

THE VENEZUELAN SALT INDUSTRY

AN ASSESSMENT



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**Venezuela Fact Sheet**

Land Area :	912,050 sq km (352,145 sq mi).
Population :	22.03 million (1997 estimate)
Population Growth:	2.1% (1995 est.)
Cities :	Caracas, pop 1,850,000 Maracaibo
Urbanization:	56.1% of population live in towns or urban centers.
Ethnicity:	67%-----Mestizos 10%-----Black 21%-----White 2%----- Amerindian
Economy:	Mixed economy heavily dominated by the petroleum sector, which accounts for 70% of foreign exchange earnings. Fairly well developed but overloaded infrastructure. Inflation a major problem.
Labor Force	7.6 million; Agriculture 12%, Services 63%, Industrial 25%.
Per Capita Income:	US \$2910 per year (1992)
External debt:	US \$40.1 billion (1994)
Exchange Rate	495 Bolivars, (Bs), per US \$ (Nov 1997)
Fertility	2.97 live births per woman
Infant Mortality	26.5 per 1,000 live births (1995 est.)
Crude Death Rate	4.57 per 1,000 inhabitants (1995 est.)
Life Expectancy at Birth	73 years; (1995 est.)
UNDP-HDI	0.820
DMFT	3.60 (1986)



1. ACTIVITY SUMMARY

The PAHO consultant arrived in Venezuela at Simon Bolivar Airport at 9: 15pm on Sunday 23rd November 1997. On Monday November 24th, the consultant accompanied by **Dra. Leyda Gomez** of the **OPS, Caracas'** office and **Dr Wilfredo Escalante** of **CONYFLUSAL** journeyed to **Maricaibo** in **Estado Zulia**. In the **Maricaibo** area where the majority of small producers are located, 6 salt processors were visited on Monday November 24th and Tuesday November 25th. On Wednesday, November 26th the consultant accompanied by **Lic. Eglee Andrade** traveled to **Barcelona** in **Estado Anzoategua** and visited the large producer, **Sal de Bahia**. Later the same day, the journey was continued by road to **Cumana** in **Estado Sucre**, where a meeting was held with officials of **Technosal**. The following day Thursday, November 27th, the crude salt production and processing facilities of **Tecnosal** at **Arya** were visited. On Friday, November 28th the return to **Caracas** was made and a final meeting at **OPS, Caracas'** offices held.

2. **BACKGROUND**

Venezuela is a major producer and processor of salt. With a population of 22.03 million persons there is a market of about 80,000 ton per year of domestic salt. In addition Venezuela's high level of agricultural and industrial development calls for the additional use of about 385,000 ton per year for non-food industrial use and about 145,000 ton per year for the animal feeds and food processing industries. **Table 1** below summarizes the annual salt flows and balance for Venezuela.

Table 1: Annual Salt Flows and Balance for the Republic of Venezuela (ton)

IMPORTS		PRODUCTION		CONSUMPTION		EXPORTS	
<u>Crude</u>		Solar Salt (Sal Solar)	705,000	Household/ Domestic/ Table (Direct Human)	85,000	<u>Crude</u>	70,000
Columbia				Industrial Food/ Bakery/ Cattle. (Indirect Human)	145,000	<u>Processed</u> Dom. Rep. Colombia Martinique Brazil Trinidad Nigeria USA	55,000
Bonaire	30,000						
<u>Processed</u>				Industrial Non-Food (No Human Consumption)	385,000		
Columbia	5,000						
TOTAL IMPORTS	35,000	TOTAL PROD'N	705,000	TOTAL CONSUMPTION	615,000	TOTAL EXORTS	125,000
TOTAL IMPORTS + TOTAL PRODUCTION = 740,000				TOTAL CONSUMPTION + TOTAL EXPORTS = 740,000			

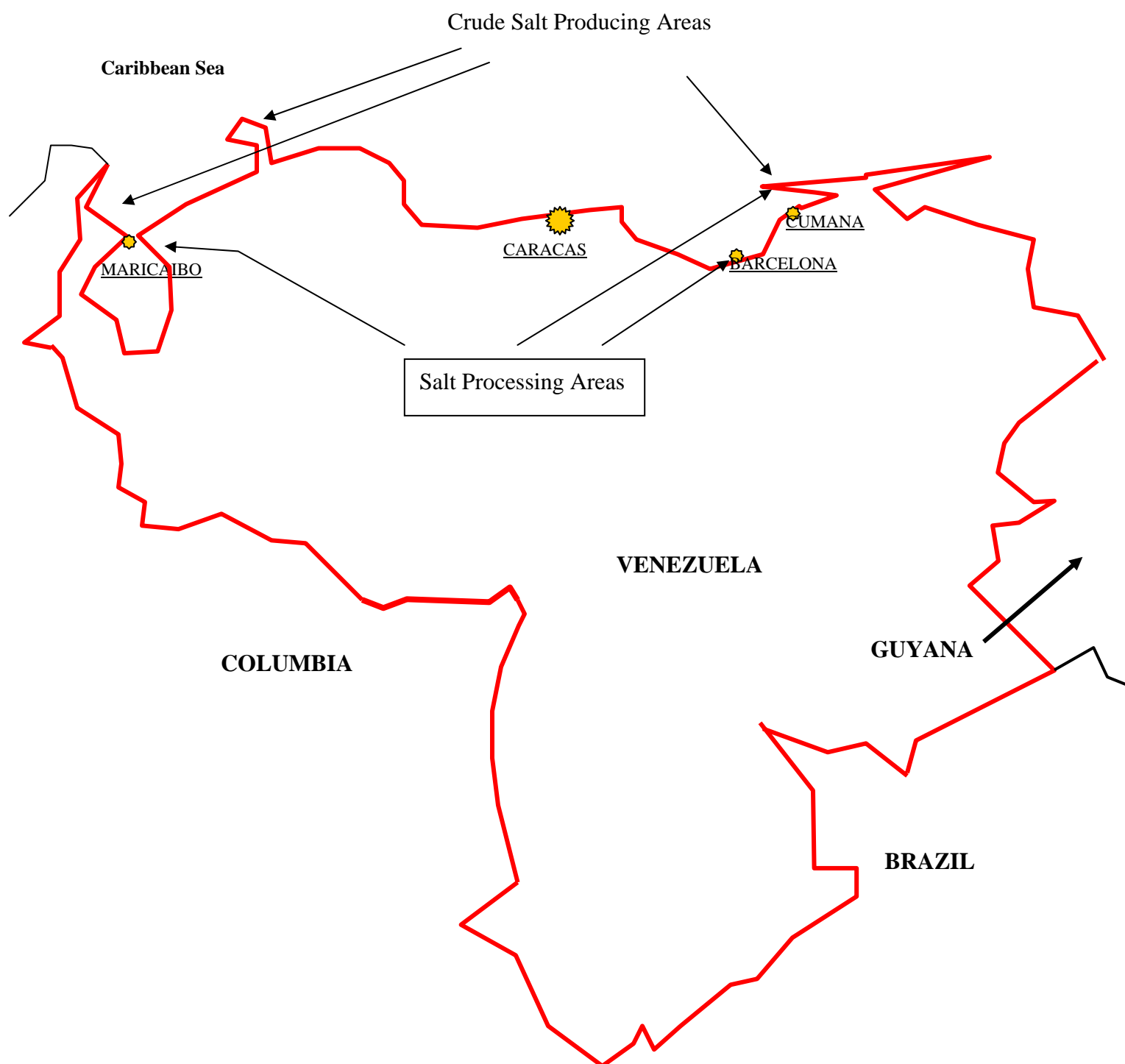
Venezuela produces about 700,000 ton per year of crude salt, all from solar evaporation of seawater. There is sufficient installed capacity in terms of evaporation pond area to produce an additional 200,000 to 300,000 ton per year. Most of the crude salt production is concentrated in two areas along the Caribbean coast. See **Figure 1** below. These areas are along the **Gulfo de Venezuela** and on the **Arya Peninsular**

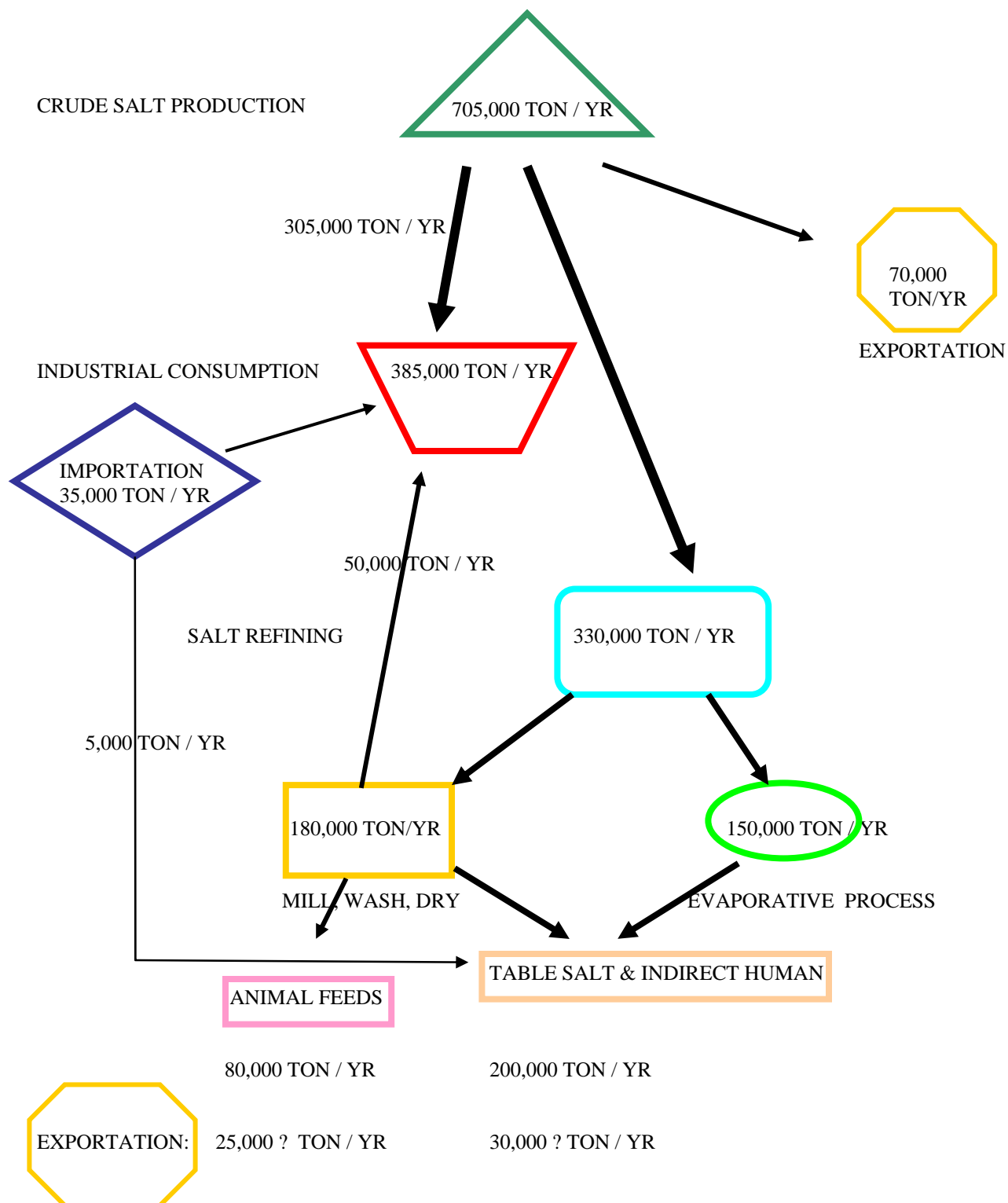
The smaller producers are concentrated along both sides of the **Gufo de Venezuela**. On the Peninsular of **Punto Fijo** and **Arya** are located the two largest salinas in Venezuela, **Araya** being the largest. Both these salinas until recently were owned by the government.



This enterprise, previously known as **Ensal** along with the previous government salt marketing and distribution company has been privatized.

Figure 1: Diagram Showing Crude Salt Production and Salt Processing Areas in Venezuela



**Figure 2: Diagram Showing Salt Flows and Balance for Venezuela**

The majority of the annual salt production is used for non-food industrial purposes. As may be seen in **Figure 2**, page 10. A total of approximately 380,000 ton per year of salt is used for industrial purposes. About 330,000 of this is utilized directly as crude, with little or no processing. The main users are the petroleum industry where low magnesium salt is an important ingredient of drilling mud. Other major users are the chlor-alkali industry for the making of chlorine, caustic soda and poly-vinyl chloride plastic. Almost all the imported crude salt is for the use in the production of chlorine.

The approximately 50,000 ton per year of processed salt, (**wash, mill & dry**) that is used for industrial purposes is used mainly in the chemical and pharmaceutical sectors.

As is seen from the **Figure 2**, page 10, the remaining crude salt is raw material for the salt processors. About 150,000 ton or 45 % of the salt processed is done by the **dissolution and evaporative** method in two plants. The remaining 180,000 ton or 55% of crude salt is processed by the approximately 12 processors, mainly medium and small, who use the **mill wash and dry** processing method.

There has been for many years now a program of iodization and fluoridation of salt in Venezuela. The iodization program began in 1966 and in 1975 laws governing the standards and control of iodized salt were passed. In 1993 fluoridation of salt was started. In 1994 the laws were promulgated to include standards for both iodized and fluoridated salt. These regulations state that:

**"The level of Iodide (I) in salt should be between a minimum of 40 mg I/kg salt (ppm I) and a maximum of 70 mg I/kg salt (ppm I).
The level of Fluoride (F) in salt should be between a minimum of 60 mg F/kg salt (ppm F) and a maximum of 90 mg F/kg salt (ppm F)."**¹

Since 1993 the responsibility for the national fluoride and iodide programs has been with **Comision Nacional de Yodacion y Fluoracion de la Sal**, or **CONYFLUSAL**. The symbol of the seal of approval of **CONYFLUSAL** is displayed prominently on salt packaging containing fluoridated and/or iodized salt. **CONYFLUSAL** is a section of **INN**, the **Instituto Nacional de Nutricion**.

¹ Resolucion No G-1.858 del 29-11-93, Gaceta Oficial No 35.539 de fecha 05-09-94. (Original in Spanish)

3.

VISIT TO SMALL & MEDIUM SIZE SALT PRODUCERS, ALESCA, MOLISOCA, PRODISAB, MOLIENDA EL CARMEN, PROSALCA & INDULSACA:

1 Alimentos la Esmeralda C.A. (ALESCA)

Alimentos la Esmeralda C.A. or ALESCA, is a medium size salt processor situated in Maracaibo. **ALESCA** is managed by Dr Carlos Nava, Vice President, along with a proficient team that includes Ing. Alberto Barros, described by many as the "grandfather" of salt in Venezuela. It is situated within a walled compound and has access to wharf facilities, where salt in 4000 ton to 8000 ton shipments is unloaded directly. The salt is obtained from a variety of sources. These include Tecnosal in Araya, Columbia, and Inagua in the Bahamas. The cost of crude salt is in the order of U\$23 per ton CIF, landed at the factory.

The plant has a capacity of 100 ton per day, or 30,000 ton per year domestic salt. The process employed is the standard **mill, wash and dry** process, see **Figure 4**, overleaf. In the case of **ALESCA** there are many imaginative but simple engineering techniques employed that improve the effectiveness and reliability of the equipment and hence add to the efficiency of the process, and lower the overall production costs.

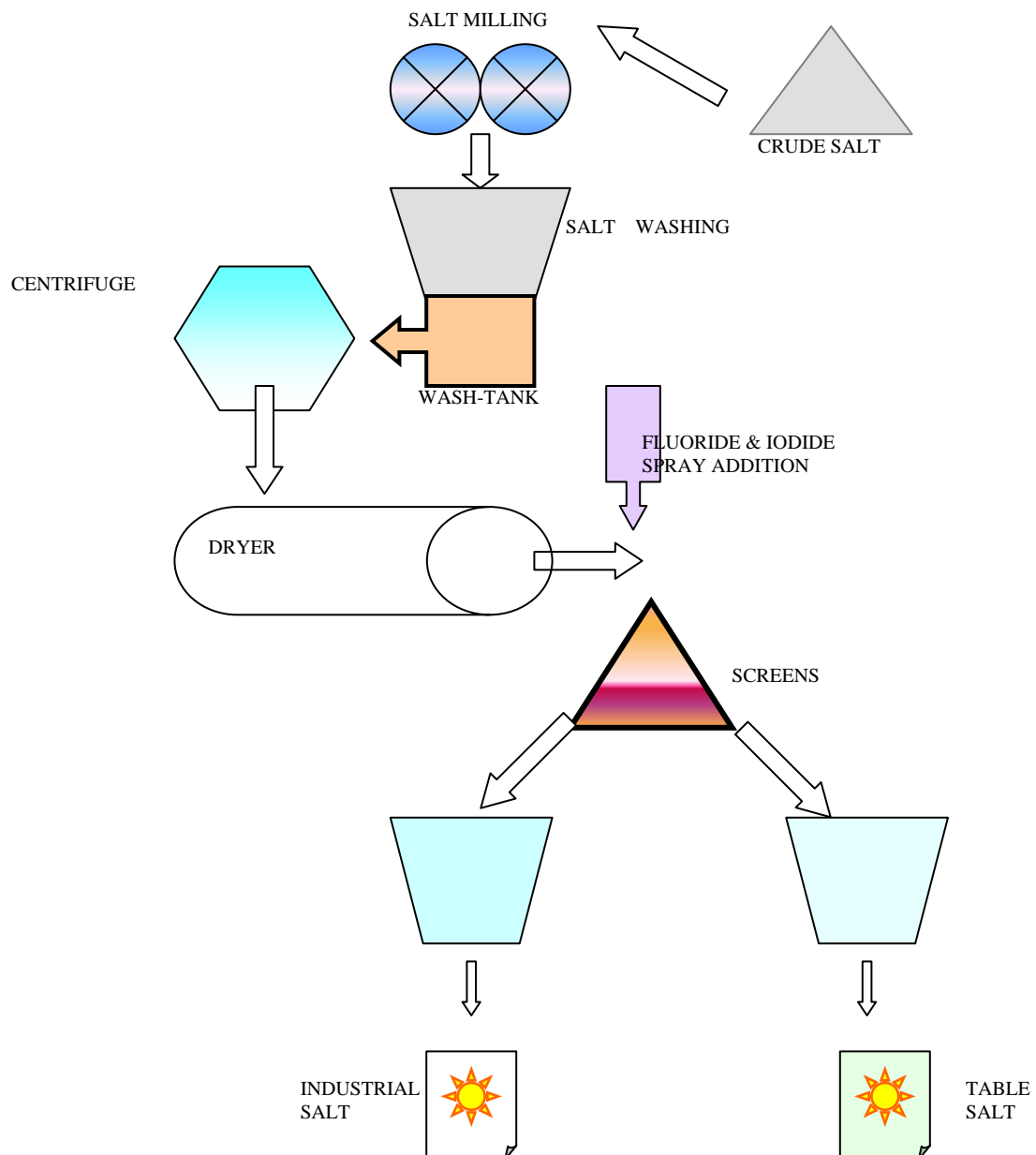
In addition to producing domestic salt there are facilities for the washing of, then the packaging of crude salt for industrial use. During washing, sodium hydroxide is added to precipitate magnesium hydroxide, in order to eliminate the magnesium content of the crude salt. In addition some of the washed crude salt is then milled, and packaged in 50kg sacks, see **Figure 3**, below. This is used mainly by the oil-drilling sector that requires a magnesium-free salt to make drilling mud.



Figure 3: Alimentos La Esmeralda C. A. 50kg Package
of Washed and Milled Crude Salt Marketed to the
Petroleum Sector

For the manufacture of domestic salt, the crude salt is first manually "picked" of stones and any other foreign matter. This is done while the crude salt is travelling on a conveyor belt to the mill. During milling the large crude salt crystals are reduced in size. The salt then falls into a wash tank where the dirt and extraneous matter are washed off by clean saturated brine solution.

Figure 4: Diagrammatic representation of the Mill, Wash and Dry Salt Process, Used by Alimentos la Esmeralda C.A. (ALESKA)



The clean salt forms a slurry with the brine solution and is pumped to an "Escher Wyss" brand centrifuge that separates the salt from the brine solution. The resulting dewatered salt is at about 5 to 7% moisture. This dewatered salt is then conveyed to one of three rotary dryers in parallel.

The dryers are good examples of the local engineering innovation being employed. Firstly they are very efficient and perform well their function of drying the salt. Secondly they are very easy and relatively cheap to construct. Thirdly, they are trouble and maintenance free. The disadvantage is that depending on the thickness of metal employed in their construction they only last 3-5 years. However this is the compromise that is struck between buying an equivalent factory made rotary kiln dryer for over US\$100,000 with expensive and sometimes troublesome infrastructure and appurtenances, e.g. large gearboxes, steam coils etc. In this case the Venezuelan made dryer costs under US\$15,000.

Air heated by burning Liquefied Petroleum Gas, (LPG), drives the moisture out of the salt. At the exit of the dryer the salt is very close to 0% moisture and at about 170° C. As the salt falls from the dryer exit into a bucket elevator it is sprayed with dosing solution containing Potassium Fluoride, Potassium Iodate and Yellow Prussiate of Soda, (YPS). YPS is an anti-caking agent.

The result of spraying the dosing solutions on the hot salt results in evaporation of the water carrying the additive chemicals, and leaves behind the additives coating the salt particles. The dosed salt is then mixed by the action of the bucket elevator scooping up the salt then dumping it down a chute into the packaging bin. This ensures complete dispersal of the additives throughout the salt.

The larger salt particles or **sal gruesa** is then separated by means of moving screens. The larger particle size salt is packaged separately under the brand name of **Sal pa Queso**, see **Figure 5** below. This salt is used in the production of cheese.

**Figure 5: Alimentos La Esmeralda C. A. 25kg
Package of Salt Brand, Sal Pa Queso, Marketed to
Cheese Makers**



The smaller particle size salt is stored in bins prior to being packed. Two sizes are packaged, 1 kg and 25kg. Three lines using rotary cup volumetric fillers fill 1kg salt packs. The lines can pack at the rate of 100 ton or 100,000 1 kg packs per 24 hr day. The rate of each machine is in the order of 20-25 packs per minute. The 1 kg packs are

packaged under two brand names, see **Figure 6** below. A total of 20 persons, mainly women work in the 1 kg packaging section.

Figure 6: Alimentos La Esmeralda C. A., La Esmeralda and La Caribeña Brand in 1 kg packs:



The other salt size is 25 kg bulk sacks. The same two brands of domestic salt are packaged in bulk, mainly for institutional use. Their packaging design is the same as for the 1 kg package. A rotary gravimetric filler designed and built in-house is used for bulk filling. Both 1kg packs and 25kg bulk sacks contain salt that is both fluoridated and iodized.

In addition, some larger particle size salt, **sal gruesa**, is packaged as industrial salt. Minerals are added to a portion of this salt, and is packaged and sold as animal salt. See **Figure 7** below.

Figure 7: Alimentos La Esmeralda C. A. La Esmeralda Brutus Lavada Sal Industria and La Esmeralda Sal Mineralizada in 25kg packs:



There are full laboratory facilities available at **ALESCA**. Regular laboratory checks are conducted on the raw material, in process and finished product salt. Good and consistent results are obtained at the present fluoride target of 90 ppm and iodide at 50 ppm. Weight checks on package contents are done regularly.

In summary, ALESCA is a well run and efficient operation. Good engineering innovation is demonstrated in their equipment choices. Quality control with respect to iodide and fluoride addition is good with consistent results obtained. The personnel was observed to be knowledgeable and enthusiastic. Improvement in the handling and storage of additive chemicals, especially fluoride, is needed.

2. Molinos Los Socios C.A. (MOLISOCA) :

Molinos Los Socios C.A. or MOLISOCA is located in Maricaibo. It has a plant capacity of 2.5 ton per hour, or equivalent to 18,000 ton per year. The facilities are located within a walled compound and contain separate buildings for offices, plant and warehouse area. A laboratory is under construction. Within the compound is a crude salt stockpile area and salt washing facilities. The facilities are neat and well organized. Housekeeping is excellent.

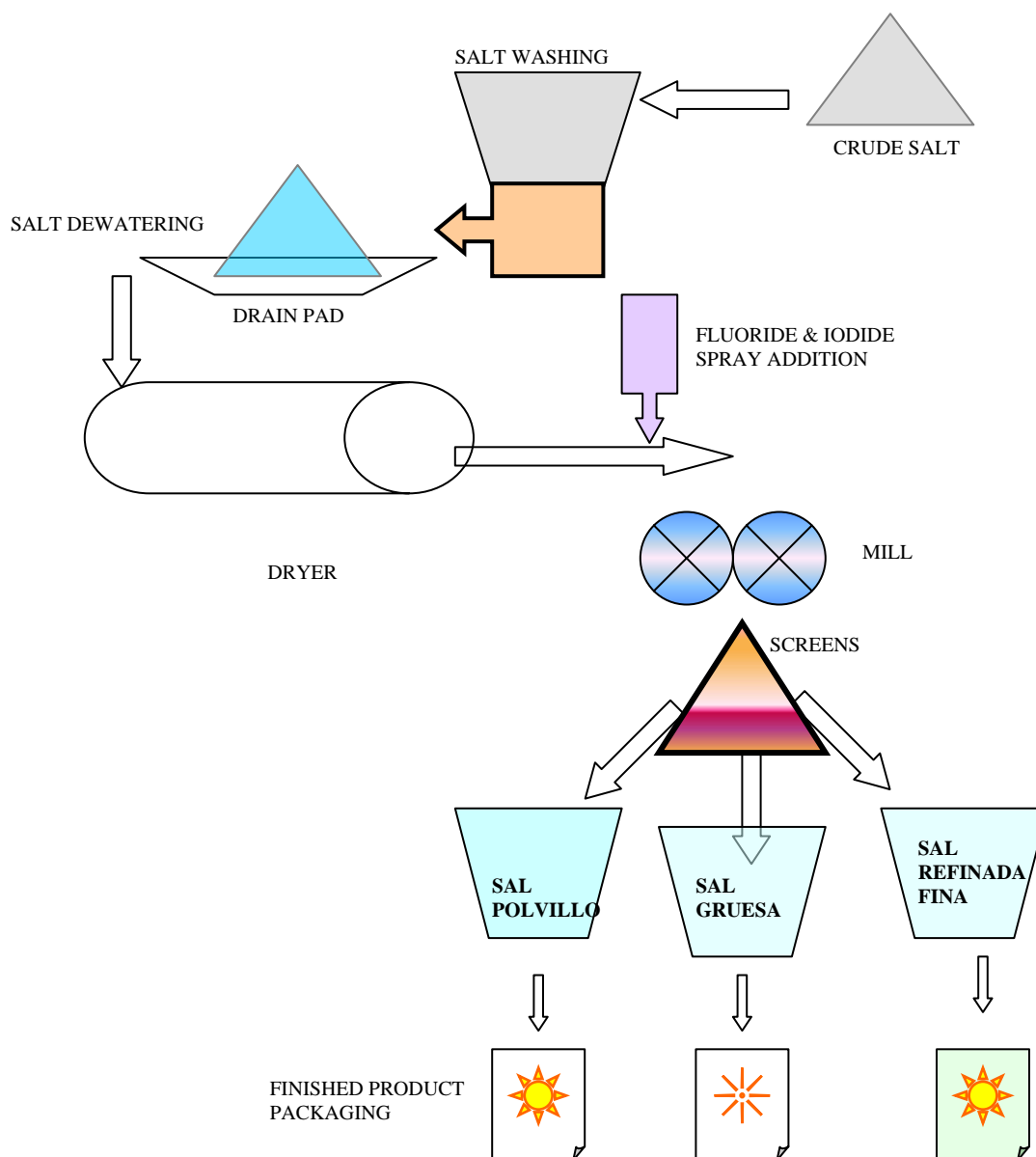
The process used is a modified **wash, mill and dry** process. In the case of MOLISOCA the salt is milled after drying. See **Figure 8**. The crude salt is conveyed to a series of washing tanks. These are of simple cuboid design, and concrete construction. Here, clean brine removes dirt and extraneous matter. The brine is settled, filtered and recycled in order to reduce wastage. This is done in another series of concrete basins. Every couple of months the accumulated dirt that has settled over time in the settling basin is cleaned out. The washed salt is then allowed to dewater by gravity after being heaped onto a dewatering pad.

The washed and dewatered salt is then conveyed to the dryer. The dryer which is locally designed and fabricated is made of stainless steel. It is 6ft long by 2.5ft diameter. It revolves at 18 revolutions per minute, (rpm), and has a 5% slope to aid in the retention of the salt. A LPG burner inserted at the exit end of the dryer provides heat.

The fluoride and iodide additives are sprayed on to the salt as it exits from the dryer. This is done as the salt falls into an entrance chute to a bucket elevator. The additives are sprayed on in solution form. They are made up and stored in dosing tank located on a platform 25ft higher than the dryer exit. A pump is therefore not needed to deliver and spray the additive solution at the point of addition, as the gravitational head is sufficient.

After dosing, the salt is conveyed by means of a bucket elevator to approximately 30ft high. It is then chuted a short distance to a hammer mill. This hammer mill is driven by a 25hp motor and revolves at 1800rpm. As mentioned earlier, this is a departure from the standard **wash, mill and dry** process, where the salt is normally milled before drying. The main advantage is that less power is required to mill the salt, since dry salt is more brittle and shatters easier. It also flows through the mill better without clumping or sticking to the mill walls. The main disadvantage is the creation of more dust than otherwise. This problem is overcome adequately by MOLISOCA by more attention to housekeeping details.

Figure 8: Diagrammatic Representation of the Mill, Wash and Dry Salt Process, Used by Molinos Los Socios, (MOLISOCA) & Procesadora y Distribuidora de Sal Benito, (PRODISAB)



After being milled the salt is then screened to classify the various particle sizes. The coarse salt, i.e. 6 to 8mm in diameter is **sal gruesa** and is used in cheese production. The medium sized particles, between 1.2 mm to 2.5mm is called **sal refinada fina** and is used for domestic salt. The finest particles sizes, those less than 1.2 mm are known as **sal polvillo** and are marketed to the bakery industry and chemical laboratories, mainly for use in detergent formulations.

The **sal refinada fina** is packaged in 1 kg packs, for household use, and 25 kg, for bulk institutional use. See **Figure 9** overleaf. The packaging of **sal refinada fina** in 1kg sacks,

is done in a packaging room adjacent to the plant. The packaging is done semi-manually. Normal packaging rate is 12.5 ton per 8hr day, which is equivalent to 12,500 1 kg packs. Eleven persons, mainly women make up the packing crew.

Storage of iodide and fluoride chemicals is done properly at MOLISOCA. A storage room that can be locked contains the fiber drums of chemicals neatly stashed. Handling procedures are clearly written, with all involved conscious of the correct way of handling the additive chemicals.

At present laboratory analysis is irregular. The enterprise is constructing a laboratory to be able to carry out all necessary analysis in-house.

Figure 9: Molinos Los Socios C. A., La Nieves Brand in 1 kg Packs (Front and Back of Package)



Although a small producer, MOLISOCA knows very well the value of good marketing. This is reflected on the design and quality of their packaging. On the 1 kg packs both panels, front and back are used advantageously to extol the virtues of their salt.

Sal gruesa and **sal polvillo** are packaged directly into 25 kg packages. See **Figure 10** below.

Figure 10: Molinos Los Socios C. A., La Nieves Brand in 25 kg packs, and MOLISOCA Brand Sal Uso Industrial Refinada Gruesa in 25 kg pack.



In summary, MOLISCA is one of the most innovative and best organized and managed small plants seen anywhere by this consultant. The completion of the laboratory and its incorporation into the day to day quality control of the operation should make MOLISCA a truly model plant.

3. Procesadora y Distribuidora de sal Benito (PRODISAB):

Procesadora y Distribuidora de Sal Benito is located about 5 miles outside of Maricaibo. It is owned and operated by Sr. Euro Sota. It may be categorized as a micro-plant, having a capacity of 1.0 ton per hour or 6,500 ton per year. However this plant and others like it of similar size in Venezuela have shown that a well designed, well constructed, well operated, well managed facility can be as efficient as, and compete with the giant players. The plant is undergoing extensive reconstruction and is incorporating many of the best features of some of the plants described in this report.

The process being utilized is the **wash, mill and dry** one. See **Figure 8**, page 17. The salt is washed in a wash basin then transferred for draining on a drainage pad. It is then fed to the dryer. The dryer is indirectly heated, with 10 LPG flames heating the outer shell of the dryer. This in turn heats the salt that it contacts with. The dryer is 18ft long and 2 ft in diameter.

It is proposed to dose the salt at the exit of the dryer by spraying on a solution of iodide and fluoride. The dosing will occur, as the salt is leaving the dryer and is being fed to a hammer mill for particle size reduction.

The salt after milling will then be conveyed to storage bins prior to packaging. Packaging is only in 25kg sizes, see **Figure 11** below, marketed mainly to institutions.



Figure 11: Procesadora y Distribuidora de Sal Benito
Bulk Salt in 25 kg Packs

The plant being extensively rebuilt by **Empresa de Sal de San Benito** involves an expenditure of Bs 35 million, or about US\$70,000. This is very good value for money. The plant design will ensure a trouble free and low maintenance operations whilst producing a good quality salt product.

7. Procesadora Occidental de Sal C. A. (PROSALCA):

Procesadora Occidental de Sal C.A. or **PROSALCA** has a factory in Maricaibo and is owned and operated by Sr Vittoriano Tenerelli. He is a relative new comer into the salt processing business having previously been involved into the distribution of crude salt for animal feed production. The plant started a little over one year ago in October 1996. The production capacity of **PROSALCA** is 1.5 ton per hour or 11,000 ton per year. His marketing strategy deliberately targets the lower price segment of the market. Hence the brand produced, **Sal Corona** is of visibly lower quality with respect to packaging, presentation and particle size.

The process is that of mill wash and dry. See **Figure 13** overleaf. Again this producer shows many innovations. The crude salt is loaded into a conveyor to the hammer mill that reduces particle size. The milled salt falls into a wash tank that is agitated to assist the effectiveness of washing. Dewatering takes place, quite ingeniously, by using an inclined screw conveyor, which at the same time conveys the salt into the dryer.

The addition of iodide and fluoride takes place in the inclined screw conveyor. Thorough mixing of the additive chemicals with the salt therefore occurs.

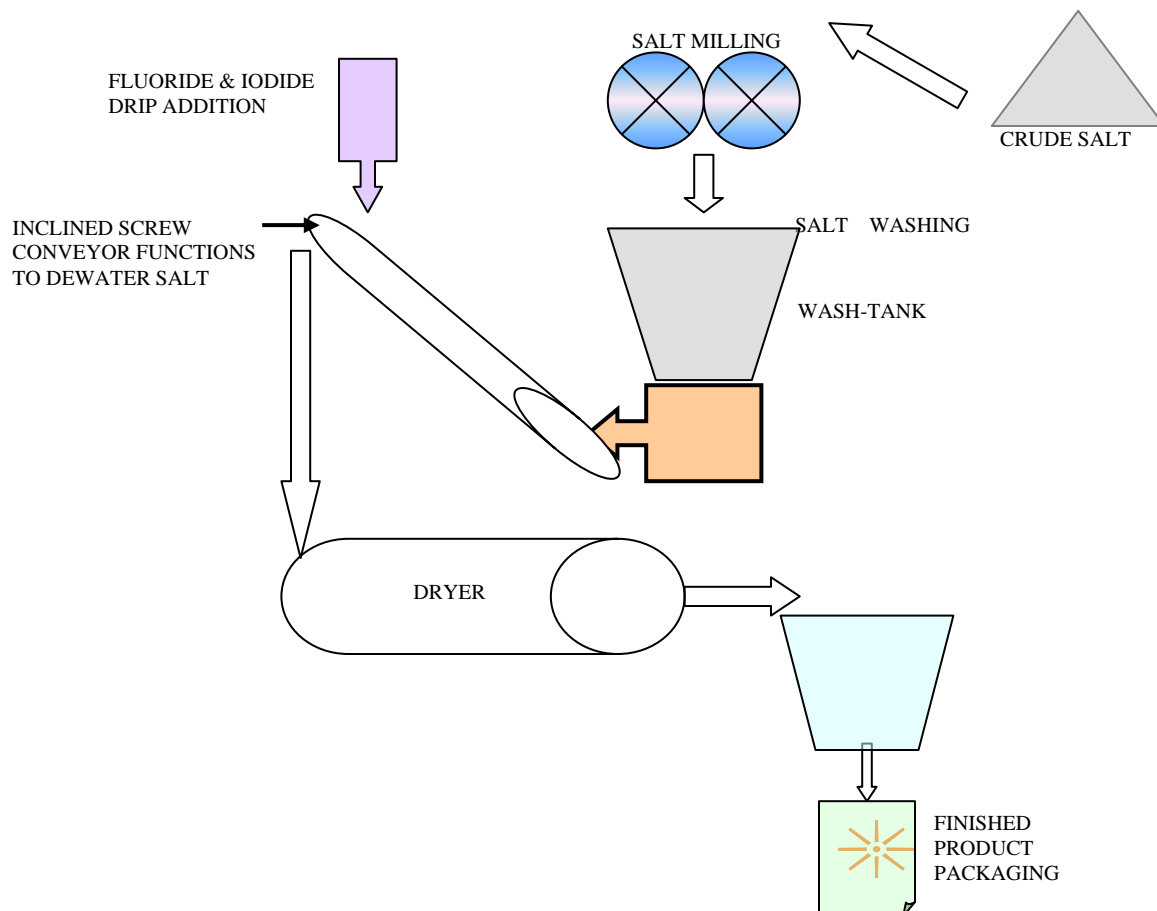
After drying the salt is transferred to the packing room. There it is placed on packing tables and manually packed by women workers. The brand produced is know as **Sal Corona** and is packed in 1 kg packs. See **Figure 12** below.



Figure 12: Procesadora Occidental de Sal C.A Sal Corona Brand in 1 kg Packs

PROSALCA operations whilst being innovative, contains some inefficiencies. There are many manual aspects of the present operation. The weaknesses are however being tackled by the owner/manager, Sr Vittoriano Tenerelli. He explained that **PROSALCA** would be moving facilities by mid 1998. The new factory would be located in an industrial estate section of Maricaibo. The new facility is presently being designed, and it will incorporate all the techniques to produce salt of a high quality as efficiently as possible. All the equipment will be purchased or fabricated locally.

Figure 13: Diagrammatic Representation of the Mill, Wash and Dry Salt Process, Used by Procesadora Occidental de Sal C.A. (PROSALCA)



6. Molienda el Carmen S.R.L.:

Molienda el Carmen is located in Maricaibo, and produces the **Sal El Carmen** brand, the best known brand of salt in Venezuela. It is a family operation run by Dr Olmedo Rodriguez, a lawyer by profession. The brand is so well known that it has been the target of counterfeiters. The plant capacity is 2.5 ton per hour or 18,000ton per year. The plant however only operates 8 hours per day and so is only 33% utilized. All of **Molienda El Carmen's** production is marketed as industrial salt for use in the food industry.

The process employed is a **wash, mill, dewater and package** process. See **Figure 15** overleaf. The crude salt is first washed by clean brine in a wash tank. It is then milled in slurry form to reduce particle size. The salt slurry is then dewatered by means of a centrifuge.

Iodide solution is added by pump just at the exit of the centrifuge. The salt exiting the centrifuge is heaped on the plant floor and packaged manually by shoveling into 25 kg sacks. See **Figure 14** overleaf.

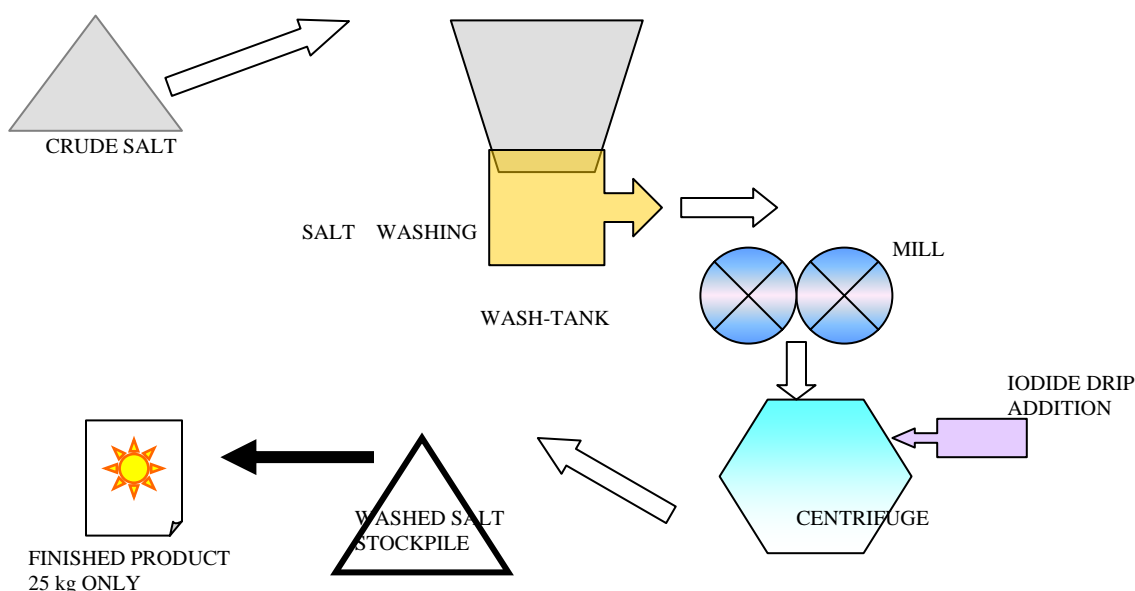


Figure 14: Molienda el Carmen Sal El Carmen Brand Bulk Salt in 25 kg packs

The overall operations, organization and housekeeping at **Molienda el Carmen's** is in need of improvement. As a result of the process, salt quality is below what may be considered normal international standards. Moisture content in the packaged salt is 4 -5 %. The irony of the **Molienda el Carmen** situation is that this enterprise was the first salt processor in Venezuela and at the time carried the quality of salt available in Venezuela to a new level. Like everything in life and industry if one stands still and fails to continuously improve, one will be overtaken by the competition.

Ideally, **Molienda el Carmen** needs to install a dryer in order to bring their salt to the standard required for fluoridation. However, **Molienda El Carmen** is in a special situation. It only produces industrial salt in 25kg packs. This salt is used by food processing plants in bulk. The salt is used a sack at a time. The problem of migration of fluoride within the pack will not be material in this case. It is therefore the consultant's considered opinion that in the specific case of **Molienda El Carmen** that fluoridation of salt as is, could be implemented. Obviously if the situation described changes this recommendation would no longer be valid.

Figure 15: Diagrammatic representation of the Mill, Wash, Dewater & Package Salt Process, Used by Molienda El Carmen



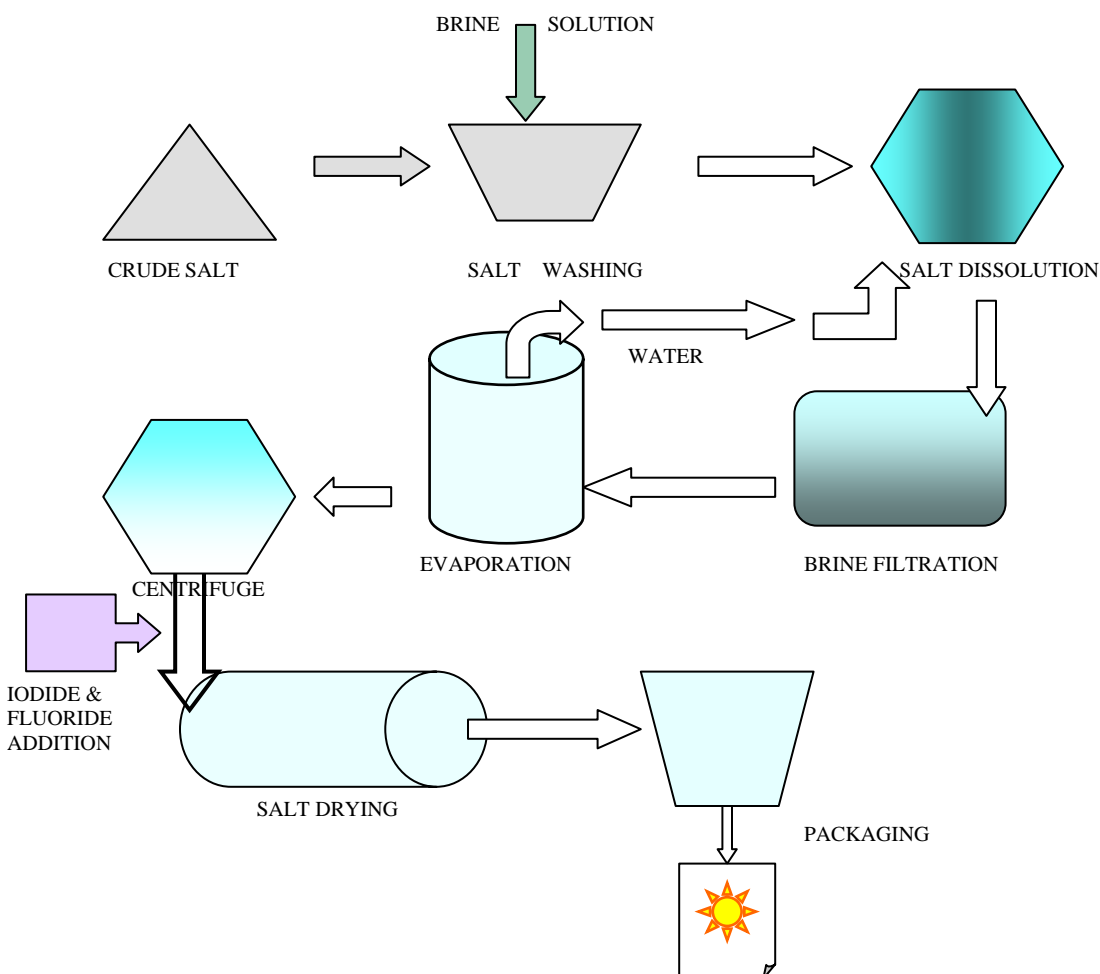
10. Industrias Salineras C.A. (INDUSALCA):

Industrias Salineras C. A. or INDUSALCA is located in Maricaibo. It is a family business run by Sr. Vincente Juaristi and his two sons, along with other related engineering and fabrication businesses. The plant's production capacity is 80 ton per day equivalent to 24,000 ton per year.

Crude salt is brought by boat from the company run salinas on the peninsular of Fijo.

The process employed at INDUSALCA is the dissolution and evaporative process. In this process, salt is first dissolved in a large dissolution tank. Dirt and other insolubles are allowed to settle. The resulting brine solution is filtered and then heated to begin evaporation. The brine is heated through a series of counterflow heat exchangers in what is known as a triple effect evaporator. After the heating process is completed the brine is then flashed or evaporated. Water is boiled off until at the end of the triple effect the brine is saturated and ready to be seeded or crystallized. See **Figure 16**, below.

Figure 16: Diagrammatic representation of the Evaporative Process for Salt Refining Used by INDUSALCA:



After crystallization is complete the resulting salt slurry is dewatered by means of a centrifuge. At the exit of the centrifuge, potassium fluoride, potassium iodate and the anti-caking compound YPS is added in solution form. The drying process follows, removing water from the salt and homogenizing the salt and additives.

The resulting dry product salt is stored in bins prior to packaging. Because of the dissolution and evaporative process used, the product salt is perfectly clean and white. In addition all the crystals are regular and of the same size. The product quality is superior to salt produced by the **mill, wash and dry** method. But in addition to higher quality, the costs of production are also higher. This is so because there are higher capital, maintenance and energy costs for this type of plant. Because of the higher quality and the higher cost of production the salt sells for a premium above **mill, wash and dry** salt.

The salt is packaged under the **Monte Blanco** brand. There are two package sizes, 1 kg and 25 kg bulk sacks. See **Figure 17** below.

Figure 17: INDUSALCA's Monte Blanco Brand of Refined Salt in 1 kg & 25 kg Packages



INDUSALCA also enjoys a reasonable segment of the crude salt market. This is supplied in bulk from their salinas or in 50kg sacks. They market about 25,000 ton per year of crude salt.

4. VISIT TO LARGE SALT PRODUCERS, SAL BAHIA & TECNOSAL

1. Distribuidora Sal Bahia, C.A.:

Distribuidora Sal Bahia or **Sal Bahia** is located in Barcelona in the province of Anzoategui. It is the largest salt processing facility in Venezuela. It is a modern and well-organized facility. Efficiency of operations is high and it ranks on par with any international company in its field. The management team is efficient and competent in addition to being quality, cost and export oriented.

Sr. Miguel Tsoukatos, who is the **Director General**, owns **Distribuidora Sal Bahia**. **Ing. Jose Luis Ocque** is the **Gerente de Planta**. In addition, there are the normal line and functional departments of any modern organization such as an export department, public relations department, and laboratory and quality control department.

The plant is situated on a large, over 25 hectare, beautifully kept compound. All of the facilities required for such a large operation are on site. For example the plant generates its own electricity using 4 large Caterpillar brand LPG generators. There are actually three salt processing plants. Their total capacities are 400 ton per day, or 240,000 ton per year. A **dissolution, evaporation and drying** plant produces fluoridated and iodized table salt in a variety of packages. A similar sized plant of the **mill, wash and dry** process produces industrial salt in a variety of packages. Finally there is a plant which produces animal feed salt.

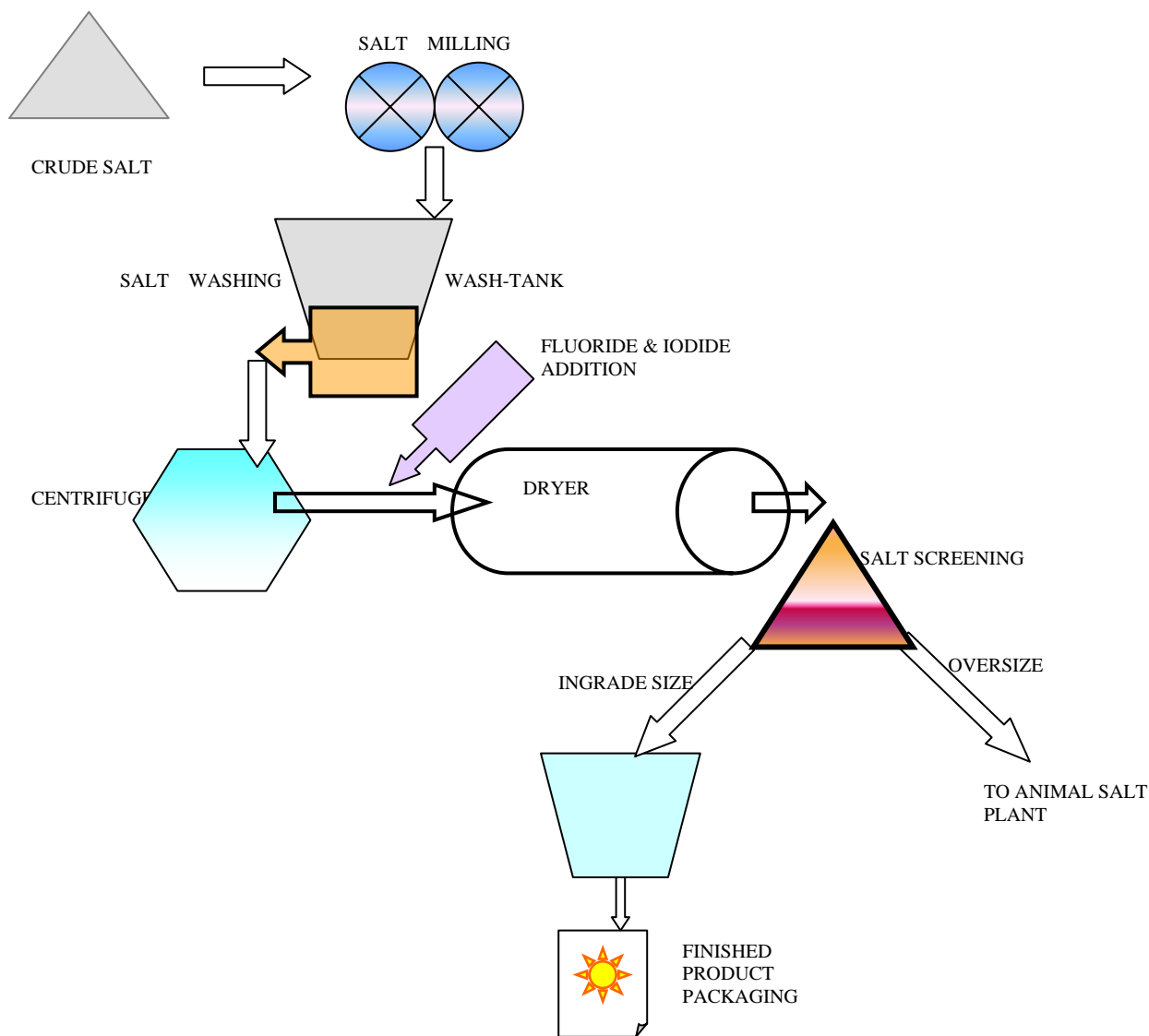
All three plants begin at the crude salt stockpile, which has a capacity of 30,000 ton of crude salt. The crude salt is obtained from the Tecnosal salinas in Araya, and is transported to Barcelona in barges and trucks.

For the **mill, wash and dry** plant the process is conventional, only on a very large scale. The salt is milled, washed, then dried. See **Figure 18**, overleaf. Milling is done by rotating hammer mills, which serves to reduce the particle size of the crude salt. The salt is then washed by clean, pre-treated brine that removes dirt and extraneous matter. The clean salt is then conveyed to the dryer.

The dryer although heated by LPG is indirectly fired. That is, the salt is not in direct contact with the burner flame, but by hot air heated by the flame. Fluoride and iodide solution is added just prior to the salt entering the dryer. In the case of **Sal Bahia** potassium fluoride and potassium iodide is used to provide fluoride and iodide. The potassium fluoride used is purchased as a liquid solution. The use of iodide is a departure from most of the other producers where potassium iodate is used. Anti-caking and free-flowing agents are also added.

After drying, the salt is classified by moving sieves according to particle size. The large oversized particles are fed to the animal salt plant, as a larger size salt particle is required there.

Figure 18: Diagrammatic representation of the Mill, Wash and Dry Salt Process, Used by Distribuidora Sal Bahia



In grade product is then conveyed where packaging in a variety of sizes takes place. These sizes range from 5kg to 25kg packages. **Figure 19** overleaf, shows the 25 kg pack of industrial salt.

For the production of animal salt the process is the same except for a few modifications. The particle size reduction is not as great as larger crystals are required. Animal salt is

iodized but not fluoridated. After size classification a dry mineral additive is added. The iron oxide in the additive imparts a red hue to the salt, which is then packaged in 25kg sacks. Sal Bahia is presently constructing a new, 1250 square meter warehouse specifically for the storage and distribution of animal salt. **Figure 19** below shows the 25 kg pack of animal salt.

Figure 19 : Sal Bahia Industrial Salt and Animal Salt in 25kg Sacks



The other plant is the Sal Bahia's state of the art, table salt plant. The plant is very impressive. The process employed is the **dissolution, evaporation and drying** process. The result is top quality table salt in terms of chemical purity, consistency of particle size and white coloration, free from visible impurities. This is complemented by equally state of the art packaging facilities. Hence first class product is placed in first class packaging to give an overall first class appearance.

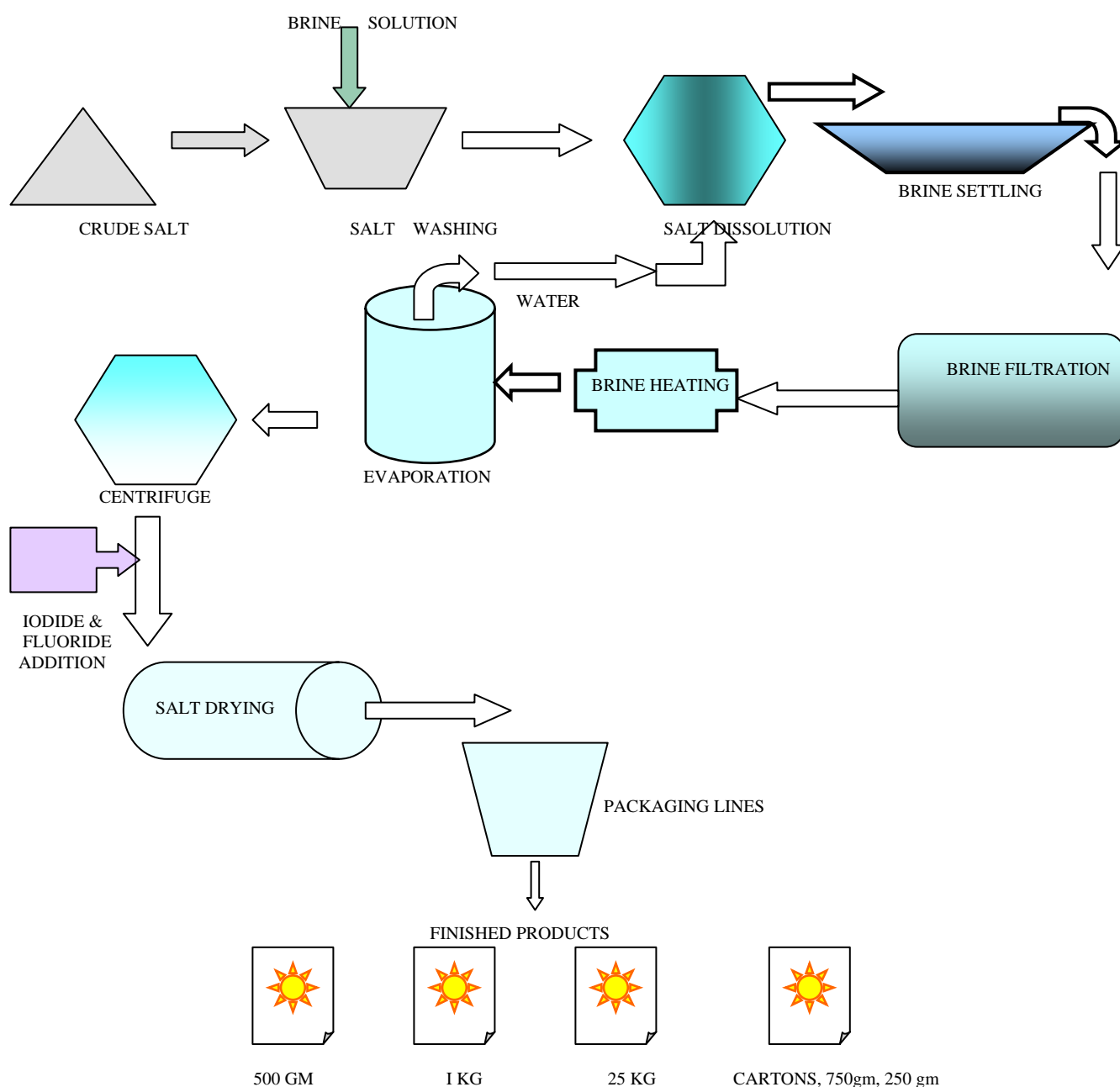
The process begins in the salt stockpile area where dissolution of the salt begins. The brine solution is then pumped over to the plant where purification of the brine takes place. This involves settling larger sized impurities, then chemical treatment of the brine by the addition of sodium hydroxide to precipitate calcium, magnesium and iron impurities. Final purification of the brine is the filtration of particles too fine to settle out.

Heating of the brine solution then takes place. The steam being removed from the evaporation of previously heated brine solution does this heating. When the brine solution has reached the correct temperature, evaporation or flashing takes place. All of this takes place in triple effect evaporators where the final effect is under vacuum. These evaporators are really the heart of the system. Since evaporation of the salt has created a saturated salt solution, crystallization is ready to take place. After crystallization, the salt

slurry is dewatered by centrifugation. Drying then takes place in an indirectly fired salt dryer. The fluoride and iodide solution is sprayed on just prior to the salt entering the dryer.

The dried finished salt is temporarily stored in silos then sent to the packaging building for packaging and warehousing.

Figure 20: Diagrammatic Representation of the Evaporative Process for Salt Refining Used at Sal Bahia:



The packaging lines are equally impressive. There are 12 stations that package 0.5 kg and 1.0 kg sacks. These lines are being upgraded from the present volumetric fillers to new form, fill and seal machines. The new machines are Venezuelan made, costing about U\$100,000 each. The present packaging machines utilize 4 persons per machine station and pack at a rate of 30 packs per minute. The new machines will probably utilize 2 persons per station, and pack at the rate of 50 - 60 packs per minute. **Figure 21**, below shows the packaging of 500 gm and 1 kg packs.

Figure 21: Distribuidora de Sal Bahia Sal Delmar and Sal Bahia Refined Salt Brands in 1 kg packs.



There are also additional stations for the packaging of 25 kg sacks under the brand names of **Sal Bahia** and **Sal Delmar**. This salt is used for industrial food processing where high purity of the ingredient salt is required, or in institutions where bulk packaging is used. **Figure 22** below shows the 25 kg bulk packs for **Sal Bahia** and **Sal Delmar**.

Figure 22: Distribuidora de Sal Bahia Sal Delmar and Sal Bahia Refined Salt Brands in 25 kg Bulk Sacks.



Other packaging is in the form of very attractive fiber canister packs. These canisters are to form the basis of export thrust to such markets as the USA. **Bahia** is in the process of setting up a fiber canister plant supplied by Sunoco Inc. This plant will manufacture the fiber canisters for the packages being used by **Bahia**. **Figure 23** below shows the carton packs of the **Sal Bahia** brand.

Figure 23: Disrtibudora de Sal Bahia, Sal Bahia Refined Salt Brands in 250 gm & 750 gm Canister Packs & Sal Bahia Lite Salt Brand in 250 gm Canister Pack.



Complete laboratory facilities are present at **Bahia**. All required analysis on raw materials, in-process and finished products are able to be performed. Statistical quality control techniques are used for package weights.

A perusal of laboratory records showed consistent results for salt quality especially with respect to fluoride and iodide content.

In summary, **Sal Bahia** is a world class operation producing a variety of high quality salt products. They will become a force to be reckoned with in the immediate geographic vicinity of Central America and the Caribbean basin. They will have no problem implementing higher levels of fluoride content in salt if the decision is made to increase this level.

2. Tecnosal Venezuela, C.A.:

Tecnosal Venezuela C.A. or **Tecnosal** has a large salinas and a processing plant located on the Araya peninsula in Estadio Sucre. There are also administrative and distribution offices in Cumana and Caracas. **Tecnosal** was formerly the government owned **EnSal**. An international syndicate including Israeli investors and George Soros, well-known financier presently owns it.

The **Tecnosal** salinas at Araya are the largest in Venezuela. It consists of a large natural lagoon, known as Laguna Madre, and a section of man-made ponds, pre-crystallizers and crystallizers constructed in 1976. These had since fallen into disuse and disrepair and are gradually being rehabilitated. Production of crude salt now totals about 400,000 ton per year. 300,000 ton from Laguna Madre and 100,000 from the rehabilitated system.

The salt processing plant that is located in close proximity to the salinas is being gradually but extensively modernized. The plant that was built in the 70s was severely run down.

The facility has two plants. One is a 100,000 ton per year capacity processing plant that makes table salt, using the **wash, mill & dry** method. See **Figure 24** overleaf. It is the largest of this type in Venezuela. Equipment is being modernized and updated. The other plant is 36,000 ton per year animal salt plant.

The salt is automatically conveyed from outside stockpiles, into the plant. Manual "pickers" take out stones and other debris. The salt is led to a large hammer mill that reduces the salt particle size. The salt is then conveyed to a second stage mill that is known as a disk grinder. This machine reduces the salt particle size further.

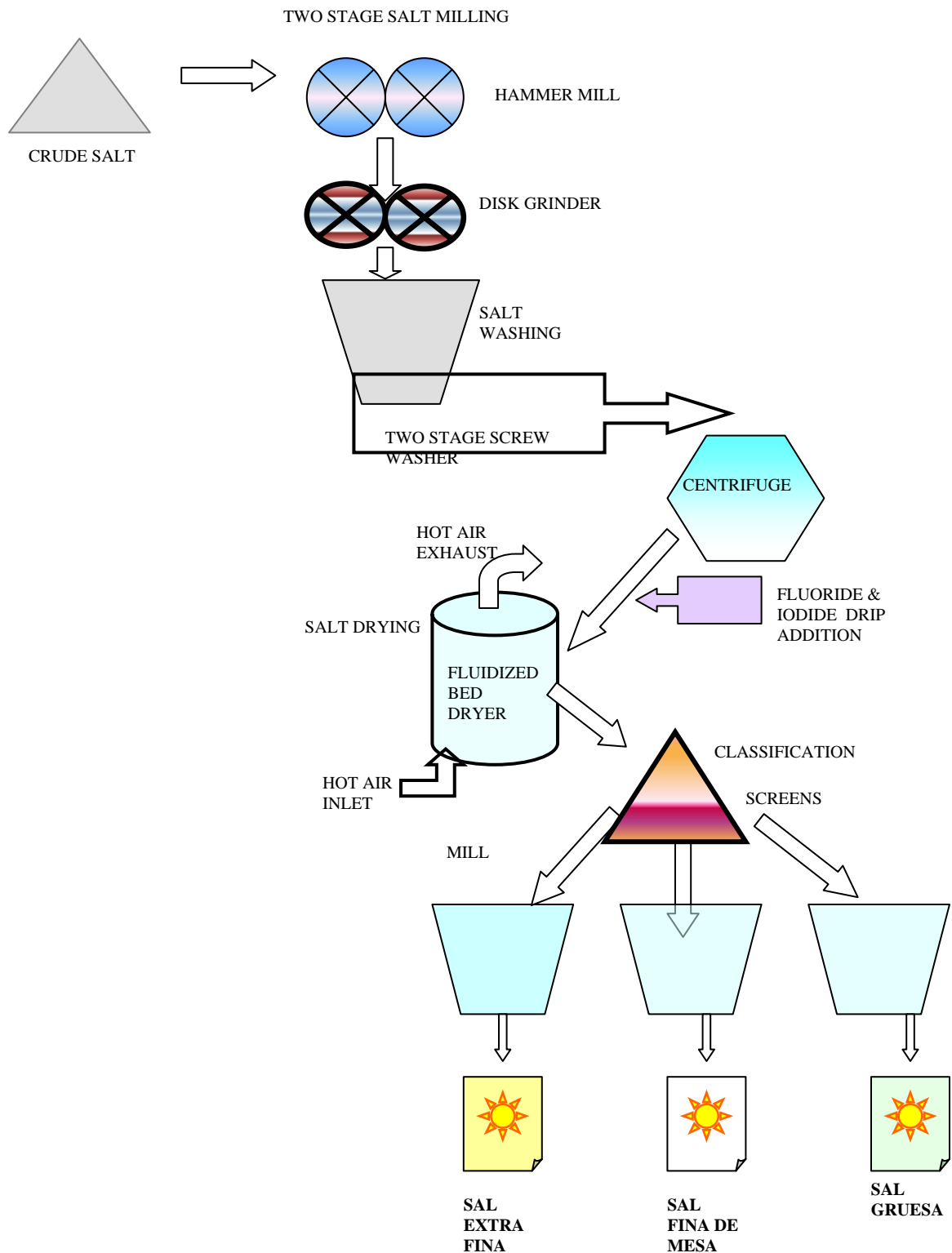
After grinding, saturated brine washes the salt in 2 stage screw washers. The salt is then dewatered by centrifugation. At the exit from the centrifuge the additives are all added in solution form. In the case of **Tecnosal** these additives are potassium fluoride, potassium iodate, sodium carbonate and YPS.

After centrifuging the salt is at about 4 -5% moisture. It then falls into a fluidized bed dryer. Hot air, which has been heated indirectly by diesel oil burners, fluidizes and dries a bed of salt. After drying the salt is classified into various particle sizes by screening.

Large vibrating screens continuously classify the salt. The size classification of the salt is as follows. Extra fine, < 0.2mm diameter. Fine, 0.2 mm diameter. Medium, 0.2mm to 0.8mm diameter.

The extra fine salt is known as **sal extra fina**. It is packaged in bulk 25 kg sacks and sold to bakeries as baking salt. The fine salt is known as **sal fina de mesa** and is marketed as domestic or table salt. The medium salt is known as **sal gruesa** and packaged in 25 kg sacks for bulk distribution. A variety of food processors use this salt.

Figure 24: Diagrammatic representation of the Mill, Wash and Dry Salt Process, Used by Tecnosol Venezuela



Sal fin de mesa is marketed in two brands, **Sal Araya** and **Ensal**. These brands come in both 25kg bulk sacks, and in 1 kg packs. The 1 kg sacks are packaged using form, fill and seal machines.. See **Figure 12** below.

Figure 25: Tecnosal Venezuela C.A Table Salt Brands, Sal Araya & Ensal in 1 kg Packs



The 25 kg bulk packaging is all done under the brand name of **Sal Araya** for **sal grueso**, **sal fina de mesa** and **sal extra fina**. See **Figure 13** below.

Figure 26: Technosal Venezuela C.A Salt in Bulk 25 kg Sacks. Sal Araya Brand for Sal Extra Fina, Sal Gruesa, & Sal Fina de Mesa



Having undergone the same process all of this salt is fluoridated. However one problem has arisen. The average fluoride level of 180 ppm in extra fine salt is about twice the average level of 90 ppm fluoride in fine salt. This is because the surface area of the

smaller particles in the extra fine salt is greater per unit weight than in fine salt. The mechanism of fluoride addition when sprayed onto the salt is to coat the salt particle with a thin layer of fluoride. The weight of this layer will be proportionately higher on the proportionately larger surface area. Hence a higher concentration of fluoride associated with finer particle size salt.

This result is a consequence of the production system and cannot be prevented. It is preferable to take this into account in the overall national fluoride balance rather than to carry out costly plant modifications to change the method of fluoride addition.

At the industrial and animal salt plant, crude salt is crushed, washed and then dried. It is then classified according to different particle sizes. The coarser grade of salt is branded as **Sal Industrial Gruesa**. The medium size fraction is branded as **Sal Industrial - Sal Comun**. The finer size fraction along with a proportion of the medium size is dosified with mineral additives and then marketed under the **SUPER A** brand as animal salt. All packaging is done in bulk 25 kg sacks. See **Figure 14** below.

Figure 27: Technosal Venezuela C.A Industrial & Animal Salt Brands in Bulk 25 kg Sacks. Sal Comun, Sal Gruesa & Super A



Full laboratory facilities are present at **Technosal** to carry out the full range of raw material, in process and finished product analysis. The latest statistical quality control techniques are employed for process control and package weight control.

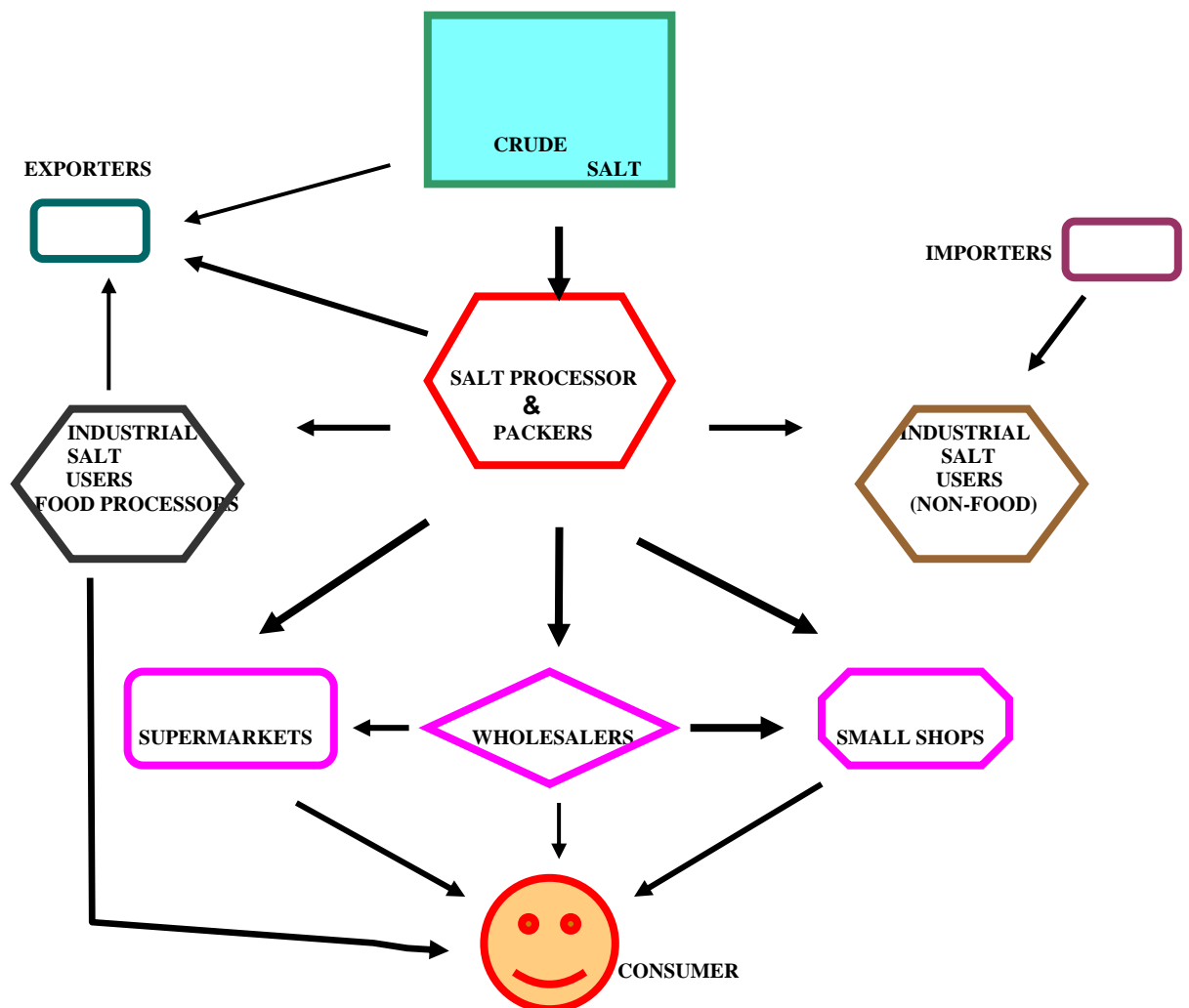
In summary, **Tecnosal** is a rapidly modernizing facility producing a variety of high quality salt products by the hydro-milling process. It has a competitive advantage by ownership of one of the largest solar salt facilities in the region. In addition although its salt quality is lower than **Sal Bahia's** its costs of production are far lower because it uses a less energy intensive process. It already is a regional player in the crude salt market and has the potential to do so with processed salt. It will have no difficulty in increasing the level of fluoride in salt if the decision is made to so do.

5. **SALT MARKETING AND DISTRIBUTION**

The **Figure 28** shown below outlines the distribution channels and marketing arrangements for salt. More study is needed to accurately quantify the various streams. The trend is for greater levels of exportation of both crude salt and processed salt for domestic consumption.

Salt marketing is highly competitive in Venezuela as evidenced by the number of brands and packaging designs and types. The 1 kg and 500 gm packs are favored by the housewife. Although all table or domestic salt, and salt used as an ingredient in food manufacturing is supposed to be fluoridated and iodized, it is estimated that approximately 75% is actually done.

Figure 28: Salt Distribution Channels, Republic of Venezuela.



6. **ANALYSIS OF THE VENEZUELAN SITUATION**

The Venezuelan Salt Industry may be characterized as being sophisticated and well developed. It is a net exporter of salt and has installed capacity to produce at about 75% above present production. Although different levels, stages, techniques and scales of production coexist, the vast majority of production takes place in enterprises that are efficient and well run. This is as true of the small and micro-plants that could well become a model for other similar sized salt producers in Latin America.

The marketing of their salt is highly competitive, reflected by the many brands, packages and labels developed for salt in Venezuela.

1. Operations are fully mechanized for the vast majority of salt processors.

The Venezuelan salt industry has very large producers of processing capacity 400 ton per day to micro producers of 10 ton per day. The large producers are fully mechanized, even moving to the stage of sophisticated instrumentation and computer process control. The small and micro producers for the most part have adopted very innovative techniques and machinery modifications in order to improve their efficiency and quality of product. Those producers whom have lagged in their improvements are either facing closure or are about to implement improvements.

2. The industry is mature and consolidated. It is able to be world competitive.

Table 2 below shows the salt processors and their categories in the Venezuelan salt industry.

Table 2: Number of Producers Categorized by Size and Respective Production

<i>Category of Processor</i>	<i>Number of Processors</i>	<i>% of Total Processors</i>	<i>Production (ton)</i>	<i>% of Total Production</i>
<i>Small < 5000 ton per annum</i>	8	57	20,000	6.7
<i>Medium 5,000 to 50,000 ton per annum</i>	4	28	55,000	18.3
<i>Large > 50,000 ton per annum</i>	2	14	225,000	75.0
Total	14	100	300,000	100

3. **The industry is for the most part differentiated between crude salt producers and salt processors.** Most salt processors are independent entities and operations from the crude salt producer. Crude salt is purchased from the most convenient source with regards to the best quality and price. This ensures competition and keeps the crude salt producers efficient. In the case of **Tecnosal** and **INDULSALCA**, they have salt processing facilities coupled to their crude salt production facility.
4. **The price of salt to the consumer is in the range of U\$ 0.35/kg to U\$ 0.10/kg.** In this highly competitive market there is a lot of marketing effort to create different brands, sizes, qualities, and types of products. This is most evidenced, and may be seen throughout this report, by the varieties of packaging and labeling designs and brand names.
5. **The salt quality is on par with what can be considered normal international standards.** In some cases the overall quality of salt and packaging is at a higher level than generally available to the consumer in even well developed countries. E.g. **Sal Bahia** 750 gm carton packaged salt can compete any where in the world. In addition salt quality parameters such as fluoride and iodide levels, soluble and insoluble impurities and package weights are for the main part consistent and within targeted values.
6. **The capacity exists, with some producers, to carry out the full range of quantitative analyses on raw material and finished products.**
7. **They have a successful salt fluoridation and iodization program.** The targeted value as set by the Venezuelan Ministry of Health at present is **Iodide 40 to 70 ppm**, and **Fluoride 60 to 90 ppm**.

7. RECOMMENDATIONS

Venezuela has for some time now carried out a successful salt fluoridation and iodization program. It is estimated that some 75 % of the salt for direct and indirect human consumption is fluoridated to a level of 90 to 100 ppm. It is hoped that in the near future Venezuela will see it fit to adopt the PAHO guidelines of 200 - 250 ppm fluoride for addition to their domestic salt. There will be no problems for producers to increase the dosage and to become compliant with a higher level of fluoride content. All that will be necessary in all the cases observed, would be to increase the addition rate of the fluoride chemical being used.

In all cases except **Sal Bahia** and **MOLISOCA**, storage and handling procedures for fluoride additive chemicals are less than ideal. The salt processors need to pay attention to improvements in this area of their process, so as to avoid any unfortunate long-term consequences.

In the case of **Tecnosal**, where the finest salt product has a higher level of fluoride than targeted, this should not be seen as a major problem. This is as a result of the salt process. To try and change the process in order to rectify this will be at too high a cost for the benefit that may accrue. Rather, a better approach would be to simply take this additional amount of fluoride being consumed by the population and lower the main target by a few points to compensate for this. An approach of an overall national fluoride balance can easily lead to fine-tuning of the target fluoride level, within the recommended PAHO range.

It is also recommended that a detailed study of the salt distribution and marketing system be carried out.

Lastly, it is important to recognize the importance of the Venezuelan salt industry as a model for those underdeveloped salt industries of Central America and the Caribbean. The solutions to some common problems in salt processing technology have been implemented in a graceful fashion by the Venezuelan salt processors. The countries and processors that are attempting to improve their salt process to the point where fluoride may be added to the salt can benefit tremendously from their Venezuelan counterparts.

It is recommended therefore, that a travelling seminar for producers and processors from Honduras, Nicaragua, Panama, Bolivia and Dominican Republic be held in Venezuela, to give processors from these countries access to the imaginative and innovative, techniques and equipment modifications of the Venezuelan processors.



APPENDICES

**APPENDIX 1****LIST OF VENEZUELAN SALT PROCESSORS**

NAME OF PROCESSOR	BRANDS PACKAGED	<u>LOCATION</u>	QUANTITY PRODUCED (ton) Fluoridated & Iodized	% of TOTAL PROD'N
1.Alimentos La EsmeraldaC.A.(ALESKA)	Caribbena,Esmeralda, Sal Pa Queso, Sal Mineralizado	Maricaibo	26,000	8.7
2.Industrias Salineras C.A. (INDUSALCA)	Sal Monte Blanco	Maricaibo	22,000	7.3
3.Molienda El Carmen S.R.L.	Sal El Carmen	Maricaibo	3,000	1.0
4.Molinos Los Socios C.A.(MOLISOCA)	Sal Las Nieves, Sal MOLISOCA	Maricaibo	15,000	5.0
5.Pocesadora Occidental de Sal (PROSALCA)	Sal Corona	Maricaibo	5,000	1.7
6. Procesadora y Distribuidora de Sal San Benito (PRODISAB)	Sal San Benito	Maricaibo	4,000	1.3
7. Distribuidora Sal Bahia C.A.	Sal Bahia, Sal Delmar	Barcelona	150,000	50.0
8.Tecnosal Venezuela C.A.	Sal Araya, Ensal	Araya	75,000	25.0
TOTAL			300,000	100

APPENDIX 2

VENEZUELA SALT QUALITY

Table 2a: Typical Crude Salt Quality.

DESCRIPTION	ANALYSIS WT %
Moisture	2.0
Insolubles	0.5
NaCl	97.0
Other	0.5

Table 2b: Typical "Mill, Wash & Dry" Process Salt Quality

DESCRIPTION	ANALYSIS WT %
NaCl	99.25
Moisture	0.25
Insolubles	0.15
Calcium	0.05
Magnesium	0.10
Sulfate	0.20
Iron	0.06
Iodine	50 - 70 ppm
Fluoride	90 - 100 ppm

**APPENDIX 2 (CONT.)****Table 2c: Typical "Dissolution & Evaporation" Process Salt Quality**

DESCRIPTION	ANALYSIS WT %
NaCl	99.8
Moisture	0.001
Insolubles	0.005
Calcium	0.01
Magnesium	0.05
Sulfate	0.04
Iron	0.0005
Iodine	50-70 ppm
Fluoride	90-100 ppm



APPENDIX 3

VENEZUELA SALT PRICES

Sal el Carmen 25 Kgs. = 1.400 Bs. Molienda El Carmen

Sal Las Nieves 1 Kgs. = 92 Bs. Molisoca

Sal Bahia 1 Kgs = 195 Bs. Distribuidora Sal Bahia

Sal Corona 1 Kgs = 140 Bs. Prosalca

Sal Molisoca 25 Kgs. = 1.500 Bs. Molisoca

Sal Araya 1 Kgs = 160 - 200 Bs. Tecnosol

Sal Araya 25 Kgs = 3.000 Bs. Tecnosol





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