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SECONDARY ENERGY RESOURCES OF INDUSTRIAL ENTERPRISES

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Abstract: The article provides a brief overview of the more significant secondary energy resources of modern industrial enterprises and their implementation confirms the need for radical improvement in the field of the possible full and rational use of these resources for energy purposes.
Keywords: Waste heat, energy service, industrial, household, heat supply, consumer, generation, compressor, blower unit, gas blower unit, energy carrier, heat carrier.

Introduction

Secondary energy resources is the waste heat obtained after the energy service of industrial, household and other processes. This heat can be used for energy purposes, that is, for heat supply to consumers and for the generation of electricity or for the production of mechanical work in compressor, blower and gas-blowing units. Depending on the type and parameters of energy carriers consumed for the energy service of certain processes, secondary energy resources can be various coolants, the quality parameters of which are determined by the processes being serviced. The most significant secondary energy resources are in the industrial sector of Russia, which consumes more than half of the fuel produced in the country and over 75% of the total amount of electricity generated [1, 2].

MAIN PART

The qualitative parameters of the secondary energy resources of industrial enterprises are given in table-1.

From those listed in table-1 of secondary energy resources, the most significant in size and having one or another practical use for energy purposes are: waste combustible gases, waste hot gases of industrial furnaces, spent industrial steam. The most significant thermal waste in the heated cooling water is generated by steel-making furnaces, in which the heat loss in the cooling water is from 16 to 25% of the consumed fuel. Recently, evaporative cooling of metallurgical furnaces has been increasingly introduced: cold cooling water is replaced by boiling water, and the latent heat of vaporization is used to remove heat from the cooled parts of the furnace [2]. The advantages of evaporative cooling over water cooling are: an increase in the reliability of the furnace, an increase in the service life of cooled parts, a sharp reduction in water consumption (by 35-50 times), the absence of cooling devices for water, pumping stations and large-diameter water pipelines, and most importantly, the possibility of direct heat recovery lost with the cooling water by using the steam obtained in exchange for it.

The heated waste water of industrial (for example, in the textile and food industry) and household heat consumption, at a temperature of about 30 °C and above, is still practically not used and is discharged into the sewer, despite the large amount of heat lost during this process. This heat can be recovered using special heating units in the form of heat pumps.

The heat released by the radiation of industrial furnaces and their products (liquid and cooling metals and their slags, etc.) is also almost not used, despite the significant amount of such thermal waste. It is known that from 1 ton of incandescent coke, 40 - 50% of the total heat of the fuel is released, which is spent on burning the coke itself. In recent years, dry coke quenching units have been built in Russia. The use of the heat of incandescent coke is carried out in the so-called waste heat boilers producing saturated or superheated steam [3,4,5].

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General characteristics of secondary energy resources of industrial enterprises

Table 1

Energy carriers	Secondary energy resources	
	types of energy resources	Quality parameters
Solid, liquid, gaseous fuels or electricity for servicing high-temperature technological processes (industrial furnaces) and cooling water	Waste combustible gases of coke oven and blast furnaces: a) coke oven gas b) blast furnace gas	a) $Q_n^p \approx 15$ MJ/м^3 b) $Q_n^p \approx 3{,}5$ MJ/м^3
	Waste combustible gases from oil industry enterprises	$Q_n^p \approx 40$ MJ/м^3
	Waste hot gases from industrial furnaces	$t_{o.r.} \geq 500 - 1000°C$
	Heated cooling water and evaporative cooling steam of industrial furnaces	$T_{in.} \leq 95°C$ $P_h = 0{,}16 - 0{,}4$ MPa
	Heat generated by molten metals, coke and industrial furnace slags	$t_{exit} > 1000°C$
Gas and liquid fuel for servicing technological power processes (with internal combustion engines, blowing, compressor and other units) and cooling water	Hot gases from internal combustion engines	$t_{og.} \geq 350 - 600°C$
	Heated cooling water from internal combustion engines	$t_{o.в.} \leq 100°C$

Continuation of table 1

Fuel and technological raw materials (in metallurgical, woodworking, textile, food and other industries)	Combustible solid and liquid production wastes	$Q_n^p \approx 40$ MJ/м^3
Steam for servicing technological power (in hammer, pressing and stamping units) and heating processes	Spent production steam	$P_{op} = 0{,}13 - 0{,}15$ MPa
	Secondary production steam	$P_{a.o.} = 0{,}1$ MPa
	Condensate from steam used for heating purposes (hot waste water)	$t < 100°C$
	Internal heat dissipation in industrial premises	$t < 100°C$
Domestic hot water	Discharge contaminated water	$t < 50°C$
Electricity serving power, thermal and lighting processes	Internal heat dissipation in industrial and other premises	$t < 100°C$
	Waste heated water from production units	$t < 100°C$

CONCLUSION

Likewise, the utilization of physical heat from dump metallurgical slags, which generally have a temperature above 1000 °C, can provide very significant fuel savings, especially in non-ferrous metallurgy enterprises, where the heat loss with slag amounts to 10 to 40 % of the heat consumption in the fuel for the process. The use of this heat is still an unsolved technical problem.

Internal heat dissipation in industrial premises, which increases the air temperature in them, can be used for heating, respectively, reducing fuel consumption and capital costs for heat supply installations. Therefore, it is necessary to take into account such internal heat release when designing heat supply systems [6,7,8].

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