The development of water-glass concrete compositions which do not contain sodium fluorosilicate is necessitated by the frequent use of concrete in which fluorosilicate compounds are impermissible, such as in heat units in the food industry, in pyrite furnaces using the contact system of manufacturing sulphuric acid, and so on.

Water-glass concrete hardens satisfactorily when nephelene slurry or granulated blast furnace slag are added.

The hardening of compositions with a water-glass base can be made certain by adding various silicates.

On the basis of work carried out in 1961, a new hypothesis has been put forward to explain the processes involved when water-glass concrete sets. It can be considered that the setting occurs before the water glass has completely decomposed and is due to coagulation of the alkaline gel, which possesses binding properties.

The study of the setting of compositions with a water-glass base and a number of different additives has shown that setting occurs in cases in which the material added causes variation in the alkalinity of the medium and does not decompose the sodium silicate. If there is decomposition of the sodium silicate when the coagulant is added, the mixture sets very quickly.

Nephelene slurry contains bicalcium silicate, hence when added instead of sodium fluorosilicate it ensures a normal setting and hardening time, and also fairly good strength characteristics when the concrete is hardened in air-dry conditions.

The compressive strength after 3 days of air-dry hardening is 130-300 kg/cm² and after 28 days from 300 to 450 kg/cm², according to the amount of nephelene slurry added.

The addition of this slurry to water-glass concrete instead of sodium fluorosilicate makes it possible to raise the temperature at which the concrete is used by 100-200°C, i.e., instead of 1000°C for sodium fluorosilicate, it is 1100-1200°C for when nephelene slurry is used.

To produce water-glass concrete we also tried out slags from ferro-alloy production (ferrochrome and ferromanganese) and self-slaking blast-furnace slag. Concrete with a compressive strength of 100-300 kg/cm² was made.

The investigations made considerably improved the possibility of making new types of chemically stable refractory concretes with new, preset properties.

It would be of great interest to use refractory concrete for the production of crucibles for melting aluminum in induction furnaces. In this case water glass concrete with fine-ground magnesite and chamotte fillers can be used.

When aluminum is melted with fluxes in concrete crucibles, the quality of the fused aluminum alloys is higher than when pigiron crucibles are used. The strength of the concrete lining is greater than that of the lining materials which once were used, and formerly cost much more.

Tests on concrete linings in vacuum-distillation induction furnaces show the advisability of using concrete for these units.

Good results have been obtained in tests with concrete linings in ladles for handing and pouring aluminum alloys.

Water glass concrete with fine-ground magnesite and chamotte fillers interacts with aluminum and aluminum melts and fluxes only on the surface, and exhibits fairly good spalling resistance.

Compositions have been worked out for water glass refractory concretes containing fine-ground magnesite, silica and chromite fillers. Concrete of this kind has been used for the fire tube of a kryptol furnace, in which it withstood more than 50 heating-cooling cycles, including five cycles at 1700°C.

This concrete is being tested in the lining of steel melting induction furnaces and also in tools for casting hydraulic turbine blades.

More extensive use in the future of corrosion resistant, refractory and super-duty concretes for building heat units requires more thorough theoretical investigation and more experimental research so as to design new heating units, develop methods of calculating and designing, and also carry out industrial tests on the new types of concretes and parts made with them.

**EXCHANGE OF EXPERIENCE**

**EXPERIENCE GAINED BY PLANT LABORATORY**

K.YE. KAPRAN AND K.S. KARMANOVA
(Chasov-Yar Refractory Combine)

The Central Laboratory of the Chasov-Yar Combine has organized sections engaged in research, analysis, heat treatment, and physical-mechanical tests, as well as a spectral-analysis laboratory, eight shop laboratories for current production inspection, two laboratories for determining the hardness of commercial water and an industrial hygiene laboratory.

The Central Laboratory employs a staff of 55, including 9 engineers and 35 technicians.

The Central and Shop Laboratories keep a daily check on
the completion of technological norms.

The Central Laboratory analyzes all materials and semi-manufactured parts reaching the Combine.

Over the last few years the Central Laboratory has received a great deal of new equipment and many new instruments.

The Analytical section now uses the photocalorimetric method for analyzing raw materials and finished products. A system for testing the corrosion resistance of carborundum plates has also been adopted.

Physical-mechanical tests are carried out with an Tshmk-2 tester at the natural frequency of the specimen. Nomograms have been developed for blast-furnace, ladle and standard brick.

This department has also begun using a new method of determining the heat conduction of lightweight parts, developed by the All-Union Refractory Research Institute.

The spectral-analysis laboratory determines the chemical composition of magnesite powder.

The Central Laboratory is gradually reducing the number of inspection jobs and other minor production jobs by concentrating them in the shop laboratories.

This has made it possible to focus the attention of the laboratory staff on research in the field of improving and introducing new manufacturing processes.

Shop workers are being invited to help with the research and other work.

Research projects are considered by the technical advisory council and approved by the Combine's chief engineer.

Results of completed work are reviewed at a conference in the presence of the chief engineer.

In 1961 the Central Laboratory of the Combine completed work on the adoption of new types of parts. Production techniques have been developed and put into practice for ultralightweight refractories.

The ultralightweight (BP-0.4) possesses the following properties: refractoriness 1710°C, bulk density 0.33–0.40 g/cm³, compressive strength 15–25 kg/cm², apparent porosity 8–16%, additional shrinkage 0.28–0.20%, thermal conductivity 0.16–0.20 kcal/m·°C·h·m.

More stable refractory mixtures have been selected for cyclone firing-boxes in steam boilers.

For their boiler cyclone firing-boxes the Mironovskiy Engine Power Station once used a refractory cement made of chromite powder with a water-glass binder (PKM-6), which lasted 3 to 5 weeks.

In collaboration with the All-Union Refractory Institute, scientists have completed work on the manufacture of experimental batches of carborundum and Mullite corundum mixtures which were applied to the journals of the boiler flame tubes. Seven types of refractory mixtures were made.

The carborundum refractory mixture with a water-glass base has been adopted on the basis of the operation of boilers equipped with fire boxes with a liquid slag removal system.

The use of a carborundum rammed mixture for standard screens has made it possible to reduce charring of the journals by a factor of 2–1.3 to 3, to prolong the life of the lining, and to make the operation of the steam boiler more economical as a whole.

The yearly saving from the production of this carborundum dressing is 393,000 rubles.

Production techniques for paraffined nonfired magnesite nozzles and inserts have been developed and put into practice. These parts are being successfully used at a large number of metal plants.

The yearly saving by excluding the firing operation and reducing the amount of spoilage amounts to about 50,000 rubles.

Twenty percent Chasov-Yar semiacid clay (C2PK) is now added to the charge for standard chamotte brick.

The yearly saving from this innovation is 22,000 rubles.

In collaboration with the Ukrainian Refractory Research Institute, research workers have developed and adopted production techniques for class A air-heater brick made of 100% Kirovgrad clay.

The use of this brick in the walls of air-heating blast furnaces at the Zaporozhstal' Plant has made it possible to step up the blast temperature from 900 to 1150°C.

Under the guidance of the Ukrainian Institute an experimental batch of stabilized magnesite-dolomite and dolomite brick has been manufactured with the following composition:

<table>
<thead>
<tr>
<th>Brick</th>
<th>Compressive strength, kg/cm²</th>
<th>Porosity, %</th>
<th>Refractoriness-under-load 2 kg/cm³, °C</th>
</tr>
</thead>
<tbody>
<tr>
<td>Magnesite-dolomite</td>
<td>711–1600</td>
<td>16.0</td>
<td>1660–1690</td>
</tr>
<tr>
<td>Dolomite</td>
<td>870–950</td>
<td>16.80</td>
<td>1570</td>
</tr>
</tbody>
</table>

The brick is now being tested in converters at the Kiev Motorcycle Works and in rotary kilns at the Podol'sk Cement Works.

New technological processes have been adopted for high density parts for steel pouring ladles and for the brickwork of blast-furnace stacks with a porosity below 14%, using kaolinized chamotte with a Kirovgrad-clay base.

The Central Laboratory of the Combine is working in collaboration with the Ukrainian Research Institute, which inspects the laboratory's research program and reviews reports on completed projects.

Seminars are held every year in the Institute for heads of laboratories and other research workers.

The combine regularly receives technical information bulletins from the Institute on the latest developments in refractory production both in the Soviet Union and abroad.

The staff of the laboratory, technical section and shops of the Combine take an active part in testing experimental batches of parts at consumer plants.

Engineers and technicians from the laboratory are sent to other plants to give them the benefit of their experience.

Schedules for 1962 envisage the following: