

POTASH

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Potash is recovered through the mining of evaporite deposits by conventional underground techniques and by solution mining. The principal ore mineral is sylvite, KCl, which generally occurs mixed with rock salt, or halite, when it is known as sylvinit. Potassium chloride is the principal commercial potash product but a number of other salts are also produced. Langbeinite, $K_2SO_4 \cdot MgSO_4$, is mined in New Mexico to produce marketable potassium magnesium sulphate. Potassium sulphate is recovered from sulphate-bearing minerals, such as langbeinite, polyhalite and kainite. Potassium nitrate is recovered from caliche deposits in Chile. Surface and subsurface brines are also important sources of potash. Carnallite, $KCl \cdot MgCl_2 \cdot 6H_2O$, is harvested from solar evaporation pans in the Dead Sea. Potassium sulphate is recovered from the brines of the Great Salt Lake. Both potassium sulphate and nitrate also are produced as secondary salts through reaction of potassium chloride with a source of sulphur or nitrogen.

About 93% of potash produced is used in the fertiliser industry where it is the principal source of the nutrient, potassium, which is essential for the healthy development of a range of agricultural crops. The balance is used in glass, ceramics, soaps and detergents, synthetic rubber and chemicals. In order to allow comparison of potassium content between marketable products, production and consumption are often expressed in terms of the oxide, K_2O . Most potash is produced as potassium chloride which contains 60-61.5% K_2O , although soluble grade contains a minimum 62% K_2O . Products for industrial use contain 62-63% K_2O . Other potassium-containing salts for fertiliser use are potassium sulphate, potassium magnesium sulphate and potassium nitrate, in which the sulphate, nitrate and magnesium contents are also of value as plant nutrients. Potassium nitrate is highly

soluble, allowing rapid uptake of nutrients and ease of use in liquid fertiliser products.

In 2001, world potash production is estimated to have fallen by about 500,000 t K_2O compared with 2000, to 25.7 Mt K_2O . Canadian production was down by about 1 Mt K_2O but most other producers, including Russia, Belarus and Germany, achieved marginally higher output. Canadian producers, in particular, adjusted output through extended summer shutdowns, in order to meet weaker demand in key markets, including Brazil, China, Malaysia, Korea and India. China, India and Brazil are the principal import markets for potash, accounting for about one third of both total world potash consumption and import trade. At the beginning of 2001, however, in a number of areas, imported material was carried over in stocks from the previous year.

Unfavourable weather conditions and lower crop prices also affected demand during the year. Import demand in China was affected by the overhang of stocks throughout 2001. Import demand in India was supplied principally by the former Soviet Union and Jordan, but was relatively slow, affected partly by drought. Contrary to expectations at the beginning of the year, imports by Brazil were down only marginally by year-end 2001, at just over 4 Mt of KCl. The largest suppliers were Germany, Israel and Canada, which accounted for over two-thirds of the volume. Poor weather in Europe affected sales of potash and other fertilisers, as did the outbreak of foot and mouth disease and continued incidence of BSE. In North America, softer potash demand reflected crop prices and lower planted acreage for corn and soybeans.

The International Fertilizer Industry Association estimated world fertilizer potash consumption in 2000 (fertiliser year to June

2001) at 21.9 Mt K_2O and projects consumption in 2005/06 at 25.1 Mt K_2O . Even then, 15 years after the collapse of Comecon, total world consumption is not expected to reach the 28 Mt K_2O that was used in 1988/89, largely because potash demand has remained so low in the former Soviet Union

Balanced fertiliser application is recognised as critical to supplying the world's growing population from an almost static arable land area. In general, increased agricultural production will have to come from higher yields because of the progressive encroachment on cultivatable land by industrialisation and urban development. It is also recognised that application of 1 kg of nitrogen-phosphorus-potassium nutrients in fertiliser increases cereal yield by about 10 kg of grains although, in turn, harvesting crops removes nutrients from the soil.

Both the application of fertiliser nutrients, and their removal through harvesting, differ particularly between nitrogen and potassium. The benefits of nitrogen application are immediately apparent in terms of yield. The benefits of potash application are more subtle, however, in terms of increased resistance to stresses from drought or infestation and, importantly, in the efficiency of uptake of both nitrogen and phosphorus. Nitrogen application tends, therefore, to receive the first call on farmers' funds.

Partly because nitrogen is not retained in the soil from year to year, nitrogen application in both developed and developing countries is reasonably well-balanced against nitrogen removal by crops. For potash, however, in developing countries, application has not

been matched by crop removal and the deficit has been cumulative. In developed countries, partly because of the ready availability of potash in North America, Europe and in the former Soviet Union, potash application was relatively balanced with respect to nitrogen until the early 1990s but, since then, has deteriorated steadily. From a global ratio of 1:0.4 for N: K_2O in 1985, which the International Potash Institute considered fairly balanced for the time, the global ratio is now 1:0.26, with developing countries at 1:0.21 and developed countries at 1:0.37. In global terms, this means that both the benefit of nitrogen application is less than it was in the second half of the 1980s and that soils are being progressively depleted in potash. Improved potash usage is essential, therefore, in order to increase food supply.

Some 15 companies produce potash from operations in 14 countries but just four companies, Potash Corp. of Saskatchewan Inc., IMC Global Inc., Belaruskali and K+S GmbH, produce around 60% of world output. Production in Canada, Russia, Belarus and Germany, together, in 2001, accounted for about 74% of the world total.

Europe and Former Soviet Union

In Germany the potash and magnesium operations of Kali und Salz GmbH are now conducted by K+S GmbH as subsidiaries of K+S AG. Mines within this group are Bergmannsseggen-Hugo, Sigmundshall, Neuhoef-Ellers, Werra and Zielitz. The company opened a new unit at the Sigmundshall plant to produce 300,000 t/y specialty magnesium sulphate fertilisers based on undeveloped resources of hartsalz

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(halite plus kieserite and sylvite) at Bokeloh, near Hamburg. Kieserite will be recovered from the hartsalz using K+S's dry electrostatic separation process. Prior to the commissioning of the new unit, production capacity at Sigmundshall was over 700,000 t/y potassium chloride and other products.

K+S sales of potash and magnesium products were essentially steady in 2001, at \square 967 million. The company anticipates continued demand for its specialty potash products, but increased competition for both potassium chloride and sulphate products. Deusa International GmbH, a subsidiary of the Siem Group, produces potassium chloride and co-product industrial magnesium chloride at its solution mine at Bleicherode.

Rotem Holding GmbH, a subsidiary of Israel Chemical Ltd purchased Cleveland Potash Ltd from Anglo American plc for US\$45 million at the end of November, 2001. The acquisition, which received approval from the UK Secretary of State for Trade early in 2002, brings nearly 9% of world potash production capacity under the control of Israel Chemical, along with Dead Sea Works in Israel and Iberpotash in Spain, the former Grupo Potasas. Cleveland Potash, considered a non-core business by the Anglo American Group since the acquisition of the Tarmac aggregates business, produced 601,000 t K_2O in 2001, essentially unchanged from 2000. An hydraulic backfill system was tested in 2001 for disposal of salt tailings in order to reduce discharge into the North Sea.

Production in 2001 in Spain by Iberpotash was around 557,000 t K_2O . The target level of output is 684,000 t/y K_2O by 2003, which will require investment of some \square 79 million. No. 4 Shaft at Suria will be closed and the focus will shift to the Sallent mine. The Suria plant has nominal capacity of 300,000 t/y K_2O , based on flotation to produce granular and standard grades. The Sallent operation has capacity of 400,000 t/y K_2O . Just over half of output is exported.

The Marie-Louise Ouest mine of Mines de Potasse d'Alsace in France is scheduled to close in 2002, followed by Amélie in 2004. Production is declining steadily in accordance with the long term plan for the French potash industry, due to exhaustion of economic reserves.

Production in Belarus is undertaken by PO Belaruskali which operates multi-shaft mining and milling complexes at Soligorsk near Minsk. Output in 2001 is estimated at 3.6 Mt K_2O . Export sales are conducted through International Potash Co. (IPC) which also handles product from JSC Sylvinitt in Russia. Total production for the two companies was reported at 5.5 Mt K_2O in 2001. The majority of IPCs volume is shipped through the Latvian port of Ventspils. Production by JSC Sylvinitt is centred around Solikamsk, about 200 km north of Perm in the Urals, and is estimated at just under 1.8 Mt K_2O in 2001.

The larger of the two Russian potash producers, JSC Uralkali, produced approximately 2.1 Mt K_2O last year, an increase over 2000. JSC Uralkali is investing in new terminal facilities at St. Petersburg, Russia, which the company anticipates will reduce costs compared to its traditional shipping through Ventspils. Total Russian exports reached approximately 6 Mt in 2001, of which about two-thirds was destined for China and India. 2001 was the first year of operation of the marketing agreement between JSC Uralkali and Canpotex Ltd, under which Canpotex will market the Russian producer's material outside North America and Europe.

Middle East

The Jordanian producer, Arab Potash Co., is among the companies planned for privatisation. Approximately 50% of output is exported to India and China, with other Asian markets accounting for a further 30%. A new plant for industrial grade potash reached commercial production in 2001. The third phase of the long-term expansion programme, designed to add a further 100,000 t/y of capacity, suffered through failure of one of the dykes surrounding the new

salt pond. Plans to achieve the fourth and final phase of expansion to 2.4 Mt/y (1.45 Mt/y K_2O) by 2004 include the conversion of the salt pond to two carnallite ponds.

Production by the Dead Sea Works in Israel was just under 1.7 Mt K_2O , of which 1.4 Mt were exported in 2001, principally to Brazil. As noted above, the parent company, Israel Chemicals now controls some 9% of world potash output through the acquisition first by Dead Sea Works of Grupo Potasas in Spain, and then by Rotem, of Cleveland Potash.

North America

New Mexico accounts for about 70% of total US potash production from two mines operated by Mississippi Chemical and, from two formerly separate mines, by IMC Global. Although potash production in New Mexico has remained relatively steady over the past few years, the number of employees has dropped sharply over the past five years. IMC produced about 7 Mt of potash products in 2001 from its facilities in New Mexico, Michigan and in Saskatchewan, Canada, equivalent to about 4.1 Mt of K_2O .

IMC Global reported potash production down by 8% in 2001, although sales achieved slightly increased average prices. IMC's total capacity at Carlsbad is just under 1.8 Mt/y, of which approximately 400,000 t/y is potassium magnesium sulphate and an estimated similar tonnage of potassium sulphate, both recovered from langbeinite. In the operation which integrates the former Western-Ag Minerals langbeinite mine with IMC's facilities, langbeinite is hoisted through the Western-Ag Minerals shaft to a new potassium magnesium sulphate plant. Sylvinite ore is hoisted via the original IMC shaft. The Hersey solution mine in Michigan has a capacity of about 145,000 t/y KCl, with co-product salt. Two potash beds are mined from the evaporites of the Salina Group at depths around 2,500 m.

Compass Minerals Group Inc. is a new name in the potash industry. Owned by Apollo Management LP and company management

(80%), with the balance held by IMC Global Inc., Compass operates the Great Salt Lake potash facilities, as well as the salt production units of IMC. Through Great Salt Lake Minerals, Compass is the largest North American producer of potassium sulphate from the brine evaporation facility near Ogden, Utah.

Mississippi Chemical suffered reduced potash production from the 1 Mt of KCl (0.6 Mt K_2O) achieved in 2001, principally because of reported mechanical problems. Mississippi Chemical operates its East and West mines near Carlsbad, New Mexico.

Reilly Industries produces potassium chloride from subsurface brines of the Bonneville Salt Flats, near Wendover, Utah. Annual production is between 90,000 t and 135,000 t of standard and coarse grades. Intrepid Mining, LLC operates the Moab solution mine and solar evaporation complex in Utah. Potash output is less than 40,000 t/y.

In Canada, Potash Corp. of Saskatchewan Inc. produced a total of 6.13 Mt of KCl in 2001, down about 1 Mt from the previous year. Its policy of matching output to demand resulted in a total of 63 weeks of shutdown, compared to only 38 weeks in 2000. The Lanigan, Rocanville, Allan, Cory and Patience Lake mines in Saskatchewan produced 4.7 Mt of KCl and the New Brunswick operation, just over 600,000 t. In addition, the company received 816,000 t of KCl from IMC Global at Esterhazy which mines reserves owned by Potash Corp. under a long-term agreement. This agreement was renewed for a further five-year period in 2001. Rocanville, with the lowest cost production, worldwide, operated at 69% capacity utilisation. Significant installed capacity remains unused at the Lanigan operation, although the production cost is second to that at Rocanville.

In New Brunswick, Potash Corp. operates the Sussex mine and mill and the Cassidy Lake mill, which is used to compact standard grade material from Rocanville. Potash Corp.

reported that the average grade of ore mined from its conventional operations was 22.9% K₂O. Total potash sales declined from 6.9 Mt in 2000 to 6.24 Mt in 2001. Virtually all of the reduction occurred in offshore markets while Potash Corp. sales in North America remained steady. Potash Corp. estimates that it owns 24% of world potash capacity, while IMC Global and Belaruskali account for around 14% each.

The Canadian mines of IMC Global are located at Esterhazy, Belle Plaine (solution mine) and Colonsay in Saskatchewan, with a combined annual capacity of about 7.2 Mt/y of KCl. Agrium Inc. is the third producer in Saskatchewan, operating a 1.79 Mt/y KCl capacity conventional mine at Vanscoy. Sales in 2001 totalled 1.36 Mt of KCl, of which 887,000 t were sold in North America. Canpotex Ltd handles offshore export sales from Saskatchewan. In 2001, Potash Corp. accounted for 56% of Canpotex sales volume, followed by IMC with 35% and Agrium with the balance.

The Russell project in Manitoba, Canada, a joint venture between Entreprise Minière et Chimique and the provincial government of Manitoba, remains undeveloped. It is located at the extreme southeastern edge of the potash basin close to the existing operations at Esterhazy and Rocanville in Saskatchewan.

South America

The Taquari-Vassouras mine in Sergipe, Brazil, produced 503,000 t of KCl in 2001, down by about 10% compared with the previous year, most of which was accounted for in the final quarter. The majority of output is used within Brazil for the production of compound fertilisers. In April 2002, CVRD, the owner, announced that it would invest US\$17 million to increase production capacity from 600,000 t/y to 800,000 t/y of KCl, in order to reduce Brazil's import requirement. The company has also reported that it is reviewing the solution mining of carnallite and exploring the Santa Rosa de Lima sylvinitic deposit. Both projects lie within the area leased by CVRD from Petrobras which

developed and operated the Taquari-Vassouras mine until 1991. Petrobras also holds the rights to the Fazendinha and Arari areas in Amazonas.

Sociedad Química y Minera de Chile SA (SQM) produces potassium chloride and sulphate (as well as boric acid and lithium chloride brine) from the subsurface brines of the Salar de Atacama, and potassium nitrate from the mining of caliche at Maria Elena, Pedro de Valdivia and Coya Sur, in Chile. In 2001, 157,000 t of potassium sulphate were produced and, while potassium chloride production was increased, direct sales were lower than in 2000 (280,000 t), since more potassium chloride was used internally for the production of secondary potassium nitrate. Potassium chloride capacity is 650,000 t/y. Potassium sulphate exports were similar to 2000, at about 160,000 t. Potassium nitrate exports increased by nearly 30% on the previous year, to reach 441,000 t.

SQM, Norsk Hydro and Rotem Amfert Negev Ltd, have agreed to co-operate in the sales and marketing of specialty fertilisers through the reciprocal use of their distribution networks, while Potash Corp. purchased a US\$130 million interest in SQM. In April, 2002, Norsk Hydro announced the agreement with the Chilean entity, SQH, to form Inversiones SQNH SA, a new private company in which Norsk Hydro will have a 49% interest. SQNH, in turn, holds a significant indirect interest in SQM. Negotiations by SQM to acquire Cosayach, an iodine producer, were terminated in October, 2001. Cosayach plans to develop production of potassium nitrate based on nitrate-rich tailings from the previous operation at Cala Cala. Capacity is reported at 200,000 t/y.

Atacama Minerals Corp., having initiated production of iodine at Aguas Blancas early in 2002, has accelerated its plans to produce sodium sulphate and secondary potassium nitrate in the second half of the year. The company expects to produce up to 100,000 t/y

of potassium nitrate within the next four years. Production is based on evaporation of nitrate-rich surface brines.

PCS Yumbes, owned by Potash Corp., has 285,000 t/y of secondary potassium nitrate capacity based on imported potassium chloride, plus 300,000 t/y of sodium nitrate and 360 t/y iodine capacity. Production in 2001 was 98,000 t of potassium nitrate.

The Potasio Rio Colorado project, in Mendoza province, Argentina, remains in the study phase. The solution-mine project could be developed with capital investment of some \$350 M. Potasio Río Colorado and Minera Tea announced in April, 2001 that an unnamed German group had become involved in the project. In August, it was reported that negotiations would take place to establish an export levy for potash product through Neuquén Province.

Asia

Following completion of financial arrangements, the interest of Crew Development Corp. in Asia Pacific Resources Ltd has been reduced to about 8% of the issued and outstanding shares, while Olympus Capital Holdings Asia has become the controlling shareholder. Asia Pacific Resources continues to hold a direct and indirect beneficial interest of 90% in Asia Pacific Potash Corporation, with the balance held by the government of Thailand. The financial restructuring has eliminated the company's debt and provides the means to move the project forward. Application for a mining licence will proceed before mid-year, pending amendment to the Mineral Resources Act. In light of recent revisions to potash resource estimates, the company now refers to the Somboon project area as Udon South and to the Udon area, which has not been subject of feasibility study, as Udon North. It was reported that villagers in the area around the proposed Somboon mine protested against its development because of fears of increased salinity that could be caused by runoff and dust from salt tailings stored on

surface. The project Environmental Impact Assessment, already approved by the government, found that there would be no significant negative environmental impacts on the area surrounding the Somboon project.

Underground backfilling of tailings will be implemented as soon as practical in the development of the mine. The feasibility study alternative to recover both salt and potash through evaporation of surplus brine has been adopted and will eliminate the need for disposal via deep seam injection. Product transportation alternatives continue to be reviewed as infrastructure improves both within Thailand and in neighbouring countries.

The ASEAN Potash Mining Co. project, based on mining of carnallite via a decline, at Bamnet Narong, Thailand, is reported to have moved into the second phase of construction of the decline. Six foreign companies expressed interest in becoming the strategic partner for the project, and this, reportedly, would obviate the need for the proposed loan from the Japanese Overseas Economic Development Fund. The companies are Basic International Development Corp. of the US, an Israel-Japan joint venture including Bateman Engineering Ltd, Cementation Skanska of Sweden, Ferrostaal AG of Germany, a Japan-Canada joint venture including Marubeni Energy & Chemical Project Corp. and a Thailand-China joint venture, TSB Trading Co. Ltd. The selected strategic investor would gain a 50% interest in ASEAN Potash. Planned capacity is 1.1 Mt/y of KCl.

An amendment to the Mineral Resources Act in Thailand was under review at year-end by a joint Senate-House committee in order to allow mining below surface without the need for permission from the landowner. This amendment, equally important to both Bamnet Narong and Somboon projects, is expected to be passed before the end of 2002.

The Qinghai Salt Lake Industry Ltd project is proceeding with the expansion of operations in the Qaidam Basin in China with the

purchase of two floating tracked harvesters, each with capability of 700 m³/h. The harvested salts will be conveyed by slurry pipeline to the processing plant. Planned output is 0.8 Mt/y potash. Construction was reported to have started in mid-2001, near Geermu on the Chaerhan salt lake.

Prices

Benchmark prices for standard grade potash fob Vancouver, remained at US\$110-129/t KCl throughout 2001 and into 2002, as reported by Fertecon. Canpotex announced the sale of 1.3 Mt of KCl to Sinochem of China, for the first half of 2002, at prices unchanged from 2001. IPC, however, is reported to have gained an increase of US\$3/t of KCl, fob port, on its contract sales to China. While this is indicative of a firmer tone to the market, it may also reflect a change from what Potash Corp. termed "aggressive pressure" on the part of IPC as it adjusts to Uralkali product being handled by Canpotex.

Average revenues reported by North American producers were essentially unchanged in 2001 on an fob mine basis. Producers' listed prices for delivery within the US, however, were well down on listed prices in 2000.

Outlook

Potash production capacity remains unused in Saskatchewan and, to less extent, in Russia and Belarus. For Potash Corp., this excess capacity amounts to between 2 and 3 Mt/y of K₂O of product that could be brought to market to meet demand. The company, although it operates some of the lowest-cost production at the mine gate, has held the position of swing producer since the late 1980s. Throughout this time, potash fertiliser demand in the developing countries has increased fairly steadily, from about 7 Mt K₂O in 1990/91 to 11 Mt K₂O in 1999/2000.

In the developed regions, demand has stagnated at best in Western Europe and North America. But in Central Europe potash demand remains less than a quarter of the level in the late 1980s, and in the former Soviet Union demand has continued to decline, to only 11% of the peak achieved in 1988 and 1989. There is little to suggest that this pattern will change over the next five years. However, as noted previously, the need for balanced fertilisation to meet the food needs of the growing world population, indicates that the rate of demand growth could improve marginally. The key import markets, China, Brazil and India, will not become any less important in global terms and, indeed, the entry of China to the World Trade Organisation is expected to allow increased access to this market for potash and other fertiliser suppliers.

World Potash Production ('000 t K₂O)

	1998	1999	2000	2001 ^p
Belarus	3,451	3,613	3,400	3,600
Brazil	326	348	340	350
Canada	9,195	8,230	9,175	8,152
Chile	280	312	355	365
China	183	218	300	320
France	417	311	321	250
Germany	3,582	3,545	3,409	3,550
Israel	1,668	1,702	1,710	1,700
Jordan	916	1,080	1,180	1,250
Russia	3,461	4,050	3,680	3,750
Ukraine	34	21	30	30
Spain	496	550	522	580
UK	608	495	600	601
US	1,365	1,200	1,200	1,200
Total	25,982	25,675	26,222	25,698

p: Preliminary

Sources: UN Food and Agriculture Organisation; Fertecon; US Geological Survey; Corporate reports; Potash & Phosphate Institute.