SALT

By Sean Mulshaw, Senior Analyst
Roskill Information Services Ltd

The compound sodium chloride (NaCl) or common salt occurs naturally in brines, or in crystalline form as halite or rock salt in thick bedded evaporite deposits in sedimentary basins. Rock salt can be mined by conventional underground mining methods or by solution mining to produce brines. Salt can also be produced by solar evaporation of seawater or of brines associated with salt lake deposits. The more important rock salt deposits are located in Europe, eastern and central North America and the Middle East. Solar salt production is preponderant in Australia, South America, China, India and the western US.

Salt is one of the most widely produced industrial minerals in the world with production taking place in over 120 countries. Although it is utilised in the production of higher value products, most salt is used in bulk form in relatively low-cost applications. The relatively low value of salt means that it tends to be consumed near to where it is produced and the cost of transport is an important component of the final trade value. As a result, the proportion of salt moved internationally is relatively small. Thus, most international trade that takes place is either cross-border or into relatively local areas. Production, particularly at solar operations, and demand, particularly in de-icing applications, is largely weather dependent.

Production

World salt production in 2000 was an estimated 210 Mt, representing annual growth of around 2.3% since 1996. A few large companies supported by a great many smaller ones dominate the world pattern of production. The US and China are the largest producing countries with a combined output of over 75 Mt/y, or 36% of the total, whereas the top ten producing countries account for 74% (Table 1). The remainder is accounted for by over 100 countries, of which almost 90 produce 500,000 t/y or less.

Regionally, North and Central America is the largest producer at around 66 Mt/y, followed by the Asia Pacific (China, India and Australia) and Western European regions, which produce around 54 Mt/y to 36 Mt/y, respectively.

Two of the largest projects in the world have had mixed fortunes in the past 18 months. The Onslow Salt project in Australia suffered extensive set-backs on account of exceptionally poor weather. Production began in April this year and will build to full production of 2.5 Mt/y by mid-2003. In contrast, the Baja Salt project in Mexico, which had already been delayed, was cancelled by the Mexican Government in April 2000 following public concern about the environmental effect of the salt operations on the adjacent nature reserve, Laguna San Ignacio.

World salt production (Mt)

Country	1998	1999	2000
US	41.2	44.9	45.3
China	30.8	28.1	30.0
Germany	15.7	15.7	15.8
India	9.5	14.5	14.5
Canada	13.3	12.5	12.5
Australia	8.9	10.0	9.0
Mexico	8.4	8.5	8.6
France	7.0	7.0	7.1
Brazil	5.5	6.9	7.0
UK	6.6	5.8	5.7
Poland	3.9	4.0	4.0
Italy	3.6	3.6	3.6
Spain	3.5	3.2	3.5
Ukraine	2.5	2.5	2.5
Russia	2.0	2.0	2.0
Others	23.6	39.8	38.9
Total	**186**	**209**	**210**

Source: USGS

In the US, IMC Salt closed its 200,000 t/y operation at Hutchinson, Kansas, whilst expanding capacity at Lyons in Kansas (to 420,000 t/y), Hersey in Michigan (to 300,000 t/y) and New Johnsonville in Tenessee (180,000 t/y). American Rock Salt opened a new mine in Livingston County, which reached full capacity in January 2001.

One plant has opened and two more are planned in Russia. In September 2000, JSC Bassol, the largest domestic salt producer, opened a new complex on the Baskunchak deposit, for processing and shipping salt, which will increase salt output by 50%. JSC Silvinit, the largest producer of potassium chloride (KCl) in Russia, commissioned a new 500,000 t/y operation in the same year. The exploitation of the Belbazh deposit is also planned. This deposit has reserves of 711 Mt and the extraction operation will cost around US$79 million to develop fully. A major investor is still required but the project will still go ahead with a shaft and underground leaching operation to produce around 80,000-100,000 t/y.

A joint venture between Uniteca SA, the Portuguese chlor-alkali producer, and VA Tech Wabag of Switzerland, is developing a new salt plant (170,000 t/y) at Carrico, Portugal. The plant, which is due to come on line in 2001, will mostly produce salt captively as a feedstock for Uniteca.

Company Activity

In the late 1990s, there was considerable corporate activity and the ownership of several of the major salt producers has changed. In Europe particularly, there has been significant restructuring in the past 18 months.

Kali und Salz (K+S) expanded its salt operations in the Netherlands through Frisia Zout BV, its newly-formed subsidiary, by acquiring the FRIMA evaporated salt plant (1 Mt/y capacity) in Harlingen. Then, in November 2000 and subject to regulatory approval, it was announced that the company was going to merge its European salt business with that of Solvay, the leading regional producer. The new company, to be 60%-owned by K+S, would have operations throughout Europe and a total production greater than 5 Mt/y. Solvay would only contribute a small amount of salt to the business as most of the salt produced at its plants is used captively.

Rohm and Haas agreed to sell Salins-Europe, its European salt business and third biggest producer in Europe, to a consortium led by Union d'Etudes et d'Investissiments SA. Rohm and Haas had previously acquired Salins as part of the merger with Morton International in 1999. At the time of the sale, the company had intended to continue to operate its US and Canadian salt operations but in November 2000, there was news of a potential alliance with US Salt Holdings to form a new North American venture.

Earlier in the year, US Salt Holdings acquired British Salt from Staveley Industries of the UK, for £80 million. British Salt is the UK's leading manufacturer of evaporated salt, producing 650,000 t/y (capacity 825,000 t/y)

for use in industries such as chemicals and food. US Salt, the leading producer of evaporated salt in the US, was formed in 1997 when it purchased a salt operation in Watkins Glen from Cargill. Since then, it has acquired a number of other companies making industrial chemicals, such as propionates and acetates.

In Germany, the merger of Degussa-Hüls with SKW Trostberg AG means that the latter will have to sell its salt business, Sudsalz GmbH. The merger, to be named Degussa, is to focus on specialty chemicals so as to compete more effectively with other major companies, such as Rhodia and ICI.

Another major salt company to be offered for sale is IMC Salt. IMC is the fourth largest salt producer worldwide, behind the Chinese State, Solvay and Morton. The company was to have been disposed of by joint venture or sale, either alone or in combination with IMC Chemicals by the end of 2000. However, firm offers had still not been received by February 2001 so it is now probable that IMC Salt and IMC Chemicals will be sold as separate entities.

World Consumption

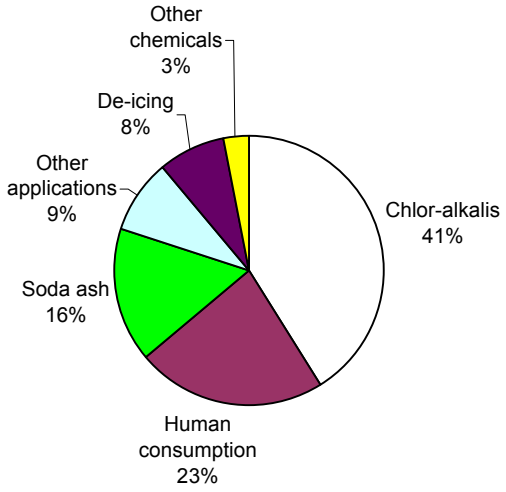
Salt is mostly consumed in three major industrial sectors, as shown in Figure 1:

- the chemical industry
- foods for human consumption
- road de-icing

The chemical industry is the by far the largest consumer of salt as it is a cheap and plentiful source of chlorine, on which much of the world's chemical processing depends, and sodium. Salt is, therefore, an important feedstock in the chlor-alkali industry, particularly in the production of chlorine and caustic soda. It is also used as a raw material in synthetic soda ash production.

Salt for human consumption is the next largest end use, followed by road de-icing, which accounts for around 8% of the world's salt consumption, particularly in the northern

World Consumption by End-Use



Source: *Mining Annual Review 2000*
Notes: Other applications include water treatment and drilling fluids used in the oil industry

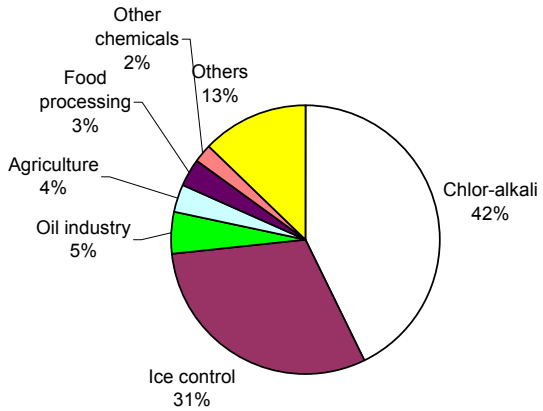
hemisphere where it may account for up to 40% of the salt consumption of some countries. The remainder of the world's salt is consumed in a number of end uses, of which the largest include animal feed, water treatment, and the oil, textile, and leather industries.

A feature of the industry is that consumption varies widely on a national basis. Countries with warm climates usually have little demand for de-icing salt. If such countries also have large populations and small chemical sectors, most demand will be from the food and agricultural sectors. By contrast, demand in the US is dominated by chemicals and de-icing (Table 2 and Figure 2) and differs further in the absence of a synthetic soda ash industry.

The electrolysis of salt forms the basis of chlorine and caustic soda production (in a ratio of 1:1.13) in the chlor-alkali industry. Manufacturers use most chlorine captively, whilst most caustic soda is sold on the open market. Long-term growth in world demand for chlorine is around 2.5% annually. In future, as power costs are so important to chlor-alkali manufacturers, new plants are

likely to be located where energy is cheapest. The balance of production of chlor-alkalis is therefore likely to shift towards Asia and the Middle East.

US Consumption by End-Use



Source: USGS

Caustic soda prices are often out of phase with those of chlorine. For example, in the US, high levels of demand for chlorine in the first half of 2000, mostly in relation to the use of PVC in construction applications, led to a concomitant increase in caustic soda output. Demand for caustic was steady at this time and the two main consumers, the pulp/paper and alumina (Al_2O_3) extraction industries, were growing healthily. Despite this, caustic demand was not sufficient to account for the extra caustic (equivalent to a 9.2% increase) that was co-produced with the increasing output of chlorine. The resultant oversupply caused caustic soda prices to fall.

Chlorine production is mainly driven by demand for PVC but this dependence can leave the chlor-alkali industry vulnerable to any downturns in demand for that commodity. One major factor that could have a significant effect on the PVC industry in the future is the consequence to health and the environment of PVC production and disposal. PVC waste in the EC alone is likely to rise from 4.1 Mt to 7.2 Mt by 2020, whilst the proportion of PVC mechanically recycled is only expected to rise

US: Consumption of salt by end use ('000t)			
	1997	**1998**	**1999**
Chlor-alkali[1]	22,400	22,000	22,400
De-icing	15,000	9,490	15,300
Petroleum	2,440	2,320	2,430
Agriculture	1,850	1,940	1,830
Food products	1,510	1,690	1,680
Water treatment	471	531	899
Textiles/dyeing	273	250	235
Metal processing	177	170	153
Paper products	107	115	112
Others[2]	5,222	5,636	4,907
Total[3]	**49,500**	**44,200**	**49,900**

Source: USGS

Notes: 1-includes other chemicals use (maximum 5% of total)
2-Others includes leather tanning, other chemical and industrial uses, and distributors
3-rounded to three significant figures

from 3% to 7%. The large number of concerns includes the following:

- PVC manufacture releases toxic furans and carcinogenic dioxins
- A wide variety of additives used to stabilise or plasticise PVC are toxic and can potentially leach out in landfill. These include lead, cadmium, organotins, phthalates and chlorinated paraffins.
- Alternative disposal involves incineration but this produces hydrogen chloride (hydrochloric acid vapour), chlorine and dioxins, all of which are potentially harmful.

The EU and Japan have considered banning PVC because of these concerns and since 1999 some bans on plasticisers (eg, phthalates) have been enforced, for instance in children's toys. The EU is currently evaluating the benefits of separate PVC waste collection and a ban on imports from developing nations. Legislation to phase out cadmium and lead additives is also being reviewed, and a vote on the dramatic reduction of PVC use in Europe was also due to be taken in April 2001. Although no direct legislation against PVC has yet to be

introduced, this could clearly change in the next few years with the potential enforcement of strong curbs on the industry.

Salt is also used by the chemical industry to produce synthetic soda ash. There is no longer any production of synthetic soda ash in the US, where low cost, high quality natural material is produced instead. Exports of US material have meant that there has often been little or no incentive to build new synthetic soda ash capacity. These exports of soda ash have also meant that production at many existing plants has remaining level or has fallen in recent years. Other plants have closed, particularly those with a capacity less than 0.5 Mt/y.

The exception has been in China, where synthetic soda ash output has risen rapidly in the 1990s to stand at 8 Mt in 2000. As Chinese output has risen so have its exports, which peaked at over 1 Mt in 1999 but fell slightly to 997,000 t in 2000. Most is exported to South and Southeast Asia, many parts of which are also major targets for US natural material. This will lead to increasing competition for soda ash in the region. Indian duties on imports have severely reduced the amount of material received from China and have excluded US material altogether. However, a marked reduction in duties announced in April 2001 could lead to the re-entry of the US to the Indian market.

Synthetic soda ash is important in Europe, where companies such as Solvay and Brunner Mond are producers. This market was previously protected from US exports by anti-dumping duties, but these are no longer in place. US exports to the region have not recovered to their former level, however, because the dollar is strong against the euro and because European-made soda ash currently has a fairly low price.

The consumption of salt in food and agricultural applications can account for half of all demand in some countries or less than 5% in others. The majority of salt for human consumption is used in food processing rather than for table salt. At present, around 48 Mt/y (23%) of salt is used worldwide for human consumption. This tonnage is likely to continue to increase in line with world population growth despite health concerns over excessive salt consumption in some countries.

Iodine Deficiency Disorder (IDD) is a leading cause of mental dysfunction but can be prevented by consumption of iodised salt. Around 100 countries now have IDD programmes, as does the World Health Organisation. The implementation of IDD schemes has led to increasing output of iodised salt. In China, for example, production of iodised salt in 1999 was more than 8 Mt and around 90% of salt for human consumption is iodised. In many countries, the incidence of IDD cases has fallen as the use of iodised salt has risen. It is likely that production and consumption of iodised salt will continue to increase.

Ice control applications for salt are mainly confined to countries in the northern hemisphere. De-icing can account for 40% or more of consumption in some countries in a given year but it is prone to some of the largest annual variations in demand of all the end uses of salt, because it is so dependent on weather patterns. In recent years, there have been a series of mild winters in parts of North America and Europe that have adversely affected demand. US demand for de-icing salt was around 10 Mt/y in the early 1990s. Winters were harsh in 1994 and 1996 leading to consumption of 16.4 Mt and 17.7 Mt in these years. In 1998, however, winters were milder and consumption fell to around 9.5 Mt but this climbed to 15.3 Mt as a result of the more severe winter of 1999/2000.

Salt has a low cost in comparison with some of its competitors in the de-icing industry, and so in previous years has had little competition in this sector. Environmental concerns may, however, lead to increasing use of

alternatives such as calcium chloride, despite their higher price.

The remainder of world consumption is made up of a number of other applications; the Salt Institute reports that there are over 14,000 uses for salt. The more important of the minor end uses include water treatment, drilling fluids, and leather tanning.

Outlook

Consumption of salt in chlorine manufacture is likely to increase in the future as demand for PVC increases, especially in areas such as East and Southeast Asia. However, the potential ban or limitations on PVC use in developed countries could significantly reduce consumption in these regions. Salt consumption in food will increase in line with population growth. It is likely to undergo strongest growth in East and Southeast Asia where population increase is amongst the fastest in the world. De-icing usage does not follow a predictable pattern as it is entirely determined by winter weather severity in the northern hemisphere. Furthermore, there are concerns over the environmental effects of salt used in this way but an economic alternative to salt for highway de-icing has not yet been developed. As a result, consumption in this application is not likely to fall significantly.

In the future, consumption of salt in many of its end uses will increase. Much of the growth will be in East and Southeast Asia, and the balance of salt consumption will shift from the mature markets of Western Europe and North America to the growing markets in the Asia Pacific region.

Industrial Minerals quotes prices for salt. In May 2001, the average delivered price for ground rock salt in 15 t to 20 t lots in the UK was £20-30/t. In the same month, the fob price of bulk Australian solar salt was US$18-20/t.