

A reader (jharding@aztec.asu.edu) filed a FOIA request with the U.S. Bureau of Mines for all available info on Boron. We regard this as a very wasteful way to conduct research (He could have gone to the library instead.) and an abuse of the FOIA act. Nonetheless, it did generate some interesting tidbits, listed below...

Annual Report

BORON

By Phyllis A. Lyday

1992

U.S. Department of the Interior
Bureau of Mines

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[EXCERPTS]

In the boron hydride series are diborane, a gas; pentaborane, a liquid; and decaborane, a solid. Government documents concerning boron fuels projects begun after the Korean War we declassified and included in a book that describes the pilot plant production at the Malta Rocket Test Station.

Boron nitride, a soft, white, highly refractory solid resembling graphite, can withstand significant oxidation to temperatures up to 650(d) C. Boron nitride produced in fibrous form equals glass fibers in strength and modules of elasticity, but is lighter in weight and more resistant to high temperature. When subject to extremely high pressure and temperature, boron nitride forms cubic crystals that rival the hardness of diamond.

Boron carbide, produced by reacting carbon and boric acid at 2,300(d) C, is a highly refractory material and one of the hardest substances known.

More than four-fifths of the U.S. production comes from mineral deposits mined only for their boron content.

Glass fiber insulation and glass fiber primarily used as a reinforcement for plastics continue to be the largest consuming industries.

The second major market for borates, manufacturing high-tensile-strength glass fiber materials for use in a range of products. The nonconductive and low dielectric properties of high-strength glass-

reinforcement materials make them transparent to radar and thus valuable for "stealth" applications. Carbon-fiber-reinforcement resins can be stronger than metals and with higher modules, more stable.

In addition, their light weight and ability to withstand high temperature have made them the material of choice for a variety of aerospace applications.

Specialty fabrics are widely used in marine and aerospace industries and have potential applications in bridge overwraps, reinforcement road systems, and automotive parts.

May 16, 1995

Mr. John E. Harding

Phoenix, AZ 85033

Dear Mr. Harding:

Most of the questions that you have asked are not new technology and can be found in information contained in most Regional Depository Libraries. The closest Depository library to Phoenix is the Arizona State University Library at Tempe. An excellent source is Kirk-Othmer Encyclopedia of Chemical Technology. At ASU the Kirk-Othmer collection can be found in the Nobel Library (602-965-7607). Attached is the portion of Kirk-Othmer Concise Encyclopedia of Chemical Technology section on elemental boron.

Industrial Minerals Directory (Surrey) lists producers of non-metallic, non-fuel minerals. The latest copy was edited by Joyce Griffiths and published in 1991.

A copy of the 1992 annual report is attached. The 1993 report is available from the Government Printing Office (GPO number 024-004-02358-9) for \$1.75 or off the internet (gopher.usbm.gov port 70 using gopher client software. For technical questions contact Matt Klevemann, 412-892-6499 [klevemme@miner.usbm.gov]). A list of how to receive electronic information and Bureau of Mines Publications is attached.

1. Boron is used as a preservative. It was used to preserve meats for many years but that use was replaced by nitrites and now other products. The usual form is as sodium borate, but boric acid is commonly used in preserving flowers. Boron is an essential micro-nutrient for many plants, and in the past five years has been identified as important in the development of bone.

2. Boron is neutron absorber. It is used in control rods of nuclear reactors as boron carbide and in the cooling system as boric acid. An excellent source of information on the end users of boron is the Kirk-Othmer Chemical Encyclopedia available in most university libraries.

3. Boron as an element in the cubic form is not as hard as diamond. In the manufactured compounds boron nitride and boron carbide are extremely hard. Boron carbide was used in bullet proof vests before the invention of Kevlar brand fiber. Cubic boron nitride is a very hard substance. Boron nitride is a man made compound and used as abrasive. Boron nitride also has been used in synthetic gemstones, but cubic zirconia is much more commonly used. Moh's modified scale of hardness list boron as 11 and diamond as 15.

4. Most of the world's boron is recovered in the United States and Turkey. Because different ores contain different amounts of boron oxide, it is difficult to make a finite comparisons of who is the largest. In the United States, the largest producer is U.S. Borax Inc., (805-287-5400) Valencia, CA, who mines at surface mine in Boron, CA. Refer to the attached 1992 Annual Report, p. 11, Table 8, for a comparison of ore production by country.

5. In addition, North American Chemical Co. (913-344-9200) Mission, KS, produces boron compounds in the United States from brines at Searles Lake, CA, which does not exist in an ore form. Another producer is American Borate Co. (804-490-2242) Virginia Beach, VA, who produces from an underground mine Death Valley, CA. Attached is a listing from the Minerals Availability Systems (303-236-5200) that list all the current and past producers in addition to prospects.

6. Boron ore and compounds are shipped from Turkey to the United States. The annual report compiled by the Bureau lists where sodium borates and boric acid are exported. In 1993 the largest exporting country for boric acid was Japan and for refined sodium borates was the Netherlands. This information is compiled from information published by the Bureau of the Census.