ICELAND

By Fridrik Danielsson

Iceland was once an exporter of a sought-after mineral, sulphur. The oldest records date the first mining to 1279 and the first exports to the 14th century. Production was considerable in the 15th and 16th centuries, as armies in Europe required gunpowder, an end-product of sulphur. Surface incrustations at hot springs, mostly in the northeast (a place called Námaskard, the name deriving from this mining activity – 'náma' means mine, skard means a mountain pass), and also in the southwest, were mined by simple means and the raw sulphurous grains initially exported more or less without processing. Refining processes were developed, washing with water and fish oil and subsequent melting to skim off the floating impurities and sediment the unmeltables. The molten sulphur was poured through a sieve into oak moulds and after solidification stacked into drums for export.

This activity has long since ceased as the sulphur incrustations are rather limited in size and purity - they stem from hydrogen sulphide in the geothermal gas that oxidizes when contacting atmospheric oxygen. This gas has lately drawn renewed attention, not so much as a sulphur source but rather as an environmental burden, due to the potential acidification of soil and vegetation around the geothermal power plants when the oxidized products rain down after having been absorbed by moisture in the atmosphere. The hydrogen sulphide gas is both ill-smelling and poisonous so where escapes to the atmosphere are large, both the locals and tourists complain of the "hot-spring-smell".

The geothermal areas are still important and even more so than before, not in order to recover minerals, rather heat, hot water and steam - surface water that has penetrated down through the porous volcanic crust and gained heat from the earth´s inner domain. The production of water for heating has increased steadily for nearly a century and generation of electric power for half a century. Although the geothermal fluid reservoirs are close to the surface in volcanic Iceland, researchers are now looking deeper to find still hotter fluid. The partners in the Iceland Deep Drilling Project (IDDP), the main power companies in Iceland, have now selected their first deep-drilling site in Reykjanes, at Iceland´s southwest tip, where the intention is to drill a well to 5 km depth to study the hydrothermal systems and collect samples. The scientific knowledge it is hoped to gain during the project could lead to new and much more efficient geothermal power production in the future.

New power plants

Electric power production in Iceland was 8.5 TWh in 2003, of which 65% goes to power intensive industries. Most of it is hydropower but geothermal power is now set to increase in large steps. Several new geothermal power plants will be built in Iceland over the next few years. The National Power Co intends to expand the Krafla plant by 30 MW and build a new one nearby at Bjarnarflag of 40 MW, later to be expanded to 120 MW.

The Reykjavik Utility (Orkuveita Reykjavikur, OR) and The Sudurnes Regional Heating Co (Hitaveita Sudurnesja; HS) have signed a contract with Nordural to supply electric power for the expansion of the Nordural plant in Grundartangi, which will be expanded by 90,000 t/y. OR will build an 80 MW plant at Hellisheidi, east of Reykjavik, and HS will build a 100 MW plant at Reykjanes. The power supply contract is unique in that this is the first time a major industrial plant project will be powered solely by geothermal power – hitherto, hydropower plants have been the main suppliers to large energy intensive projects. The OR and HS plants are expected on stream in 2006.

The construction of the National Power Co's (NPC) new 630 MW Kárahnjúka hydroelectric power plant in east Iceland is progressing according to plan. The nearly US$1.3 billion Kárahnjúka plant will power the Alcoa smelter at Reydarfjördur. Impregilo of Italy, the main contractor for the power plant, will drill the large subterranean headrace tunnel from the dam to the generator turbines already on-site. The power plant is expected to come on stream early 2007.

NPC has started construction of a new water damming system upstream of its existing power plants in the central southwest which will increase power production in the plants there. Several other hydroelectric power projects are on the drawing board but no dates have been announced.

Aluminium

Fjardaál, a subsidiary of Alcoa, has signed a contract with the Bechtel Group Inc for the construction of the 322,000 t/y aluminium smelter at Reydarfjördur. Many Icelandic contractors are expected to participate in the project, besides suppliers and subcontractors from various countries. The smelter will be the third in Iceland and is expected to be commissioned in 2007. Construction work started at the site during 2004, the main infrastructure-related construction having commenced last year.

The Columbia Venture's Nordural plant has now been sold to Century Aluminium Co of California. A plant expansion of 90,000 t/y could enter the construction phase shortly and come on stream in early 2006. Further expansions could be made, as the company has an operating licence for a 300,000 t/y smelter. The plant produced 90,100 t in 2003.

The Alcan ISAL plant produced nearly 176,000 t in 2003 plus about 14,000 t of remelt metal. Studies and preparations, including land purchase, have been made for an expansion of the plant from its present 170,000 t/y to about 460,000 t/y but no firm plans have been announced.

Several aluminium companies have been studying locating smelters in Iceland, the favourable investment climate and energy prices being among the main attractions. (Table 1) Project studies have been undertaken for an alumina plant in northeast Iceland, in conjunction with development of geothermal steam extraction for the bauxite processing. The Theystareykir geothermal area would be exploited as the steam source, recent drilling there having given indications of sufficient steam to supply a large consumer. The establishment of an aluminium smelter has also been studied in conjunction with the alumina plant but possibly at another location in northern Iceland.

A newly-formed company, Kapla hf, in co-operation with R&D Carbon Ltd of Switzerland, is studying operation of a 340,000 t/y electrode plant in Iceland, probably in the Grundartangi industrial area where Nordural and Icelandic Alloys have their plants. The rapid expansion of aluminium production has made Iceland an attractive location for the plant. Alur hf's dross processing plant has now commenced operation. Alur has an agreement with Icelandic aluminium smelters to process their dross and intends to access raw material from overseas sources as well.

Ferroalloys, siliceous minerals

The Icelandic Alloys plant has a capacity of 120,000 t/y of 75% FeSi, whilst smaller quantities of FeSi with lower and higher Si-content are also being produced. (Table 2)

The Kisilidjan diatomite plant on Lake Myvatn, owned by Allied Efa Ltd, will close at the end of 2004 when the sales contract for the diatomite products expires. There have been disputes with environmentalists over potential effects on the Lake Myvatn ecosystem where the siliceous algae sediments the plant uses as raw material are dredged. These effects have been difficult to prove and the lake still has large reserves of raw material and the algae keep producing it. The plant operator has plans to use key parts of the plant and infrastructure to produce precipitated silica products by a proprietary process, developed by Promex in Norway. Production is expected to commence within a few years.

The Steinullarverksmidjan mineral wool plant produced 7,158 t of insulating wool from basalt in 2003, somewhat less than the year before.

Cement production by Icelandic Cement Ltd was similar to last year's but was expected to increase considerably during 2004 because of cement sales to hydropower dam construction. The cement plant was sold in 2003 to a group of private investors, including BM Vallá hf, an Icelandic producer of concrete and building elements, Björgun hf, a supplier of raw material to the cement plant and Norcem of Norway.

Pumice exports have also been stagnant over the last two years and are declining as compared to a few years ago. Pumice has traditionally been exported to the European lightweight building aggregate market. (Table 3)

Aggregates for the construction industry are mainly gravel and sand from land sediments, often formations close to new or old river estuaries, sand dredged from fjords and ground rock from quarries. Lava is also worked and used in the construction industry, the more recent lava fields being free of surface cover, porous and easy to work and do not require blasting - some form of scraping or ripping is often sufficient. Lava, ground to applicable grain sizes, has long been used for unpaved roads in areas where it is accessible. Due to the properties of the lava grain, the roads become soft and dense as they pack easily when brittle lava grains break down into finer grain. Pumice and ground lava are also used as a light aggregate for concrete casting of light building elements.

Calcareous minerals

Shell sand, light-beige coarse sand from sediments of broken mollusc shell remains on the seabed, consisting of about 90% calcium carbonate, has been dredged from depths of 20-40 m at the bottom of fjords in Iceland for more than half a century and utilised as a lime source for the production of cement and for other purposes also. Most of the dredging has been done in Faxaflói in the southwest but there are other fjords with shell sand beds. One company, Björgun hf, has shell sand dredging vessels in constant operation, and has dredged 100,000-200,000 t of it every year, mostly dependent on sales of cement.

Differing from the shell sand sediments are layers of maërl, magnesium-containing calcareous algae that have accumulated in quantities in some fjords in Iceland. Celtic Sea Minerals of Ireland has now joined forces with partners in the Icelandic Sea Minerals project to dredge maërl from Arnarfjördur in northwest Iceland. Construction of facilities will start during 2003 and initial dredging is scheduled for 2005. The present plans are to dredge about 50,000 t/y. The extent of the sediments size is put at over 20 million m^3 of maërl containing about 85% calcium carbonate. The main uses will be as fertiliser, animal feed and smaller quantities as a filler in hygienic products and filter aids.

Similar sediments to those at Arnarfjördur are also being investigated at Húnaflói in north Iceland with dredging in mind.

Scrap and recycling

Exports of ferrous scrap were similar in 2003 to the year before, but exports of aluminium scrap fell. Exports of copper and lead have been stagnant or decreasing. (Table 4)

Table 1: Aluminium Production (t)

	2001	**2002**	**2003**
ALCAN	168,276	173,528	175,803
Nordural	74,250	90,000	90,100
Total	**242,526**	**263,528**	**265,903**

Table 2: Ferroalloy production (t)

	2001	2002	2003
FeSi (as 75%)	112,600	118,810	119,070

Table 3: Siliceous minerals production (t)

	2001	2002	2003
Diatomite	30,434	26,494	27,692
Mineral wool	7,812	7,948	7,152
Cement	127,660	84,684	85,000
Pumice (export)	76,699	44,409	40,531

Table 4: Metal scrap exports (t)

	2001	2001	2003
Ferrous	32,919	38,296	37,712
Aluminium	8,366	6,191	4,862
Copper	355	339	318
Lead	1	1	1

