the Institute should strive for new and fruitful results.

Improvement in the system of coordination work and partial specialization by the Institute will ensure more effective scientific research by refractory-industry institutes and successful implementation of the tasks set by the Twenty-Second Party Congress.

SCIENCE AT THE SERVICE OF REFRACTORY PRODUCTION

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The reductions adopted at the Twenty-Second Congress and Program of the Soviet Communist Party outlined ways of building communism in the USSR. Industrial development is envisaged on a scale which would be impossible under capitalist conditions. In order to cope with the ambitious tasks set for the Soviet people by the Communist Party much has to be done as well in the refractory industry.

In developing advanced scientific thought and progressive high-efficiency techniques, the refractory institutes must bring about a further development of the refractory industry with a view to meeting all the requirements of the national economy in super-duty, inexpensive refractories.

For many years the Ukrainian Refractory Research Institute, one of the oldest in the Soviet Union, has been promoting the development of high-grade refractories for the metallurgical, glass, coke-chemical and other branches of industry. Of late, the Institute has completed a number of projects on the production and use of refractories in the development of advanced intensified technology.

The construction of large-capacity blast furnaces, the use of natural gas and higher air-blast temperatures have necessitated considerable improvement in the properties of blast-furnace and air-heater refractories.

It has been possible to attain this end by organizing the production of high-alumina refractories using commercial alumina, and an air-heater refractory made of high-grade kaolin from the Kirovograd deposit, which works stably at air temperatures up to 1200°C. This refractory has been manufactured at the Zaporozh'ye Refractory Plant.

Further research will make it possible to manufacture the refractory for air heaters in which the air is heated to 1300°C, and also blast-furnace kaolin refractories and commercial alumina refractories containing 50-55% Al₂O₃. This research is the basis of the production of refractories for blast-furnace bottoms using local raw material from the UkSSR.

On the Institute's recommendation, production of plasticized fine-grain high alumina and chamotte mortars is now under way at the Semiluki Refractory Plant.

Particular attention has been given to refractories for steel production. The production of dense, high-fired parts has been tried out on a wide scale in the brickwork of the main roofs in open-hearth furnaces at the Zaporozh'ye Plant and the Nikitovka Dolomite Combine. The parts show increased wear resistance in the furnace roofs operating at a faster ratio with partial use of oxygen, thereby ensuring an improvement in the strength of the roofs by 15 to 40%. This type of roof brick should be universally adopted as soon as possible.

Magnesite spinel-bonded refractories are being studied and tried out in open-hearth furnaces; they wear out to the same extent as the magnesite-chrome brick used at the present time, but valuable chromite raw material is totally omitted from the charge.

A new, improved design for a suspended roof⁶ has been worked out and tested in 400-ton open-hearth furnaces; it enables the roof to continue working until it burns through without loss of shape or danger of collapse, thereby improving the strength of the roof by 20%.

Smooth operation of the lower structure in open-hearth furnaces with basic roofs is attained by rational use of the basic refractories. At the metal works of the south extensive use is made of chrome-magnesite and magnesite-chrome refractories in the brickwork of the walls and roofs of slag pits.

Work is going on at the same time to replace the uptakes made with chrome-magnesite and magnesite-chrome refractories in these units by forsterite ones.

Forsterite checkers improve furnace output from 2 to 6.5% and last for up to 2 or even 3 campaigns per roof. Nonfired forsterite refractories, which exhibit the same strength and thermal efficiency in checkers as fired parts are being successfully adopted. Nonfired refractories are 14% cheaper than fired ones, and production potentials are considerably greater.

Synthetic forsterite and nonfired magnesite refractories developed by the Institute have been tested in gas-regenerator checkers and it has been found that they do not crumble during service.

The work of the regenerators can be stepped up still more and a saving in refractories made at the same time by using thin-walled checkers. Tests have shown that the heating surface area of the checker is thereby increased by 13-25%, and the consumption of refractories is reduced by 10-25%. Thin-walled checkers are being adopted successfully.

The Institute is carrying out exploratory work on the use of super-duty concretes in the form of large blocks for building open-hearth furnaces.

1Patent No. 128478 registered by A.S. Frenkel'.
Tests with magnesia concrete with an expanding filler in 500-ton furnaces have shown that it lasts just as long in the back wall and uptakes as fired magnesite and chrome-magnesite parts.

The Institute has worked out recommendations for improving the strength of the front wall columns.

A systematic study of the service life of different refractories in the brickwork of open-hearth furnaces and an investigation of the mechanism of wear has enabled the Institute to improve production techniques for refractories, improve the grade of the brickwork and reduce its wear and tear as well as to recommend refractories for the brickwork of 600 and 900-ton furnaces.

A further increase in steel production is planned on the basis of extensive development of converter production. This requires mass production of cheap converter refractories. Downblast oxygen converters in operation at the present time are using periclase spinel linings with the technical assistance of the Institute. But this kind of lining is expensive and its use for the development of converter steel production cannot be considered a good idea.

The Institute has worked out production techniques for nonfired dolomite-magnesite converter refractories with a tar binder which can be kept for 10 days without hydration. It has also developed compositions and methods of manufacturing dolomite concretes with a periclase carbon binder for block lining converters. Nonfired parts made from these concretes can be kept in air for 3 or 4 weeks.

The prompt introduction of block methods of repairing converters is essential. It will make it possible to cut down idle periods during which linings are replaced, to mechanize repairs and ease working conditions. It must be taken into consideration that large converters standing idle for long periods while the lining is being repaired with piece refractories a fact which is impermissible in large-scale production.

A tar-dolomite and tar-magnesite refractory shop should be constructed as soon as possible at the Krivoy Rog Metal Works for the production of nonfired block linings.

For steel arc furnaces, the Institute has developed a nonfired cassette brick made of magnesite-chrome concrete with an expanding filler. During service in walls of 40-60-ton arc furnaces the strength of this brick has shown itself to be the same as high-fired periclase spinel brick and almost double that of the block lining with a pitch binder.

When tried out in the roofs of small steel-melting arc furnaces, the dinas-zirconia brick developed by the Institute wore out to a lesser degree than dinas by a factor of 1-1/2. Tests on this refractory are still going on in large arc furnace roofs.

Systematic research on the part of the Institute has ensured the requisite types of refractories for extensive introduction of continuous and semicontinuous steel pouring in the metallurgy industry. It has been found that for pouring boiling steel the best refractories are high-alumina types, and for killed steel, zirconia nozzles; the production of these is in progress. The manufacture of proportioners for semicontinuous casting of stainless steel under synthetic slag is being developed.

With a view to eliminating the consumption of metal on the manufacture of steel inserts for protecting trays during top pouring of killed steel a manufacturing technique has been worked out for graphite-containing inserts. They can withstand 40-60 and sometimes 80 pourings, which will make for great savings. The production of these inserts should be further developed.

The Institute has completed a great amount of research for refractories for coke furnaces. Work in collaboration with dinas plants has resulted in the use of high-grade dinas refractories for coke furnaces.

An improved plasticized dinas mortar has been developed by the Institute and its use will provide airtight brickwork for coke furnaces.

The problem of removing dust from dinas mortars has been solved. When coke furnaces are being constructed, a method developed by the Institute is used to prevent the mortar forming dust at the building site. On the basis of a design developed by the Gipropro Institute, work will shortly start at the Krasnogorovka Refractory Plant on a shop to be used to manufacture granulated hygroscopic nondust forming dinas mortar in accordance with the Institute's recommendations. A granulated aluminosilicate mortar shop, which has already been designed, will also be built at this plant.

A long service life for coke-furnace brickwork necessitates hot repairs in good time. Up to the present time the materials available on the market for this operation are gunnite mixtures, the efficiency of which is low. Extensive industrial tests at coke-chemical plants with a new gunnite mixture developed by the Institute have shown that the periods between repairs are considerably lengthened. This, in turn, protects the brickwork. The commercial production of the new mixture for hot repairs will begin next year.

To lengthen the service life of quick-wearing brickwork in coke furnaces there have been developed new spalling-resistant types of refractories — dinas gunnite and alumina-carborundum; industrial tests on them have begun in heads and hearth linings, and in the first stone of the coke chamber overlay.

There has been systematic research on improving the strength of fire-box linings in both the main and auxiliary steam boilers of ships. An increase in service life from 3-4, 000 hours to 10-12, 000 hours has been obtained.

Work is going on to develop refractories for marine boiler boxes, the use of rammed mixtures and rational designs for the brickwork so as to improve their strength even further.

Several types of aluminosilicate rammed mixtures have been devised for melting aluminum alloys in induction-furnace crucibles. Use of them at the Moscow Aluminum Alloy Plant makes the larger crucibles exceptionally strong. For example, a one-ton crucible lasted 403 work days and withstood 1661 melts; one 5-ton crucible has now been working for more than 3 months and has withstand more than 400 melts. Work on the linings of induction furnaces used in nonferrous metallurgy is being stepped up.

A production technique has been worked out for new types of lightweight refractories — high-alumina types with a bulk density of 1.5 and less than 0.9 g/cm², zirconia, forsterite and carborundum types. Work is going on to establish the best sites for their use. In particular, high-alumina lightweight with a bulk density of 1.5 g/cm² is extremely effective for lining the fire-boxes of auxiliary marine boilers and the zirconia type, which has a bulk density of 2.5 g/cm², can be used for furnaces with a working temperature of 2000-2200°C.

The production of refractories for thormite (rall weld-