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Disposal of Heat Waste for Heating and Hot Water Supply and Industrial Equipment Applied for This

Samatova Shoira Yuldashevna[1]

Nurmamatova Madina Nodir Kizi[2]

Abstuct: This article discusses different methods of using heat for secondary energy purposes. The accumulated and reused heat makes it possible to replace expensive fuel or electrical energy without creating additional emissions of harmful substances into the atmosphere. There are a number of technologies to efficiently convert waste heat.

Key words:energy efficiency, industrial, energy-consuming, equipment, heat waste, technology, utilization, low potential, waste boiler units, furnaces, drying plants, separators, motors, pumps.

[1] Associate Professor, Karshi Engineering – Economics Institute
[2] Student, Karshi State University

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Introduction

About one third of all energy used in the republic is accounted for by industry, which has a significant amount of thermal (secondary energy) VER. The main directions of increasing energy efficiency at industrial enterprises are focused on reducing the energy consumption of technological equipment (boilers, furnaces, drying plants, separators, motors and pumps) and improving production technologies. One of the ways to improve the efficiency of energy-consuming equipment is to collect and reuse thermal waste. In some cases, the utilization of thermal waste from industrial furnaces can increase their efficiency by 10% - 50% [L.1.p.9-10].

Methods and discussion. The accumulated and reused heat makes it possible to replace expensive fuel or electrical energy without creating additional emissions of harmful substances into the atmosphere. There are a number of technologies that can effectively convert waste heat into an end-use product. However, a significant amount of thermal energy resources still remains unused.

For the efficient utilization of thermal (secondary energy) secondary energy resources, the following components are required: 1) an available source of thermal secondary energy resources; 2) technologies for their use; 3) the final consumer of recycling products. The main characteristics of thermal waste sources are their quantity and quality, availability of utilization technologies, problems in organizing a heat recovery system. The results of the analysis of these factors are used to determine the production due to RES, which improves the energy efficiency of an industrial enterprise.

1. Each source of RES is considered from the point of view of the amount of heat contained in it, quality indicators (discharge temperature), existing and available technologies, problems of organizing heat recovery systems. The amount of heat contained in thermal waste depends on the flow rate of the coolant, its composition, temperature and is determined on the basis of the power consumption mode, required temperatures and mass balance.
2. The maximum amount of energy that can be obtained by using thermal VER to drive a heat engine is determined by a quantity called potential work (exergy). Determination of this characteristic makes it possible to evaluate the efficiency of using different sources of water energy resources with different temperatures.
3. Analysis of existing technologies shows that thermal waste is usually obtained from clean, high-temperature sources of secondary energy resources in large systems. Improvement of technologies is possible in the field of optimization of existing systems, development of technologies for chemically aggressive systems, utilization of low-temperature waste heat.
4. The introduction of thermal waste disposal systems is often limited by factors such as the temperature level of the waste and the cost of disposal equipment. There are cases when utilization equipment is installed, however, it is not possible to use the full potential of thermal waste. One of the reasons may be the limited possibility of using some structural materials of heat exchangers.
5. The analysis of sources of thermal waste, given above, shows that about 60% of waste heat is low-temperature (2320C and below). Utilization of such heat is less efficient from a technical and economic point of view, but it is this type of heat waste that is available at enterprises in large quantities, which suggests that the disposal of low-grade waste should not be neglected. Modern technologies provide various possibilities for its recovery and use for heating and hot water supply, technological purposes.L. [L.2; .pages 27 - 31].

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At a number of enterprises, the use of thermal RES may be limited by the content of chemically active elements in them.

The use of thermal waste is possible in three directions:

Closed circuits - heat is used for processes occurring in the main technological units (heating of combustion components, preheating of material). It should be noted that, according to the definition of VER, thermal waste used according to such schemes does not belong to secondary energy resources.

Open-loop circuits of installations using VER are characterized by the fact that VER is used for external purposes that are not related to the processes occurring in the main technological devices that are sources of VER (steam generation in steam generators, air heating to third-party consumers, etc.).

The third direction is combined installations in which waste is used both for internal and external purposes in relation to the process in the technological installation (closed-open circuits) steam-gas, gas-steam, waste heat boilers. [L.3; p. 43 -46.].

For example: the Tashkent Metallurgical Plant during heat treatment of metals in furnaces directly for their heating uses only 10-15% of the supplied heat; losses in the form of heat of the furnace exhaust gases are up to 60-70%; external losses (masonry, emissions, etc.) - 10-20%. With an increase in the temperature of the air supplied for combustion, the fuel utilization coefficient increases and its consumption decreases.

The main most economical direction of fuel saving is preheating of combustion components and feed material. Preheating of combustion components, for example, air, is carried out in heat exchangers due to the heat of the flue gases of the furnaces. An increase in air temperature leads to a decrease in fuel consumption. For these purposes, the following heat exchangers are most widely used: recuperators, furnace regenerators, rotating regenerators, air heaters. [L.4; pp. 93 - 97].

Results. Recuperators are used to recover the heat of exhaust gases for medium and high temperature applications. Their work is based on radiation, convection, or radiative-convective heat transfer. It consists of two concentric cylinders. Waste hot gases pass through the inner channel, giving off heat to the wall of the channel, and then to the air passing through the outer annular channel. After that, the heated air is supplied to the burners of the furnaces.

In convective tubular recuperators, hot gases pass through a bundle of tubes of relatively small diameter, placed inside the duct. The incoming air is fed into the outer channel and washes the pipes, taking heat from the hot gases passing inside them. Combined radiation-convective recuperators, including a radiation section located below the convection one, which makes it possible to increase the efficiency of the heat exchange process between the media.

The recuperators are made of metal and ceramic materials. Metal recuperators are used at temperatures below 1093 ^{0}C, while at higher temperatures, ceramic tube recuperators are better suited. They can withstand temperatures above 1500 ^{0}C on the hot side and about 980 ^{0}C on the cold side.

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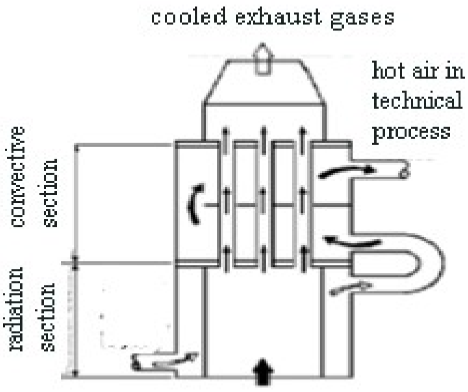

Fig. 1 Convective recuperator Fig. 2 Combined radiation Convection- convection recuperator

Regenerative furnaces include two chambers with brickwork, through which hot and cold flows alternately pass (Fig. 2). When the combustion products pass through the chamber, the brick nozzle takes heat from them and heats up. Then, the air flow is supplied in such a way that the air entering the combustion process passes through a hot nozzle, which transfers heat to it. The chambers are used in such a way that while one nozzle picks up the heat from the exhaust gases, the other heats up the air. The airflow direction changes approximately every 20 minutes. Regenerators were widely used in glass and coke ovens, and were previously widely used in steel open-hearth furnaces, until they were supplanted by more efficient devices. They have also been used for hot blast preheating in iron making. However, in this case, the regenerators were not utilization equipment of VER, since they were used to preheat the air entering the furnace, i.e. for heating the components involved in the main technological process due to the heat of the exhaust gases. Regenerators can be effectively used for high temperature applications of contaminated gases. Their main disadvantage is their rather large size and high cost compared to recuperators.

The principle of operation of rotating regenerators is to accumulate heat using a porous packing, which is alternately washed by hot and cold gas passing through the regenerator. Rotary regenerators are often used as air heaters and are a rotating drum containing a packing and connecting adjacent channels, one of which moves hot exhaust gases, and the other - cold gas. A packing made of a material with a high coefficient of thermal conductivity rotates between two channels, transferring heat from a hot gas to a cold one.

The use of such systems is limited (low and medium temperature applications), which is caused by the resistance of the nozzles when working at high temperatures. Significant temperature differences between the two channels can lead to expansion and deformation, which in turn compromises the integrity of the drum seals. When using rotating regenerators for high-temperature purposes, the packing can be made of ceramic. Another problem with such systems is contamination that is transferred from one gas stream to another through the packing.

One of the advantages of rotating regenerators is that they can be used to transfer moisture as well as heat from uncontaminated gases. With hygroscopic materials, moisture can be transferred from one channel to another. This makes it possible to use the regenerators in air conditioning systems where the hot, humid inlet air transfers heat and moisture to the cold outlet air. Apart from the main application in space heating and air conditioning systems, rotary heat exchangers

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are also used on a limited scale and in medium temperature systems. Regenerators are also designed for high-temperature furnaces, although such systems have not found widespread use due to their cost. Regenerators are also used to recover the heat of flue gases from boilers, although more often economical recuperators and economizers are more preferable. As noted earlier, a significant amount of thermal waste in industry is low-grade heat. For example, the physical heat of flue gases from boilers with a temperature of 150-1800C. At the same time, significant reserves of heat are contained in the cooling water of industrial equipment and the cooling air [L.2; 3; 4;].

Low-grade heat can be roughly divided into two ranges: Although most often economical recuperators and economizers are more preferable. Heat with a temperature of 40 to 1500C, which can be directly used for heating purposes. In this case, when heat is utilized, heat is transferred from sources with a higher temperature to sources with a lower temperature.

The main sources of such waste are:

waste steam, heated water, waste gases from steam and gas turbines.

Heat with a temperature below 40 ^{0}C, which cannot be directly used for heating and hot water supply, since its temperature is lower than the one required by the consumer. Often this heat is discharged into the environment. For example, a plant may have significant stocks of thermal waste at a temperature of 30 ^{0}C, while other processes may require hot water at a temperature of 60 ^{0}C and above. In this case, a heat pump can be used, which makes it possible to increase the temperature level of heat in accordance with the requirements of the consumers. External energy is required to drive the heat pump.

Energy-intensive industrial processes - such as those taking place in refineries, steel mills, glass blowing plants, cement kilns - are sources of waste heat and hot waste gases that can be used in modern power generation technologies. Utilization of thermal waste for such purposes is an unused type of combined energy generation (cogeneration), in which one source of energy (fuel) is used to jointly generate heat (cold) and electrical energy [L.4; 5;].

A cogeneration system consists of a primary source, a generator, a heat recovery system and electrical interconnected equipment assembled into an integrated system. Combined generation is characterized by higher efficiency and the possibility of avoiding or reducing losses during the transportation of energy from the source to the consumer, as a result of which the consumption of primary fuel and the emission of harmful substances into the atmosphere are reduced.

Using the example of the Mubarek gas processing plant:

The use of the BKZ - 75/39 boiler for the purpose of utilizing flue gases, gas turbine installations, the purpose for ensuring the heat and power supply of the gas processing plant is justified. At this time, the boiler burns 13 x 103 m3 natural gas. The introduction of the proposed development will solve the problem of energy and resource conservation and ecology. Five pieces of BKZ - 75/39 boilers, utilization of a waste heat boiler for the purpose, approximately in one boiler, equivalent fuel savings of 6000 m^3. Five pieces of boiler BKZ - 75/39 per year Vus.top = 365 x 30000 = 10950 x 103 m^3 / year. For two gas turbine units, the plant provides itself with electrical energy. From the heat and the generated energy, utilities, showers, greenhouses, the heating system of administrative buildings, industrial units, factory workshops can be used.

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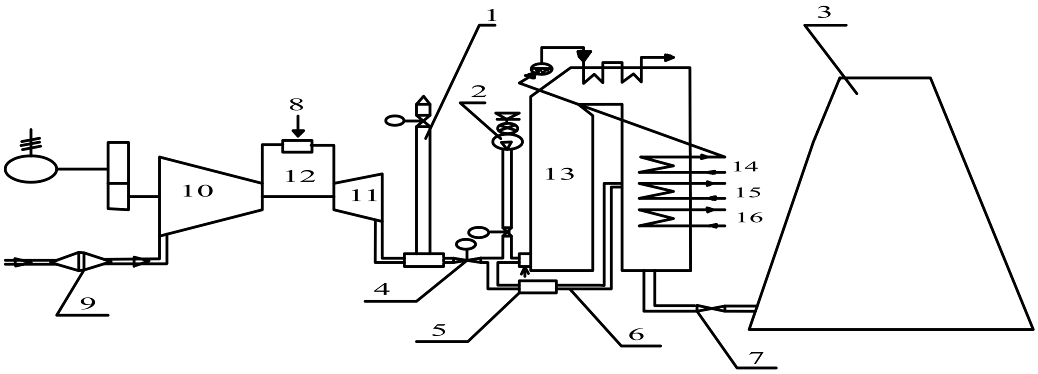

Fig-3.Use of the BKZ - 75/39 boiler for the purpose of utilizing flue gases of gas turbine plants for heat and power supply of a gas processing plant.

1 spare chimney; 2 - smoke exhauster; 3 - chimney; 4.7 - repair gate; 5 - regulating gate; 6 - spare boiler furnace; 8 - combustion chamber; 9 - air suction pipe of the compressor; 10 - compressor; 11 - gas turbine unit; 12 - additional fuel supply; 13 - steam boiler; 14 - water econamizer; 15.16 - water gas high and low heating unit.

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CONCLUSIONS

1. The introduction of the proposed development will solve the problem of energy and resource conservation and ecology.
2. From the heat and generated energy, you can use utilities, showers, greenhouses, the heating system of administrative buildings, industrial units, factory workshops.

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