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RECOVERY OF ALUMINA FROM ANORTHOSITE

One of the current cooperative research projects jointly sponsored by the California Division of Mines and the U. S. Bureau of Mines involves an attempt to develop a commercial process for extraction of alumina from California anorthosite, an igneous rock rich in feldspar. Large resources of this type of aluminum-rich rock occur in southern California, but commercially feasible methods of recovery of alumina from them have not been developed.

The lime-soda sinter process, extensively studied by the Bureau of Mines, is being applied in this research. Current investigation by the Bureau is geared to learning the chemistry of the lime-soda sinter process in greater detail than is presently known.

A 1-ton sample of anorthosite from the San Gabriel Mountains was taken from a roadcut exposure on the south side of the mountain summit. The location was in the general area of T. 3 N., R. 12 W. The analysis of the sample was:

Al_2O_3	27.8%	K_2O	0.29%
SiO_2	52.6%	MgO	.40%
CaO	9.5%	TiO_2	.25%
Fe_2O_3	1.9%	L.O.I.	
Na_2O	5.8%	1000°C	.72%

A sample from another area of the deposit will be taken later this spring.

Basically, the lime-soda sinter process for recovering alumina from aluminum silicates involves mixing the ore with sufficient limestone and soda ash so that upon sintering the mixture a dicalcium silicate and sodium aluminate will be formed. The sodium aluminate is soluble, while the dicalcium silicate is insoluble in causticized solutions. After separating the leach liquor from the insoluble residue, the alumina may be recovered by precipitation.

In practice, the operation of the process is more complicated, and additional operational steps and techniques are necessary. These are briefly as follows:

All of the components—anorthosite, limestone, and soda ash—must be finely ground to achieve intimate mixing. The components must be mixed in such ratio that the final sinter will carry a mol ratio of CaO to SiO_2 of about 2.0 and a mol ratio of Na_2O to Al_2O_3 of about 1.0. Some means of control to assure uniform sintering is desirable.

The mixture may then be sintered in a rotary kiln in the same manner used to prepare cement clinkers. However, up-draft sintering on a traveling grate appears to promise a better job than the rotary kiln. It has not been tried commercially for the lime-soda sinter, but a laboratory up-draft sintering hearth produces an excellent sinter. When this type of hearth is used, crushed

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petroleum coke is added to the mixture, prior to sintering, to act as a fuel. Sintering temperatures are controlled to the range of 1350°C to 1400°C.

The sinter is ground to about100 mesh and mixed with the leach liquor in a ratio of about 2 milliliters of liquor per gram of sinter. An optimum leach liquor should be composed of about equal equivalents of NaOH and Na_2CO_3, and the total Na_2O content should be about 50 grams per liter. This composition is subject to wide variations in practice.

The best temperature for leaching is about 70°C, and contact time of half an hour is generally sufficient. Immediate separation of liquor from the leached solid is desirable. Serious troubles can occur at this point because poorly made sinters tend to gel or set. The lime-soda sinter composition is not far removed from the area in a ternary system representing Portland cement compositions. Therefore, cement characteristics should be expected in the lime-soda sinter, and such is actually the case where leach slurries gel on standing. To minimize such occurrences, sintering techniques must be carefully controlled.

Leaching also takes a small amount of silica into solution. The pregnant leach liquors will carry about 3 grams of SiO_2 per liter. This silica must be removed before precipitating the alumina, for alumina specifications generally require that the SiO_2 content be less than 0.03 percent. The SiO_2 is removed from leach liquor by adding about 6 grams per liter of lime and autoclaving for one hour at 200 p. s.i.g. This treatment drops the SiO_2 content of the liquor to less than 0.1 gram per liter.

Alumina is recovered from the purified leach liquor by treating the liquors with a gas mixture of CO_2 and air. In a commercial operation, the gas mixture would be flue gases from a furnace operation in the plant. The alumina recovered is pure alumina trihydrate ($Al_2O_3 \cdot 3H_2O$). Calcining the trihydrate gives the alpha alumina of commerce.

Early tests, using the foregoing laboratory techniques, have demonstrated that an alumina recovery of 90 percent is possible.

NEW MINING LAW...

Public Law 86-390, approved March 18, 1960, amends the United States mining laws to permit millsite locations in connection with placer mining claims. Prior to the passage of this law, millsite claims could only be obtained for use in connection with lode mining claims.

Section 2337 of the Revised Statutes of the United States (30 U.S.C. 42) is amended (1) by adding "(a)" after "**SEC. 2337.**", and (2) by adding at the end thereof a new subsection as follows:

"(b) Where nonmineral land is needed by the proprietor of a placer claim for mining, milling, processing, beneficiation, or other operations in connection with such claim and is used or occupied by the proprietor for such purposes, such land may be included in an application for a patent for such claim, and may be patented therewith subject to the same requirements as to survey and notice as are applicable to placers. No location made of such nonmineral land shall exceed five acres and payment for the same shall be made at the rate applicable to placer claims which do not include a vein or lode."

LOCATING GUANO DEPOSITS—a correction

The April 1960 issue of *Mineral Information Service* carried an article on commercial guano. This article contained an error in describing the manner in which one could gain legal right to a bat guano deposit. Such deposits are not subject to location, but may be leased as phosphate deposits from the United States Government under the authority of the Mineral Leasing Act of February 25, 1920 (30 U.S.C. 211-214) and the regulations of the Secretary of the Interior (43 CFR 196). We have been further advised that where the composting action has gone on for thousands of years, cave niter results, as in the small caves in the rhyolite in northern Nevada. Such deposits may be leased as sodium-bearing deposits.

NEW U.S.G.S. PUBLICATION

Results of a detailed study of the foraminifera of the Monterey shale and the Puente formation in the Santa Ana Mountains and San Juan Capistrano area, Orange County, in southern California, are described in a new publication by the Geological Survey.

The rocks in which the foraminifera (tiny middle and late Miocene marine animals with calcareous shells) occur represent an eastward extension of strata which are prolific oil producers in parts of the Los Angeles basin.

Studies such as this make possible the correlation of rock units, since various species of foraminifera reflect the geologic age of the bed in which they are present.

The Geological Survey carried on oil and gas investigations in and near the Santa Ana Mountains from 1945 to 1955. Shells of hundreds of foraminifera from the area were collected and examined. The localities sampled are shown on maps accompanying the report and are described in the text. The maps also show areas of rock outcrops and the locations of test wells and core holes that were used in preparing the structure section and that were sampled for foraminifera. A list of these wells and core holes is given.

Also included in the report are charts showing distribution of the foraminifera and the geologic ranges of the more important and abundant species, and systematic descriptions and photographs of foraminifera of the Monterey shale and Puente formation.

Foraminifera of the Monterey shale and Puente formation, Santa Ana Mountains and San Juan Capistrano area, California, by Patsy Beckstead Smith, has been published as Geological Survey Professional Paper 294-M. Copies can be purchased from the Superintendent of Documents, United States Government Printing Office, Washington 25, D.C., for 40 cents each. The report is also available for over-the-counter sale (but not by mail) at Geological Survey offices at 1031 Bartlett Building, Los Angeles, and 232 Appraisers Building, San Francisco, California. It is not sold by the Division of Mines.

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If you are touring the historic Mother Lode country this vacation, let our Bulletin 141, *Geologic Guidebook along Highway 49*, be your personal guide. On sale at any Division of Mines office for $1.50 plus tax. *(B—a)*

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