AUTOMATIC MACHINING OF LIGHT-WEIGHT CORUNDUM BRICK


UDC 666.762.11:621.923

Light-weight corundum bricks of density 1.2-1.3 g/cm³ are produced by casting followed by drying and firing. The fired bricks are machined because their shape and dimensions deviate considerably from the Technical Specifications TU 14-8-63-72 as a result of the technology involved [1]. At the Semiluk Refractories Plant the process of machining the bricks is being reorganized.

The first step in the preliminary studies was choosing the machining method and tool. Trials with milling, grinding and cutting with wheels of black silicon carbide and with diamond wheels with continuous and segmental cutting edge resulted in the choice falling on cutting with the Soviet-made segmental diamond wheel with narrow grooves between the segments (State Standard GOST 16116-70).

In milling with cutters fitted with blades of VK carbide the tool life is too short owing to the abrasive action and hardness of the brick material. Grinding and milling are less productive and more power-consuming than cutting. In the former two methods the excess refractory material is converted to fine dust which can be used only as intermediate product for more refractories whereas in cutting the excess material in the form of sheets can serve as lining or heat-insulating filler. Cutting with silicon carbide wheels is inefficient and the strength and durability of the tool are inadequate.

Machining with segmental diamond wheels is held by the writers to be the best method. The productivity of the tool in machining light-weight corundum brick depends to a large extent on its long-term cutting properties which may be degraded not only by a high cutting temperature but also as a result of the abrasive and mechanical attrition of the cutting edges and tips of the diamond grains [2].

The dimensions of the diamond chips of the wheel are a significant tool parameter. The optimum size for maximum cutting productivity and minimum diamond consumption was determined from the relation

![Graph](image)

**Fig. 1.** Specific diamond consumption \( q_p \) vs the size of the diamond chips (a), the peripheral speed of the wheel (b), and the longitudinal feed (c) when using wheel type KOSA 500 × 3,8 × 5 × 90, A630/500, M50, 25%, 25 carat. Cutting conditions: a) peripheral wheel speed 50 m/sec, longitudinal feed 0.96 m/min, cutting depth 70 mm; b) longitudinal feed 0.96 m/min, cutting depth 70 mm; c) peripheral wheel speed 45 m/sec, cutting depth 70 mm.

between diamond consumption and the size of the diamond chips of the wheel (see Fig. 1a). Diamond consumption decreases, i.e., the useful life of the wheel increases, with an increase in the size of the chips.

The experiments showed that the durability of the wheel increases with an increase in the peripheral speed from 20 to 65 m/sec (Fig. 1b). The specific diamond consumption is showed as a function of the longitudinal feed in Fig. 1c. The dependence of diamond consumption on the longitudinal feed is explained by the corresponding increase in the load on the diamond chips. In cutting light-weight corundum bricks specific diamond consumption increases five times with an increase in the longitudinal feed from 0.5 to 2.5 m/min. The durability and productivity of the wheel are at a maximum when the recovery of the cutting power of the diamond chips and the firmness of their bond until they are broken out of the bond predominate over the complete blunting of the chips [3].

The durability and productivity of a diamond wheel used for cutting a brittle material can be increased by choosing a wheel with the best diamond grades, the correct chip size, bond, chip concentration, and most important, correct cutting conditions. Studies of these parameters in a joint project of the Ukrainian Scientific Research Institute for Refractories and the Semiluk Refractories Plant have led to the design of a semiautomatic line which was subsequently set up at the Semiluk Plant for machining the six faces of light-weight corundum brick of apparent density 1.0-1.3 g/cm³.

The line (Fig. 2) consists of a welded frame 1, the cutting wheels 2, drive heads 3, guides 4, supports 5, roller chains 6, push rods 7, clamps 8, tilting and turning mechanisms 9 and 10, cuttings collector 11, and ventilation hood 12.

The brick is placed by hand on the supports of the starting position. The roller chain moving between the support plates is equipped with cams which by means of push rod 7 move the brick towards the cutter wheels 2. The guides 4 align the brick which is held between clamps 8. After two faces have been machined the brick is slewed 90° horizontally by device 9 and moved to the supports of the second position where the two widthwise faces are machined. Next, the brick is tilted 90° vertically by device 10 for the remaining two faces to be machined after which it is delivered ready for packing.

The line contains six segmental diamond wheels of the following specifications: outside diameter 500 mm, height (thickness of the segments) 3.8 mm, thickness of the steel body 5.0 mm, hole diameter 90 mm, bond M50, diamond chip size A630/500, diamond concentration 25%, total weight of the diamonds in the wheel 25 carat. The cutting conditions in the three positions are as follows: peripheral wheel speed 50 m/sec, longitudinal feed 0.016 m/sec, cutting depth 150 mm for the three positions together.

The line machines 140 bricks per hour compared with 10 per hour on a lathe equipped with abrasive wheels.

The line has undergone successful trials and has been accepted for industrial-scale operation at the Semiluk Plant where three more such lines have now been set up. Their high quality and dimensional accuracy have earned the light-weight corundum bricks produced by the Semiluk Plant the Badge of Quality.

The line can be fully automated by automating the loading, doffing and packing operations.