Will Chlorine Demand Set the Table for Salt?

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INTRODUCTION

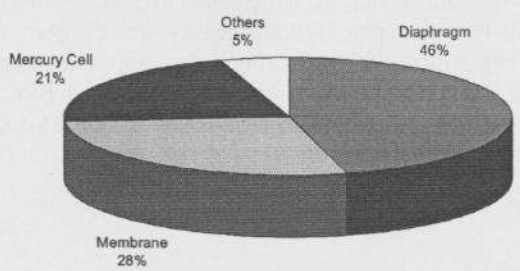
This presentation will provide a long-term forecast of the global chlor-alkali market. The forecast will assist in identifying how much salt will be required through 2010 by the global chlor-alkali industry and, as important, where its growth is forecast to occur.

For the purposes of this presentation, we will focus our attention on the chlorine side of the chlor-alkali industry. This focus on chlorine is not intended to preclude the importance of caustic soda in the global markets. Because of the hazardous nature of chlorine, chlorine is not stored in large quantities and is shipped only short distances primarily via pipeline to chlorine derivative producers. Therefore, chlor-alkali production volumes are usually established by chlorine derivative demand.

BACKGROUND

The global chlor-alkali industry, which represents 60 percent of the global petrochemical industry, utilizes three technologies: membrane, mercury and diaphragm. The basic raw materials for all three of these technologies are electricity and salt. As shown in the pie chart to the lower left, in 1998 world chlor-alkali capacity reached almost 51 million metric tons with the predominant manufacturing process being diaphragm technology representing 46 percent of the world capacity to produce chlor-alkali.

WORLD
1998 CHLORINE TECHNOLOGY DETAIL



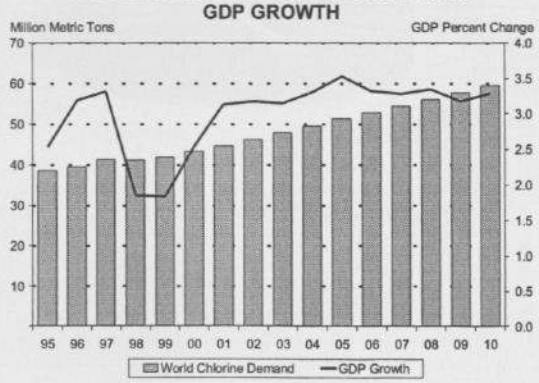
Total Capacity = 50.9 Million Metric Tons

The importance of the global chlor-alkali industry to the salt industry is evidenced in the fact that it takes approximately 1.75 metric tons of salt to produce 1.0 metric ton of chlorine and 1.1 metric tons of caustic soda, commonly referred to as an Electro-Chemical Unit (ECU). In 1998, we estimate that the global chlor-alkali industry consumed over 74 million metric tons of salt. This represents about 37 percent of the salt consumed/produced in 1998 of an estimated worldwide total of 200 million metric tons.

ASSUMPTIONS AND METHODOLOGY

Our forecast of world chlor-alkali growth is based on a supply/demand model developed by CMAI, which

WORLD CHLORINE DEMAND GROWTH VS GDP GROWTH



utilizes Gross Domestic Product (GDP) growth in each of the consuming countries of the world. This model calculates historic demand elasticity, which is the ratio of demand growth to GDP growth. Future elasticity is forecast using historical elasticity, the GDP forecast and the consultants' knowledge of chlorine and derivative demand in each country. The graph on the previous page shows our forecast of world chlorine demand versus GDP growth from 1995 through 2010. Chlorine demand closely follows GDP growth, since the demand for chlorine derivatives is mainly driven by GDP growth.

GLOBAL CHLORINE MARKETS

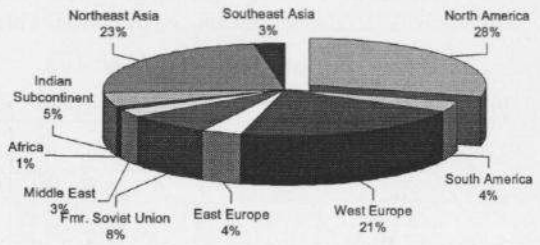
In 1998, the size of the global chlorine industry was about 51 million metric tons. The pie chart below illustrates the regional distribution of chlorine capacity around the world. The capacities in North America, West Europe and Northeast Asia combine to represent 72 percent of the world capacity. Of these regions, only North America is a net exporter of chlorine derivatives. The Middle East, which only represented 3 percent of the world capacity in 1998, is the other major regional exporter of chlorine derivatives. Since chlorine is not stored in large quantities or transported long distances anywhere in the world due to the hazardous nature of the product, chlorine plants have been erected as either part of a complex with derivative production in close proximity or simply close to derivative facilities. Chlorine imports and exports, therefore, are expressed in the amount of chlorine contained in the traded derivatives.

The chart to the right shows the regional comparison of per capita consumption of chlorine into water treatment. There are two key points that are important regarding this comparison. First, there is a significant difference in per capita consumption between the developed areas of the world, like West Europe and North America and developing regions of the world. The second point is the tremendous potential for chlorine demand growth in the developing regions as these regions improve their economic condition, stabilize their political environments and add infrastructure for their large populations.

WORLDWIDE WATER TREATMENT
PER CAPITA CHLORINE CONSUMPTION
Kilograms Per Capita

COUNTRY/REGION	1994	1998	2004	AAGR 94-98 Percent	AAGR 98-04 Percent
CANADA	2.23	2.29	2.41	0.58	0.90
MEXICO	0.27	0.29	0.34	2.19	2.58
UNITED STATES	2.04	2.08	2.12	0.46	0.37
NORTH AMERICA	1.64	1.67	1.70	0.38	0.37
ARGENTINA	0.58	0.75	0.83	6.42	1.73
BRAZIL	0.22	0.24	0.26	2.17	1.85
COLOMBIA	0.14	0.16	0.17	2.88	1.27
VENEZUELA	0.56	0.60	0.61	1.78	0.15
SOUTH AMERICA	0.22	0.25	0.27	3.01	1.50
WEST EUROPE	0.51	0.53	0.54	0.59	0.58
EAST EUROPE	0.43	0.47	0.58	2.47	3.59
FORMER SOVIET UNION	0.44	0.44	0.45	-0.06	0.38
AFRICA	0.06	0.06	0.06	0.93	0.86
MIDDLE EAST	0.25	0.32	0.37	6.02	2.51
CHINA	0.32	0.44	0.61	8.29	5.31
JAPAN	1.13	1.41	1.45	5.61	0.57
KOREA (SOUTH)	0.45	0.63	0.73	8.76	2.48
TAIWAN	0.64	0.84	1.23	6.96	6.70
NORTHEAST ASIA	0.40	0.53	0.68	7.47	4.20
AUSTRALIA	0.57	0.65	0.83	3.56	4.20
INDONESIA	0.11	0.14	0.16	6.79	2.48
MALAYSIA	0.41	0.51	0.68	6.00	4.90
PHILLIPINES	0.03	0.04	0.05	8.39	2.96
SINGAPORE	0.92	0.86	1.04	-1.64	3.19
THAILAND	0.45	0.44	0.59	-0.78	5.25
SOUTHEAST ASIA	0.40	0.53	0.68	7.47	4.20
INDIA	0.04	0.06	0.09	12.08	6.33
PAKISTAN	0.27	0.28	0.29	0.56	0.99
INDIAN SUBCONTINENT	0.06	0.08	0.10	7.05	4.56
TOTAL WORLD	0.34	0.38	0.43	2.94	1.91

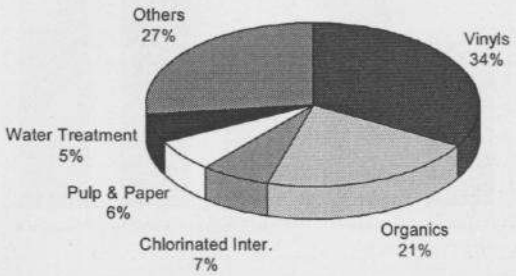
WORLD
1998 CHLORINE CAPACITY



Total Capacity = 50.9 Million Metric Tons

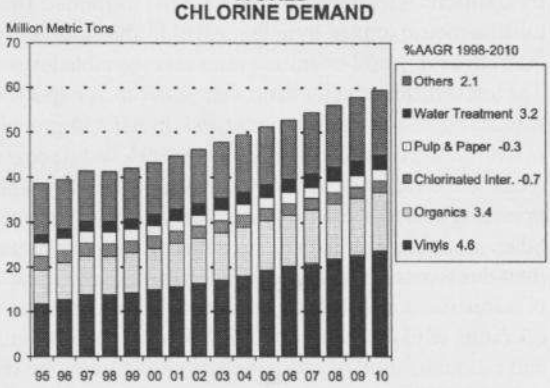
The downstream consumption of chlorine in the key derivative markets in 1998 is illustrated in the chart on the following page. Vinyls is by far the largest end-use market for chlorine representing 34 percent of the world demand for chlorine in 1998. Vinyls demand is dominated by the construction industry, which uses vinyls for the manufacture of pipe for drainage and water distribution, siding, wire and cable, flooring and roofing. For emerging economies and less industrialized countries, PVC is the primary material utilized to build infrastructure to support the development of the local industry.

WORLD
1998 CHLORINE DEMAND



Total Demand = 41.3 Million Metric Tons

WORLD
CHLORINE DEMAND

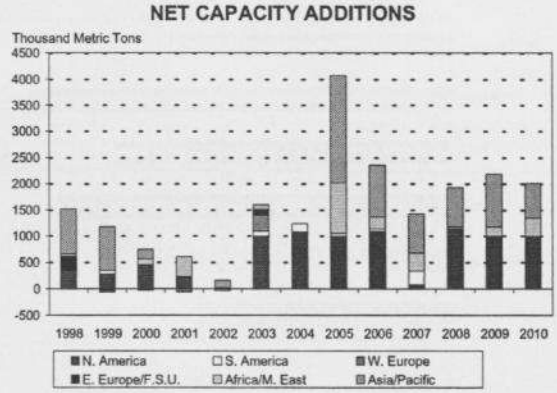


Propylene oxide, included in the organics category, represented the second largest derivative chlorine market with about 7 percent of worldwide chlorine demand. Propylene oxide is utilized to make polyurethane applications, which include rigid and flexible foam, adhesives, coatings, etc. The third largest end-use market is pulp and paper, which is declining due to environmental issues. In 1998, the pulp and paper sector consumed about 6.4 percent of the total world chlorine production. As a comparison, in 1995 the pulp and paper industry consumed about 3 million metric tons of chlorine, but by 1998 that volume had declined to around 2.7 million metric tons, a decline of 10 percent over this period. The combined end-use markets of MDI/TDI, included in the organics category, represented about 6.3 percent of the world market for chlorine. These products are used to manufacture rigid and flexible foam products for consumer and industrial applications, like insulation, floatation devices, swimming pools, furniture and carpet underlay. We estimate that the construction and consumer manufacturing industries consume almost 70 percent of the chlorine manufactured in the world in one form or another.

From 1995 to 2010, chlorine demand is forecast to grow at a rate of 3.1 percent per year, as shown in the comparison of CMAI's forecast of GDP and chlorine growth. Since chlorine growth is a result of downstream derivative growth, the chart to the upper right depicts the growth over the same period for the key chlorine derivatives. Overall, demand for vinyls, which in 1998 represented 33 percent of the world demand for chlorine, is forecast to grow at a rate of around 4.6 percent per year with chlorine demand by vinyls forecast to represent 40 percent of the demand for chlorine in the world by 2010. This growth in vinyls demand for chlorine is the result of strong demand for infrastructure in the less industrialized areas of the world. Other end-uses are also forecast to grow, like epichlorohydrin (4 percent), MDI (4 percent), TDI (3.5 percent) and polycarbonates (8.5 percent). The demand for some derivatives, however, is forecast to decline or exhibit very slow growth mainly due to environmental pressures as in the case of chlorinated intermediates (-0.7 percent) and pulp and paper (-0.04 percent).

Chlorine capacity growth, on the other hand, is forecast to take place in very different locations than the growth in demand, as shown in the graph on the previous page. Chlorine capacity in the early part of the fore-

WORLD CHLORINE
NET CAPACITY ADDITIONS

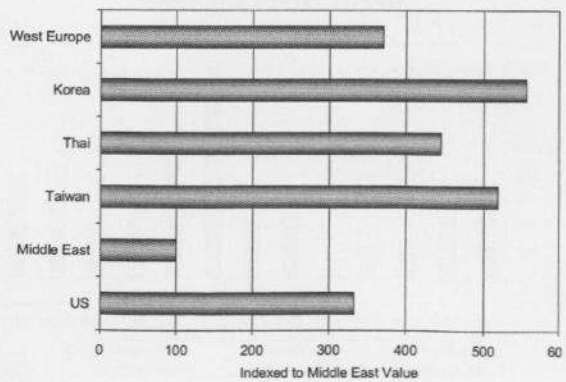


cast period is based on public announcements of capacity additions. Beginning in 2003, CMAI has added 16.2 million metric tons of hypothetical chlorine capacity in order to keep world operating rates at reasonable levels. The total world capacity to produce chlorine is expected to reach close to 70 million metric tons in 2010. A growth of over 37 percent versus capacity in 1998. While some areas of the world are capable of operating at very high operating rates, like North America and West Europe, other areas are less capable to achieve high operating rates due to intermittent power interruptions and the lack of infrastructure. While we expect an increase in overall operating rates due to improved efficiencies, larger plants and rationalization of older inefficient facilities, we do not expect this improvement to be more dramatic than 1-2 percent over the forecast period.

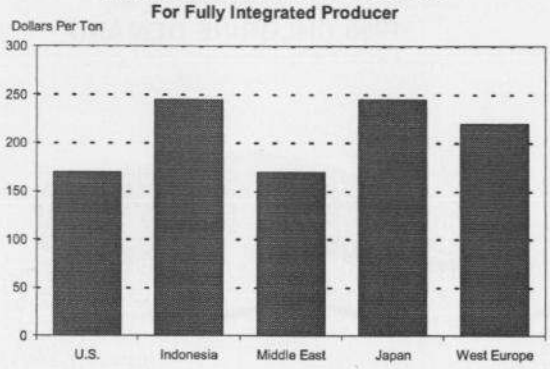
The major growth areas for chlorine capacity are North America and the Middle East due to a favorable cost structure. As shown in the chart below, which compares CMAI's estimate of power costs in the key chlor-alkali producer areas of the world, both North America and the Middle East are considered to be the lowest cost regions in the world to produce petrochemicals. This advantage is derived almost exclusively from low energy costs, since the production of chlorine requires large volumes of electricity. In fact, a lower level of power consumption primarily drives the industry's transition to membrane technology; for example membrane technology consumes more than 5 percent less power than diaphragm technology.

The graph above illustrates CMAI's estimate of the competitive cost differences for the manufacture of chlorine in several representative countries. Not surprisingly,

1999 ELECTRICITY COSTS



1999 CHLORINE CASH COSTS
For Fully Integrated Producer

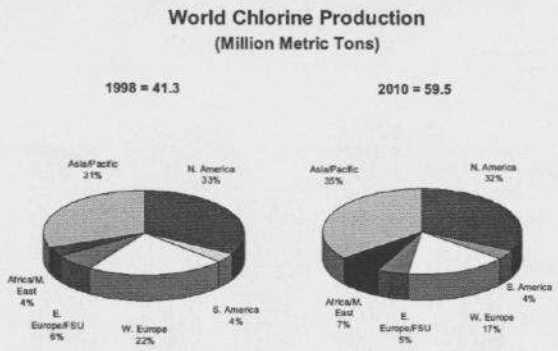


the Middle East emerges as the lowest cost producer. This advantage stems from its abundant and low cost energy base and the size of its facilities. The U.S. is also considered a low cost producer for much of the same reasons as the Middle East. This analysis, however, is not intended to label the facilities in other countries as high cost, but rather attempts to point out that the average facility in these countries is not competitive on a world basis.

IMPACT ON SALT INDUSTRY

The analysis of the chlorine industry, its long-term growth in terms of demand and the location of new capacity to meet this demand, is of particular importance to the Salt Industry. The manufacture of chlorine represented about 45 percent of the overall demand for salt in 1998 or about 74 million metric tons of salt in one form or another. By 2010, demand for salt to produce chlorine is forecast to reach 104 million metric tons, an increase of over 40 percent. Year-to year demand growth will follow the same trend as chlorine production.

The forecast of future chlorine capacity additions assists the salt producer to identify potential business opportunities and begin to work to develop client relations and define logistics costs associated with delivery from the major salt producing regions. The pie charts on the following page compare regional production of chlorine in 1998 with 2010. It is not surprising that the Asia/ Pacific region will demonstrate the greatest growth in production over this period going from 31 percent of the world production in 1998 to 35 percent by 2010. The Middle East share of world chlorine production will in-



crease by 3 percent reaching a total of 7 percent by 2010. Unlike the Asia/Pacific region, which will consume the derivatives produced by chlorine locally, the Middle East will export almost all of the derivatives produced.

The pie chart below is based on the hypothetical chlorine capacity added by CMAI during the forecast period by region and illustrates the estimated type and amount of salt that will be consumed by these capacity additions. In North America, mined solution salt supplied locally will be the predominant type of salt. In the Middle East, solar salt will be required, while in most other regions, mined crystal salt will be consumed in the production of chlorine.

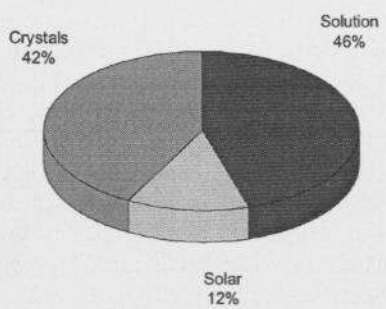
SUMMARY

Chlorine demand is forecast to grow at a rate of 3.1 percent per year from 1998 to 2010. The increase in demand for chlorine is driven by worldwide positive economic performance in all regions. Chlorine demand is forecast to accelerate more quickly in those regions of the world that have large populations and are less industrialized, primarily in Asia. Chlorine derivative demand is driven to a large extent by the construction industry as infrastructure projects and consumer demands escalate in the emerging economies of the world.

Salt demand for this important industry is forecast to reach 104 million metric tons by 2010. The demand for salt is shifting from the traditional demand markets to production areas, which are centered in the lower cost regions of the world, like the Middle East.

The title of this speech is "**Will Chlorine Demand Set the Table for Salt?**" Perhaps, as a result of this analysis, the title should have been "**Chlorine Demand Has Already Set the Table for Salt!**"

WORLD
SALT DEMAND INCREASE BY TYPE



Total Additional Demand = 28.6 Million Metric Tons