An experimental rotary-ring tunnel kiln for heat-treating large intricate-shaped phosphate-bonded refractory products for the lining of glaze-firing kilns has been constructed in the chamotte-kilning section of the Suvorov Ore Administration on assignment by the Main Administration of Refractories Production in accordance with proposals for the mechanization and automation of refractories production [1, 2]. The design project of the kiln, which became operational in Nov. 1974, was developed by the Eastern Institute of Refractories and the Suvorov Ore Administration.

The working drawings of the kiln were based on a technical project developed at the Eastern Institute of Refractories in 1971 for a unit for the Bogdanovich Refractories Plant. *

A schematic drawing and sectional elevation of the kiln are shown in Fig. 1 and the theoretical and measured temperature conditions in the kiln in Fig. 2.

*The unit had been intended for the heat treatment of lightweight chamotte brick.

Fig. 1. Schematic drawing of the rotary-ring tunnel kiln and of the cross section of its working channel; 1–25) are the positions; the remaining notation is in the text.

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The kiln consists of a ring-shaped horizontal tunnel with a moving bottom. The tunnel of the kiln is divided into 25 positions which constitute the drying, heating, holding, and cooling zones, and the ring-shaped bottom into 27 positions two of which lie outside the tunnel and form the charging—discharging zone. The bottom 26 (Fig. 1) is designed to move the products being heat-treated through the kiln.

The ring-shaped tunnel 27 is constructed of heat-insulating refractory materials enclosed in a steel housing 28. The entire roof of the holding (i.e., firing) zone and part of the roof of the adjoining heating zone are provided with a combustion chamber 29, and the walls of these zones with distribution channels 30 and dampers 31. The combustion chamber is equipped with nozzles 32. The ring-shaped bottom of the kiln has a flat refractory surface resting on two rings constructed of channel beams joined with radial tie rods. The lining of the bottom consists of standard chamotte and lightweight bricks set in mortar. The width of the expansion joints situated at intervals of 5–6 m along the median circle of the bottom is 20–30 mm. The ring-shaped bottom is supported on rollers 33 which also prevent its horizontal displacement. The bottom is rotated by hydraulic drives 34 installed at diametrically opposed points of the kiln. The rollers and hydraulic drives are situated on the lower frame of the kiln body 28 in the space under the bottom which is ventilated by the natural air movement.

The working space of the kiln is separated from the ambient medium with sand gates 35 situated between the outer cylindrical surfaces of the bottom and the surfaces of the tunnel walls, and with doors 36 at the entry to the drying zone and the exit from the cooling zone.

Pipe connections 37 are installed in the walls of the drying and heating zones at position No. 1 and at the junctions of positions Nos. 1–2, 7–8, 9–10, and 11–12, and pipe connections 38 at the junctions of positions Nos. 5–6, 6–7, 10–11, 12–13, and 14–15.

Pipe connections 39 are installed also in the walls of the cooling zone at the junctions of positions Nos. 20–21 and 23–24, and pipe connections 40 at the junctions of positions Nos. 21–22, 22–23, 24–25, and at position No. 25. The kiln is provided with pumps 41 for operating the hydraulic drives 34 of the kiln bottom and the doors 36, VVD-9-type blowers 42 and 43, a D-8-type exhaust fan 44, a D-10-type exhaust fan 45, a fuel oil pipe 46, pipelines 47 for air and gases, and a flue 48.

The technological process in the kiln is as follows. The green products are placed on the stationary kiln bottom in the charging—discharging zone at the same time as the heat-treated products delivered from the cooling zone are removed from it. Next, the pumps are started, the kiln doors open, and the ring-shaped bottom is moved (rotated) by the hydraulic drives 34 by one position so that the green products enter the drying zone while the finished products emerge from the cooling zone. The doors are then closed, the hydraulic drives are returned to the starting position, and the pumps are stopped. The products are moved through the drying, holding, and cooling zones from and into the charging—discharging zone by periodically rotating and stopping the kiln bottom until it has completed one revolution.

The products are dried and heated in the zones concerned with flue gases at a temperature of 900°C which reach the working space of the heating and holding zones along distribution channels 30 from the combustion chamber 29, and with air (100–200°C) admitted through connections 38. The flue gases formed in the combustion of the fuel in the combustion chamber are rarefied during their passage through the kiln channel with hot air supplied by the exhaust fan 45 through connections 38. The hot air (100–400°C) is tapped from the cooling zone through connections 38.