A Model SPA-4 drying-kilning unit for firing semidry and plastic molded chamotte brick has become operational at the Sukholozhsk Division of the Bogdanovich Refractories Plant. The design project of the SPA-4 was developed by the Eastern Institute of Refractories.*

The main difference between the SPA-4 and conventional tunnel kilns [1] is the fact that the drying and preheating zones have been combined into a single one (without dividing curtains). The role of curtain is played by air supplied by a TsV-18 No. 9 blower through nozzles in the walls and roof at the junction between the drying and preheating zones.

For firing standard brick the capacity of the SPA-4 is 75,000 tons p. a. The peak firing temperature is 1400°C. The principal dimensions of the SPA-4 are: length including the precombustion chamber 153.05 m, width on the level of the truck deck 2.25 m, height from the truck deck to the roof 1.81 m. The kiln trucks are 1.65 m long and 2.14 m wide.

The drying-kilning units is divided along its length into four zones: drying (positions 1-19), preheating (positions 20-44), firing (positions 45-66), and cooling (positions 67-89). The trucks are moved automatically every 30 min by a cable winch of a traction force of 60 tons. Air-locks are provided at each end of the SPA-4 unit to safeguard the aerodynamic conditions inside the unit during truck movements.

The unit is fired by producer gas of an efficiency of 1450 kcal/m³ (under normal conditions) processed from Chelyabinsk brown coal. The firing zone contains 20 pairs of lateral burners. Combustion is by primary and secondary air.

Fig. 3. Thermocouple installed on the kiln truck: 1) platinum-rhodium/platinum thermocouple; 2) thermocouple can; 3) protective jacket; 4) steel sleeve; 5) threaded steel cylinder; 6) steel sheet; 7) thermocouple head; 8) chamotte seal; 9) truck lining; 10) chamotte filler.

Fig. 4. Variation of the firing temperature through the charge: 1) temperature at the top; 2) at the bottom of the charge.

The primary air is fed to the burners from a hot-air manifold by means of injectors and two rotary water-cooled GRMK-4 type blowers one of which is reversible. The secondary air is supplied directly along the channel of the kiln.

The drying and firing conditions were determined with reference to the actual range of products being handled, viz. Sh-3, Sh-6, and Sh-7 semidry-molded chamotte bricks and plastic-molded siphon brick predried in tunnel driers. The setting of the load on the kiln trucks is shown in Fig. 1. The weight of a charge of standard brick per truck was 4.9-5.3 tons depending on the brick type.

During the running-in period of the SPA-4 only 18 of the 20 burners, i.e., those in positions 45-62, were used because the heat produced by them was adequate for normal firing. The temperature field in the unit is plotted in Fig. 2.

To produce a temperature of 1280-1320°C in the firing zone with producer gas the combustion air must be preheated to a high temperature. According to the design project the air manifolds are mounted in the kiln roof and the hot air to the burners is fed in the downward direction so that it proved impracticable to feed air to the burners with GRMK-4 blowers as in the case of the Model SPA-5 unit [2]. Owing to the geometric pressure head in the vertical channels and the low injection capacity of producer-gas burners compared with natural-gas burners [3] the pressure in the manifold when using GRMK-4 blowers was only 2.2 mm H₂O which is not enough for coping with the head in the vertical channels which at 800°C approaches the manifold pressure.

The injector air was, therefore, fed in with a high-pressure blower after the injector was modified by the replacement of the 20 mm diameter taper-nozzle pipe with a 120 mm diameter stainless pipe. The pressure of the injector air was thus increased to 6 mm H₂O. The air temperature in the manifold was 440-600°C. The air for the drying zone is conveyed along the kiln channel for combustion, is tapped off for the drier and then lost through leakage. To maintain normal firing conditions the air flow to the cooling zone must be regulated precisely. The determining factor is the pressure at position 72 which was found to be 1.5-2.0 mm H₂O.

The green moldings are dried in the SPA-4 with a mixture of hot air and flue gas, the latter being tapped off at the beginning of the drying zone at positions 1 and 2 and at the beginning of the preheating zone at positions 20 and 21, in addition to which the drying zone is supplied 15,000-16,000 m³/h hot (200°C) air from the cooling zone. This arrangement makes it necessary to maintain a maximum negative pressure at the beginning of the drying zone which was achieved by installing a 100 kW motor rotating at 730 rpm for