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PROTOTYPING OF ULTRASONIC DIE FOR EXTRUSION OF CERAMIC BRICK

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A scaled-down prototype of a die for extruding ceramic brick with ultrasonic oscillations from a magnetostriction transducer delivered onto the die wall was tested. Extruder productivity was increased. There is a complex improving effect on the microstructure of the ceramic, drying properties, shrinkage, water absorption, and density and strength, making it possible to reduce the plasticity requirements of clay. The test result shows that it is possible to develop an ultrasonic die for industrial extruders.

***Key words*:** ceramic brick, extrusion, ultrasonic die.

A promising direction for improving extrusion molding technology for ceramic brick is to decrease the friction of the clay bar against the die wall, remove internal stresses in the bar, and improve the compaction of batch particles during plastic pressing. In modern extruders friction is reduced by injecting lubricating liquids through the die wall, using special alloys with reduced coefficient of friction and more resistance to the abrasive action of the moving ceramic body [1].

The experience accumulated in using ultrasound during dry pressing of technical ceramic in closed compression molds [2] and extrusion of slip ceramic [3] and ceramic tubes and rods [4 – 7] attracts interest in it as a method for solving urgent problems of molding bricks from not very plastic and rough ceramic bodies.

The laboratory and industrial extruders manufactured for brick, tile, and unglazed tile are not fitted with ultrasonic dies, and there are no publications on the subject [1, 8]. For this reason the problem of developing such a die is innovative and technically complex. This is because dies for brick are massive (up to 100 kg) steel parts operating under pressures up to 40 atm. According to our preliminary calculations [9], for appreciable reduction of the friction against the clay the walls must oscillate with amplitude about 1 μm and frequency 20 – 35 kHz. That is, the die must be made in the form of a resonating acoustic waveguide, and an ultrasonic transducer of appropriate power and connected optimally to the die must be obtained.

Considering the large dimensions of the ultrasonic die for ceramic brick the aim of the present work is to test a scaled-down prototype of the die on a laboratory extruder and investigate the ultrasonic effect on the properties of the ceramic.

EXPERIMENTAL PART

Raw material for ceramic samples. Five types of ceramic bodies were used, differing in plasticity because of the difference of their molding moisture content, type of clay, and modifying additives. The batch was prepared from red-burning, low-melting, polymineral clay from the Alekseevskoe deposit, clayey marl from the Salmanovskoe deposit (both deposits are located in the Republic of Tatarstan), and white-burning refractory kaolin clay from the Orskoe deposit in Orenburg oblast.

The Alekseevskoe and Orskoe clays were extruded in pure form as well as with modifying additives. In one case, 5%[4] scrap (industrial waste) of glass fiber ground into pow-

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[4] Here and below, weight content, %.