TUBE FURNACES IN REVAMPED PLANTS

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Tube furnaces were “turnkey” assembled and started up according to Kedr-89 plans in plants at Orsknefteorgsintez Co. and Rosneft’–Komsomol’sk Oil Refinery Oil Company in 2002-2003.

The hydrotreating unit coil was moved from furnace F-1 to separate cylindrical furnace F-1/1 with a circular convection chamber and air heater placed in it in catalytic reforming unit 35-11/300 at Orsknefteorgsintez in accordance with the specifications (Fig. 1). A smokestack (35 m mark) was installed on the furnace.

The thermal capacity of the furnace in feedstock is 42.155 GJ/h and 2.36 GJ/h for the air heater. The feedstock coil in the convection chamber is quadruple-flow (tubes $\varnothing$ 152×8 mm), double-flow in the radiation chamber (tubes $\varnothing$ 219×9 mm), and the coil tube material is 08X18H10T steel.

This coil scheme provided for a pressure drop no greater than 0.16-0.18 MPa for a feedstock load of 53 tons/h and feedstock composition: naphtha cut with a density of 720 kg/m$^3$ at 20°C and hydrogen-containing gas (HCG) with 74-81 vol. % hydrogen in the ratio of 1200 nm$^3$ HCG per ton of naphtha.

The upper return bends of the radiant coil go out into overhead U-bend chambers (caissons), which allows pinless assembly and disassembly of the coils. The convection coil is made of identical sections, which also facilitates maintenance: the existence of a reserve section greatly reduces the time for eliminating possible breakdowns due to tube burnout.

The temperature of the stack gases at the inlet into the convection coil (at the “crossing”) is 630-675°C as a function of the load at medium heat-release rate of the radiant tubes (114,996 kJ/(m$^2$·h)), which is 100-120°C lower than the calculated temperature. This required introducing corrections in the method of calculating the radiant chamber.

The temperature of the stack gases at the outlet from the furnace is 145-160°C for a 3.5-3.6 vol. % oxygen content, which ensures efficiency of a furnace with an air heater at the 94-95% level. The air heater circuit provides for recirculation of heated air at the fan inlet. This allows maintaining the air temperature in front of the air-heater cluster in winter at 30-40°C.

The furnaces have three IMDOS GMGD-4.0 PKTs burners (Korolev, Moscow region).

Furnace F-1/1 was started up in August, 2001. With respect to economy, flexibility of regulation, conserving power, and possibility of burning gas fuel of variable composition, it is one of the best at the refinery.

We note that after removal of the hydrotreating unit coil from reforming furnace F-1, the feedstock coil was repiped according to a scheme (Fig. 2) selected as a result of calculating several versions. This scheme ensured a minimum heat-release rate for the heating surface by stages, the corresponding tube wall temperatures, the assigned temperature drops, and an overall pressure drop within the limits of 0.16-0.18 MPa.

For the EDU – AVT unit at Orsknefteorgsintez Co., a new furnace block including atmospheric F-1 and vacuum F-2 furnaces were designed, manufactured, and assembled. The previous block consisted of two physically worn out (the unit has been operating since 1980) A-type furnaces with malfunctioning air heaters.

The new furnaces are box, vertical-flame furnaces with smokestacks installed in them. Each furnace (Fig. 3) has a stack gas heat utilization unit – a heater for the air going to the burners.

Fig. 1. Furnace F-1/1 in catalytic reforming unit 35-11/300 at Orsknefteorgsintez OJSC.