthetic rubbers, etc.); thermal (the physical heat of the exhaust gases of technological installations, the physical heat of the production and waste of the main production, water, steam, condensate heat used in the technological process), which also include the low-potential heat of vent vents, waste liquids and gases from technological installations; overpressure, in which the potential of natural energy of gases and liquids leaving technological unitswith excessive pressure, it is necessary to reduce before the subsequent stage of using these liquids or gases when released into the atmosphere.

The use of SER is the most important direction of energy saving in industrial enterprises. Depending on the types and parameters of SER, four main directions of the use of secondary energy resources can be distinguished:

Fuel - direct use of combustible SER as fuel;

Thermal - the use of heat obtained directly as SER or generated by SER in recycling plants (this direction also includes the production of cold due to SER in absorption refrigeration units);

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Power - the use of mechanical or electrical energy generated in recycling plants (stations) at the expense of secondary energy resources;

Combined - the use of thermal and electrical (or mechanical) energy simultaneously generated by SER in SER plants (recycling HEC) according to the heating cycle.

The classification of SER and directions of use is given in Table 1 [1].

Combustible SER additional fuel resources are formed mainly in four industries: ferrous metallurgy, chemical, petrochemical and pulp and paper. At the enterprises of ferrous metallurgy, blast furnace, converter and ferroalloy gases are referred to as SER fuels. Of the three types of combustible SER, blast furnace gas is most fully used as boiler-furnace fuel at HEC plants, in boiler houses and process furnaces. A significant part of this gas (34%) is consumed in the blast furnace shop itself for heating air heaters. The average loss of blast furnace gas in the industry is 5.5% and is approaching the technically inevitable, which is estimated at 5% of the yield. The resources of converter gas when it is cooled without air access are currently about 400-450 thousand tons of cu. t., but in modern conditions, due to uneven output and difficulty of accumulation, converter gases are practically not used as fuel, but are burned by candles. Ferroalloy gas is used as fuel in energy boilers and technological furnaces for lime firing. Currently, approximately 30% of the available ferroalloy gas resources are utilized at metallurgical plants.

Table 1. Classification of SER

Type of SER	**Carriers of SER**	**Energy potential**	**SER output**	**Method of use**
Hot	Solid, liquid and gaseous combustible waste	Heat of combustion	$Q = Q_H^P m_{\text{ВЭР}}$; $B = \frac{Q_H^P m_{\text{ВЭР}}}{7000}$	Combustion in fuel-using installations (fuel)
Thermal	Waste gases, cooling water, condensate, production waste, intermediate products, finished products	Physical heat	$Q = c\,(t - t_0) m_{ser}$	Generation of heat energy in the form of water vapor or hot water (thermal) in a heat recovery unit
	Secondary or waste water vapor	Enthalpy	$Q = (i - i_0) m_{ser}$	In heat-using installations (thermal) or in a recycling turbine for generating electricity (power and combined)
SER overpressure	Gases and liquids with excessive pressure	The work of isentropic expansion	$W = l m_{ser}$	Production of electricity or mechanical work in a recycling turbine (power)

Note: Q^P_H- lower heat of combustion; m_{ser}- specific (hourly) amount of energy carrier in the form of solid, liquid or gaseous products; l - work of isentropic expansion; c - heat capacity of the energy carrier; i - enthalpy of gas before expansion, i_0 - enthalpy of gas at the end of isentropic expansion, K.

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In the chemical industry, combustible SER are formed in the production of ammonia, methanol, caprolactam, acetylene, caustic soda, phosphorus and in the production of organic synthesis. In the production of ammonia, combustible SER are oxide-carbon fraction, tank, retour and purge gases, as well as liquid hydrocarbons, in the production of methanol and caprolactam − purge gases, in the production of acetylene - soot sludge, in the production of caustic soda - hydrogen gas, in the production of phosphorus − furnace gas. The insufficient level of use of combustible SER in the industry is explained by the fact that some of their types, for a number of objective reasons, are not used at all. Currently, furnace gas for phosphorus production is practically not used due to its explosiveness; the issue of using excess hydrogen in the production of caustic soda has not been completely resolved. Purge gases are used to a low degree in the production of methanol according to the old schemes and retour gases in the production of ammonia. The industry is developing the use of these SER as fuel. In the petrochemical industry, the following types of combustible SER are formed: abgas and motor fuel (liquid hydrocarbons) produced by synthetic rubber (SR), methane-hydrogen fraction (MHF) produced by ethylene and waste gases produced by carbon black (soot). A significant reserve of fuel economy is the use of waste gases from the production of carbon black. In the pulp and paper industry, the combustible SER are: sulfate and sulfite liquor, bark and wood waste. Along with the use as fuel, sulfite liquor, bark and wood waste are also used in the commodity direction. One of the promising areas of energy saving that requires joint coordinated efforts of enterprises and research and design organizations (providing the development of heat supply schemes and services for the operation of heat supply sources) for its implementation is the integrated use of SER in heat supply schemes. The economic mechanism did not contribute to such work until recently. Often the departmental interests of heat energy suppliers and its consumers were reduced to the desire, on the one hand, to increase the capacity of heat sources, and on the other, to eliminate its economical consumption. According to the established tradition, designers of heat supply schemes are still forced to develop heat supply schemes on the basis of overstated thermal loads issued to enterprises and consumers. This practice of developing heat supply schemes becomes a kind of protection for industrial enterprises from the need to pursue a vigorous energy-saving policy. Selective examination of projects of industrial enterprises shows that, taking into account the real possibilities of energy saving, the thermal loads of many consumers can be reduced by 20-30% or more. If we compare the need of industries for thermal energy without taking into account energy saving, i.e. according to the claimed prospective loads, with data taking into account the possibilities of energy saving reserves, then in such heat-intensive industries as chemistry and petro chemistry without taking into account energy saving, an increase in heat consumption by enterprises by 20-50% is unreasonably planned for the future. The analysis shows that taking into account the real reserves of energy saving, the need for thermal energy at the same enterprises can be reduced by 30-40%. The data of the analysis of energy use at industrial sites show that the main reserve for saving thermal energy is SER. These include: heat losses with spent energy carrier (outgoing gases of fuel aggregates, condensate of heat-consuming aggregates, etc.), heat losses to the environment and heat losses caused by technology features (these are losses with production waste, intermediates and product). Fuel-using units - various kinds of furnaces in all industries - have the lowest efficiency in industry and, accordingly, the highest SER output. The heat of the exhaust gases from these units is the most widespread type of SER. Therefore, the more industrial enterprises consume direct-use fuels, i.e. for the power supply of technological units, the greater the output of SER and the greater the possibility of covering thermal loads due to their use. In the industry as a whole, the output of SER, including the low-potential heat of exhaust gases, thermal effluents and vent emissions, is about half of their total energy consumption [2].

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Therefore, the most important task in assessing the possibilities of energy saving at industrial sites is to analyze their energy consumption, structure, characteristics of consumers in order to identify the volumes of SER output and their possible use. When starting to develop heat supply schemes, it is advisable to conduct a preliminary analysis of the claimed thermal loads, taking into account data on the output and possible use of SER at the industrial site. Technical and economic calculations of the efficiency of the implementation of energy saving reserves, as well as the combination of energy saving costs with the costs of constructing additional heat supply sources, make it possible to reasonably reduce the claimed thermal loads of enterprises. In such calculations, it is also necessary to take into account the environmental effect of both the use of SER (usually not taken into account) and the reduction in the power of heat supply sources. In many cases, the environmental effect of the use of SER exceeds the energy effect and is an additional important incentive in the implementation of measures for the use of SER. The conducted research at industrial sites shows that when analyzing reserves for saving thermal energy at enterprises, in addition to the use of SER, such large-scale measures as: regulation of heat consumption modes; introduction of automatic control and accounting systems for heat energy consumption at the consumption stage; analysis of condensate return and increasing the degree of its use have a great effect; analysis of the specific heat energy consumption of the main technological equipment, their comparison with the modern level and recommendations for the introduction of modern equipment and technological processes; reasonable use of the heat of ventilation emissions [3].

Taking into account these measures at the industrial site should be a serious factor in reducing the claimed loads. Carrying out such technical and economic calculations justifies not only the reduction of thermal loads, but also the savings of energy resources obtained from the development of an optimized scheme taking into account these measures, savings in capital costs due to a decrease in the amount of heat energy produced and distributed, and improvement of environmental indicators at enterprises and heat supply sources. Carrying out these calculations will allow us to develop heat supply schemes taking into account the real possibilities of energy saving.

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