DRYING REACTOR LININGS WITH AN INDEPENDENT HEAT SOURCE

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The gunite-concrete lining of the reactors in catalytic reforming and hydrotreating equipment is used to protect the shells of the apparatus from the effects of high temperatures and hydrogen corrosion.

According to the Giproneftemash instructions, the lining should be dried by circulating flue or inert gases at atmospheric pressures, or at pressures up to 18 atm.

Up to the present time, reactor linings have been dried principally by means of 5G-600/42-60 hydrogen compressors, circulating an inert gas at a pressure of 18 atm.

This method of drying has a number of disadvantages. The method can only be used when there is a complete installation of 5G-600/42-60 compressors, as well as tubular furnaces, heat exchange apparatus, power equipment, and control and measuring devices, and, to get the inert gas, the equipment has to work throughout the whole of the drying time.

Making the compressors, the tubular furnace, and the coolers work uses up a lot of electric power, fuel, and water. Further, drying the reactor linings causes serious disturbances at the refinery, due to the operation of the tubular furnaces used to heat the inert gas.

The authors of this paper have thought up and tried out the idea of drying the reactors in L-24/6 hydrotreating equipment with flue gases at atmospheric pressure, heated from an independent heat source. The drying was carried out by the method shown in Fig. 1. The drying unit consists of an air furnace and a blower, mounted on the same frame (Fig. 2).

The 1Ts-9-55 No. 8 blower, with a capacity of 40,000 m³ of air per hour at a pressure of 200 mm Hg, operates from an 18–25 kW electric motor, and forces the air into the furnace 2 along the air pipe leading into the combustion chamber and, for mixing, into the annular gap in the furnace.

Fig. 1

Fuel
Gas

Fig. 2

Fuel
Gas

Fig. 1. Diagram showing how the reactors are fastened up for drying from an independent heat source. 1) Blower; 2) furnace; 3) collector; 4) reactor; 5) slide valve.

Fig. 2. Diagram of drying unit. 1) Blower; 2) furnace.
The air furnace (Fig. 3) is made according to a design that is widely used in industrial furnaces operating under pressure. The furnace is provided with burning and operating nozzles. To get normal drying of the gunite-concrete, the smoke gases in the reactors must have a linear velocity of not less than 0.5 m/sec.

The volume of the flue gases at a temperature of 50°C is:

\[ V = \frac{0.785 \cdot 2.6 \cdot 0.5 \cdot 273 \cdot 3600}{273 + 50} = 8200 \text{ m}^3/\text{h}. \]

The volume of the flue gases at a temperature of 550°C is:

\[ V = \frac{0.785 \cdot 2.6 \cdot 0.5 \cdot 273 \cdot 3600}{273 + 550} = 3200 \text{ m}^3/\text{h}. \]

The furnace is designed to operate with two reactors, i.e.:

\[ V = 6400 \text{ m}^3/\text{h}. \]

The heat content of the flue gases at 550°C is 170.5 kcal/m³, and the amount of heat picked up in the furnace is\[ Q = 6400 \times 170.5 = 1.1 \times 10^6 \text{ kcal/h}. \]

The working cross section of the combustion chamber is:

\[ \phi = \frac{1.1 \times 10^6}{2 \cdot 10^6} = 0.55 \text{ m}^2; \text{ taken as } 0.65 \text{ m}^2 \]

The diameter of the combustion chamber is:

\[ D = \frac{0.65 \cdot 4}{3.14} = 0.91 \text{ m}. \]

The volume of the combustion chamber is:

\[ W = \frac{1.1 \times 10^6}{1.0 \times 10^6} = 1.1 \text{ m}^3, \]

where \( 1.0 \times 10^6 \) is the volume heat stress of the space in the furnace.

The height of the combustion chamber is:

\[ H = \frac{1.1}{0.65} = 1.7 \text{ m}. \]

The volume of the mixing chamber for a mixing time of 0.1 sec is:

\[ W_1 = \frac{3200}{3600} = 0.89 \text{ m}^3. \]

The cross sectional area of the annular space at a velocity of 10 m/sec is:

\[ \phi_1 = \frac{8200}{3600 \cdot 10} = 0.23 \text{ m}^2. \]

The combustion chamber and the mixing chamber of the furnace are lined with a single layer of chromagnesite brick.

When drying a lining, the temperature in the reactor is raised smoothly to 420°C, and held at the maximum temperature for 24h.

The air flow was measured with a segment diaphragm, and compared with the reading of an anemometer. The amount of air fed into the furnace was controlled by slide valves mounted on the upper reactor parts.

After the drying was over, the reactor linings were carefully inspected by the factory workers with the aid of the "heat project" brigade. The quality of the gunite coating was pronounced good.