GUNCRETING BASES OF TUNNEL KILN CARS

A. G. Belogrudov, G. A. Kalugin,
V. N. Eremin, V. M. Klyuev,
and V. V. Erofeev

UDC 666.76:66.042.23.004.67

To reduce material and labor expense for lining kiln cars, increase the service life of the lining, and reduce metal construction and downtime of these sections, the Sukholozhe Firebrick Plant together with the Uraldomnaremont Trust is carrying out work on the guncreting of tunnel kiln car bases.

In experimental guncreting, tests were done with guncrete concrete containing alumina cement. The aggregates consisted of chamotte slaked with water. The composition of the body was 75% by volume of chamotte fractions <10 mm, and 25% alumina cement made by the Pashiisk Factory.

The properties of the aggregates and cements are given in Table 1. All the analyses of the bodies and guncrete concretes were made by the laboratories of the Sukholozhe Factory.

To reduce the dust content in guncreting the moisture content of the guncrete body was maintained within the range 6-8%. With this purpose in mind the aggregate was premoistened so as not to moisten the body during blending of the chamotte with the cement, since part of the cement may then be excessively moistened. The cement was moistened during crushing and grinding to 8-10%. If the moisture content was lower than this the chamotte was under-moistened in the mixer.

To the uniformly moistened chamotte was added the aluminous cement, and during blending the grains of chamotte were uniformly enveloped with particles of cement. The body was prepared in a blade mixer, the combined blending time of all materials equalled 3-5 min.

Guncreting was done with a guncrete machine type S-702. The body with a moisture content of 6-8% for guncreting had sufficient pourability, without holding onto the walls of the guncrete machine, and was uniformly fed and transported by compressed air through a hosepipe. Upon leaving the nozzle the body became satisfactorily wet, and the dust emission during guncreting did not exceed the specified health norms.

Experimentally it was established that the body with the moisture content of 6-8% can be stored up to 3 h without danger to the original strength of the guncrete concrete.

Guncreting was done in wooden shuttering fitted on the frame of the car. Inside the shuttering on a metallic base was welded armature made from wire of diameter 6 mm, so that a network was obtained with cells of 150 ×300 mm away from the frame of the car at a distance of 150-170 mm. The layer of insulating brick was laid on edge on the base of the frame. The apparent density of the brick was 1.3 g/cm^3.

The dimensions of the car bottom in plan were 2100 × 1650 mm. The total thickness of the refractory lining was 250-270 mm. No temperature joints were specified during guncreting.

TABLE 1

Material	Refractoriness, °C	Moisture content, %	Content, %		
			Al_2O_3	Fe_2O_3	loss on ignition
Chamotte....	1710	8—10	38,12	2,56	0,16
Aluminous cement	1500	—	44,2	2,76	0,16

The guncreting was done at a pressure of 1 atm. The moisture content was 12-15%.

First the guncrete concrete was laid at the corners and perimeter of the base. To obtain high-quality ramming of the densified step the shuttering at the edges of the car was divided from top to bottom into two sections, so that a mortar gap was not developed. After guncreting and storage for three days at 20-30°C, the material was periodically wetted, and then dried for two days at 40-50°C.

Sukholozhe Firebrick Factory. Uraldomnaremont Trust. Translated from Ogneupory, No. 6, pp. 58-61, June, 1971.

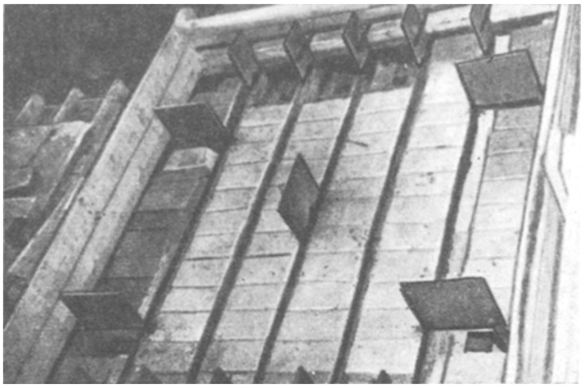

Fig. 1. Arrangement of armature on the base of the car.

The dried base was loaded with green refractory bricks and the car was put into the kiln. The products on the experimental car were fired according to the usual cycle. The maximum firing temperature was 1280-1300°C.

After the first cycle the lining of the car was found to be in satisfactory condition. The upper layer of the guncrete concrete to a depth of 80-100 mm was well sintered, and its strength was greater than that of the fired brick.

The lower layer of the hearth had a reduced strength typical of guncrete concrete based on aluminous cement, since the temperature of the lower layer was about 200°C. Cracks appeared in the guncrete concrete up to 2 mm wide and up to 200-300 mm long.

After 12 cycles the guncrete-concrete sections in the corners and in the densified step were partially broken. The width of the cracks developing after the first cycle in practice did not increase.

Under the car it was necessary to carry out running repairs but it was not possible to make repairs by the guncreting method owing to technical reasons. Therefore, for the corners of the base, instead of the broken guncrete concrete, we placed standard brick using a chamotte mortar. After this repair the car completed another nine cycles, and then the brick in the corners of the base was replaced with guncrete concrete.

After 13 cycles the guncrete concrete of the upper layer of the base was partly destroyed, and almost the entire densified step was completely destroyed. At this time the car had made 34 cycles.

During normal repairs the whole of the broken and splintered guncrete concrete was removed, and the cracks were widened, so as to restore the burnt-out armature; all the defective spots in the base were filled with guncrete concrete.

Up to 15% of the guncrete concrete in the base was replaced. The remaining part of the base had preserved its strength.

After being pushed through the kiln, the layer of new and old concrete was thoroughly sintered together, and there was no lamination or cracks at the sites of contact.

During the checking of the first experiments three more bases on tunnel kiln cars were guncreted. The results of the operation completely confirmed the original data.

After testing, the factory equipped itself with a section for carrying out repairs to the lining of tunnel kiln cars by the guncreting method. The working plans for preparing the guncretes, screening, and feeding them into the guncrete machine were used as the project for this factory department.

We constructed a drier for guncreted cars. Changes were made in the design of the edge of the car. The cavity between the floors of the girder are now filled with guncrete concrete. The optimum version for arranging the armature over the base of the car (see Fig. 1) has now been selected.

Bodies containing water glass and high-alumina cement produced by the Klyuchevsk Ferroalloy Factory are being tested. The body and the guncrete concrete based on high-alumina cement were prepared in accordance with recommendations from the Urals Scientific Research Building Project Institute. The guncrete concretes made from these bodies have been thoroughly recommended during service.

Since the start of 1970 the guncrete method has been used to complete 38 tunnel kiln car bases.

The first experimental car completed 62 cycles without capital repairs during three running repairs to the hearth. The cars lined with brick require capital repairs after five cycles. The remaining experimental cars were subjected to running repairs (guncreting of the corners) after 12 cycles.

With an increase in the number of pushings there is an increase in the strength of the main mass of the base made from guncrete concrete, which eliminates the need for replacing it during repairs. There was no need for repairs to any of the cars' guncreted edges after 20 cycles.

CONCLUSIONS

The life of car bottoms made from guncrete concrete is five times greater than that of bottoms made from brick. Using the guncreting method the labor productivity for repairing bases is doubled. The working conditions of the metal construction and car bypass are improved. There is a reduction in the expense for lining bases, taking into account the difference in the costs of the brick and the guncrete body.

The body containing high-alumina cement has proved itself in service, and is suitable for objects with working temperatures above 1300°C. Preliminary moistening of the aggregate sharply reduces the dust emission during guncreting.

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