

## BORON

*By Lester Hunt*

**A**fter growing by 1-2% in 1999, the global borate market declined by around 1% in 2000 to approximately 1.25 Mt B<sub>2</sub>O<sub>3</sub>.

Glass fibre manufacture continued to be the single largest market for borates on a global basis with 60% of the market concentrated within North America. Boric oxide is an important ingredient in fibre glass as it reduces the temperature necessary for fibrisation, improves process productivity and increases glass fiber durability. For insulation fibre glass applications, the infrared absorption properties of B<sub>2</sub>O<sub>3</sub> can also enhance product performance. For continuous strand fibre glass used in reinforcement applications, B<sub>2</sub>O<sub>3</sub> can improve productivity by reducing fibre breakage in the process. Borate demand by the insulation fibre glass sector was reduced during 2000 primarily due to the cooling of the US economy during the second half and associated reduction in housing starts. However, demand for glass fibre for electronics and re-inforcement applications continued to show strong growth particularly within the Pacific Rim markets.

The frit and ceramics sector continued to exhibit growth during 2000, particularly from the major production areas in Spain, Italy, Brazil and China. This market accounted for 16% of total global B<sub>2</sub>O<sub>3</sub> consumption last year. Sodium perborate manufacture and detergents made up 14% of the total B<sub>2</sub>O<sub>3</sub> demand during 2000 as sodium percarbonate continued to make in-roads in this European dominated market. Borate utilisation in household cleaning products and traditionally non-borate-based detergents increased albeit from a relatively small base.

Borates used in the manufacture of borosilicate glass accounted for approximately 9% of total B<sub>2</sub>O<sub>3</sub> demand.

Boric oxide acts as a flux and aids in the melting of the glass batch materials. B<sub>2</sub>O<sub>3</sub> also enhances performance by reducing the tendency of glass to fracture due to rapid changes in temperature. Borates also improve the glass clarity and resistance to chemical attack and consequently borate compounds have been used in the production of a wide range of glass products including cookware, decorative glass, laboratory glass and pharmaceutical glass. Growth in this market has been relatively flat in recent years due to substitution by plastic materials and tempered glass.

The market for borates in agriculture continues to grow as awareness of the importance of the presence of boron as a micronutrient in soils grows. Most agricultural areas of the world are boron-deficient and the introduction of boron can often lead to increased yields and improved quality for certain crops including grapes, sugar beet, sunflower, alfalfa, cotton, and olives. Agricultural applications currently account for about 5% of global B<sub>2</sub>O<sub>3</sub> demand.

There are over 300 additional end uses for borates which in total account for 24% of world demand on a B<sub>2</sub>O<sub>3</sub> basis. These end uses include cellulose insulation, metallurgy, chemicals, pesticides, automobile brake fluid, antifreeze, aerospace and nuclear-absorption applications.

The growth rate in demand for borates is expected to remain relatively flat over the next few years with some projected modest growth primarily in relatively new applications such as wood preservatives, fire retardant, paper manufacture, gypsum board and bricks.

The US Food and Nutrition Board (FNB), a unit of the National Academy of Sciences' Institute of Medicine, recently completed an

evaluation of the essentiality of several micronutrients, including boron. The outcome is a recommended set of Dietary Reference Intakes (DRIs), which can be expressed as different categories that range from a Recommended Dietary Allowance (RDA) to an Adequate Intake (AI) level. In addition, the DRIs may include a maximum intake level above which risks of adverse effects could increase (ie, the Tolerable Upper Intake Level, or 'UL'). On January 9, 2001, the FNB announced a UL for boron of 20 mg/d. Meanwhile, a number of research institutes are investigating the possible health benefits from boron.

### Producers

Rio Tinto Borax, a wholly-owned subsidiary of Rio Tinto plc, continued to be the world's leading borate supplier, holding more than 40% of the market with its wide range of refined industrial and speciality borate products. Mines at Boron, California, and in Salta Province, Argentina, were supplemented in 2000 by the acquisition of additional reserves in Argentina. Two milestones were reached at the Boron mine – remediation of the 1997/98 pit wall slippage was completed without disruption to production, and the US\$130 million mine expansion was finished on schedule. After falling in 1999, total mine production returned to 1998 levels in 2000, up 5% to 590,000 t B<sub>2</sub>O<sub>3</sub>.

Eti Holding, the state-owned company responsible for borate mining in Turkey, supplied around 35% of global demand. It is the world's largest supplier of borate minerals, based on colemanite/ulexite mines at Bigadic, Emet and Kestelek, as well as producing refined borates at Kirka and Bandirma. There were no major capacity changes during the year, but work continued on the construction of a new 100,000 t/y boric acid plant at Emet and on expansion of borax pentahydrate capacity at Kirka. In its 1999 annual report, the company's general manager announced that Eti Holding had decided to withdraw from non-core activities

in order to concentrate on its boron and aluminium operations. As a result, the chromium, ferro-chrome, silver and copper operations were transferred to privatisation administration. In December, the privatisation of Eti Holding was also proposed in a letter to the IMF. The Minister responsible for Eti Holding is strongly opposed to the privatisation of the borate mines, and the decision has been deferred for six months. Turkish borate exports fell by some 5% to 945,000 t in 2000, following a similar rise in 1999.

Other US producers, accounting for around 7% of the market, included American Borate Co. and IMC Chemicals. ABC supplies ground colemanite from its underground mine in Death Valley, California, and IMCC produces soda ash and industrial borates from brines at Searles Lake, California. IMC Global has been seeking a buyer for its chemicals operations since purchasing them from Harris Chemicals in 1998, and in 1999 classified IMCC as a discontinued business. No buyer was found in 2000, but chief executive Douglas Pertz recently said that he expected significant progress to be made with the divestment in 2001.

In South America, borates occur mainly as 'salar' type deposits high in the Andean altiplano where they are exploited by a number of smaller operators. Excluding the aforementioned Rio Tinto operations, they together account for about 7% of the world market.

In addition to the Rio Tinto Borax operations in Argentina, a number of other companies produce a variety of borate products there. Most notable are Ulex, producing graded colemanite and hydroboracite products; Procesadora de Boratos Argentinos (PBA) producing calcined mineral concentrates; and a small boric acid producer – Minera Santa Rita.

In Bolivia, boric acid production by Tierra Ltda was halted in August following the arrest of

the general manager and others by the anti-drug authorities. They are alleged to have diverted supplies of sulphuric acid purchased for boric acid production to illegal cocaine processing plants in Chapare district. The plant had not re-opened by the year end.

Quiborax, in the north of Chile, is the largest South American boric acid producer, based on ulexite extracted from Salar de Surire. Production at its plant near Arica remains fairly constant at 25-30,000 t/y, but output of ulexite mineral for agricultural applications increased to around 30,000 t/y. SQM's new boric acid plant based on Salar de Atacama brines continued to be affected by problems with the associated potassium sulphate process. Production was again some 50% of the stated 16,000 t/y capacity, but SQM expects 'normalisation' of the process before the year end.

Output from Peru's sole borate producer, Inkabor, fell by 25-30% in 2000 as a result of prolonged flooding of its ulexite mine at Laguna Salinas. Production of both boric acid and ulexite were similarly affected. In July 2000, Inkabor was reported to be investing US\$6.5 million in its operations - US\$2.5

million in the borax plant in Lima and US\$4 million in its mine.

In Russia, Energomash-Bor remained the only significant borate producer, supplying 3-4% of global demand. The company mines a borosilicate mineral, datolite, at Dalnegorsk, Primorsky Region, and refines it to boric acid and synthetic calcium borate. In March it was reported that Bor was refurbishing its second boric acid plant, with the objective of increasing its output to 130,000 t/y boron-containing products. Boric acid output was said to be doubling by May. However, progress on the project was suspended in October 2000 when the Energomash-Bor joint venture was declared illegal, and Bor was returned to the administration of the regional government. Russian borate exports for the year declined by around 20%.

Chinese borate production represents 6-7% of global supply. It occurs mainly in Liaoning and Jilin Provinces in the northeast of China, where there are a number of szaibelyite (magnesium borate) mines. The mineral is refined locally to produce borax decahydrate, mainly for the domestic market. Chinese statistics show that production increased by 7% in 2000.