EXECUTIVE SUMMARY

1.0 INTRODUCTION

1.1 Soda ash is the common name for the technical grade anhydrous sodium carbonate (Na_2CO_3).

1.2 In the eighteenth century soda ash was produced by LeBlanc process based on roasting salt cake with carbon and limestone. The synthetic process for the manufacture of soda ash by ammonia soda process was developed by Ernest Solvay in 1861.

1.3 Natural deposits of soda containing sodium carbonate (known as 'Trona') mostly occur in America, East Africa, Mexico and China.

1.4 About 30% of world soda ash production (90% of this is in U.S. alone) is from natural deposits and the rest 70% from synthetic process.

1.5 Soda ash is a white, finely crystalline, hygroscopic powder. When freshly packed, contains at least 98.5% Na_2CO_3. It absorbs moisture and carbon dioxide from the atmosphere during storage and transit.

1.6 Soda ash is available in four standard forms as light, medium, dense and granular according to the bulk density to suit various industrial requirements.

1.7 Soda ash is moderately soluble in water and the solution is strongly alkaline. Although it is low in toxicity, ingestion can be harmful. Product dust may produce irritation of eyes, nose, throat and lungs.

1.8 Packing of soda ash is generally dóne in 75kg and 50kg gunny bags and storing is done inside godown on concrete or wooden floor. It should not be stacked more than 15 ft high.

1.9 The main consuming industries of soda ash are glass, detergent, laundry soap, sodium silicate, cotton yarn, dyes and dyestuff, paper board and other chemical industries.

1.10 For countries which do not posses natural resources of soda ash, the following synthetic processes are available :

— Solvay Process
— Akzo Dry Lime Process
— Dual Process
— New Ashai (NA) Process

1.11 The raw materials and utility consumption by different process routes have been tabulated.

1.12 The most accepted technology for producing synthetic soda ash is ammonia-soda or Solvay process mainly because investment and maintenance cost is low compared to other processes.

2.0 STRUCTURE AND STATUS OF INDIAN INDUSTRY

2.1 The manufacture of soda ash in India started in 1932 at Dharangadhra in Gujarat with an installed capacity of 50 tonne per day under the name of 'Shri Shakti Alkali Woks' which later became Dharangadhra Chemical Works Ltd. This was followed by the entry of Tata Chemicals at Mithapur in Gujarat in 1994 with an installed capacity of 100 tonne per day. In a span of 50 years it has grown to be the biggest soda ash unit in the country with daily capacity of 2000 tonne. In the same Saurashtra region in Gujarat, two more soda ash plants came up after-wards. Saurashtra Chemicals at Porbandar was commissioned in 1959 with a capacity of 200 tonne per day which has been expanded to 800 tonne per day. Gujarat Heavy Chemicals Ltd at Sutrapada, near Veraval was commissioned in 1988 with a capacity of 1200 tonne per day. All these four units in Saurashtra are based on Solvay process.

2.2 Three units are operating on the modified Solvay process (Dual Process) in which ammonium chloride is the co-product. The first plant based on this technology was set up in 1959 at Varansai, U.P. in the name of Sahu Chemical & Fertiliser with an installed capacity of 120 tonne per day but since August 1988 this unit is lying idle. The other two units operating on Dual process at a capacity of 200 tonne per day are Tuticorin Alkali

Chemicals and Fertilizer Ltd at Tuticorin, Tamil Nadu since 1982 and Punjab National Fertiliser & Chemical at Nayanangal, Punjab since 1984.

2.3 The present installed capacity of Six soda ash manufacturing units is 17.09 lakh tonne.

2.4 With the expansion of existing soda ash manufacturing units and after commencement of production of the new units the total production of soda ash will be 27.4 lakh tonne.

2.5 Substantial quantity of soda ash was being imported upto 1987-88 (till the commissioning of Gujarat Heavy Chemicals Ltd in 1988) to meet the domestic demand.

2.6 Soda ash export potential does exist specially to the Middle-East and South-East Asia. Tata Chemicals, Gujarat Heavy Chemicals Ltd and Saurashtra Chemicals are exporting to Middle-East Asia since last three years.

2.7 The projected demand of soda ash in 1999-2000 is 26.80 lakh tonne. With the expansion of existing units and with commenced production of the new companies, the availability of soda ash is assured.

2.8 Soda ash industries manufacturing soda ash by Solvay process are doing well and the current growth rate is around 8.0% per annum. Tata Chemicals estimated that their production will be 10 lakh tonne by 1996-97

2.9 Raw materials for Solvay process are salt, lime-stone and coke. Ammonia is also used in the process as an intermediate carrier Catalyst'. In soda ash industry solar salt is used which contains 93-94% NaCl as against 98% available in the international market. Similarly, the quality of lime stone does not meet international standard. As regards coke the industry has no option but to import it from China, Japan etc.

Coal is not a raw material for soda ash manufacture but all soda ash units are having coal based captive power plants for co-generation of steam and power required in the industry.

2.10 In India out of six soda ash manufacturing units, four are based on Solvay process and 91.2% soda ash is produced by this process. In view of this a detailed write-up of Solvay process is given.

2.11 Though some soda ash units have imported technology; a few of the Indian soda ash units are capable of designing and engineering of soda ash plants.

2.12 All the manufacturing units in India are producing soda ash of BIS grade.

2.13 The list of major equipment with specifications has been worked out for a 1200 TPD soda ash unit.

214. Approximately 10 m^3/Tonne of effluent is generated in ammonia-soda process (Solvay Process) and all soda ash units manufacturing by this process are discharging effluent to sea after some treatment. The procedure of effluent treatment followed by Indian industries is discussed subsequently. The treated effluent from soda ash industry is non-toxic and exclusively inorganic in nature compatible with seabody system.

2.15 The norms proposed as per Minimal National Standard (MINAS) for effluent discharge from soda ash industry are:

i	Total suspended solid	:	not to exceed 6000 mg/lit
ii.	pH	:	Up to 9.5
iii.	Ammonia	:	Up to 20 mg/lit
iv.	Temperature	:	45°C max

2.16 The gaseous emission from soda ash industry is compatible to atmospheric air and none of the industry is monitoring it.

2.17 There is some dust emanating from solid handling section for which no standard exists. Any how, some of the soda ash industries have provided de-dusting equipments at the dust emission points to control dust.

2.18 Ammonia, hydrogen sulphide and milk-of-lime are hazardous chemicals handled in soda ash industry which need special care.

2.19 Maintenance and safety training programme must be an internal part of company culture.

2.20 The cost of production of indigenous soda ash is much higher compared to that of international soda ash market due to inferior quality of raw materials and also higher cost.

2.21 The ex-work price of soda ash in India is Rs 7000-8000 per MT while European price is $130-159 per MT and US price is $ 145-170 per MT.

2.22 The minimum viable capacity and the estimated cost of such a soda ash plant are as under:

a) 1000 TPD Solvay process plant costing Rs 700.0 crores investment

b) 300 TPD Dual process plant costing Rs 300. 0 crores investment

2.23 Ammonium chloride is produced as co-product in Dual process. It is used primarily as a fertiliser.

2.24 Ammonium chloride is moderately toxic by ingestion. Tolerance (Fume) limit is 10 mg per cubic meter of air.

3.0 INTERNATIONAL SCENARIO

3.1 The present global capacity of soda ash is 37.0 million tonne per annum and the long term growth rate is 1.5-2%.

3.2 A list of Global major soda-ash units are given.

3.3 The major technology suppliers are :

Solvay and Cie SA, Belgium
AKZO-ZOUT Chemie BV, Netherlands
Asahi Chemical Industry, Japan
Polimex Cheepok, Poland
Technology Exports Divn, DSTA, China

3.4 Contemporary Technology

i) Solution mining of trona technology.

ii) As a co-product in the production of vinyl chloride monomer.

3.5 The basic process for the manufacturer of soda ash has not undergone much change since last 130 years. Developments however are taking place in the following areas :

i. Process technology
ii. Operation technology
iii. Improvement of quality
iv. New product from waste

4.0 R&D EFFORTS, TECHNOLOGY ABSORPTION AND GAP

4.1 In almost all the Indian soda ash industry, in-house R&D facilities exist and some of them are recognised by Ministry of Science and Technology, (Department of Scientific and Industrial Research) Govt. of India.

4.2 In some soda ash units, research is going on to find new products from waste through pilot plant trial.

4.3 Simulation of various sections for plant optimation is in progress in some soda ash units.

4.4 Upgradation of DCS system for automation is going on in Gujarat Heavy Chemicals Ltd.

4.5 IS: 251-1982 (Third Revision) gives national specification for soda ash while ASTM E-1099 and ANSI/AWWA B-201-87 is American standard, BS 3674-1963 is British standard and JIS-K-1201-1950 is Japanese Industrial standard for soda ash.

4.6 Comparison of Indian standard with International standard is given.

4.7 Facilities for manufacture of process equipment is available in the country. A few critical equipment and instruments are however still being imported.

4.8 Consultants with wide design and engineering experience are available in the country who can implement such projects.

5.0 CONCLUSIONS AND RECOMMENDATIONS

5.1 Conclusions

India do not posses the natural resource of soda ash. So it has to depend on synthetic route.

5.2 At present, soda ash is manufactured in India by six manufacturing units with a total installed capacity of 15.10 lakh tonne. Out of six soda ash units, four are based on Solvay process and two are based on Dual process.

5.3 All the four units based of Solvay process are located at the costal region of Saurashtra, Gujarat and producing more than 90% soda ash produced in India.

5.4 Two units based on Dual process are located at inland near Fertilizer units. Ammonium chloride is a co-product in the manufacture of soda ash by Dual process.

5.5 The constraints of Dual process are :

i. It has to depend on the availability of carbon dioxide gas and ammonia from fertilizer unit.

ii. At times, the production is to be restricted for want of ammonium chloride market.

5.6 In India none of the soda ash unit has adopted New Asahi (NA) process as initial investment is very high.

5.7 Effluent generation from Solvay plants is more compared to other process plants. Because of proximity to the sea, the

effluent from Solvay plants are discharged into sea after some minor treatment which does not affect the ecological balance because the composition of effluent compares favourably with sea-body composition.

5.8 Fresh capacity of 11.4 lakh tonne per annum of soda ash has been licensed to various parties, but implementation of most of the projects are doubtful.

5.9 The present capacity utilisation of soda ash in India is more than 90% which calls for immediate capacity generation to the extent of 6.4 lakh tonne.

5.10 Export potential does exist and there is some export of soda ash since last 3 years. Govt may consider export incentives to the industry.

5.11 The consumption of raw materials and utilities is higher in Indian Industries because of poor quality raw materials, old plant and old technology. Accordingly the cost of production is higher compared to international norms.

5.12 India, has both technology and engineering capabilities to build new soda ash units however R&D has not received the attention it deserves.

5.2 Recommendations

5.2.1 The choice of a particular technology would depend on plant location, availability of raw materials, marketability of products etc. Generally, a costal soda ash plant should go for the Solvay process whereas inland plant should opt for Dual process near a fertilizer unit. The New Asahi process might not be quite adaptable to Indian conditions as more investment has to be made in the limeburning/lime slaking, ammonia recovery and ammonium chloride crystallisation sections. However, it would be worthwhile to incorporate the improvement section-wise of NA process in Solvay/Dual process as the case may be.

5.2.2 More than 90% of soda ash production is from the soda ash units located at the western region whereas a good number of soap and

synthetic detergent industries and glass industries are in the eastern region. To reduce the cost of transportation of soda ash from western region to eastern region, new soda ash units in eastern region, may be considered.

5.2.3 Use of dry lime is recommended in ammonia still for heat recovery and to reduce volume of effluent generation in Solvay Process.

5.2.4 Good quality raw materials may be made available to soda ash industries. Salt upgradation technology needs to be incorporated by soda ash manufacturing units. Necessary penalty may be imposed by the State Government to safe guard the interest of soda ash industries for good quality lime stone from Saurashtra region as it is being rapidly consumed by large number of cement industries. All the captive power plants of soda ash industries may be assured supply of coal like other priority industries. Coal should be washed properly in coal washery to reduce ash content.

5.2.5 Natural gas may be made available as an alternative fuel for burning of lime stone in vertical kilns.

5.2.6 Natural gas in place of coal may be used in power plant boilers specially in Western India.

5.2.7 R&D in the industry should focus more on efficient plant operation through improved equipment design, energy conservation, better material of construction as also development of specific process technologies.

5.2.8 Safe transportation mode may be adopted for salt, coal and coke to minimise transit loss. Incidentally it can be mentioned that all transportation from raw material to finished product at Gujarat Heavy Chemicals are by road transport only. For better transport system, raliway line may be extended from Veraval to Sutarpada.

5.2.9 Focus may be on new product development, specially for detergent, glass and oil exploration sector.

5.2.10 Development of indigenous technical know-how for specialised equipments and instruments which are now being imported may be taken up.

5.2.11 Where high ash coal is used for captive power plant, feasibility of making building material with power plant clinker and waste lime stone/lime dust from limekiln may be studied.

5.2.12 Export potential for soda ash does exist and Govt may provide export incentives to the industry. Manufacturers desire that to boost export coke and coal be allowed import without duty. Also all equipments imported for energy saving, pollution control, analysis; and also special material of construction like titanium tubes and plates for fabriation of equipment could be made available in the country duty free.

5.2.13 There is a need to form a co-operative research organisation to be established by the industry and Alkali Manufactures Association of India with Government support. This organisation may identify research programmes and interact with national research institutes.

5.2.14 The AKZOZOUT CHEMIE process for co-production of vinyl chloride monomer and soda ash needs a critical study.