ARTIFICIAL AIR COOLING IN EXTRACTION SYSTEMS FOR GLASS MELTING SHOPS

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As properly stated in the paper by M. Ya. Suponitskii et al. [1] despite the equipment of glass furnaces with mechanization (batch loading, breakers for glass sheets, etc.) remote control and regulation, the working conditions in machine-tank furnace requires improving, in particular, it is essential to see that the air temperature in these conditions does not rise above the standard level.

When it is impossible to prevent serious heat separation (heat insulation, baffles, etc.) it is necessary to arrange effective heat removal. In the southern regions of the country where during summer external air cannot be fed to provide cooler conditions in departments, artificial cooling of the air should be provided.

To cool the outside air it is possible to use cooling units used to obtain cold air with different types of energy: electricity, thermal, etc. It is obvious that choice of the installation must be determined by the economic factors.*

Compressor-piston and turbo-compressor cooling installations need large amounts of electricity (0.2-0.6 kw-h/1000 kcal with a cost of 2.7-3 kop) [2]; owing to the complexity of the design we require the highly skilled services of engineers (especially for turbo units) and special rooms.

Steam-ejector cooling units do not require highly qualified operators, but they have low power factors and need a lot of water and steam. According to existing data [3] the consumption of working steam at a pressure of 6-7 atm is 2.7-6 kg and water – 0.3-1 m^3 per 1000 kcal of cold.

In glass furnaces with flue gases there is a large amount of heat spent on the working of the glass which is lost (for furnaces making building glass 20-35%) [4-5]. The use of boiler-utilizers working on waste heat permits us to obtain industrial low-pressure steam (about 1-2 kg of steam per kg of glass melted) [6]. Consequently, in glass works it is desirable to use absorption cooling equipment for cooling external air.

In the proposed scheme (see diagram) the steam from the boiler-utilizer 5 enters the absorption cooling equipment 7 which cools the water. Cooling water enters the air cooler where external air is cooled.

Selection of the type of air cooler is determined by the problem in hand. If cooling of the air does not require the humidity to be changed then it is desirable to use dry air coolers (smooth pipes or finned tubes), the advantage of which is the high specific heat exchange and the possibility of creating high air velocities (up to 20m/sec) which reduces their diameter and therefore the cost. When it is necessary to regulate both the temperature and humidity of the air, use is made of wet air coolers (nozzles with sprinklers). They permit regulation of the air parameters depending on the temperature of the water being sprayed; they are simple and cheap. Their drawbacks include the need for low air velocities in the spray chamber (up to 2.5 m/sec) and interruptions in the circulation circuit for the coolant—water.

In glass factories it is desirable, in our opinion, to use air coolers made from ribbed pipes sprayed with water from jets [7]. As seen in the diagram, the cold water from the cooing equipment 7 is fed into the ribbed coil 11 made from aluminum tubes with rolled fins. On the air input side the coils are sprayed from the jets 13. The water flowing from the surface of the coils is collected in the tray and returned by the pump 14 to the sprinklers. The

*In this article we do not cover machine-less methods of cooling air, the economics of which need special proving in glass-plant conditions.

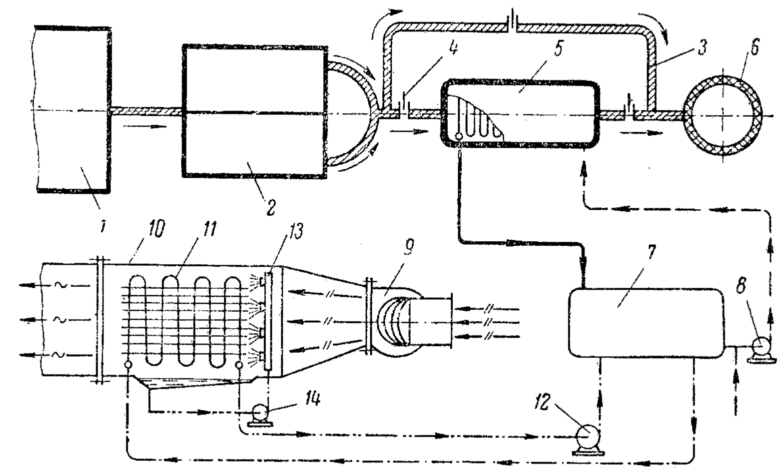

Fig. Principle scheme for obtaining cold air. 1) Glass furnace, 2) regenerators, 3) gas pipes, 4) valves, 5) boiler-utilizer for waste gases, 6) extraction pipe, 7) absorption cooler, 8) pump for return of condensate to boilers, 9) fan, 10) frame of air cooler, 11) finned coils, 12) pump for recirculating coolant, 13) collector with nozzles, 14) return waterpump.

advantage of this air cooler over others is the possibility of controlling the parameters of the air with simultaneous cleaning to get rid of dust during storage in the closed system of circulation and the high heat exchange.

Calculations done in relation to the developed scheme for cooling and glass furnaces in Krasnodar showed that with the use of boiler-utilizers working the waste-gas heat, the consumption of steam with a pressure of 3-4 atm is 2.3-3 kg per 1000 kcal of heat at a water temperature fed into the air cooler of +7 – + 12°C. This water temperature cools the outside air at any temperature above the normal. The consumption of power with this is 0.03 kw-h per 1000 kcal of heat and the cost is 0.443 kop.

The simple process of switching into the cooling equipment permits us to use it for preheating cold external air.

Since the producer-factory supplies absorption cooling equipment in combination with automatic apparatus the cost of installing is not great, and the absence of complex moving parts and the simplicity of the design means that the equipment can be installed in the open air under a roof, that is, without capital building expenditure.

Absorption cooling equipment does not require continuous servicing which greatly simplifies the operation. Practical use of these machines [8] suggests that they are very effective and reliable in operation.

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