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A SUMMARY OF THE SOLAR SALT INDUSTRY IN CUBA 1/

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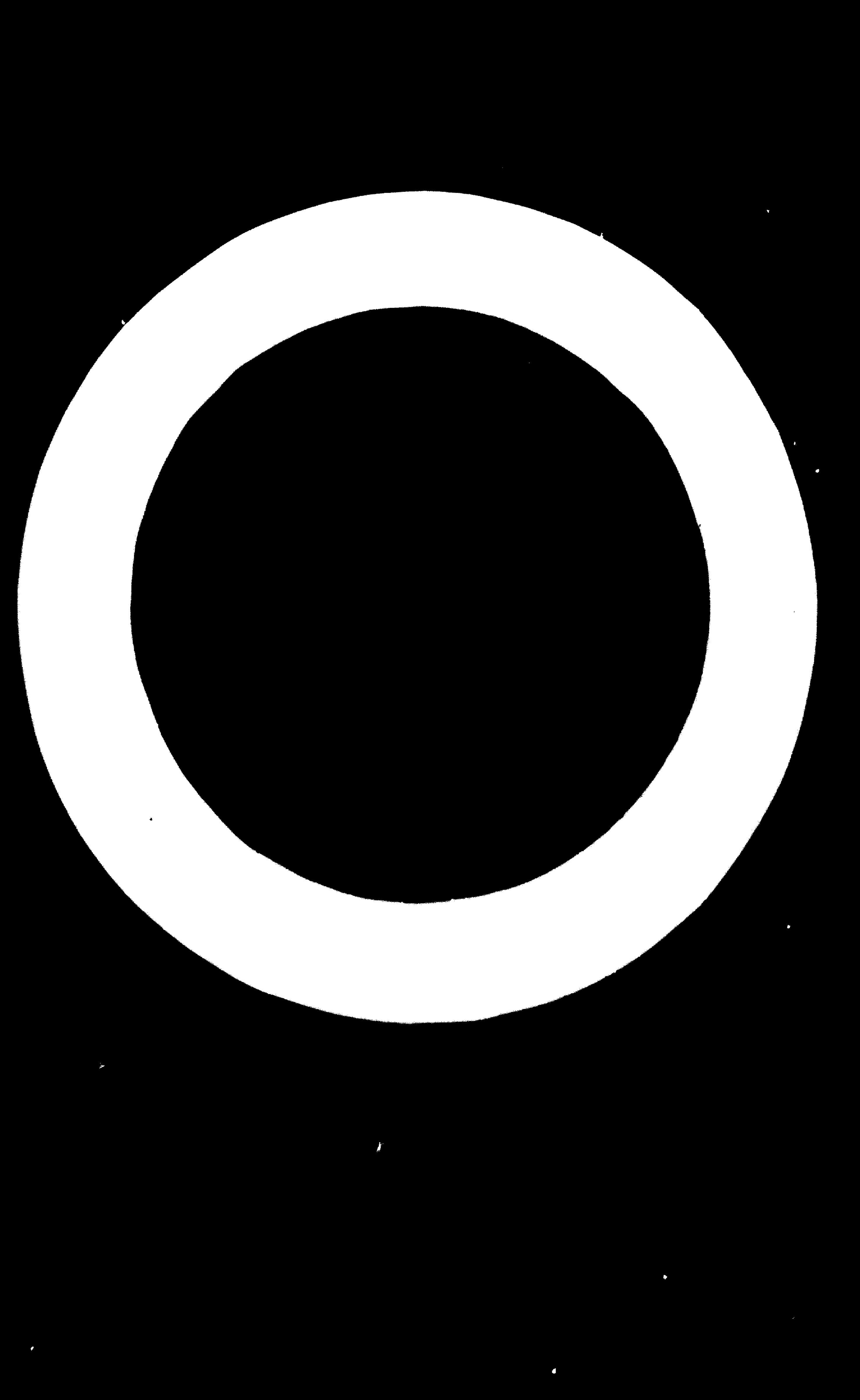

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SITUATION OF THE SALT INDUSTRY IN THE REPUBLIC OF CUBA

Historical background

Salt is produced in Cuba entirely by the solar evaporation of seawater.

The first solar evaporation plants were set up along the coast in various parts of the country with a view to supplying local needs for salt for human consumption. These plants were small, equipped as a rule with minimum technical facilities of the handicraft type, and produced salt of very poor quality.

The beginning of the century, with the boom in the sugar industry, saw the emergence of industrial consumption needs, together with facilities for rail transport. The first two plants for the production of salt on an industrial scale were thus established after the First World War - one in the west of the country, in the Province of Matanzas (Bidos), and the other in the east, in Oriente Province (Caimanera).

Producers in both regions embarked on intense competition for the conquest of the western market, which comprises the capital and consequently the main centre of consumption.

This competition was possible because although freight charges were lower in the west, owing to the greater proximity of the consumers, climatic conditions in the east are such that production is three times higher per unit of area.

However, the governments of the time set no standards regarding quality and did nothing to promote the technological development of the salt-producing industry; this had a most detrimental effect on the industry, which could only use equipment discarded by other factories since, as we all know, salt is a product of low value and considerable volume and the aim of producers was to extract the maximum profits for a minimum of investment, knowing that capital takes longer to recover in this industry than in other industries.

Between 1950 and 1955 the Bidos and Caimanera plants acquired more modern equipment, and more advanced techniques were applied in the production of solar salt. This resulted in a better quality product and it was possible to reduce imports of salt from abroad.

With the triumph of the Revolution in 1959 and with the subsequent nationalization of private enterprise the salt-producing industry could be rationalized at the national level thanks to the application of the more up-to-date techniques available in all Cuban production centres and, for the first time, it became possible to build up a technology of solar salt-production on the basis of our experience in this type of industry and to pass it on to our workers through courses organized in the salt plants.

The system of concentrating brine in a number of well-defined stages, with specific gravity checks at each stage, has been introduced, the specific gravities corresponding to each stage being as follows: stage No.1 - 3.5°Be; No.2 - 5°Be; No.3 - 10°Be; No.4 - 15°Be; No.5 - 20°Be; No.6 - 25°Be and No.7 (in the crystallization pans) from 25.5° to 28°Be. This system is designed to ensure the gradual precipitation of undesirable salts until a brine concentration of 25.5°Be is reached, with subsequent [illegible] possible sodium chloride.

Simple meteorological equipment, such as rain-gauges, evaporimeters and thermometers, has been installed at all salt plants, the larger of which also have barographs and hygrometers.

We have established two new quality control laboratories and set technical standards or norms for quality as well as taking measures to improve quality without additional investment ([illegible]).

All these measures have resulted in a 10 per cent increase in production per unit of area and a corresponding improvement in quality. We do not intend to rest there, however, but are planning to construct fixed and portable washers and we have also set new technical standards for quality (Annex 2).

The enterprise responsible for operating the fourteen salt-production units in Cuba is the Empresa Consolidada de la Minería, which produces approximately 150,000 tonnes of granular sea salt a year. There are seven salt-processing plants, and one small brine plant using the thermocompression system of evaporation which has a capacity of 0.9 tonnes per hour.

The processing plants are equipped for washing, drying crushing and screening or classification. The plants at Bidos and Caimanera have facilities for all the above-mentioned operations; the others lack facilities for one or more of them.

Mechanization of the extraction process is our greatest problem, since all the digging and piling of the salt in the crystallization ponds, as well as its conveyance to our piling at the storage points, is done manually, except in a few salt plants which have facilities for mechanized haulage and piling and where transport is provided by narrow-gauge locomotives and pneumatic-tired tractors, while belt conveyors and cranes are used for piling.

Natural conditions in Cuba

The excellent natural conditions described below will show how well adapted our country is for this type of production.

1. Favourable climatic conditions due to:

(a) High annual evaporation index, with long dry spells, and low precipitation index (Annex 3).

(b) Pattern of almost constant favourable winds throughout the year.

2. Topographical conditions:

Cuba has a long and irregular coastline with a considerable number of flat areas of firm ground capable of bearing heavy loads and, although unsuitable for agriculture, well fitted for the construction of salt plants.

3. Transport facilities

Owing to Cuba's coastal configuration, on the whole there are excellent transport facilities, chiefly for sea transport but also for road and rail haulage.

Problems confronting Cuba

The major problem confronting us, as we have already said, is that of extraction, since this is carried out manually and there is a shortage of available manpower; moreover it is this operation which considerably raises production costs per tonne of salt.

We believe that mechanization of the extraction process should be undertaken in two different ways: first, small-scale mechanization, using inexpensive equipment that could be constructed in the workshop of the small salt plant itself out of sturdy and economical construction material should be introduced in salt plants with a production capacity of less than 30,000 tonnes per year; secondly, mechanization on a larger scale should be introduced into salt plants with a greater production capacity (over 30,000 tonnes/year), using heavier equipment.

One of the drawbacks we are encountering as a result of our non-mechanized extraction methods is that we have to begin extracting when we only have two inches (50mm) of salt in the crystallization ponds, since it is at this thickness that we obtain the highest output per man. If extraction were mechanized we could double or treble the thickness of the deposit, extracting a greater quantity of salt per unit of area in less time; this would result in more effective use of the crystallization ponds, since the same volume of production would be achieved through one mechanized operation as could be effected by human labour in two or three stages.

In present conditions in Cuba, the labour situation is becoming critical since the salt harvest, which takes place between March and September, coincides with the season for harvesting the sugar crop and other agricultural activities. Moreover extraction work is arduous and fatiguing, especially in a hot climate such as ours.

We also have problems with transport within the salt plants and with piling.

In an attempt to solve these problems, workers and technicians in our factories have made very great efforts, within the limits of their technical capacity, to solve the problems of mechanizing extraction and have succeeded in constructing two small experimental harvesters of their own invention. On the basis of these inventions, the fifth-year students in mechanical engineering at Oriente University have designed a set of equipment, now under construction, for the purpose of gathering the salt from the crystallization ponds, washing it and delivering it to the transport trucks.

As can be deduced from the foregoing, technical conditions in Cuba are at present somewhat unfavourable as we lack sufficient qualified and specialized personnel for this work and therefore have to contend with many difficulties.

As regards the technology of solar salt production, this has been developed largely on the basis of the practical experience of workers and on the scanty technical material we have at our disposal; there are therefore a number of technological points on which we would need expert advice.

Plans for the development of our salt industry provide for the expansion of the country's leading salt plants, one of which (at Caimanera in Oriente Province) is already being enlarged to a capacity of 150,000 tonnes - a project for which we have requested United Nations technical advice. We should like to mention that we would be very interested in any outside experience regarding the automation of the process of salt production and in a scientifically-based system for the design of new salt plants.

We have also asked the United Nations for technical advice concerning the utilization of the mother-liquor, which we are at present discarding, to obtain magnesium oxide, bromine, potassium chloride, etc.

We are also interested in obtaining information on the utilization of wind energy so as to increase evaporation through the dispersion of brine particles, thus obtaining a greater area of contact between brine and air.

We should have liked to discuss a number of other very interesting problems concerning solar salt production, but to avoid making this short summary too lengthy, we feel we should conclude it at this point.

We wish you every success in the completion in your work and the best possible results.

ANNEX 1

NORMS FOR PROCESSES TO BE CARRIED OUT

To obtain crude granular salt of good quality in solar salt plants, the following requirements must be observed:

(a) The brine must be allowed to flow slowly from one reservoir or pond in the evaporation area to the next, in proportion to its rising specific gravity (Baumé scale), so that it is kept clear and transparent until it reaches saturation point (25° Baumé), when it can be admitted to the crystallization ponds so that precipitation of the salt on the pond bottom can begin. If this is done, undesirable salts, which could detract from the quality of the final product, are precipitated out between 7° and 25.5° Baumé.

(b) The brine flow must be controlled by proper use of the channels and ponds and their respective sluices, all of which are especially constructed to separate brines of different specific gravity.

(c) Sudden mingling of brines of different density and temperature must be avoided since, as explained in the instructions on production technology, this can lead to decomposition of the brine.

(d) The evaporation area should be operated at an average depth of 10 centimetres, avoiding depths over 15 centimetres.

(e) Rain-water accumulating on the upper part of the brine must be drained off through drainage trenches and channels by means of overflow or finely adjustable sluices so as to ensure maximum utilization of the brine, provided there has not been a considerable drop in its specific gravity.

(f) All possible measures must be taken to keep the edges and corners of reservoirs or ponds and crystallization pans free from impurities such as slime, accumulations of discolouring matter and all waste products such as wood, stone, etc.

(g) The crystallization ponds must be supplied with as much saturated brine (25.5° Baumé) as possible up to a depth of 20 centimetres or more. At higher brine levels there is less risk of sudden changes in specific gravity and temperature, greater protection against rain-water for the salt that has crystallized on the bottom of the ponds, greater ease in efficiently draining off rain-water from the top of the brine and better opportunities for producing salt of large, firm, crystalline and pure grain.

(h) The specific gravity of the brine in the crystallisation ponds must be verified as often as necessary by means of a Baumé hydrometer, so that the mother-liquor can be removed when it reaches 30°Be, thus avoiding excessive precipitation of magnesium salts.

(i) The salt must be washed with saturated brine (if possible, new brine with a specific gravity of 25° Baumé) when it is piled in the crystallization pan, so as to cause dissolution of the magnesium salts which crystallize out when the brine reaches 27.5 to 30° Baumé, and also to ensure that the salt is cleansed of mud from the pond bottom, pieces of wood, stone, or any other extraneous and undesirable matter, thus obtaining a whiter, cleaner and purer granular salt.

(j) The floors and walls of stockpile areas or storehouses must be kept clean, especially before depositing the salt - an operation that should be accomplished with the utmost care to avoid contamination of the salt and possible wastage.

(k) The channels, ponds tools and transport and piling equipment must be kept clean to void impairing the quality of the salt.

(l) The crude granular salt produced must be inspected for size, consistency, colour, transparency and shape.

ANNEX 2

TECHNICAL SPECIFICATIONS FOR THE VARIOUS TYPES OF SALT PRODUCED IN CUBA

Technical specifications	Common salt extra coarse	Common salt coarse (for softening)	Common salt coarse (tannery 56)	Common salt coarse (tannery 14)	Common salt fine (used for human consumption and other purposes)	Common salt fine (used chiefly for feed·mixes)	Common salt extra fine
Sodium chloride NaCl (minimum)	98.00%	98.00%	98.00%	98.00%	98.5 %	93.00%	99.9%
Moisture (maximum)	3.00%	0.4 %	0.4 %	0.4 %	0.4 %	4.5 %	0.1%
Insolubles (maximum)	0.1 %	0.07%	0.07%	0.07%	0.05%	0.6 %	-
Calcium and magnesium salts (maximum)	1.7 %	0.5 %	1.2 %	0.3 %	1.0 %	1.9 %	-
Grain size	20mm–5mm minim. 95% 5mm max. 5%	20mm–5mm 100% 5mm max.5%	6.5mm–3.5mm minim 95% 3.5mm max.10%	1.1mm–0.86mm minim. 95% 0.86mm max 10%	0.70mm–0.20mm minim. 95% 0.20 max.10%	1.2mm min 95%	0.80mm–0.30mm mn 95%

ANNEX 3

	OBIDOS		CAIMANERA	
	Evaporation	Rainfall	Evaporation	Rainfall
January	110	35	161	14
February	140	25	187	16
March	170	30	220	22
April	200	40	212	38
May	240	100	168	90
June	280	110	205	54
July	280	90	203	30
August	200	100	211	52
September	160	140	170	92
October	130	140	148	184
November	100	60	137	30
December	90	30	122	13
	2100	900	2144	635

Note: The Indices of evaporation and rainfall are given in mm.

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