HEAT TECHNOLOGY

TUNNEL KILN FOR FIRING INSULATING FIREBRICK


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In 1975 the Bogdanovich Factory brought about a tunnel kiln, reconstructed according to a project from the East Institute of Refractories for firing insulating firebrick products grade ShLB-1.0 and ShLB-1.3 with an apparent density of 1.0 and 1.3 g/cm³. In fact, a new kiln was built using the foundations, forechamber, pusher and doors of the old one. Previous experience with the firing of insulating products containing sawdust as the combustible was used in designing the project.

The assembly of the kiln and the draft-extraction equipment took into account the possibility of housing the unit in the existing department.

The control and adjustment of the firing process were effected from a control panel in the control and instrument section, and from a panel in the forechamber at the entrance end of the kiln.

The plan of the kiln and its cross section are shown in Fig. 1, the temperature and aerodynamic cycles in Fig. 2, and the setting layout for standard sized products in Fig. 3.

The annual outputs of the kiln (ShLB-1.0 and ShLB-1.3) were 40,000 and 50,000 tons, respectively. The maximum firing temperatures for these two products are 1200 and 1280°C, respectively.

The basic dimensions of the kiln's working channel are: overall length with forechamber, 142.05 m; length excluding forechamber, 138.6 m; including the preheat zone, 57.75 m; firing zone, 16.50 m; cooling zone, 64.35 m; width, 2.14 m; and height from car base to roof crown, 1.81 m. The car dimensions are: length, 1.62; width, 2.14; and height from level of rail heads, 0.99 m. The number of cars in the kiln channel is 84. The setting weights for ShLB-1.0 and ShLB-1.3 products on a car equal 2.2 and 2.9 tons, respectively. The products are in the kiln for 40-42 h.

The fuel consists of mazut with a combustion heat of 9250 kcal/kg, and consumptions for burning ShLB-1.0 and ShLB-1.3, respectively, of 300 and 400 kg/h. The car pushing interval is 26 ± 2 min. Only one type of product is placed on a car at any one time.

The kiln channel is divided into 84 positions, the fixed positions of the cars, of which 35 make up the preheat zone, 10 the firing zone, and 39 the cooling zone. Oil is fed into the kiln through 11 pairs of burners located at the junctions of positions from Nos. 35-36 to Nos. 45-46.

The combustion air is fed through burners with one of two fans of the VVD-9 high-pressure type. The air is fed to the cooling zone with two VS-12 fans: one is concentrated form, the other dispersed. The first air feed using cold air goes through three pairs of windows at the junctions of positions Nos. 79-80, 81-82, and 83-84. The distributive air feed is made through 8 pairs of windows at the junctions of positions Nos. 59-60, 61-62, 63-64, 65-66, 69-70, 71-72, 73-74, and 77-78. The intake of cold air in the preheat zone is effected through the pipes located in the roof at the junctions of positions Nos. 7-8, 10-11, and 14-15. The hot air is taken up from the cooling zone through the flues at the junctions of positions Nos. 57-58, 67-68, and 75-76, and fed to the drier, and also is partially removed into the atmosphere through the flues.

Flue gases are taken from the kiln through two pairs of window at positions Nos. 1-4, and through an underground channel with one of two D-15.5 flue pumps (second reserve) and rejected into the chimney. A proportion of the flue gases is fed from the chimney to the recirculation system in the preheat zone through a pipe in the walls at the junction of

Fig. 1. Layout of tunnel kiln (a) and its cross section (b): 1-84) kiln position numbers; 85) flue in roof; 86) flue pump D-15-5; 87) VD-12 fan; 88) flue pump D-12; 89) VVD-9 fan; 90) VD-12 fan; 91) kiln car; 92) burner.

Aerodynamic sealing of the working zone of the kiln is arranged by taking air from the control channel at position No. 8 with the VD-12 fan (see Fig. 1a, position 87), and feeding air into this corridor at the junction of position No. 72-73 (position 90).

Many years' experience with firing insulating brick [1-3] shows that complete burning-out of the additives can occur up to the start of vitrification. Therefore, in contrast to the design of the demolished kiln, the preheat zone of the new kiln was elongated by 5 positions, thus occupying almost half of the kiln. The combustion of sawdust begins at position No. 13 at 250-300°C. Rapid combustion with an air consumption factor of 1.5 occurs at positions Nos. 17-35.

The temperature and aerodynamic schedules were worked out as the kiln was being brought into operation. The temperature in the preheat zone is regulated in accordance with the temperature curve by using the D-12 pump (see Fig. 1a, position 88) to feed recirculating flue gases through the pipe in the walls at the junctions of positions from Nos. 9-10 through No. 20-21, and cold air through the pipe in the kiln roof due to the vacuum in the working channel. To create the optimum aerodynamic schedule for firing ShLB-1.0 and ShLB-1.3 brick reduced pressures of 20-22 and 10-12 mm water, respectively, were created in front of the D-15.5 flue pump.

The properties of the products fired in the new kiln correspond to GOST 5040-69. The refractoriness of the ShLB-1.3 is not less than 1690°C, the compressive strength 35-122 kgf/cm², and the apparent density 1.11-1.24 g/cm³.

The refractoriness of ShLB-10 products is not less than 1690°C; the compressive strength, 30-71 kgf/cm²; and the apparent density, 0.91-0.99 g/cm³.