BERYLLIUM DEVELOPMENTS

1. French Production

This side of the Iron Curtain and outside of US borders, there is only one major producer of beryllium—Pechiney in France. So, during a recent visit to the city by the Seine we took advantage of French hospitality and paid a visit to Monsieur Roy, Pechiney's engineer in charge of new product research.

We learned that Pechiney has been in the beryllium business since 1951, supplying metal in the form of ingots, flakes, powder, sintered or forged shapes, plates, bars, tubes, and forged pieces. The firm is the only producer to base its operations on the electrolysis of beryllium chloride. Beryl ore, largely from Madagascar, is refined to BeO at the firm's chemical plant at Salindres in southern France, and transformed to metallic beryllium at the Calypso plant high in the French Alps, near Pechiney's aluminum reduction works. Calypso is an old electrolytic reduction works which was modernized in 1958 and put exclusively into beryllium service.

First step in the production of beryllium at Calypso is the mixing and briquetting of powdered beryllium oxide and carbon. The resulting briquettes are charged into the classical type of chloridizing furnace. Temperatures are maintained at 900°C while chlorine gas is injected into the furnace and the more easily sublimed metallic chlorides, including beryllium, are allowed to pass from the unit.

After condensation, the resulting crude chloride is passed through a series of purification steps which are vital to the production of high-purity beryllium. By means of precise control over sublimation and condensation conditions, low-temperature chlorides are first sublimed by heating to temperatures below 900°C. At a later step, higher sublimation-point chlorides are left as a residue, while beryllium chloride is sublimed. The resulting purified chloride contains no silicon, less than 0.1 pct Al + Fe, and only a small quantity of oxygen.

Fused-salt electrolysis of the eutectic mixture of purified beryllium chloride and sodium chloride (about 45 pct NaCl) is the next step. The operation takes place at temperatures between 350° and 400°C in nickel cells operating at 1000 amp. The pot itself serves as the cathode, while a graphite anode is employed. Periodically, beryllium metal, together with a certain amount of the electrolyte, is gathered from the side of the cell and transferred to another area where water and acid are employed to wash the beryllium free of such impurities as nickel.

Washed beryllium metal has the following analysis: 300 ppm C, 300 ppm Na, 200 ppm Ca, 50 ppm Mg, 300 pm Si, 300 ppm Fe, 300 ppm Al, 200 ppm Ni, 1100 ppm halogens (except F) expressed as Cl, and 4000 ppm insolubles in bromine-alcohol (assumed to be oxides of beryllium). The metal is further refined by vacuum melting in an induction furnace, and the resulting ingot shows a considerably lower halogen content. Beryllium ingots may be made into chips which are ground in a ball mill into beryllium powder.

Recently, Pechiney has begun the trial production of some 1 kg per day of refined beryllium through the utilization of a second fused-salt electrolysis in a cell not unlike that used experimentally by the US Bureau of Mines and reported in the October 1960 issue of JOURNAL OF METALS. Pechiney's refined beryllium is made according to the following chemical specifications: 100 ppm C, 20 ppm Si, 20 ppm Fe, 10 ppm Ni, 50 ppm Na, 5 ppm Cu, 20 ppm Mn, 20 ppm Zn, 1 ppm Ti, 500 ppm halogens, and 300 ppm insolubles. According to spectrographic analysis this metal contains 5 ppm Mg, 10 ppm Ca, 20 ppm Al, and 0.5 ppm B. Under study by Pechiney is the production of ingots and powder from this refined metal.

As an added crown to its achievements Pechiney is experimenting with a new electrolysis technique designed to produce metal containing less than 5 ppm total impurities. Thus, the quest for perfection is in sight!

2. US Self-Sufficiency

Bruce W. Odlum, President of Beryllium Resources Inc., expects the US to be self sufficient in beryllium concentrates within a few years, thanks to the continuing exploration of deposits and the development of beneficiation techniques.

Previously based only on the limited deposits of beryl, the industry is now turning its eyes toward more plentiful deposits of other beryllium-containing minerals. Draw-back to the utilization of these low-grade ores has been a means of concentration.

In order to accomplish this task, Mr. Odlum's firm was established, taking as its technological starting point a flotation process developed by Edward Van Dornick for beryl. After several years of pilot-plant work, satisfactory beryllium concentrates have been produced from phenacite, bertrandite, helvite, and other minerals.

So successful has been the work, that Beryllium Resources is now constructing a 250-tpd mill to process bertrandite-like ores from the Topaz Mountain region of Utah. This mill is expected to be in operation before the end of 1961, processing 1 pct BeO-containing ores to a 7-pct BeO concentrate, reportedly satisfactory for beryllium extraction. With a better-than 90 pct recovery, output of this mill—some 2 pct of contained BeO per day—should be adequate to supply not only Brush Beryllium Co. (a stockholder), but some requirements of The Beryllium Corp. as well.

Continuing its exploration work, Beryllium Resources has mining claims in a number of states including Alaska. It is also putting its technical know-how to work in attempts to recover beryl from mine waste dumps, probably in such places as Mozambique. There hand cobbling has recovered only about half of the beryl contained in the ore.

The application of flotation techniques to non-beryl beryllium minerals is likely to mean US self-sufficiency in raw materials for beryllium production. And this, together with the application of flotation to beryl mining operations in various parts of the world, may indeed spell the end to the raw materials bottle-neck of the beryllium industry.

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