AlF_3: Fluorspar supply - Is relief in sight?

By **Mike O'Driscoll**

SepFluor Plant: Sepfluor's Nokeng Fluorspar Mine Project, South Africa, pictured here under construction in January 2019; now complete and ramping up to full production. Courtesy SepFluor.

Gulf Fluor Plant: Gulf Fluor's 60,000 tpa AlF3 plant, Abu Dhabi, started in 2015: the world's fifth largest producer and largest in the region, now supplying Emirates Global Aluminium with 45,000 tpa AlF3, previously imported from Tunisia and Italy. Courtesy Gulf Fluor.

Without fluorspar, you can't make aluminium fluoride (AlF_3), and without AlF_3, you can't make aluminium. However, there are relatively few commercially developed fluorspar sources worldwide, and the largest producing country is now facing cutbacks, while new suppliers have been facing delays in start-up.

With the aluminium industry poised as it is, with a deficit in supply meeting growing demand, AlF_3 producers should be assured of growing demand for the foreseeable future – but will they be able to secure adequate supplies of fluorspar?

Fluorspar input to aluminium

Fluorspar is a mineral composed primarily of calcium fluoride (CaF_2). Commercial grades are generally categorised by CaF_2 content: metallurgical grade, "metspar" (60-85% CaF_2) is mainly used as a fluxing agent in steelmaking, but is also used in cement clinker manufacture; ceramic grade (85-96%) used to make certain glasses and ceramics; and acid grade, "acidspar" (>97%), accounting for 60-65% of total fluorspar production, is used to make hydrofluoric acid (HF) the precursor to a wide range of fluorochemicals (fluorocarbons, fluoropolymers).

The primary aluminium production process consists of three stages: Bauxite mining, refining of bauxite to alumina, and the smelting of alumina to aluminium. Acidspar is the critical ingredient for manufacturing aluminium fluoride (AlF_3) used in the smelting stage.

The Hall-Heroult process is used to produce aluminium metal by electrolytic reduction of alumina which takes place in shallow rectangular cells, or "pots". AlF_3 is a critical additive to the molten electrolyte in this process.

Adding AlF_3 permits a process temperature around 850°C, considerably lower than the melting point for alumina (1,500°C), resulting in considerable energy savings. AlF_3 also acts to adjust the molecular ratio of the electrolyte, and controls the thermal balance of the pot.

Estimates of AlF_3 consumption vary, ranging 10-23kg/tonne aluminium, a rule of thumb AlF_3 specific consumption is about 18kg/t aluminium.

With world aluminium production in 2018 estimated at 64.3m tonnes (according to IAI data), this would indicate an annual consumption of about 1.1m tonnes of AlF_3.

Most AlF_3 is produced from acidspar reacting with sulphuric acid (to form HF) and alumina hydrate via a wet (yielding a low bulk density product (LBD)) or dry (high density (HBD)) process. Smaller scale production of AlF_3 is derived from fluorosilicic acid (FSA), a by-product of phosphate fertiliser manufacture.

Generally, to make 1.0 tonne of AlF3 requires 1.5 tonnes acidspar, 1.0 tonne of alumina hydrate, and 1.8 tonnes of sulphuric acid.

Thus some 1.6m tpa of acidspar is consumed via AlF_3 in aluminium production, and makes it fluorspar's third largest market accounting for about 25% fluorspar demand, after HF production (40%) and steel (30%). In 2018, the world fluorspar market was about 6.36m tonnes.

World AlF_3 production is about 1.2m tpa, of which about 90% is HBD (1.3-1.5 t/m^3) and 10% LBD (<1.0 t/m^3).

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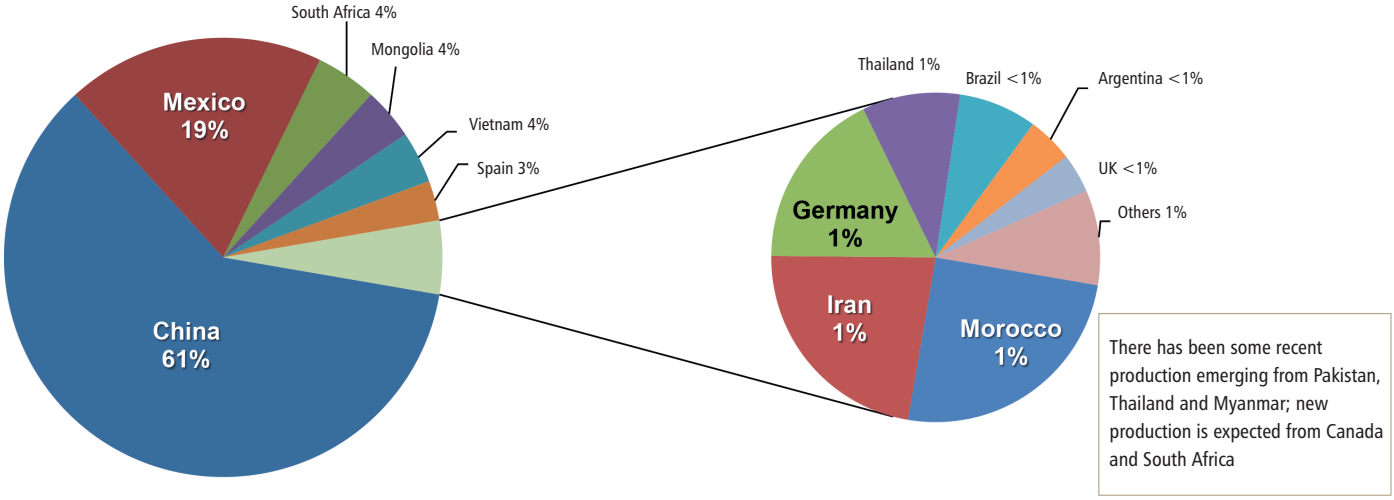

World fluorspar production 2018 Primary source countries; total 5.8 m tonnes. Source: data from USGS

Where in the world is fluorspar from?

China remains the world's top fluorspar producer, accounting for around 60% of total world output of 5.8m tonnes in 2018, followed by Mexico, South Africa, Mongolia, Vietnam, and Spain (see accompanying charts). There has been some recent production emerging from Pakistan, Thailand, and Myanmar.

Fluorspar supply for 2018 was reasonably tight, mainly owing to mine closures from environmental controls in China, and limited and delayed production from new and emerging producers in Canada, South Africa, and Asia.

This looks set to continue through 2019 and even 2020 unless new capacity comes on stream soon.

China's hold on global export markets for fluorspar has declined significantly in recent years from the peaks of 2010-11. For the first time, in 2017 and continued in 2018, China became a net importer of fluorspar: Over 500,000 tonnes imported against just over 400,000 exported in 2018 – a reflection of the squeeze on domestic supply by environmental controls as well as increased domestic demand from a growing fluorochemicals market. The trend is expected to continue in 2019.

China's sharp increase in metspar imports was sourced mainly from Mongolia, but also Myanmar; acidspar was imported from Mexico and South Africa.

The leading world acidspar exporters are Mexico, Vietnam, South Africa and China; for metspar it is Mongolia, Mexico, and China.

The main regional markets for acidspar are the USA, Italy, India, and Germany, reflecting the main centres of fluorochemical manufacturing; next ranked is the UAE with its significant and relatively recent aluminium production.

The main regional markets for metspar are China, Russia, Turkey, USA, Japan, and South Korea, reflecting the world's leading steelmakers.

The tightness in global supply in 2018 resulted in sharp price increases for acidspar which peaked at over $500/t, this has carried over into 2019, with reports that metspar prices were also rising and even overtaking acidspar levels at up to $550/t.

US net import reliance on Chinese fluorspar has declined from a dominant 52% in 2009 to a mere 6% in 2018, being eclipsed by increasing imports from Mexico (at 69%), and most recently, although on a smaller scale, from Vietnam.

Although the US raised tariffs from 10% to 25% on US$200bn of Chinese products on "List 3" in May 2019 which includes many minerals, fluorspar (acidspar and metspar) was excluded, while aluminium fluoride and hydrofluoric acid remain on the list.

In contrast, there was certainly more of a risk from US President Trump's recent threats to impose 5% punitive tariffs on all goods imported from Mexico beginning 10 June 2019.

As it turned out, Trump backed off his plan, announcing on 7 June that the USA had reached an agreement with Mexico, and there will be a renegotiated United States-Mexico-Canada Agreement (USMCA). So US fluorspar consumers will feel somewhat relieved…..for now.

New sources finally emerging

Depleting high quality fluorspar reserves, high cost of acidspar production, and likely continued pressure and perhaps further capacity reductions in China, combined with continuing demand for fluorspar in chemical, steel and aluminium markets mean that there is a case for alternative and new fluorspar sources to come on line.

The two players ahead of the pack are Sepfluor Ltd and Canada Fluorspar Inc. However, each has experienced start-up delays. But prospects for progress are good.

In South Africa, SepFluor's ZAR1.7 bn(US$122m) Nokeng Fluorspar Mine open pit mine and concentrator was finally commissioned and ramping up to commercial production (180,000 tpa acidspar capacity) by end of July 2019 (a 60,000 tpa AlF_3 plant is also planned).

Canada Fluorspar Inc. (CFI) is ramping up production at its St Lawrence, Newfoundland, facility with a nominal target of full production capacity of 200,000 tpa acidspar. CFI is planning a new location for development of a vital marine terminal near its mining property.

Elsewhere, Australian Bauxite Ltd's wholly-owned subsidiary, ALCORE Ltd, has commenced chemical refining of bauxite into AlF_3 using its patent (pending) technology at Berkeley Vale, New South Wales. A 50,000 tpa AlF_3 plant is envisaged, as well as global licensing of this alternative AlF_3 process via bauxite – which, if successful, could disrupt the AlF3 processing market and acidspar demand.

By the end of 2019 we shall know if these new sources are fully on stream, if they are not, 2020 may see continued tight supply and upwards pressure on prices for fluorspar.

All the key trends and developments in the entire fluorspar supply chain from source to market will be examined and discussed at IMFORMED's upcoming Fluorine Forum 2019, Prague, 21-23 October, including "Trends in aluminium fluoride supply and demand" by Adam Coggins, Analyst, Roskill, UK; and "A comparison of HBD and LBD AlF_3" by Evgeniy Torochkov, Head of Dept., PhosAgro Group, Russia. Full details at www.imformed.com. ■