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THE USE OF BORON SUBSTANCES IN FUELS

I. Significance of Boron in High-Energy Fuels

The potentialities for high-energy yield render boron substances extremely useful in the development of fuels for aircraft, missiles, and other specialized weapons. The added energy provided by the use of boron powder in slurry fuels is translated directly into greater thrust and increased range. Boron propellants are used in rockets and other special weapons. Recent research has shown that at least two boron compounds in low concentrations will provide satisfactory properties and at the same time will maintain and even exceed, for example, the performance of hydrazine in rockets.

II. Research and Development of Boron Fuels

A. US Development of Boron Fuels

The US Defense Establishment is engaged in a comprehensive program to enlarge the scope of practical applications for boron substances as fuel. At the present time the largest US consumption of boron raw materials for fuel purposes is in making boron powder for slurry fuels. In the near future, military requirements for all boron raw materials in scheduled aircraft and missile programs are expected to exceed the current US annual production of 800,000 tons, with a boric oxide content of about 250,000 tons.

B. Other Free World Development of Boron Fuels

The countries which are most likely to engage in boron research are those capable of conducting lengthy and complex chemical investigations. In the free world, not only the US but also the UK and West Germany are known to possess such capabilities. British reports published during the past decade indicate that the UK attributes the same importance to continued boron research as does the US. In the post-war period, boron research in West Germany has been confined to non-military applications. With the end of the occupation, however, their programs might be extended to include military uses of boron substances. Very little information is available on boron research in other free world countries.

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C. Soviet Developments in the Field of Boron Fuels

The USSR is believed to be conducting boron fuel research programs. Technical know-how regarding the manufacture and application of boron substances in fuels may be as far advanced in the USSR as in the US or in any other country. This conclusion is derived from an examination of recent technical literature published in the USSR. Such published information does not demonstrate that the Soviets are using boron fuels in actual aircraft or missile operations; on the other hand there is equally no assurance that they are not doing so.

III. Sino-Soviet Bloc Boron Position

A. Deposits and Production

The principal deposits of boron-containing minerals in the Sino-Soviet Bloc are located in the USSR, although there are known to be some in Communist China.

Reserves of unmined boron ores available in the USSR in 1938 are shown in the attached table (See Annex). They show a total ore availability in geologically explored reserves of about 2,000,000 metric tons, having a boric oxide (B_2O_3) content of approximately 150,000 tons. If inferred or geologically investigated reserves are also included, the total becomes about 7,500,000 metric tons, having a boric oxide content of about 630,000 tons.

About 22,000 tons of minerals, containing about 8,000 tons of boric oxide, are reported to have been mined in 1938. 1/ If, since that time, it is assumed that output in terms of boric oxide content has varied approximately with Gross National Product, the total depletion of the 1938 reserves would have been about 170,000 metric tons of boric oxide. This presumes a current annual output of perhaps 35,000 to 40,000 tons of minerals, containing 10,000 to 15,000 tons of boric oxide.

The major deposits of the USSR are in the vicinity of Inder Lake at Inderborskiy (48°31' N - 51°47' E) and at many points along the north shore of the Caspian Sea. Good highway and railway transportation is available from these deposits. Other deposits are located in the Mineralnovod-Cheskiy Rayon in the North Caucasus and the Azov-Black Sea area. Although of lower grade, these deposits are being worked, and are also favorably situated for transportation facilities.

1/ Demitri B. Shimkin, Minerals - A Key to Soviet Power (Cambridge, Mass., 1953), p. 253.

Usable Chinese reserves of boron resources are believed to be small. Very high-grade deposits in Tibet are relatively inaccessible for present large-scale exploitation. Several recent reports indicate some recovery of borax from long-established salt brine wells and the beginning of construction on a borax plant at Tsu-Kung, Szechwan Province. Transportation facilities linking these latter areas with other parts of China appear to be adequate.

B. Imports from the Free World

The interest of the Sino-Soviet Bloc in borax, boric acid and related products seems to be increasing. Preliminary estimates indicate that Bloc imports of these materials from the free world totalled at least 15,000 metric tons in 1954, virtually all to the European Satellites and Communist China. Imports appear to have been greater in 1954 than in any other recent year. Recently there have been possible diversions of US-origin borax. Also, Turkey is exporting significant portions of its boracite production to the Satellites. Thus total movement of boron materials from free-world countries to the Bloc during the first nine months of 1955 surpassed the total for the whole of 1954.

C. Adequacy of Supplies

Information available on Soviet use of boron materials in either civilian or military programs makes any precise estimate of the adequacy of supplies difficult. There is reason to believe that in 1954 East German borax imports were 1,000 tons less than was required and planned. At the end of November 1954, borax was released from East German "State Reserves" to meet urgent industrial needs. As of 11 January 1955, only 30 tons of this had been returned to the Reserves. Subsequent reports indicate that borax continues to be a chief bottleneck in supplies for the East German chemical and glass-making industries.

ANNEX I

USSR RESERVES OF UNMINED BORON ORE

(1938 estimate)

NATURE OF RESERVES	ORE TONNAGE (In thousands of metric tons)	
Explored Ores		
Thoroughly Explored a/		
Good grade (25-35% B_2O_3)	264	
Low grade (3-9% B_2O_3)	1,417	
Total		1,681
Geologically Explored b/		
Good grade (25-35% B_2O_3)	342	
Low grade (3-9% B_2O_3)	112	
Total		454
Total Explored Ores		2,135
Geologically Investigated Ores c/		
Good grade (25-35% B_2O_3)	138	
Low grade (3-9% B_2O_3)	5,245	
Total		5,383
Total Explored and Investigated Ores		7,518

Source: Geologicheskaya Izuchennost i Mineralno-Syrevaya Baza SSSR k XVIII... Syezdy VKP (b), /Geological Study of Mineral Raw Material Sources of the USSR for the XVIII Congress of the VKP (b)/, Moscow-Leningrad 1939.

a/ Reserves explored ready for mining.

b/ Reserves geologically explored and defined by tests, with preliminary examinations computed.

c/ Reserves established on the basis of naturally or artifically induced appearance of the material on the surface.