Осылайша, қатты және газ тәрізді қалдықтарды қайта өңдеу кезінде энергия үнемдеу шараларынан бөлек агломератты пайдалану да АФЗ электрпештерінің өнімділігін көтеретіндігі, электр энергиясының үлес шығыны мен қалпына келтіргіш шығынын, ендеше, дайын өнімнің өзіндік құнын төмендететіндігі анықталды.

Түйін сөздер: *аглогаздар, металлургиялық өндіріс қалдықтары, ферроқорытпа газдарын пайдаға асыру, қайта циркуляциялау, жылуды үнемдеу.*

RESUME

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Methods of energy saving increase under during agglomerate production at Aksu Ferroalloy Plant Branch of "Kazchrome" JSC

In this article issues of efficient use of ferroalloys production waste to save costs are considered; energy efficiency of agglomerate production is calculated; sintering heat balance data are presented by a case study of Aksu Ferrolloy Plant. According to the annual economic benefits calculation the folowing results are obtained: due to aglogases recirculation, fuel saving is 1334.5 t.o.e.; due to reheating it is 1491 t.o.e.; due to installation of thyristor converters to the unit the annual energy saving is 1714000 kWh.

Thus, it is identified that besides energy-efficiency measures during recycling of solid and gaseous wastes, the use of agglomerate increases IPF electric furnaces performance as well, decreases specific energy and reducing agent consumption which means the prime cost of finished products will be reduced.

Key words *aglogases, metallurgical wastes, ferroalloy gases recycling, recirculation, heat economy.*

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Waste-heat recovery of turbine condenser water Method

Annotation. *One of the directions of energy saving is the application of heat pumps by means of which it is possible to use low-potential, usually waste heat. The question of the possibility of using heat pumps in thermal power plants is considered in the present article. Also a diagram of possible use in thermal power stations of low-grade waste heat with heat pump installation is presented in the article.*

Key words: *thermal pump, thermal power plant, waste heat, energy saving, secondary energy resources, cooling water of turbine.*

A heat pump is a device that provides heat energy from a source of heat to a destination called a «heat sink». Heat pumps are designed to move thermal energy opposite to the direction of spontaneous heat flow by absorbing heat from a cold space and releasing it to a warmer one. A heat pump uses some amount of external power to accomplish the work of transferring energy from the heat source to the heat sink.

While air conditioners and freezers are familiar examples of heat pumps, the term "heat pump" is more general and applies to many HVAC (heating, ventilating, and air conditioning) devices used for space heating or space cooling. When a heat pump is used for heating, it employs the same basic refrigeration-type cycle used by an air conditioner or a refrigerator, but in the opposite direction - releasing heat into the conditioned space rather than the surrounding environment. In this use, heat pumps generally draw heat from the cooler external air or from the ground. In heating mode, heat pumps are three to four times more efficient in their use of electric power than simple electrical resistance heaters.

Operating principles (figure 1): Mechanical heat pumps exploit the physical properties of a volatile evaporating and condensing fluid known as a refrigerant. The heat pump compresses the refrigerant to make it hotter on the side to be warmed, and releases the pressure at the side where heat is absorbed [1].

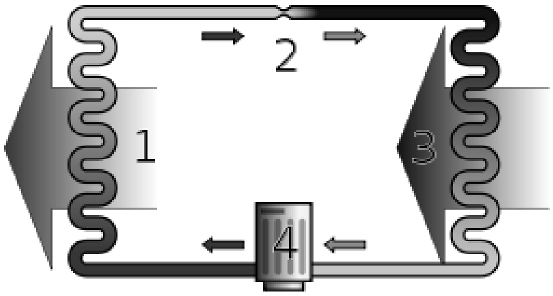


Figure 1 – Heat pump

A simple stylized diagram of a heat pump's vapor-compression refrigeration cycle: 1) condenser, 2) expansion valve, 3) evaporator, 4) compressor.

The working fluid (figure 2), in its gaseous state, is pressurized and circulated through the system by a compressor. On the discharge side of the compressor, now hot and highly pressurized vapor is cooled in a heat exchanger, called a condenser, until it condenses into a high pressure, moderate temperature liquid. The condensed refrigerant then passes through a pressure-lowering device also called a metering device. This may be an expansion valve, capillary tube, or possibly a work-extracting device such as a turbine. The low pressure liquid refrigerant then enters another heat exchanger, the evaporator, in which the fluid absorbs heat and boils. The refrigerant then returns to the compressor and the cycle is repeated.

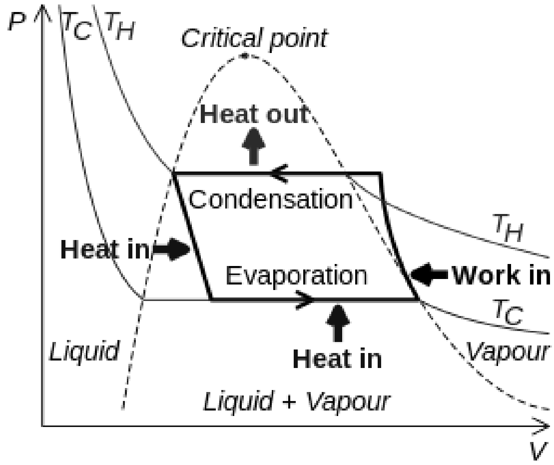


Figure 2 – A fictitious pressure-volume diagram for a typical refrigeration cycle

It is essential that the refrigerant reaches a sufficiently high temperature, when compressed, to release heat through the "hot" heat exchanger (the condenser). Similarly, the fluid must reach a sufficiently low temperature when allowed to expand, or else heat cannot flow from the ambient cold region into the fluid in the cold heat exchanger (the evaporator). In particular, the pressure difference must be great enough for the fluid to condense at the hot side and still evaporate in the lower pressure region at the cold side. The greater the temperature difference, the greater the required pressure difference, and consequently the more energy needed to compress the fluid. Thus, as with all heat pumps, the coefficient of performance (amount of thermal energy moved per unit of input work required) decreases with increasing temperature difference.

Insulation is used to reduce the work and energy required to achieve a low enough temperature in the space to be cooled.

To operate in different temperature conditions, different refrigerants are available. Refrigerators, air conditioners, and some heating systems are common applications that use this technology.

Heat pumps are more *effective* for heating than for cooling an interior space if the temperature differential is held equal. This is because the compressor's input energy is also converted to useful heat when in heating mode, and is discharged along with the transported heat via the condenser to the interior space. But for cooling, the condenser is normally outdoors, and the compressor's dissipated work (waste heat) must also be transported to outdoors using more input energy, rather than being put to a useful purpose. For the same reason, opening a food refrigerator or freezer has the net effect of heating up the room rather than cooling it, because its refrigeration cycle rejects heat to the indoor air. This heat includes the compressor's dissipated work as well as the heat removed from the inside of the appliance [2].

The COP for a heat pump in a heating or cooling application, with steady-state operation, is:

$$COP_{heating} = \frac{\Delta Q_{hot}}{\Delta A} \le \frac{T_{hot}}{T_{hot} - T_{cool}},$$

$$COP_{cooling} = \frac{\Delta Q_{cool}}{\Delta A} \le \frac{T_{cool}}{T_{hot} - T_{cool}},$$

where ΔQ_{cool} is the amount of heat extracted from a cold reservoir at temperature T_{cool};
ΔQ_{hot} is the amount of heat delivered to a hot reservoir at temperature T_{hot};
ΔA is the compressor's dissipated work.

Currently a great attention is paid to the issue of application of the waste heat on thermal power plants. The certain scheme of thermal power plant (patent: Russian Federation № 2269011, F01K17/00, published in 27.01.2006) is well-known, where the waste-heat recovery of power plants method is realized by means of recovery of turbine condenser water for heating the condensed water, next directed into a digasifier. But the disadvantage of this scheme is that the heated medium of heat-pump system condenser connected with the supply of the main condenser of low - pressure feed-water preheater concurrent to feed water preheater of the second stage. This allows excluding one of the feed water preheaters, that leads to temperature and pressure boost on turbine exit which in its turn depraves vacuum environment in the condenser.

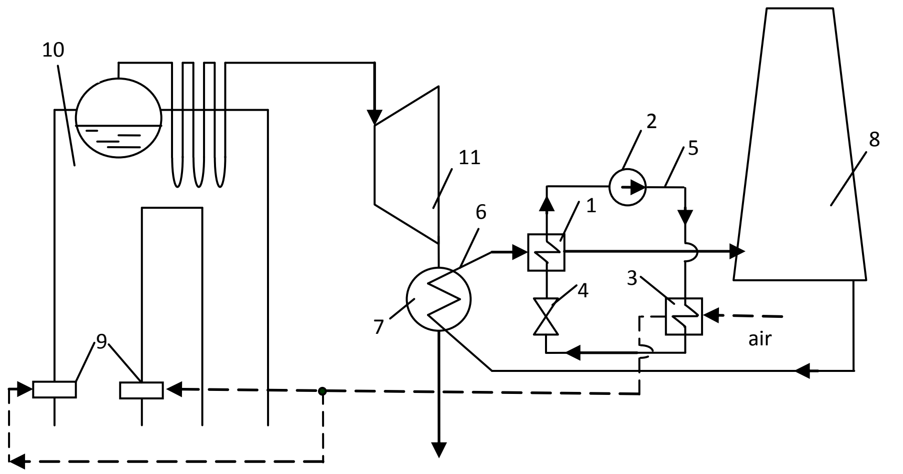
The most congenial to the suggested method, which is taken as a prototype, is the waste heat recovery of turbine condenser water method by means of transferring heat of condensing water in heat exchanger surface functioning as utilizer, to the air directed on the steam generator for fuel burning. Thereby the heat which condensing water gets in a condenser while steam condensation returns to the steamers (CHP plant gaining in performance by means of utilization of waste energy for heating the blasting air \\ Egorova M.A., collection of articles on Mechatronics, (gain in performance)-CHP).

But this scheme disadvantage is that while utilization of natural gas in summer period of initial air and condensing water temperatures are close so much that it decreases the efficiency of the present scheme, i.e. transferring the heat from warming to heating substance, besides when the heating atmosphere temperature is about 30 ^{0}C the utilization of waste heat in heat exchanger is supposed to be inefficient because of the irreversibility of heat exchange.

The task on realization the heat process of the air burning by means of utilization of those low grade heat sources which are present on electric power plants particularly the circulation water of turbine condenser, was set.

This method is realized by heat removal from circulation water of condenser with the help of heat pump and it's transferring to the air burnt in steam generator, with definite equipment application, which is depicted in figure 3 and includes the following: 1. heat pump with flash chamber; 2. condenser; 3. choke (regulation valve); 4. Interconnected duct system for circulation of working medium of the heat pump. The flash chamber 1 is connected to the pipeline 6. from which the circulation water is pumped.

After flash chamber of heat pump the circulation water is pumped into cooler 8, from where it returns to the condenser. In condenser 3 heat pump of the working medium is cooled by transferring heat to the air which delivers to burning in burner 9 of steam generator 10. The generated steam in steam generator 10 delivers to turbine 11 where it extends and after completing its work goes for condensation to the condenser 7.



1 - evaporator,
2 – compressor,
3 – condenser,
4 – regulation valve,
5 – the pipeline working agent,
6 – piping circulating water,
7 – condenser steam,
8 – cooler,
9 – burner,
10 – generator,
11 – turbine

Figure 3 – Basic circuit of heat pump switching on at CHP by utilizing the rejected heat of circulation water

As a result of low grade heat source intake that is circulation water of condenser 7 over the pipeline 6 to the flash chamber 1 the working medium of heat pump is boiled, resulting in circulation water cooling and directing to cooler 8, after which it returns to the condenser 7. The heat pump working medium steam is compressed in compressor 2 with enthalpy and temperature increasing by means of compression. The heat of working medium transformation is transferred to the air in condenser 3; the air is directed further for fuel burning in burner 9 of steam generator 10. After condenser 3 the working medium of heat pump restricts the flow in regulation valve 4 as a consequence the temperature and pressure are reducing to pressure in flash chamber and the heat pump cycle repeats. Due to the fuel burnout the steam is generated in steam generator 10 and transferred into turbine 11. The steam in turbine completes the useful work and after that transfers into condenser 7.

Consequently the transit of low grade heat circulation water of turbine condenser into the air heat is completed, and the air is further delivered to the steam generator for burning.

Findings - it is necessary to develop the work in this direction with the purpose of creation of structures of a different range of modern heat pumps for various purposes and usage patterns «waste» heat in the industry with the purpose of introduction of energy saving technologies.

REFERENCES

1 Янтовский Е.И., Пустовалов Ю.В. Парокомпрессионные теплонасосные установки. – М.: Высшая школа, 1991. – 213 с.

2 Янтовский Е.И., Левин А.А. Промышленные тепловые насосы. – М.: Высшая школа, 1998. – 145 с.

REFERENCES

1 Yantovskiy E.I., Pustovalov Yu.V. Parokompressionnie teplonasosnie ustanovki. – M.: Visschaya schkola, 1991. – 213 s.

2 Yantovskiy E.I., Levin A.A. Promischlennie teplovie nasosi. – M.: Visschaya schkola, 1998. – 145 s.

ТҮЙІН

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Турбина конденсаторы суының жылуын пайдаға асыру әдісі

Энергия үнемдеу бағыттарының бірі жылулық сорғыларды қолдану болып табылады, олардың көмегімен төменәлеуетті тасталған жылуды пайдалану мүмкін болады. Мақалада жылу эдектр станцияларында жылулық сорғыларды қолдану мүмкіндігі қарастыралған. Жылулық сорғыны орнату арқылы төменәлеуетті тасталған жылуды ЖЭС-та қолдану сұлбасы берілген.

Түйін сөздер: *жылулық сорғы, жылу электр станциялары (ЖЭС), тасталған жылу, энергияны үнемдеу, екінші рет қолданған энергетикалық ресурстар, турбинаның салқындатқыш суы.*

РЕЗЮМЕ

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Способ утилизации тепла воды конденсатора турбины

Одним из направлений энергосбережения является применение тепловых насосов, с помощью которых возможно использование низкопотенциального сбросного тепла. В статье рассмотрен вопрос возможности использования тепловых насосов на тепловых электрических станциях. Дана схема возможного использования на ТЭС низкопотенциального сбросного тепла с установкой теплового насоса.

Ключевые слова: *тепловой насос, тепловые электрические станции (ТЭС), сбросное тепло, экономия энергии, вторичные энергетические ресурсы, охлаждающая вода турбины.*