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iDECO

1638

SALT WASHING PLANT IN MOZAMBIQUE

FINAL REPORT

PROJECT no. TF/MOZ/82/001

CONTRACT no. 83/5/RT

INDUSTRIAL DEVELOPMENT ENGINEERING COMPANY S.r.l.
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FINAL REPORT

PROJECT N° TF/MOZ/82.001

Rome, April 1987

Re. A297MZ87.106

SUMMARY

SYNOPSIS

- The aim of this Final Report is essentially to up date the progress of the project as at 9/12/86, date on which the Performance Test Certificate was signed by the parties (Annex H).

  As general consideration IDECO wants to point out that due to the lack of certain Government inputs the project completion has been heavily delayed. Furthermore for some reasons the commissioning performance guarantee as well has not been achieved until above mentioned date.

  IDECO is sure that due consideration will be given to these matters.

- Also the scope of the amendment to the contract that has been only partially performed by IDECO personnel due to lack of mozambican personnel, lack of materials and the general situation of the country as it is well known.

- Details are given in the body and annexes of this Report.

1. REPORT

1.1 The supply of the technical know-how, drawings, specifications, manuals, etc., has been completed in the required terms and during the work progress.

First lot of drawings for civil works were supplied on 20.5 and 16.6.83.

After the receipt from Government of the planimetries (12.6.83) and erection drawings (22.8.83) IDECO has delivered the whole set of execution drawings and erection details (12.10.83). Meanwhile all the mechanical drawings where settled on the 19.5.83 and given to manufacturers. As soon plant components were ready for shipment an inspection was carried out by UNIDO on 22.9.83 in Bologna. Together with the plant IDECO has supplied also 5 sets to the Government and 2 sets to UNIDO of a "Comprehensive Operational and Maintenance Manual for the salt washing plant".

1.2 The supply CIF Maputo of machinery, equipments, spare parts and materials was performed as required and in due time. Salt washing plant was shipped in all together with spare parts with S/S Efdim Junior on the 31.12.83 our progress report as at 16.1.84.

The additional of chemical laboratory equipments, as per UNIDO purchase order no. 15-4-A0828 of the 23.8.84, was shipped with S/S Diego on the 13.3.85.

The additional supply of the conveyor belt, salt laun-

cher, electrical fitting and spare parts as per UNIDO purchase order no. 15-5-A1010 of the 20.8.85 were shipped with M/N Africa on the 18.3.86 and delivered on site in June while cement and steel rods necessay for some minor civil works were delivered locally in September and December 1985.

Please note that IDECO at his own initiative, well aware about the total lack of all materials in the local market, has supplied also an extra quantity of epoxy paints, tools for maintenance and a pressure vessel pump. That will help the government to solve the problem of lack of fresh water at the site.

1.3 On the-job training of Mozambican personnel has been provided by IDECO's experts during the erection, assembly and commissioning of the plant. See our progress reports as at 5.4.84, at 31.12.84 and the 1985 "ad interim report". The supervisoring and assisting in the initial period of operation of the plant for one month after the start-up was not accomplished because of lack of government inputs (namely lack of raw salt) in spite of IDECO's experts presence on site.

1.4 The training for two mozambican to be provided abroad for the duration of two months was not been done untill August 86 because of Government delay in solving this matter. In fact on the 22.8.83 IDECO received a tlx from

the Government asking to convert this training in a on-the-job training. We reverted the matter to UNIDO pointing our willing to fulfil our commitments as per contract terms.

On 6.4.84 we stressed again the point to send the two selected persons to Italy for training.

Finally on the 16.10.85 a tlx was received stating that Mr. Mota do Amaral and Celestino Joaquin were selected to be trained abroad on May 86.

Mr. Celestino has been replaced by Mr. Zulu and the two selected are arrived in Italy on the 3rd August 86 and since the 4th August they were transferred to Southern Italy, near Margherita di Savoia Saltworks, for a period of 2 months of training.

2. COMMENTS AND RECOMMENDATION

2.1 Referring to item 1.1. Since the beginning of the project IDECO has supplied to the Government 5 sets of a complete and detailed operation and maintenance manual, including all drawings, schemes, units, mechanical details, ecc.

As per contract terms this was written in English language.

This fact has caused some confusion to the local personnel because their ignorance of this language. As immediate action our expert on site has written down a synthesis of this manual (operation manual) using very simple terms and the italian language which looks to be more understandable to them (see annex A).

We repeat our strong recommendation to UDIS to provide locally to the translation into Portoguese of our manual and distribute copies to all workers involved with the plant.

2.2 Referring to item 1.2. All machinery, equipment, material and spare parts concerning the project were supplied at the beginning of the work.

Latest consignment was the additional supply of one belt conveyor and a salt launcher which formed the object of a separate order, upon a recommendation of IDECO to complete the installation.

Should be noted that IDECO has supplied also free of charge a pressure vessel pump to be fitted to the fresh water line as to feed the necessary water to the shower system of the washing plant. This was necessary because the lack of fresh water in the area of Matola and the inability of UDIS to solve the matter locally. We do not recommend the presence of our expert to fit the salt launcher and the conveyor belt being these additional units completely indipendents from the washing plant. Moreover they are complete of all the electricals fittings and need only to be connected by cable to the main cabin. That can be done by any local electrician. Drawings where already delivered to the Client.

2.3 We refer to item 1.3 the on-the-job training of local personnel was performed during the erection period, the dry run operation tests and the commissioning. On this respect we must remark that it was not possible to perform this training in a continuous manner and very long delays from one stage to the other happened because of lacking of some government inputs.

Precisely:

- the very long time taken to find the necessary materials and to execute some works like the electrical cabin, the chemical laboratory, etc.

- their impossibility till now to execute the concrete flooring of the area, the protection walls and the discharging slope to the feeding hopper.

  This is the most important issue, supposed to be executed since the beginning of the work and the consequence is that the plant is now laying in a very mudly place; the salt brought from saltworks is firstly discharged on the ground and than reclaimed into bags and discharged by hand into the feeding hopper. This kind of operations increase the insoluble matters (sand, stone, etc.) into the salt which is already of a very poor quality and also it is impossible by hand to feed the plant at his noted capacity. Washed salt is discharged again directly on soil.

  We strongly recommend to the client to complete this part of civil works to avoid further pollution on raw and washed salt and to feed the plant by means of trucks which are discharging directly into the hopper (annex B).

2.4 The training abroad for two mozambican was stressed by us many times and the Government has delayed in shortlisting the personnel.

Finally in October 85 this issue was urged again together with the UNIDO local representative which provided the Government also with all the necessary

forms and documents to be fulfilled. It is only in the middle of April 86 that finally the two names were shortlisted and filled forms given to UNIDO's local representative.

The trainees arrived in Italy on the 3rd August 86 and were immediately transferred near Margherita di Savoia Saltworks for a period of 2 months.

The training was very intensive for both of them, also due to the fact that in this period the saltworks were starting their yearly harvesting campaign. We had the chance to have all saltworks sections in full operation and training was performed by means of theoretical lessons integrated by practical training on spot.

We are pleased to say that due to the similitude between Portuguese and Italian, they encountered no difficulty in understanding the lessons.

- Mr. Zulu, being the future Working Plant Responsible, was exhaustively trained on washing plants under all aspects, such as: production, daily maintenance, extraordinary maintenance, emergency intervention, training and responsibility of the personnel, interaction with management, etc.

  He has also received a general training in other operations such as mechanical salt harvesting, pump operation, workshop intervention (routine and emergency), general organization and relationship with

other sections, such as management, production, sales, etc.

- Mr. Mota do Amoral, being the Project Chief, was trained as Mr. Zulu, but with special attention to general operations in a saltworks, sich as salt production on crystallizers, brine circulation, pumping stations, management operations and general organization.

We are very pleased to say that both of the trainees have shown a great interest and care, and obtained the best results from this training. We also wish to stress out that on the human ground, they have been extremely disciplinated and educated.

Indeed, our Chairman, Mr. Luigi Ferrari, was proud to hand them a Testimonial Certificate for the completion of the prescribed training and we are sure that they will be able to transfer their knowledge to their colleagues in Mozambique.

It is our firm opinionthat the aim of the training abroad has been fully reached.

The trainees left Italy for Maputo on the first week of October 1986 (see ANNEX H).

3. AMENDMENT TO THE CONTRACT (30.9.83)

The overall attendance of IDECO's technicians under the scope of the contract and his amendment no. 1, has been so far as follows:

3.1 Mechanical experts (Maputo):

Mr. Bertinelli	6.3.84 - 3.5.84
Mr. Terragni	21.1.86 - 28.1.86
Mr. Piroddi	1.3.86 - 8.3.86

The mechanical expert Mr. Bertinelli has discharged his duty with the erection of the plant and personnel training. During the month of March he has checked the material arrived at the port and attended the civil works on site. He also worked side-to-side with local personnel to establish a proper maintenance and repairing program to the existing saltworks equipments (as pumps) and vehicles (wheel loader, trucks, etc.).
Mr. Terragni and Mr. Piroddi have carried further short checks on the mechanical installation and the dry run tests.
Particularly: tideness of all bolts has been verified, rating of vibrator and vibro-feeder, calibration and roting of conveyor belt, calibration of dryer and pumps, connection of all pipe lines, test of all electrical engines and electrical connections.
The dry-run test has been performed and normal leakages from junctions and valves were sealed.

Load test run has been performed using only the brine of the washing cone because of lack of fresh water. Raw salt available was of a very poor quality but in spite of that the washed salt outflowing was of a good standard.

3.2 Sea salt experts (Maputo)

Mr. Gasbarro	9.1.84 - 29.1.84
Mr. Vaccari	9.1.84 - 7.3.84
	8.4.84 - 6.7.84
	8.8.84 - 5.10.84
	26.5.85 - 14.7.85
Mr. Spallasso	30.9.85 - 12.11.85
	15.4.86 - 29.4.86
	23.11.86 - 10.12.86

Mr. Gasbarro as senior expert has reviewed the whole project including Matola saltworks and the possibility of salt production development in Mozambique.

Mr. Vaccari has lead IDECO's team and has assisted the management of the saltworks: to improve the quality and quantity of salt production; to organize maintenance program etc. (detailed report is attached as annex C).

Finally, due to health reasons, Mr. Vaccari was replaced by Mr. Spallasso which continued to assist the saltworks management (see report attached as annex D).

3.3 Chemical expert (Maputo)

Mr. Fimiani 16/2/86 - 18/4/86

Mr. Fimiani has performed the one-month period to train the local chemical analyst (see Annex E) and assisted the start-up and the production of all available raw salt for one month (see Annex F).

3.4 Marketing expert (S. Africa - Zambia - Zimbabwe)

Mr. Valente 12/3/84 - 31/3/84

10/10/85 - 28/10/85

Mr. Valente has checked up the future potential export market produced in Mozambique that will compete with the one produced in S. Africa. (See Annex G).

3.5 Project coordinator (Maputo)

Mr. Vitali 9/1/84 - 14/1/84

21/10/85- 6/11/85

21/1/86 - 24/2/86

4. GENERAL

In spite of his good willingness the government perhaps has taken less than expected from the presence on site of our experts limiting often their intervention only to the theoretical ground. Improvement in quality and quantity of salt produced was not as planned due to some unavoidable and well know situations. Maintenance program, training and personnel selection, storekeeping and so on were developped and discussed only with the Management of UDIS. This is mostly because of the local situation like:

- low standard qualification of workers (low level of salaries has pushed most of the qualified people to expatriate to neighbouring countries with more attractive wages);
- the lack of transport and fuel which is causing an absenteism which reached sometime 40% of the permanent personnel;
- the general lack of the most common materials and tools has heavily delayed all type of works ever the simpliest one;
- the local situation of poor safety out of urban areas has limited our research in selecting new sea salt sites in the area surrounding Maputo or along the coast;
- the raw salt to be processed by the washing plant is produced in Matola area by the various saltworks belonging to Extrasel; it is collected, loaded on truck and discharged by hand, but actually UDIS dispose of only

one truck which is in very poor condition and often out of order. By that, the feeding capacity to the plant is very low, and the quality is very poor in fact the average conters of insoluble matter is of 1.6% including a great quantity of stones.

Our latest information given by the trainees on their arrival is that from April 86 to July 86 the Client was able to collect and stock near the washing plant about 50 tons of raw salt, equal to about 3 hours of work of the washing plant.

5. CONCLUSIONS

All the above conditions were not solved at the beginning of December 1986, period in which UNIDO representatives visited the site. On theat occasion, the Commissioning Performance Tests were carried out.

In order to carry out the final test, the Client has stocked in the area near the plant about 450 Tons of salt.

Important Note: The above mentioned salt has been collected from the various saltworks of UDIS, and only a small quantity was fresh from harvesting. That means that it was salt harvested several months before (up to one year before) and not sold as it was heavily polluted with sand. Its long stay in the open air, the many handlings and finally its stocking near the plant on a muddy surface has naturally strongly increased the degree of pollution (sand, stones, wood and rust particles, etc).

Being this the only salt available, we agreed with the parties to carry the tests anyway, especially in the light that it would be possible to obtain out of it a salt of such a quality as to be sold on the market. This would mean good income for UDIS, considering that they have considered the 450 Tons already and definitively lost.

Another note to be pointed out is that the client was never in condition to let us work for eight continuous hours (practically ten: personnel arrival, start-up, shut down, clearing and plant washing) for the well known

reasons; security, personnel absenteism, lack of transports, water and electrical black-outs, etc.

5.1 Performances

Performances were verified by the parties with IDECO's assistance and supervision

Ref. 2.08 a) Production capacity

As soon as the brine reached the saturation point, the plant rated capacity was 15 t/hours of washed salt.

The input (16 t/h) was calculated considering the volume of the feeding hopper by the numbers of hoppers per hour by the specific weight of crude salt.

The output capacity (15 t/h) was calculated by measuring the volume of the washed salt in a heap having a geometrical shape by the specific weight of the washed salt.

Ref. 2.08 b) Direct tests during the performance have shown that the humidity is reduced up to 5 % and insoluble matters are reduced more than 0,5 %.

Samples were properly collected during the tests and the same direct analysis were carried on spot.

The final analysis report must still be

received from the client due to his inability to complete and prepare the final analysis certificate during the test period.

Ref. 2.08 c) Consumptions

As stated under chapter a),
the salt losses during washing do not exceed 1.05 tons
The direct reading of electrical consumption on the relevant meter show 3 kolowatt/hour (including the salt launcher not included in the contract).

Fresh water consumption was not considered due to the inability of the Client to bring fresh water to the site until now.

5.2 Conclusions

Once ascertained that the rated performances were achieved, IDECO has given instructions to adjust the plant in a way that the salt stocked at site shall be washed and cleaned in such a way as to be recuperated and sold.

In order to reach this target, being the quality of this salt very poor and polluted, the following will be necessary:

- to reduce the hourly rate reducing the plant speed, increasing the time in which the salt is under dynamic action for the circuit brines
- increasing the inlet water (showers) on the rotating plate. This action will remove most of the sand contents.

  Please note that this operation which is foreseen to be effected with fresh water is presently done using brines, as the Client is not able to have water in the battery limits.

- decreasing the salt thickness on the rotating plate; this will help the dynamic action of the brine showers to remove the sand and the other particles.

- if necessary, wash the salt twice, repeating the whole operation.

  Please note that the salt available for the moment is the scrab-salt of last year harvesting (unsoluble matters from 1,69 % to 2,45 %) caked and mixed with stones, wood and rust particles, etc.

  Discharged on a muddy area and fed to the plant by a wheel loader, again mixed with soil (see enclosed photos).

6. GENERAL RECOMMENDATION

The first thing we strongly recommend to be executed is the construction of the cement floor of the area assigned to stock the raw salt and the washed salt. This will reduce the consequent pollution by handling salt on soil as it happens now.

This civil work, that was part of our project was supposed to be executed before the commencement of the plant erection, together with the protection walls that will save the plant and the stocking area from the rain water-flow and the concrete ramp necessary to unload the raw salt from the tippers directly into the feeding hopper . This will allow the feeding rate to meet the out-put capacity of the plant. Of course this capacity will never be reached until this operation will be carried out by hand or by wheel loader like it is now.

The second recommendation is that the client must improve the saltworks services as transport from crystallisers to the plant so as to exploit the whole salt production during the most favourable period (dry season) and by consequence the washing plant shall work continuosly during the whole period of harvesting. This will improve the economics and also the maintenance will be more effective.

Finally, we recommend that all the suggestion given "on spot" by our salt experts are adopted and executed until they become "a routine work". We refer to all of these "manual works", as collection of data on brine circuit,

repairing of dikes and channels by hand showel, construction of wood gates, etc. This will not require heavy expeditures but only initiative and good will from workers and management. The result will be a sensible improuvement in quality and quantity of salt production.

Another important result will be that Matoia will become a "pilot project" to train in salt field the manpower necessary to the future development of salt in the country.

However to reach the target of improving quality and quantity of salt production to copy with the domestic and export demand a major program has been set up according to the annex G which will form a good base to fetch the requested financement.

A N N E X " A "

IMPIANTO LAVAGGIO SALE - MATOLA

MANUALE OPERATIVO

Il suddetto impianto serve per effettuare il lavaggio con acqua satura del sale.

Bisogna attenersi scrupolosamente alle norme di avviamento ed ai controlli preliminari prima di iniziare la produzione.

CONTROLLI PER AVVIAMENTO IMPIANTO

1. Controllare che nelle vasche della salamoia vi sia sufficiente acqua per poter iniziare il processo di lavaggio.
2. Controllare che tutte le vasche siano chiuse.
3. Controllare che il piatto filtrante girevole sia libero senza presenze di corpi estranei.
4. Controllare che lo scarico del nastro sale alla vaschetta sia libero.
5. Controllare che l'aspirazione della torbida nella vasca di lavaggio sia libera.
6. Controllare che lo scarico del ciclone sia libero.
7. Controllare che il troppo pieno acqua di lavaggio della vasca sia libero.
8. Controllare che vi sia acqua per la tenuta pompa torbida.
9. Controllare che il vibratore tramoggia sale funzioni.
10. Controllare che l'alimentatore sale al nastro funzioni.

11. Controllare che non vi sia acqua nella carcassa del ventilatore, scaricarla attraverso la valvola sottostante.
12. Controllare che gli spruzzatori funzionino.

NORME PER AVVIAMENTO IMPIANTO

1. Avviamento pompa salamoia
   - Accertarsi che sia chiusa la valvola sulla mandata pompa ed aperta quella che immette la salamoia nella vaschetta;
   - accertarsi che vi sia salamoia od acqua nelle vasche;
   - mettere in marcia la pompa ed aprire lentamente la valvola sulla mandata;
   - accertarsi che arrivi la salamoia;
   - attendere che la salamoia trabocchi dal troppo pieno della vasca di lavaggio.

2. Avviamento pompa torbida
   - Accertarsi che le valvole sulla mandata e sullo scarico siano chiuse, aprire l'acqua di raffreddamento tenuta pompa.
   - Aprire lentamente la valvola aspirazione.
   - Avviare la pompa torbida.
   - Aprire lentamente la valvola sulla mandata al ciclone. Accertarsi che arrivi la salamoia.

4. Avviamento piatto filtrante girevole

- Accertarsi che non vi siano corpi estranei sul piatto.
- Avviare il motore controllando che giri il piatto.

5. Avviamento nastro trasportatore

- Accertarsi che lo scarico del nastro alla vaschetta sia libero.
- Avviare il motore ed accertarsi che il nastro giri regolarmente e sia centrato, in caso contrario agire tirando o mollando i tiranti del suddetto.

6. Avviamento vibratore tramoggia

Accertarsi che nella tramoggia ci sia sale, quindi inserire il vibratore, non far mai vibrare a vuoto la tramoggia, per evitare rottura della stessa.

7. Avviamento alimentatore nastro

- Accertarsi che il nastro sia in marcia.
- Inserire l'alimentatore dalla cabina elettrica, quindi girare la manopola del quadro vicino alla tramoggia, inserire la velocità sull'orologio da 1/10 a secondo della quantità di sale che si vuole.

8. Avviamento motore ventilatore

- Accertarsi che non vi sia acqua nella carcassa del ventilatore, in presenza scaricarla dall'apposita valvolina sotto il ventilatore.

- Appena si è formato uno strato di sale sul piatto filtrante avviare il ventilatore.

9. Lavaggio sale tramite spruzzatori
   - Effettuare il lavaggio quando si nota il sale con presenza di sale sporco.

NORME PER FERMATA IMPIANTO

1. Fermata alimentatore nastro
   - Posizionare l'orologio a 0, girare la manopola sullo 0, disinserire la corrente dalla cabina.
2. Fermata vibratore tramoggia
   - Disinserire il vibratore dalla cabina.
3. Fermata nastro trasportatore
   - Accertarsi che non vi sia più sale sul nastro quindi fermare.
4. Fermata pompa salamoia
   - Fermare la pompa e chiudere la valvola.
5. Fermata pompa torbida
   - Quando non esce più sale sul piatto filtrante aprire la valvola per scaricare la salamoia attraverso il troppo pieno.
   - Chiudere la valvola di mandata al ciclone.
6. Fermata piatto filtrante
   - Fermare il piatto.
   - Pulire il piatto dal sale rimasto.

7. Fermata ventilatore

   - Fermare il ventilatore scaricando l'acqua attraverso l'apposita valvola sottostante.

8. Fermata pompa torbida

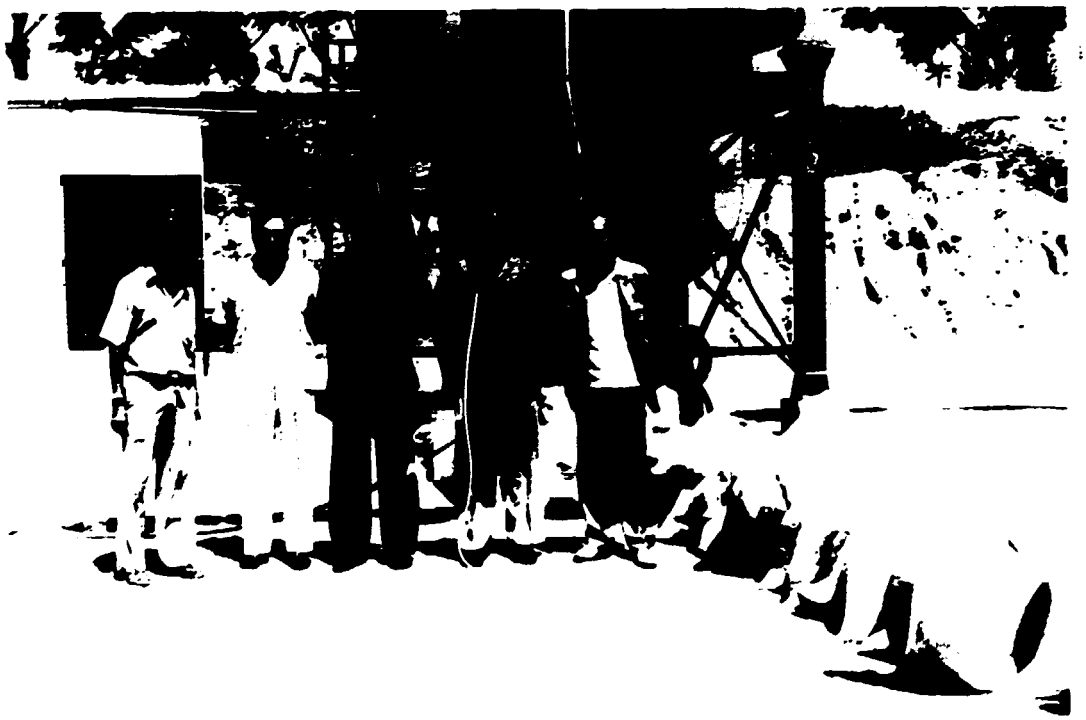
   - Appena ultimato di scaricare la salamoia fermare la pompa.
   - Chiudere la valvola di mandata.
   - Chiudere l'acqua di raffreddamento alla tenuta pompa.

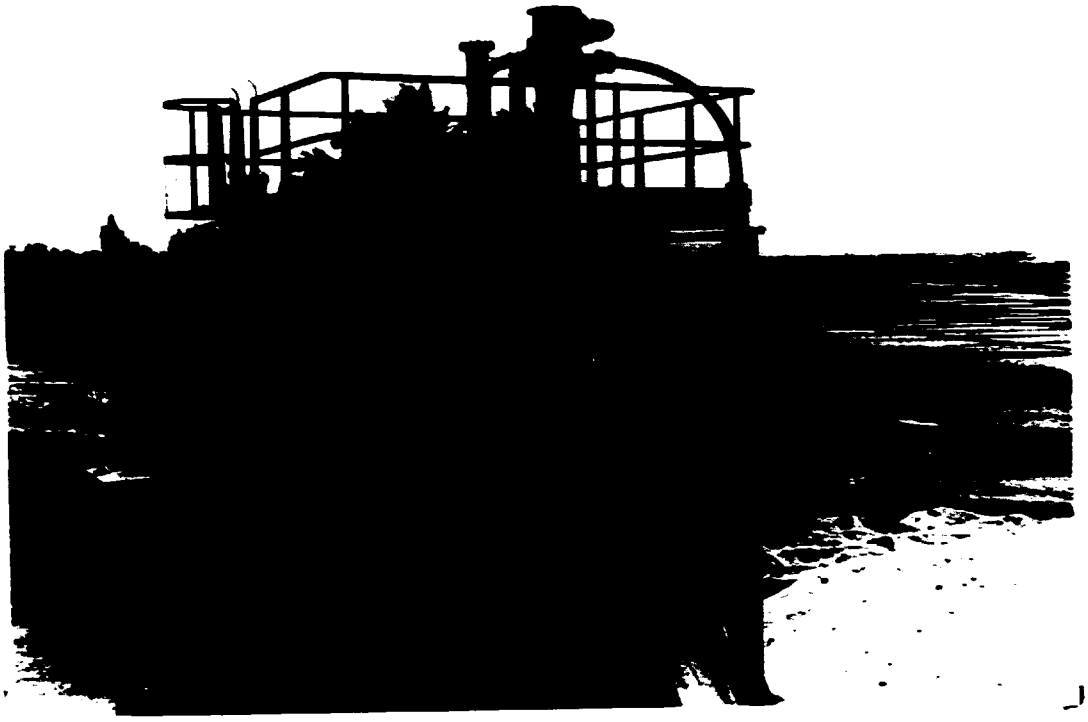
IMPIANTO FERMO PER LE DOVUTE PULIZIE

1. Aprire la valvola sottostante al cono primario
2. Eseguire il lavaggio dell'impianto.

A N N E X "B"

MATOLA – December 9, 1986 – PLANT PERFORMANCE TEST.
Above from left to right; Mr. B. FARIAO, General Manager of UDIS, Mr. JUDT repr. UNIDO of Vienna; Mr. GOULART local UNIDO repr.; Mr MONDLANE Udis site Manager; Mr. MOTA DO AMARAL Udis Project Manager
Below on the left Mr. R. SPALLASSO repr. of IDECO.

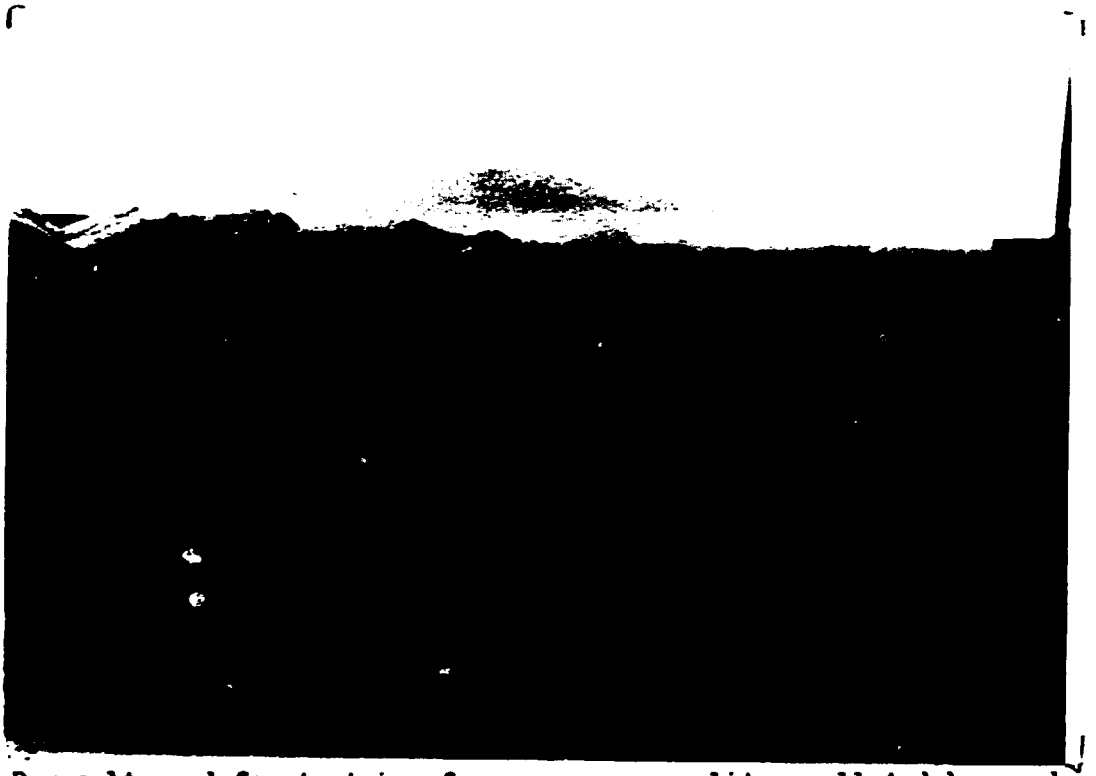




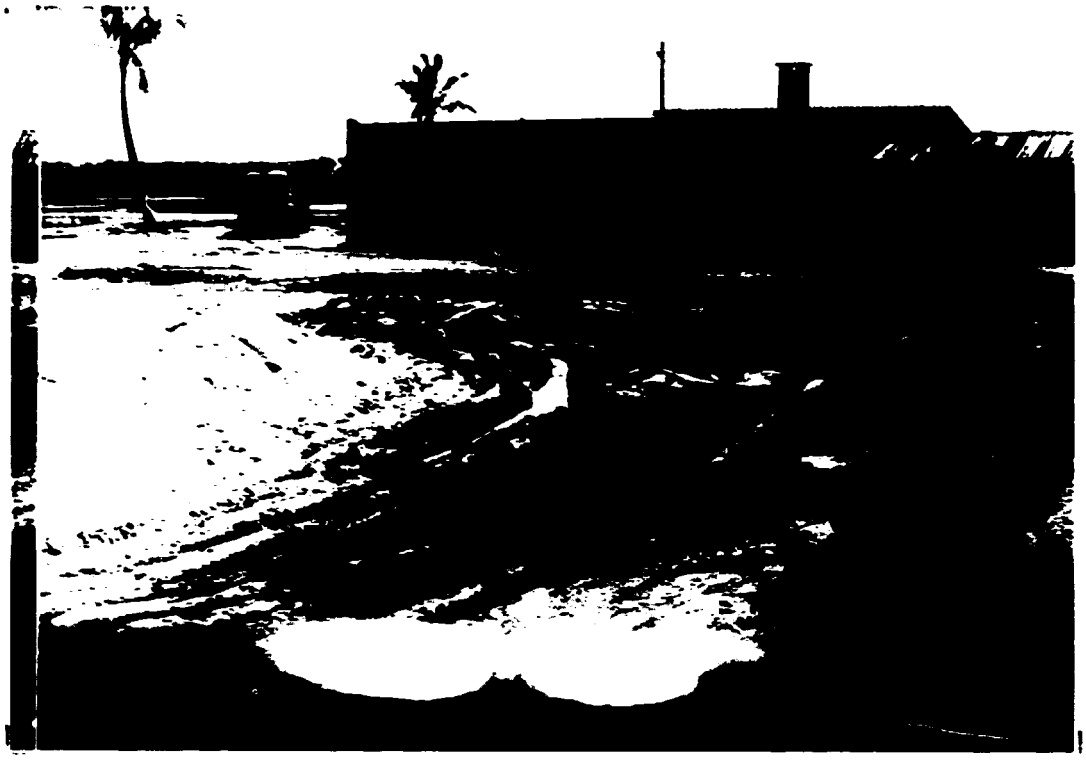
The washed salt is outcoming from the plant. (above)

Detail of washed salt standing on the rotating dryng plate (below).

Salt is loaded by wheel loader (or hand) into the hopper.



Raw salt used for test is of a very poor quality, polluted by sand, clay, stones, etc. and is the scrap of old harvesting campains.



Raw salt (and washed salt) are lyng on a very muddly area and the wheel loader mouvements heavily increase the pollution.

Rainflod brings sand and clay to the plant area. Erosion is evident due to the missing of the necessary civil works.

A N N E X "C"

FORWORD

This report was made on the basis of the following information obtained on the spot:

- Salt output in Mozambique during 1983
- Output before thecountry's independence
- SADCC report (January 1983)
- 1984 plan
- Forecast on the increase of population in Mozambique and the SADCC area
- Development of the industry

Based on these parameters we tried to demonstrate that the future development of Mozambique may not be achieved fully without an adeguate increase in the salt production and that, consequently, also the other countries of the SADCC area would suffer a possible shortage of salt that would compel them to apply to other areas with incalculable economical and political repercussions.

We also tried to demonstrate the absolute urgency in solving this problem because statistics show that as concerns the salt industry Mozambique is on the point of reaching levels of mere survival, levels below which cannot fall without dangers of serious consequences in both the public health and social fields.

1. SALT PRODUCTION IN MOZAMBIQUE IN 1983

The following statistical data were obtained from the UDIS office (Unitade de Direçao de l'Industria do Sal).

In 1983, approximately 60,000 tons of salt were produced in the various provinces of Mozambique the whole output being provided by marine saltworks, as detailed below:

1.1 Province of Maputo

Saltworks		Ownership	Production tons	Remarks
SALINA 1	Azevedo	Government property	841.3	
	Ribeiro	do	1,320.0	
	Emanuel Paiva	do	680.8	
	Elidio Paiva	do	1,374.6	
	Salina 1	do	2,992.2	
	Rapsina 1	do	1,026.8	
	Rapsina 2	do	1,477.5	
	Salina 2	do	953.5	
MINOR Saltworks	Fonseca	do	1,461.5	
	Martins 1	do	2,181.5	
	Ismaek	do	568.9	
	Martins 2	do	108.2	
	T.M. Moco	do	-	
	Graca	do	1,001.3	
	Simoca	do	306.3	
	Maia	do	510.2	
	M.Ferrer	do	364.0	
	G.Junior	do	196.7	
	Exploradora	do	2,226.7	
	Salina Nova	do	365.7	
	Spencer	do	-	
Joaquim Martins		Private property	1,600.0	January-April output The owner has retired from the activity
Antonio Anacleto		do	215.0	-
Pereira Marques		do	55.0	Complete information lacking
Baptista Saltwork		do	730.0	-
Katchi Saltowrks		do	-	No info available
Zacarias Saltworks		do	907.0	January-October output
Lipgamo Saltworks		do	1,306.0	Production until October. Now inactive.
Mussa Sassub saline		do	-	Inactive. No info available
Total Government property			19,958.0	

Total private property	4,813.0
TOTAL PROVINCE	24,771.0

1.2 Province of Inhambane

Saltworks	Ownership	Production	Remarks
Nova Mambone	Government property	2.889.0	A 50 hectare saline built by North Coreans
Batanhe Saltworks	Private property	164.0	-
Manuel Nunes	do	42.0	Uncorfirmed figure Presently inactive
L.Comane Teniela	do	6.0	do
Others	do	8.0	do
Quissico Saltworks	Co-operative society	5.0	Uncorfirmed figure
Total Province		3,114.0	

1.3 Province of Sofala

Saltworks	Ownership	Production (tons)	Remarks
Mercantil Co.	Private property	800.0	-
Mondlane Co-operative soc.	Co-operative soc.	2,867.0	-
Beira Saltworks	-	-	Inactive since 1982
Total Province		3,667.0	

1.4 Province of Zambezia

Saltworks	Ownership	Production tons	Remarks
Escola saltworks	Govern.prop.	768.0	-
Comp.de Zambezia	Priv.prop.	1,037.0	Active until October
Irmanos Vieiras	do	-	No info available
Comp. do Boror	do	-	do
Soc.Agr.do Madal	do	512.0	Active until October
Sector Co-op. soc.	Co-op. soc.	-	No info available
Total Government property		768.0	
Total private property		1,549.0	
Total Province		2,317.0	

1.5 Nampula Province

Saltworks	Ownership	Production tons	Remarks
Martins & Irmano	Priv.prop.	8,758.0	-
Mateus Saltworks	do	4,233.0	-
Ismail Abacassamo	do	-	No info available
William Philippi	Priv.prop.	1,956.0	-
Lima Saltworks	do	3,147.0	-
Mozambique Salt.	do	500.0	-
Sector cooperative society	Co-ope.soc.	-	Inactive
Castano Salt.	Priv. prop.lacking	66.0	Complete information
Aussena Salt.	Priv. prop.lacking No inactive	71.0	Complete information
Omar Antibo Saltworks	do	792.0	do do
Lumbo Saltworks	do	622.0	do do
Moussuril Salt.	do	165.0	do do
issifali Salt.	do	174.0	do do
Monapo Saltworks	do	20.0	do do
Total Province (all private property)		20,504.0	

1.6 Cabo Delgado Province

Saltworks	Ownership	Production tons	Remarks
Mieze Saltworks	Govern.property	-	No info avaiable
Tormahomed Summer	Private prop.	143.0	Complete info lacking
Jacob	Private prop.	-	No info available
Lusaka Co-op. society	Co-op.soc.	-	No info available
3 fevreiro co-op. society	do	-	do
Rovuma co-op. society	do	-	do
Total Province		143.0	

1.7 Total

From these data, confirmed at the UDIS, one can assume that the overall output of 1983 was as follows:

- Government sector	23,615.0 tons	(43%)
- Private property	28,029.0 tons	(52%)
- Co-operatives Societies	2,872.0 tons	(5%)
TOTAL	54,516.0 tons	

Owing to lack of direct communication, due to the

current internal situation, these data can be considered incomplete and, taking into account that some saltworks which did not provide any information, may have produced salt, one can conclude that, even adding 10% for the aforementioned motive, Mozambique, during 1983, may have produced 60,000 tons of salt at most, whereas the Ministry Plan expected an output of 80,000 tons.

2. FORECAST FOR THE 1984 CAMPAIGN

Also for 1984 the Plan provides for a total production of 80,000 tons of salt, but one can foresee that this level can hardly be achieved because, according to the information received, some saltworks have discontinued their operations, either temporarily, owing to rearrangement and rehabilitation, or definitively.

One can foresee that, even considering an exceptional year (as to favourable wheather) the total output in 1984 will not be very far from the one in 1983, i.e. the situation will remain stationary.

3. PROVINCE OF MAPUTO-MATOLA AREA

As in the "Extrasal" saltworks - province of Maputo-Matola Area - 19,958 tons of salt have been produced (the 37% of the total production of Mozambique) we have considered useful to point out with particular care the situation of this saltwork. The present paragraph depicts the actual situation of these saltworks and the future prospects of the salt industry in the Maputo area.

3.1 Matola saltworks complex

The existing saltworks complex in the town of Matola can be broken down as follows:

SALINA 1 - This saltwork is the result of the amalgamation of 8 old artisan saltworks named:

Azevedo - Salina 1

Ribeiro - Rapsina 1

Emanuel Paiva - Rapsina 2

Elidio Paiva - Salina 2

The area of the complex can be estimated at about 148 ha.net.

Moreover, this is the only saltwork for which there are topoaltimetrical findings.

FONSECA, MARTINS 1 AND ISMAEL SLTWORKS - These saltworks are to be found in the vicinity of Salina 1. It is the intention of UDIS to unite these three saltworks with the Salina 1 in order to have a single

modernly-restructured saltwork to increase the production. However this project calls for a topoaltimetrical campaign to be able to determine the hydraulic course of the new saltwork, the position of the pump stations, ecc.

MINOR SALTWORKS - In a radius of 8 to 10 km around Matola there exist another ten saltworks of a few hectares each, i.e.:

Martins 2	-	M. Ferrer
T.M. Moco	-	G. Junior
Graca	-	Exploradora
Simoca	-	Salina Nova
Maia	-	Spencer

Also for these saltworks planimetry is non-existent, only production figures.

3.2 Production

The total production of all the pans of the complex in 1983 was 19,958 tons of unrefined salt as per enclosed schedule. In the Salina 1 of Matola alone production amounted to 10,667 tons. Seeing that the Salina 1 of Matola has an area of 148 hectares it follows that the specific production was 72 tons/ha or 7,2 kg/m2, a truly low production for a pan which should give about 120 tons/ha.

PROVINCE OF MAPUTO - MATOLA AREA - PRODUCTION 1983 (Kg)

SALTWORKS	JANUARY	FEBRUARY	MARCH	APRIL	MAY	JUNE	JULY	AUGUST	SEPTEMBER	OCTOBER	NOVEMBER	DECEMBER	TOTAL
Azevedo	39780	98640	59430	64650	63850	79200	79630	103630	58320	115110	78890	-	841330
Ribeiro	79200	98230	130640	84910	112350	71830	88770	94540	65690	275170	218740	-	1320070
Emanuel Paiva	118490	31310	4 270	82880	76740	35610	41750	50340	107410	-	89020	-	638350
Elidio Paiva	230840	63850	134450	52180	56850	98230	160730	64460	91480	317160	104360	-	1374590
Salina 1	303670	116400	258810	208540	602630	37570	192280	167970	409620	444240	250490	-	2992220
Raçsina 1	87920	56110	42050	87420	152870	93320	61450	48500	55250	239370	96450	6140	1026850
Raçsina 2	201060	40700	46120	117570	263870	18420	93690	143660	159800	283700	108910	-	1477500
Salina 2	77230	13200	27010	154960	77110	12030	154910	76680	117630	181640	61150	-	953550
Fonseca	132240	78890	42420	45250	277560	115730	97920	154770	141390	201490	165880	7980	1461520
Martins 1	-	-	-	-	-	-	-	773430	448410	682200	230840	46000	2181480
Israel	-	9210	11660	130770	22470	-	21490	49110	216720	82880	24560	-	568870
Martins 2	-	-	-	-	-	-	-	-	26150	61330	20690	-	108170
T.M. Moco	-	-	-	-	-	-	-	-	-	-	-	-	-
Graca	162030	121410	55570	47490	36490	-	119500	119590	102410	107560	119250	-	1001300
Simoca	104370	12280	-	-	55250	48500	85950	-	-	-	-	-	306350
Maia	61390	76250	47890	79320	66320	-	15960	16330	57100	69680	-	-	510240
M. Ferrer	55440	-	33520	-	-	-	6140	19830	74160	94360	80550	-	364000
G. Junior	38760	13110	11650	55460	18086	-	-	20380	-	30944	8340	-	196730
Exploradora	218740	183770	155920	207020	255700	50160	255580	141330	124320	163980	451240	18910	2226670
Salina Nova	69990	16940	45680	85090	29470	-	7370	7370	-	70650	33150	-	365710
Spencer	-	-	-	-	-	-	-	-	-	-	-	-	-
TOTAL	1981150	1030500	1160090	1503510	2187616	660600	1447120	2051920	2255890	3421464	2142510	79630	19950000

3.3 Future prospects - Reunification of the Fonseca, Martins 1 (Ismael) Saltworks

Apart from the modernization of the above-mentioned saltworks, it is also the intention of UDIS to unify them, seeing that Fonseca and Martins 1 border each other, and between Fonseca and Salina 1 it would mean digging a channel or laying a pipe about 1.5/2 km long.

The Ismael saltworks could also be connected to the other three.

3.4 Initial intervention

3.4.1 Channels surrounding Salina 1

Salina 1 is to be found at the foot of a plateau on which is situated the town of Matola. This plateau slopes down towards the saltwork. It follows that, in the event of rain, a large quantity of rain-water flows towards the saltwork thus diluting the water therein. It is noted that even the drain-exits of the road that runs by the saltwork discharge the rain in its direction.

The density of the water in the basins near the steep slope has been measured and found to be 1° Bè (entrance of the sea water 300 mt away 2.8 Bè).

It is evident that the first job to be done is that of digging a surrounding channel to receive the rain water coming from the hill and discharge it into the sea, thus protecting the saltwork from pollution. The sketch of this channel, trapezium-shaped, 1 mt wide at the bottom and about 3 km long, has been presented to the management of UDIS.

When it will be dug and will be connected with the 9 discharge channels, already existing, which cross the pan, we can expect that it will be possible to increase production by approx. 2000 tons/year.

3.4.2 Weirs

Another problem to be resolved is that of the separation of the various basins connected with each other so as to avoid the "mixing" of the water in case of wind. It should be suitable a box-type weir about 50 cm wide which could be constructed during the period August-November using the wood of the washing plant packing cases, in view of the serious shortage of working wood. With the installation of a series of weirs at strategic points ist is hoped to further increase the pan's production.

3.4.3 Rain water

There remains the problem of the draining off of

the rain water fallen into the basins; it is considered that this problem must be resolved within the framework of the restruction project for the saltwork.

3.5 Technical notes regarding works of improvement to the saltwork" Salina 1

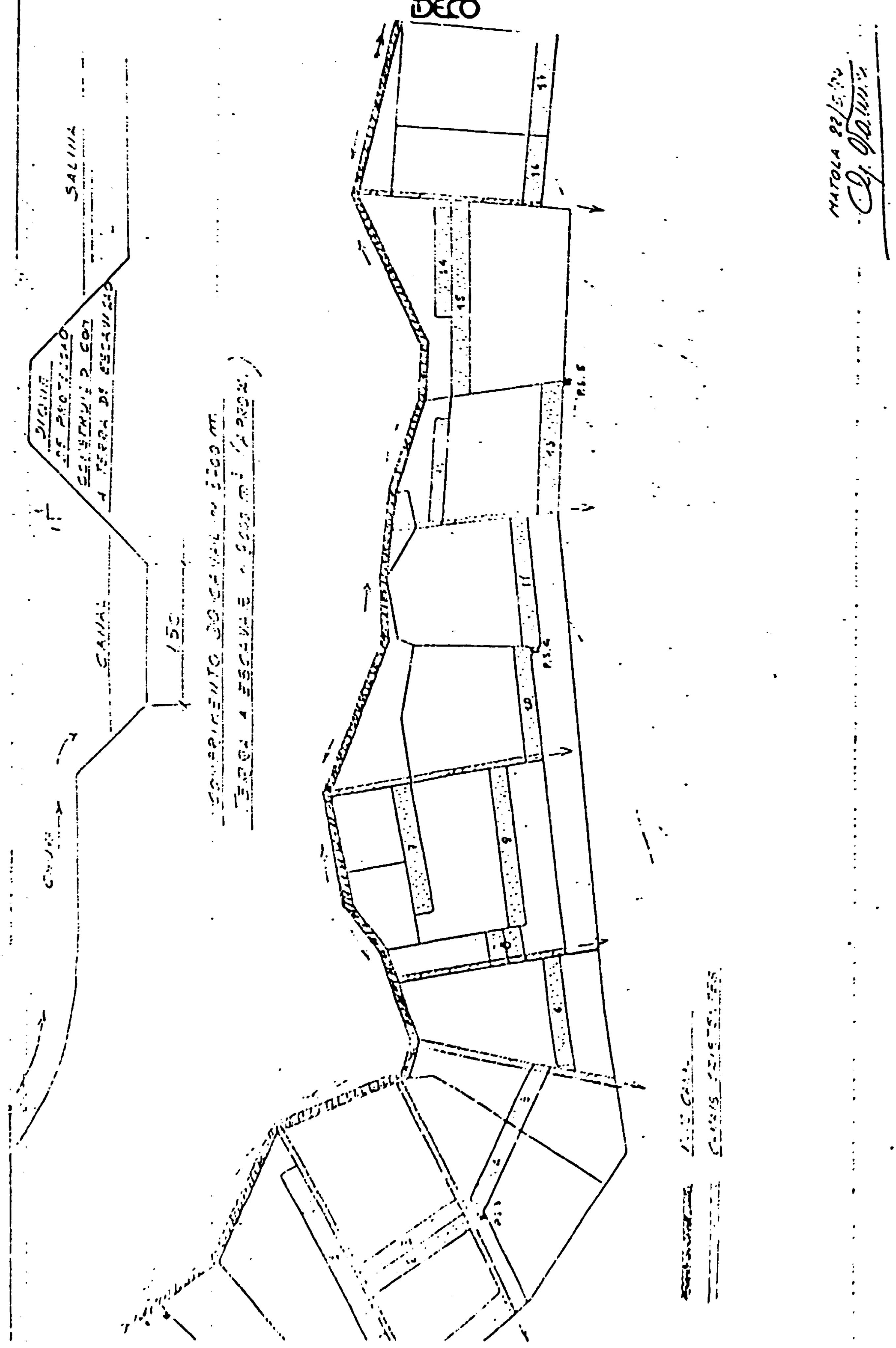
3.5.1 Protection of the saltwork from rain water

One can really say that the Matola saltwork has no defence against the rain water: it is situated at the foot of a hill which itself pours rains water towards the saltwork.

The saltwork is crossed in the traverse sense by 9 channels of 1 mt width but these channels can do very little seeing that they are not connected between themselvels by a surrounding as soon as possible if one wants to start producing salt in a reasonable manner.

This means digging a channel to act as a collector for the rain water coming from the hill, carrying it to the 9 transversal channels and then emptying itself into the sea at both ends. In this manner one would create 11 outlets for the water, more than sufficient for an effective protection. The existing transverse

channels are 1 mt; wide and lend themselves ably to the discharge of the rain water, even though they are in need of some maintenance work.


SALINA
CANAL
150
MATOLA

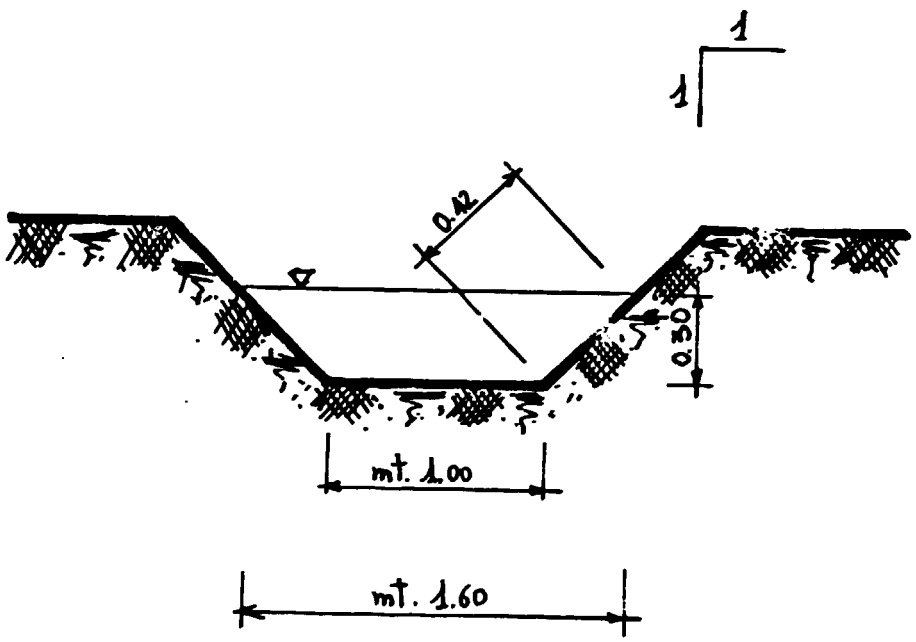
The sorrounding channel should have a width of approx. 1.5 mt at the bottom and should be more than sufficient to drain the water towards the transverse channels without having to contain the total quantity. During the last 30 years the maximum amount of rain registered was 256.6 mm in 24 hours, i.e. $\frac{256.6}{24}$ = 10.7 litre/h or 107 m^3/ha.

Considering that surrounding the saltwork there is a sloping area of 300 ha one can calculate that there can arrive at the saltwork

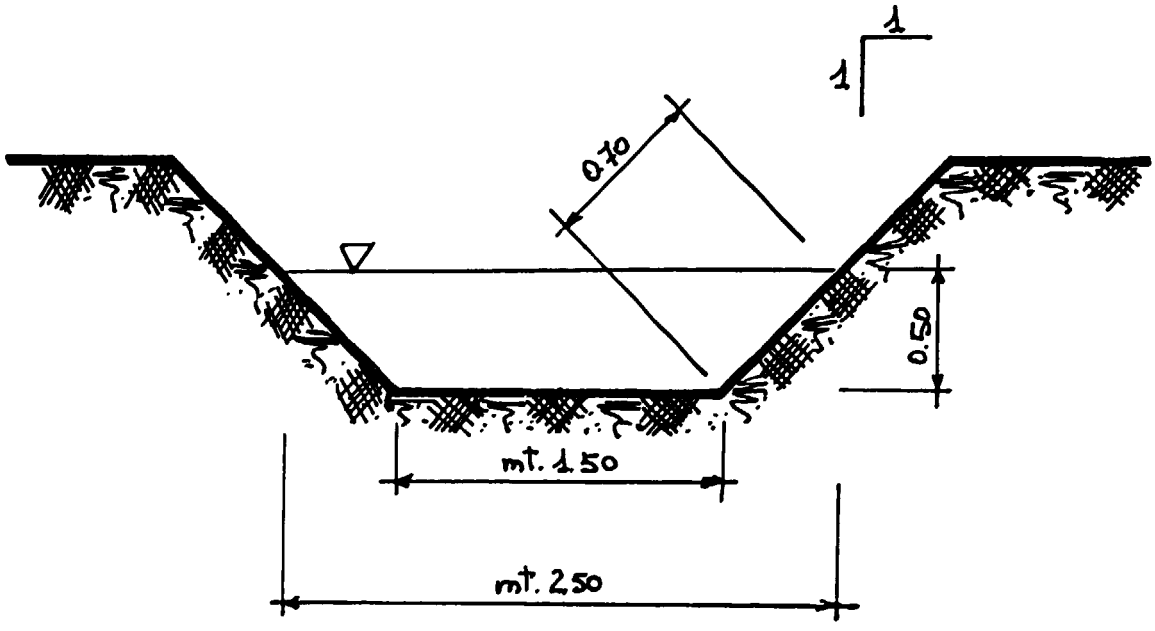
$\frac{107 \times 300}{24}$ = 1338 m^3/h or 0,371 m^3/sec, which divided by 11 exits gives, for each channel, $\frac{0,371}{11}$ = 0,034 m^3/sec

3.5.2 Channels

From these data it is possible, with theoretical calculations, to suppose that the section of each channel must be to the following:


1
1
0.42
0.30
mt. 1.00
mt. 1.60

As the surrounding channel, that is fed with rain water along its whole length, must be suitable to support the maximum flow of water of 4 channels, it is possible, with theoretical calculation, to suppose that its section must be the following:

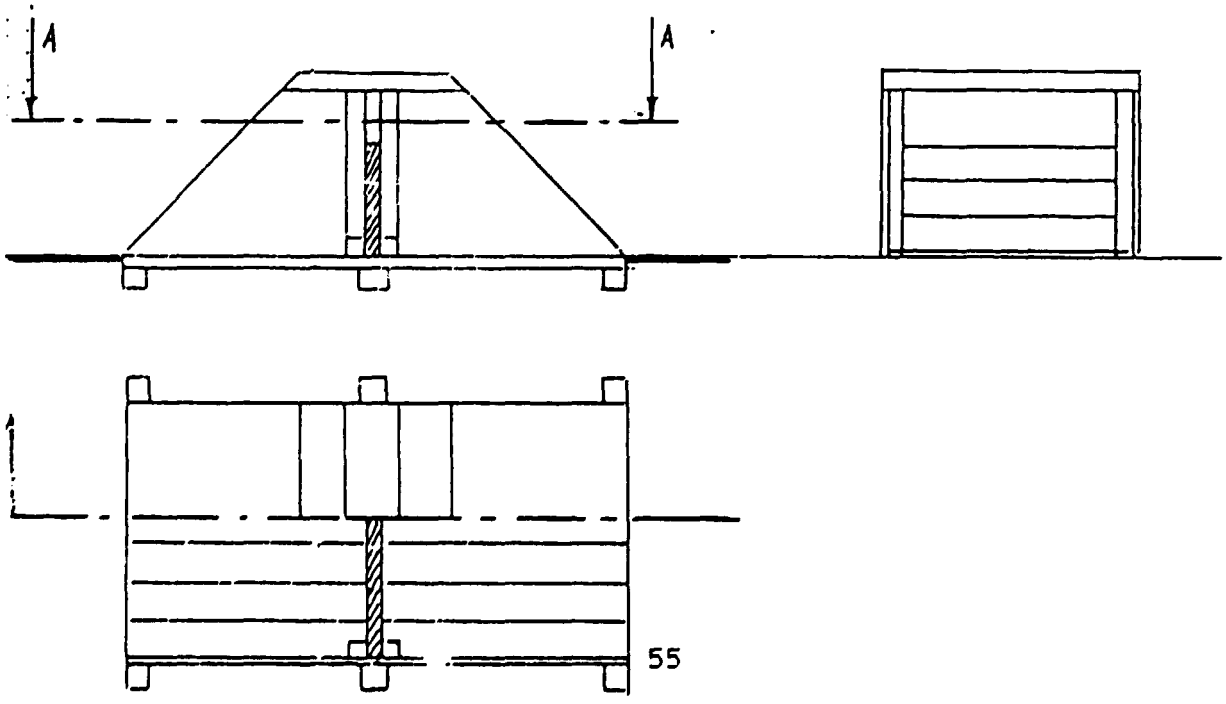


3.5.3 Modifications to the hydraulic system of the saltworks

The actual hydraulic system of the "Salina 1" presents the serious disadvantage of having evaporation basins directly connected with one another: there are no weirs and only 4/5 very rudimental doors. As a consequence of this state of affairs the wind, mixing the waters, lowers the density, and consequently there is an enormous amount of time lost before arriving at saturation point.

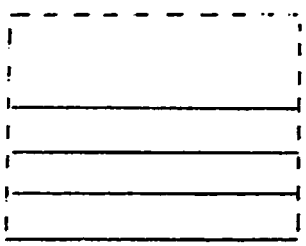
Another serious drawback is the total lack of skimmers for the straining of the rain water from the basins.

It is therefore opportune to construct and install weirs and skimmers in wood, which could be of the following type:

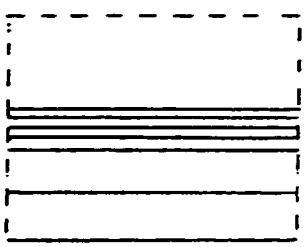


For the rain water skimmers one could use the same box-like construction, only that instead of ordinary planks wooden strips of 1/2 cms in height would be used.

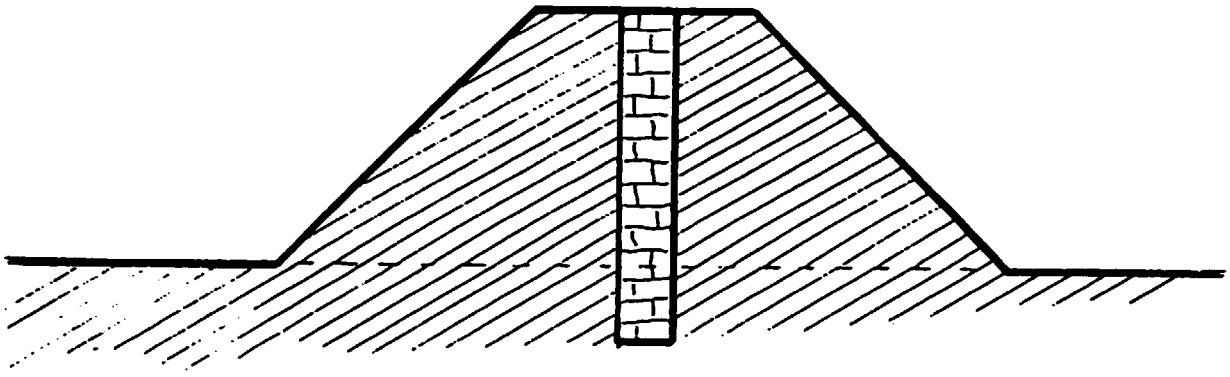
Weir



Skimmer



A third snag has been found along certain of the dykes protecting the basins. It is noted that there is a type of shellfish that digs tunnels in the dykes from one side to the other: probably this is due to the organic substances contained in the clay on which these shellfish feed. Where this problem arises it is adviseable to reinforce the centre of the dyke with a small wall of stones and malt, in order to prevent the perforation of the dyke.



3.5.4 Basins

Seeing that "Salina 1" is the result of the union of 8 old artisan-type saltworks, it follows that the evaporation basins, and those for crystalisation, are very small; therefore it would be adviseable to enlarge them all, but more especially the evaporation basins, by opening passages in the dykes so as to form chicanes which would increase the course of the water and aid evaporation. Naturally this work would be done on the occasion of the installation of the weirs.

With regard to the crystalisation basins, their reorganisation can be delayed until the realisation of the definite project, i.e. when the existing series of 17 basins will be grouped together into a single complex.

3.5.5 Theoretical calculations of the saltworks

The saltworks is furnished with a small weather station which consists of the following:

a weather hut containing

. 1 double thermometer Humidity/Dryness

. 1 Puhe-type evaporation gauge

. 1 double horizontal thermometer Max/Min

Outside there is:

- 1 Rain-gauge of the funnel type with the cylinder marked for instant reading
- 1 Anemometer of the totalisor type (the total kilometers are divided by the hours and one has the average speed per hour).

There is also an evaporation gauge consisting of a circular tube of circa 1 mt painted white, but this is not considered reliable because:

a. it is not protected by a roof and therefore it also receives the rain;
b. the tube is not protected by wire-netting and thus serves as a drinking place for birds;
c. the tube is installed on the ground at the edge of the saltworks and not in the basin, and therefore must give higher evaporation fugures, since on the ground the atmosphere is less saturated than in a basin.

The meteorological data gathered from the weather station at the saltworks only refer to the years 1981, 1982 and 1983 and, from the statistical point of view, does not give a complete picture of the situation since one

would need the figures for at least ten years; however it can be useful as a starting point for a general study.

The figures gathered from the weather station at Matola are the following:

Temperature °C

YEARS	J	F	M	A	M	J	J	A	S	O	N	D
1981	--	25,6	25,8	23,1	20,7	18,2	18,7	18,7	20,4	21,3	25,1	25,2
1982	26,3	26,9	25,5	23,0	21,0	18,7	19,2	20,7	22,2	16,3	17,3	17,3
1983	17,7	19,2	16,8	17,0	14,5	17,0	19,4	19,3	22,2	22,3	23,8	23,8
MEDIA	22,0	23,9	22,7	21,0	18,7	18,0	19,1	19,6	21,6	20,0	22,1	22,1

Humidity %

YEARS	J	F	M	A	M	J	J	A	S	O	N	D
1981	--	73,0	69,5	64,0	69,5	61,0	63,9	76,0	65,0	62,5	71,6	69,5
1982	71,0	67,8	70,8	75,8	71,0	74,5	70,5	77,5	66,0	75,0	71,0	69,0
1983	75,8	69,5	72,0	62,0	65,8	68,0	63,8	60,0	59,0	63,8	74,0	68,8
MEDIA	73,4	70,1	70,8	67,3	68,8	67,8	66,1	71,2	63,3	66,8	72,3	68,8

Gross Evaporation $^{m}/_{m}$

YEARS	J	F	M	A	M	J	J	A	S	O	N	D
1981	---	109,3	143,4	117,4	126,6	77,0	93,1	89,3	121,0	128,8	148,1	156,7
1982	166,9	169,8	160,5	106,7	86,9	71,6	76,9	97,3	126,6	142,0	159,0	202,1
1983	199,8	156,4	137,9	----	63,2	93,7	106,0	127,2	126,6	171,4	136,2	170,4
MEDIA	183,4	145,2	147,3	112,1	91,9	80,8	92,0	104,6	124,7	147,4	147,8	176,4
TOT	1553,6											

Total Rain $^{m}/_{m}$

YEARS	J	F	M	A	M	J	J	A	S	O	N	D
1981	---	69,9	100,7	32,3	141,1	7,8	24,3	22,3	69,0	120,8	91,1	46,
1982	34,0	43,1	56,5	226,9	16,4	3,3	15,0	16,4	1,9	14,0	14,6	57,
1983	126,3	43,6	44,1	1,2	60,1	4,1	5,3	14,7	1,9	22,9	169,5	110,
MEDIA	80,2	52,2	67,1	86,8	72,5	5,1	14,9	17,8	24,3	52,6	91,7	71,
TOT	636,6											

Average Net Evaporation Years 1981/2/3

J	F	M	A	M	J	J	A	S	O	N	D	TOT
103,2	93,0	80,2	25,3	19,4	75,7	77,1	86,8	100,4	94,8	56,1	105,0	615,

Wind (Speed in km/h.)

YEARS	J	F	M	A	M	J	J	A	S	O	N	D
1981	---	3,9	5,6	5,0	5,5	4,8	6,3	6,5	7,8	7,7	7,0	6,
1982	6,7	7,3	5,4	4,0	4,9	3,6	3,2	5,0	6,7	6,1	6,2	4,
1983	6,7	6,2	5,4	5,3	5,3	4,8	5,4	6,2	7,4	8,1	7,0	5,
MEDIA	6,7	5,8	5,5	4,8	5,2	4,4	5,0	5,9	7,0	7,6	6,4	5,

3.5.6 Theoretical elaboration of the Matola meteorological data

For the theoretical calculation of the meteo data of Matola we have at our disposition two practical formulas.

One of these can be Dalton's formula whereby for the tension of the brine vapour one substitutes the tension of the saturated atmospheric vapour at the same temperature.

$$(1)\quad E = 1.44 \times C \times \frac{F - UF \times N}{760}$$

where E = evaporation in In.

C = constant variable from 300 to 500 according to ventilation (in our case C = 350).

F = pressure of saturated vapour at average temperature.

N = number of days in the month.

The values of F are to be taken from the following table of temperature in function:

F		F		F	
T°C	mm di Hg	T°C	mm di Hg	T°C	mm di Hg
16	13.6		22	19,8	28 28,4

18	15,5	24	22,4	30	31,8
20	17,5	26	25,3		

This is taken from the formula for the evaporation of the lakes and is only valid in the months with little rainfall.

U = relative humidity in %

T = temperature in °C

C_1 = corrective factor for the ventilation variable from 0 to 1.3 (0 = breeze system, 1.3 = wind higher than 20 km/h. In our case C_1 = 1).

The data furnished by the weather station of Matola is insufficient to establish which of the two formulas should be used, therefore one must look to the figures for the ten year period (1973 - 82) supplied by the stations of Maputo, Machaca and Umbeluzi, whose positions form a triangle of which the saltwork "Salina 1" is the centre.

From the information from these three stations one can establish that the wettest months are January, February, March, April, November and December, therefore for these months formula (1) will be used and for the other months formula (2) will be put to use.

3.5.7 Development of calculation with the Matola data

January $E = 1.44 \times 350 \times \frac{19.8 - 0.734 \times 19.8 \times 31}{760} = 108.3$

February $E = 1.44 \times 350 \times \frac{22.4 - 0.701 \times 22.4 \times 28}{760} = 124.4$

March $E = 1.44 \times 350 \times \frac{20.7 - 0.708 \times 20.7 \times 31}{760} = 124.3$

April $E = 1 \times (0.08 - 3 \times 67.3^{-4})\ (21^{1.5} - 21) \times 30 = 135.0$

May $E = 1 \times (0.08 - 3 \times 68.8^{-4})\ (18.7^{1.5} - 18.7) \times 31 = 114.4$

June $E = 1 \times (0.08 - 3 \times 67.8^{-4})\ (18^{1.5} - 18) \times 30 = 104.5$

July $E = 1 \times (0.08 - 3 \times 66.1^{-4})\ (19.1^{1.5} - 19.1) \times 31 = 120.1$

August $E = 1 \times (0.08 - 3 \times 71.2^{-4})\ (19.6^{1.5} - 19.6) \times 31 = 122.1$

September $E = 1 \times (0.08 - 3 \times 63.3^{-4})\ (21.6^{1.5} - 21.6) \times 30 = 144.6$

October $E = 1 \times (0.08 - 3 \times 66.8^{-4})\ (20^{1.5} - 20) \times 31 = 129.1$

November $E = 1.44 \times 350 \times \frac{19.9 - 0.723 \times 19.9}{760} \times 30 = 109.7$

December $E = 1.44 \times 350 \times \frac{19.9 - 0688 \times 19.9}{760} \times 31 = 127.6$

E Total	1463.5
Rain	636.6
E net	826.9

Summarising

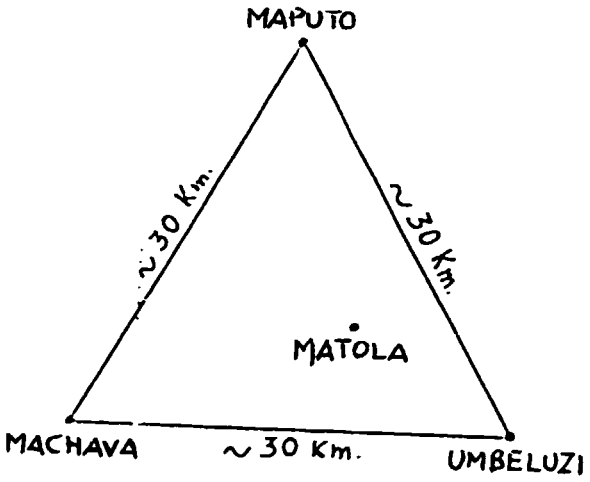
E net registered = 917 mm

E net calculated = 826.9 mm

Average net monthly F. = 68.9 mm

3.5.8 Development of calculation of the ten-year figures of the Maputo, Machava and Umbeluzi stations

Location:



The average figures are taken from the findings carried out at the 3 stations during the years

1973 to 1982 inclusive.

Average Temperature °C

STATION	J	F	M	A	M	J	J	A	S	O	N	D
Maputo	23.5	26.0	25.2	23.3	21.5	19.5	19.1	20.1	21.2	22.3	23.9	25.2
Machava	26.2	25.8	24.8	22.9	21.0	19.4	19.0	20.3	21.6	22.9	24.3	25.5
Umbeluzi	26.7	26.5	25.7	23.2	20.7	18.0	17.9	19.8	21.4	22.9	24.5	26.0
Average	25.5	26.1	25.2	23.1	21.1	19	18.7	20.0	21.4	22.7	24.2	25.6

Average humidity %

STATION	J	F	M	A	M	J	J	A	S	O	N	D
Maputo	76.9	79.6	78.9	78.4	75.2	73.4	74.6	74.0	75.7	75.1	77.7	76.7
Machava	67.4	70.1	69.4	69.2	66.7	64.1	65.7	64.4	63.4	62.5	66.2	66.4
Umbeluzi	72.7	75.6	74.3	74.8	72.5	69.9	69.2	68.7	71.3	63.2	73.1	70.9
Average	72.7	75.1	74.2	74.1	71.5	69.1	69.8	69.0	70.1	66.9	72.3	71.3

Average Evaporation - Ins. (Gross)

STATION	J	F	M	A	M	J	J	A	S	O	N	D
Maputo	98.8	82.7	88.2	80.0	84.1	80.6	80.6	92.6	85.9	94.0	87.0	99
Machava	157.8	132.0	132.1	127.7	122.9	112.8	131.7	148.1	147.7	155.5	146.7	150
Umbeluzi	117.2	90.3	101.2	92.4	99.6	100.0	107.9	130.5	127.7	136.8	116.9	129
Average	124.6	101.7	107.2	100.0	102.2	97.8	106.7	123.7	120.4	128.8	11.9	126
TOT	1356.3											

Rain - Ins.

STATION	J	F	M	A	M	J	J	A	S	O	N	D
Maputo	191.7	136.7	104.6	152.9	37.0	9.7	11.5	15.1	83.3	48.1	80.1	97
Machava	150.7	167.8	95.3	58.4	26.0	7.9	9.4	14.1	59.5	39.2	78.1	84
Umbeluzi	157.0	129.0	94.9	56.4	28.9	6.0	13.5	14.2	55.1	42.1	86.9	103
Average	166.5	144.5	98.3	89.2	30.6	7.7	11.5	14.5	66.0	43.1	81.7	94
TOT	848.9											

Net Evaporation - Ins.

J	F	M	A	M	J	J	A	S	O	N	D	TOT
41.9	-42.8	8.9	10.8	71.6	90.1	95.2	109.2	54.4	85.7	35.2	31.5	507

3.5.9 Development of calculation on the average figures of Maputo - Machava - Umbeluzi

Using the two formulas, as done for the datas of Matola station,

(1) $E = 1.44 \times c \times \frac{F - UF}{760} \times N$

(2) $E = C_1 (0.08 - 3U \times 10^{-4}) (T^{1.5} - T) \times N$

we can calculate that the net evaporation will be as follows.

Net evaporation calculated = 758.5 mm

From the records the net evaporation recorded can be assumed equal to 507.9 mm.

Summarizing:

Net evaporation May-December:

Matola Station (1981 - 1983):

Net evaporation recorded = 917.0 mm

" " calculated = 826.9 mm

Maputo, Machava and Umbeluzi Stations (1973 - 1982).

Net evaporation recorded = 507.9 mm

" " calculated = 758.5 mm

Observation

It is to be emphasised that the Matola figures only cover three years and therefore for statistical purpose they are insufficient, above all due to the fact that 1982 was an anomalous year for its low rainfall.

With regard to the average figures, both recorded and calculated, for the Maputo, Machava and Ambeluzi stations, it is to be noted:

1) The approximation of the Puhe evaporation gauge;
2) The approximation of the practical calculation formulas.

If one appreciates the difference between theory and practice, it is sufficient to make the following calculation with the theoretical and practical data of the Maputo, Machava and Umbeluzi stations:

evaporation calculated	758.5	mm
evaporation recorded	972.9	mm
difference	185.6	mm

in 365 days one has

$$\frac{185}{365} = 0.50 \text{ mm/day difference}$$

a difference which can be overloocked if the

evaporation gauge is not of the writing type and perfectly calibrated.

From the elaboration of data in our possession, both from the statistical and calculative point of view one can arrive at the conclusion that at Matola there is a net average annual evaporation of 700 mm and that the adapt period goes from May to December inclusive.

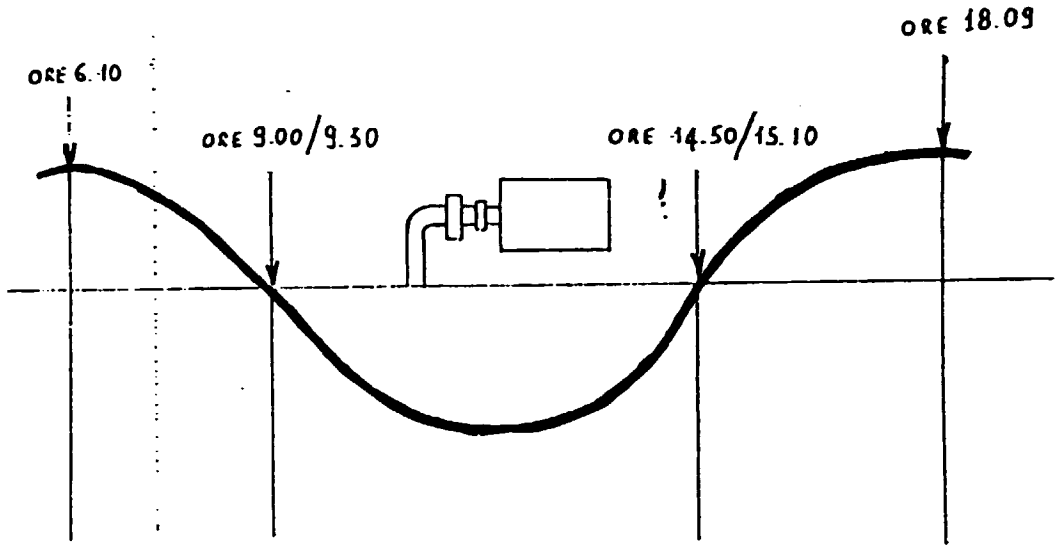
There is another consideration to be amade: the evaporation over a stretch of water is greater than that on land, therefore it is more reliable to consider the calculated evaporation than the recorded one, even if the calculation is made by practical and not strictly rigid formulas.

3.5.10 The sea

The Matola saltwork is situated on the river of the same name, near to its estuary. It is obvious that to avoid pumping sweet water one is obliged to await the two daily high tides which, ascending the river, carry salt water as far as the saltwork.

The saltwork is supplied with water by means of four pump stations staggered along the river bank. They are the PS 1, PS 2, PS 4 and PS 5. With the object of determining the density of the sea water with the highest possible

accuracy, or 3rd May, 1984, the process of measuring the density of the water was started at Pump Stations No. 5 and No. 1 at the two extremes of the saltworks, i.e. that nearest the valley (No. 5) and that highest up (No. 1) along the Matola river. Naturally, since the pumps do not suck up water for the whole duration of the tide, samples were taken only during the two phases of the tide which affect the suction pipes of the pumps.


ORE 6.10
ORE 9.00/9.30
ORE 14.50/15.10
ORE 18.09

Figures Recorded

Data on Tides (Maputo Tide-gauge of 3.5.84)

Morning	max.	high	m. 3.45	hour	5.40	(At Matola	5.55)
"	"	low	m. 0,66	"	11.48	(" "	11.33)
Afternoon	"	high	m. 3.41	"	17.54	(" "	18.09)
"	"	low	m. 0,67	"	00,01 following day	(" "	23.46)

Data on Density. The density was measured by means of a densimeter graduated from 0° to 10° Bè at a temperature of 15°C, and a thermometer.

Hight Tide - to fall

Station 5

TIME	Bè		T°C	15°C
5,55	(2)	2.8	22	3.16
7.00	(2)	2.7	22	3.06
8.00	(2)	2.7	23	3.11
9.00	(2)	2.8	22.5	3.19

Station 1

TIME	Bè		T°C	15°C
6.17	(2)	2.7	22	3.06
7.20	(2)	2.7	22	3.06
8.20	(1)	2.6	23	3.01
9.30	(1)	2.5	23	2.91

Low tide - to rise

TIME		Bè	T°C	15°C	TIME		Bè	T°C	15°C
14.50	(2)	2.5	28	3.20	15.50	(1)	2.6	26	3.18
15.50	(1)	2.5	27.5	3.17	16.05	(1)	2.5	25	3.03
17.00	(1)	2.6	24.5	3.10	17.15	(1)	2.6	24.5	3.10
17.55	(1)	2.6	24	3.07	18.10	(1)	2.7	24	3.17

From these sample charts there results an average density of 3.1°Bè at a temperature of 15°C.

However, seeing that the calculations will be carried out according to the table of prof. Baseggio which starts with the temperature of the sea water at 22°C, the density must be corrected from 3.1 to 2.8°Bè which will be the basic figure for the calculation of the areas.

A N N E X "D"

FIELD NOTEBOOK

PREAMBLE

It is obvious that part of what will follow in this field notebook, both as direct survey or recommended improvements to be adopted, is a repetition of those expressed already by my foregoing collegues and unfortunately not applied till now, handicapping quality and quantity of actual salt production.

I do not emphasize over the potential productivity of sea salt in Mozambique (its meteo-geographic location, coastal length, ecc.), either over its good position for a network distribution of salt products to those neighbouring countries which are importing their total needing of salt. I do not emphasize also about the "principles" on how to produce salt there is an heritage of the Portughese technique that have spryed all over the country innumerable small saltworks artisananly driven.

I will try my best to pay attention only to Matola's saltworks, where also a salt refinery is sited (obsolete and out of production due to several breakages since my arrival on site) and the new salt washing plant supplied by IDECO; it

will be here that I will try to develop, those basic principles necessary to obtain good quality and quantity as in all modern saltworks.

I have to point out my deep discouragement to cooperate with the staff actually uncharged for the production of salt. I have to note that I found them extremely kind, polite and confident, but also extremely listless, confused and without initiative. Some of them have been sent in the past, for training periods, in Cuba and/or Brazil, but despite this, and for reasons I was not able to detect, they do not apply the acquired knowledgements, that is similar to the "mediterranean experience". In short words I did not find in them the so called "sensitivity of salt".

Matola's saltworks

Waiting the conclusion and the start-up of our salt washing plant and the chemical laboratory, I had the opportunity to walk around Matola and Spence's saltworks. Matola is the result of the unification (only as sea water supply) of a group of small saltworks having characteristics much different one to the others, with the result to have 17 lines of crystallisers sprayed here and there. Theoretically we are supposed to have "17 brine flows" to keep under control in an area of about 240 hectares (it is a very difficult job also for a salt expert). The best solution would be to modernise and unify in a large single production unit, through a heavy

resettlement work interrupting, of course, the production of salt till the works are completed. It is obvious that this kind of solution might be adopted only if included in a larger project on salt production development in Mozambique; in other words the resettlement work of Matola shall be done only when another sea salt production unit will be available (Costa do Sol?). Meanwhile certain small betterment works are to be adopted in Matola so to improve considerably the quantity of salt production.

I was astonished by the relinquishment appearance that Matola gives; damages caused by the rain water flood of many months ago are still evident.

I insist to remark that maintenance and betterment, works are to be constant item in a saltworks management especially when those works are to be done by "hand showel" and it looks that (at least numerically) the man-power is available.

As a matter of fact in many places in the higher side of the saltwork the rainwater flood has damaged and partially demolished the partition dams putting in direct contact several evaporating ponds and under the wind action brines are mixing one to the other, moreover the palm trunks, here adopted to protect the foot of the dam's side slope foot, where unanchored and pushed all in one corner. In occasions like the one happened from 30.9 to 15.10.85 when the saltworks was

with no sea water supply due to the cut-down of the main electric cable and the area went dry for about 50% of its extension, it was a good opportunity to intervene with adequate man-power to rebuild these damaged partition dams, scrapping by showel the slipped down clay and reanchoring the trunks. Those maintenance interventions are depending only on the sensitivity and initiative of the personnel in charge of the production; this personnel must immediately sensibilize the management together and a work time schedule should be immediately applied, the result will be:

a) negative; there will be two weeks of lack of sea water supply and translated in missed salt production (force majeur).
b) positive; recuperation of those evaporating areas to a standard production regimen, and therefore a partial recovery of salt production. The production of these areas are actually under the potentiality due to the damages of the rainwater flood.

I believe that, within the circumstances, the result is desirable.

Of course this is only one item, not enough alone, among other elements to be considered together as: controlled brine circuits, good gates between ponds, controlled sea water supply, etc., that will see later on. I do hope also that

this field report will not be considered as a simple criti-

cism but as an incitement to establish a program to improve the main flows of the saltworks, efficient load and discharging channels and well fitted ponds (evaporating, serving and crystallizers).

1. Ring channel to divert catchment of storm water (already pointed out many times).

   This item, constructed today, will remain very usefull also for the future modernization of the saltworks. It is extremely necessary to protect the area from the storm water flowing in from the adjoining catchment areas of about 300 hectares being the saltworks sited in the lower part of Matola. Dimensions of the above channel were already given in previous IDECO's report.

2. Cleaning and maintenance of the 9 transversal channels

   The main function of those channels is to drain off to the sea the storm water collected by the ring channel; other function is to drain off also bittern brine or any other function is to drain off also bittern brine or any other water arising from salt production operation. Sediments deposited on the channel bottom are to be scrapped and spayed on the sides to repair the slopes.

3. Repairing of all embankments

   Contrary to the previous two items that are extraordinary

or seasonal, this intervention must be an everyday routine. As soon that damages done be crabs, water erosion, trucks passage, etc. are noticed an immediate action to repair the damage must be taken.

4. Reconstruction of embankments damaged by the water flood or by the water movements under the wind action. All those embankments are generally slipped on the ponds bottom so it will be enough to carry by hand showel the material and reconstruct the original shape of the embankment.

For all the above 4 items the necessary material is generally available on spot, if the quantity is not enough the necessary clay should be found in the surrounding area, but it is imperative not to dig bottoms so not to fuddle the hydrostatic balance and the bottom's waterproofing already established.

It is obvious that, as soon as these works will be executed, in case of rainfall, the saltworks will have to take care only about the rain directly fallen to his surface, and according to the quantity registered intervene on the overflow spill ways (if available) or to close all the gates and evaporate the rain water before moving again brines. At this stage the Saltwork Management, through the staff responsible for the salt production and the execution of maintenance program, will have in hand the whole activity. Also a good

control over the brine circuit is extremely necessary and not to leave things like they are now. In other words all the above elements are strictly tied one to another and no benefits will arise if only some of them will be adopted.

Brine movements

Actually there is no control on it or either collecting of datas about densities. The actual system is limited to pump in water during high tide, to flow this water in ponds and when it seems enough concentrated to flow it in crystallizers where it is left until dried up totally till the salt crust looks sufficient for manual harvesting. We have not to forget that this non controlled brine flow is also spoiled by continuous mixings where embarkments are damaged and on the gates; in fact in all the saltwork there is no one weir or siphon gate and all ponds are in direct contact and in no most of the cases passages are frontally sited. All that is causing detriment to the salt production, in fact salt actually looks brown coloured, with evident traces (deposit) of sulphate and magnesium, moreover the chrystal shape looks very small. It would be very interesting to have the opportunity to execute several analysis on salt and brines and that will be possible as soon as laboratory will be completely fitted. Just as an idea I report herebelow an analysis result done some time ago comparing it with the average characteristics of salt for industrial purposes:

	Salt of Matola	Average indus.salt
Insolubles	1.7 %	0.2 %
Ca	0.25 %	0.04 %
Mg	0.56 %	0.02 %
SO_4	1.37 %	0.1 %

Another astonishing matter is that there are no data available on the density of the inlet water and according to the information given by your personnel in charge on pumping stations the density of the sea water pumped, ranges between 1° Bé to 1°9 Bé. If this is true we are pumping and consequently evaporating a large quantity of fresh water of Matola river.

Collecting data sheets drafted by Mr. Vaccari were given since many months ago and were not used until now consequently we have no real reference data on this very important element.

It is not even possible to have the exact number of pumping hours. The only available references are those given by meteo station (temperature, humidity, evaporation, wind); but of course being the station wrongly sited these data will not be fully reliable also. You also have some references on tides which are taken from the port of Matola and adopted to your site.

Description of betterment works

a. Severe and continuous control of the intake of sea water with a daily hours haours of pumps functioning and hourly water salinity so as to have the exact volume of water taken from the sea in cubic meters and the water average density. You should start to use EASY data sheets for your pumping stations personnel while your technical office could use Vaccari's sheets as summary.

b. Progressive reconstruction of all gates, applying these basic principles used in all saltworks, as several times discussed in our meetings.
Density control in all gates should be applied.

c. Keeping in hand items a) and b) once applied, it will be possible to increase the brine thickness from the actual 7 cm to a minimum of 10 cm, much better if up to 15 mm.

d. Longer period must be left from one harvesting to the other so as to give more time to salt crystals to grow up, that will also reduce the deposits of other salts.

e. It is imperative to discharge totally the bitter brines, that must be done when the real density will be 29°5 Bè.
A daily density control must be effected.

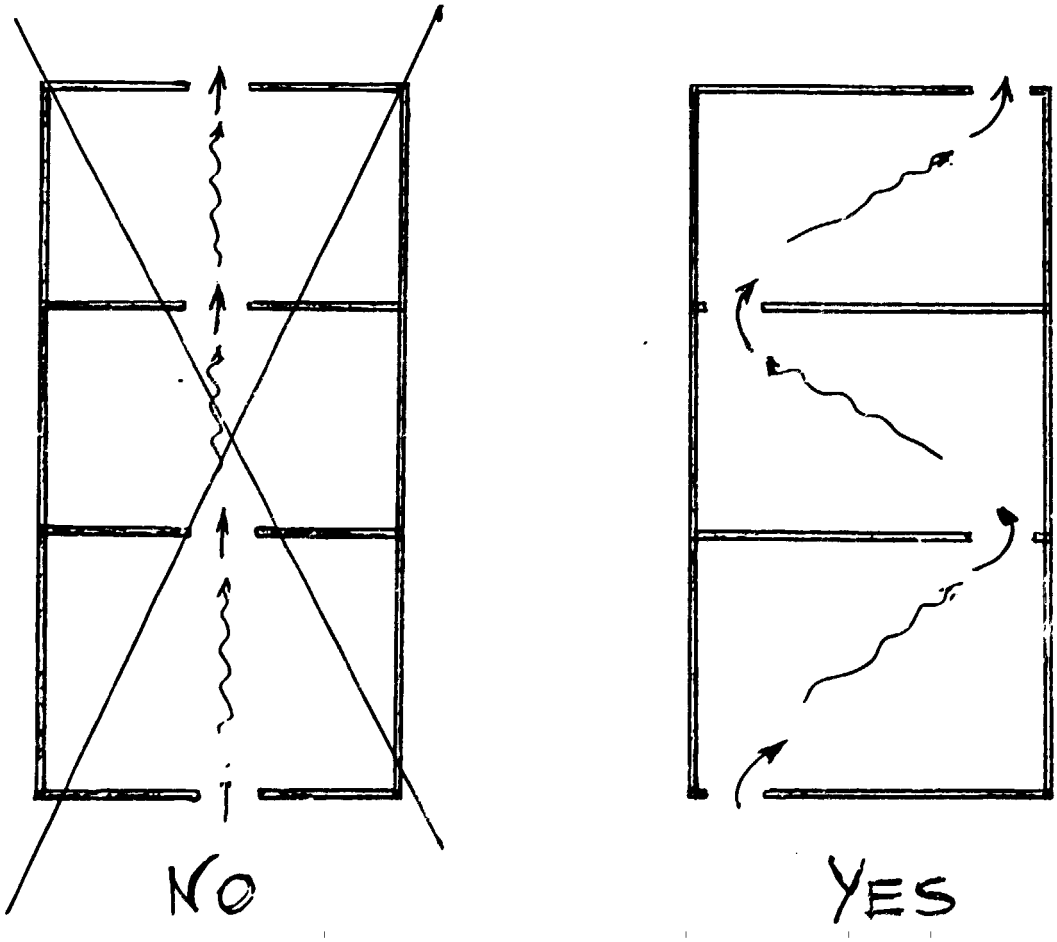
In detail:

a. As we have already agreed with your staff, from the 1st November 1985, each pumping station (sea or brine) must keep up-dated the data sheets (the one we drafted), so as to have the exact number of hours of water pumping made every day (and not the theoretical number) and the real water salinity (density). The Technical Ofice will summarize those data on the sheets given by Mr. Vaccari.

With these two well-known elements it will be possible to ascertain the exact amount of "salt" that we have pumped from the sea; together with other elements given by the meteo-station it is possible to calculate the saltworks production balance. Eventual differences between calculated production and real production will allow us to locate percolation loses, if any, or wrong brine flow circulation; it will also allow the Management a cross checking of consumptions done by a pumping station expressed in Kw or gasoil/lt so as to overlook these expenditures that actually are uncontrolled, especially for gasoil that actually supplied under ratio (e.g. see Spence Saltworks that is under productivity and partially dry because of the lack of gasoil, matter that I feed not to be true).

b. Reconstruction of all gates. This matter was also longly

and exhaustively discussed with you. Every time you have the opportunity you must intervene on general maintenance works around the saltworks repairing the damaged embankments so as to recuperate all surfaces for evaporation; at the same time, all gates sited frontally must be closed and ree-opened "diagonally". This is a basic principle to have the maximum exploitation of the evaporating surfaces and the longest brine circuit that will put under control the brine flow concentration until it reaches NaCl saturation point, i.e. 25°5 Bè (at 20°C of temperature) finally the crystallising ponds shall be fed. I willnow try to summarise the above principle in a single sketch, showing the brine flow scheme.

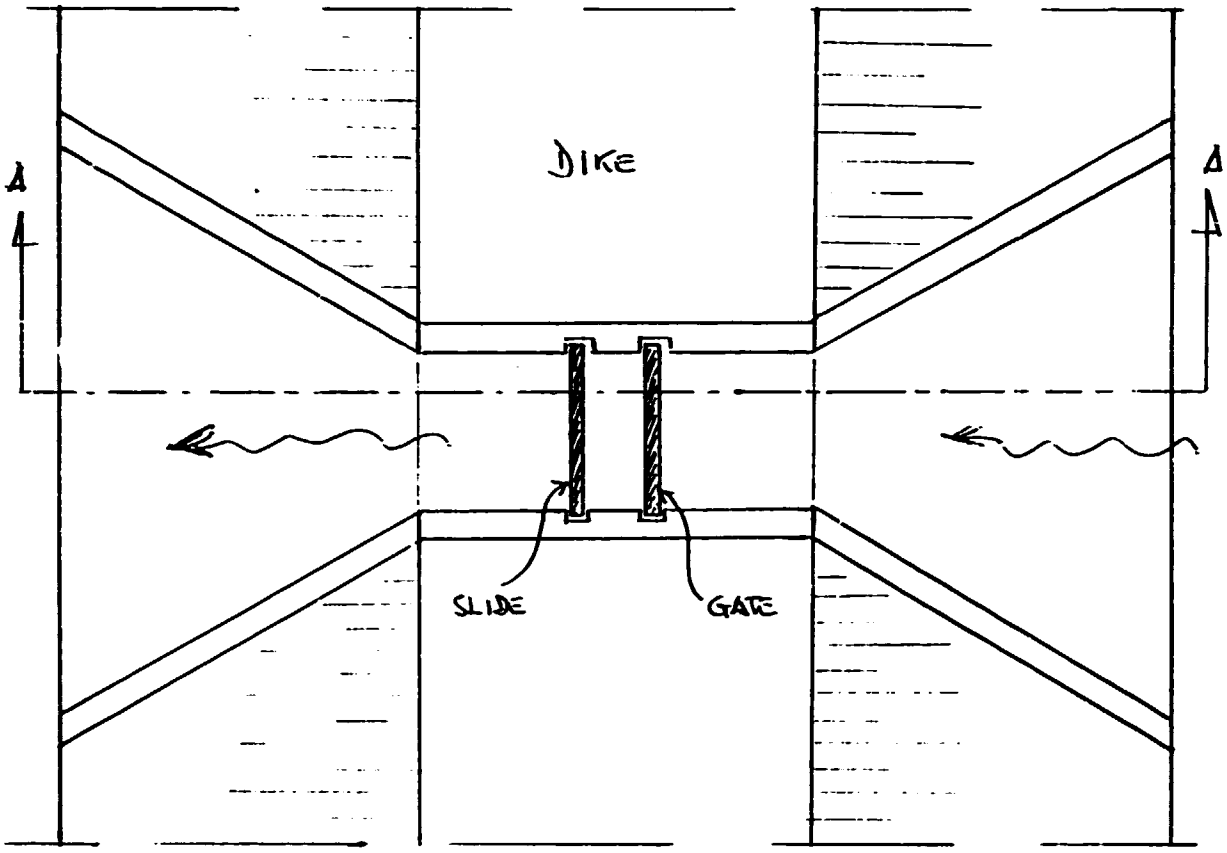


At this stage, knowing the evaporating and crystallising areas, it is possible to calculate the density that the brine must have in all gates. With a daily control and acting on the water intake volume and/or acting on the gates water thickness we may exploit the maximum evaporation and obtain "normally concentrated brines".

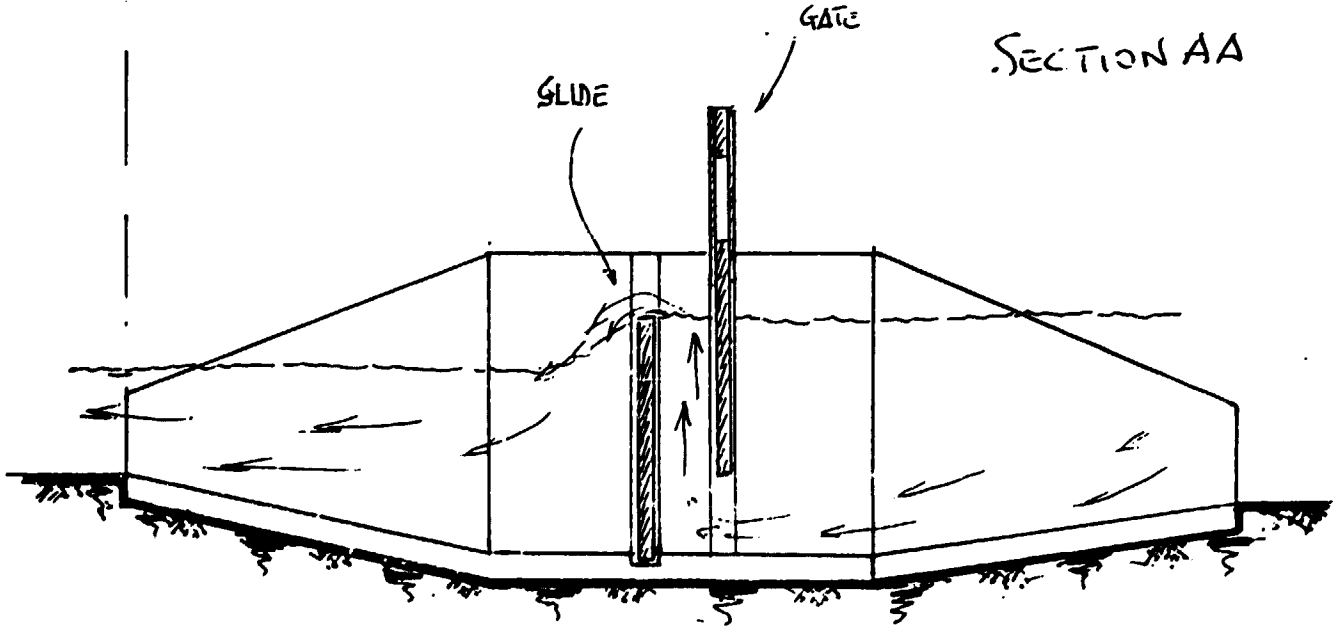
Simultaneously you shall also provide maintenance works to all existing channels (feed and bittern channels) scrapping sides and bottoms till you recuparate the original shape without spoiling the hydrostatic balance. This material scrapped by hand showel will avoid the necessity to transport clay from the near-by sites. Your best attention must be given to the maintenance of the existing 9 transversal channels supposed to be connected to the future ring channel.

c) Construction and placement of new gates, as we deeply discussed. The adoption of siphon gates allows the full control of the volume of the brine flow (and production of course); working with greater water thickness (creating emergency stock of brine) also we shall flow ahead waters from the bottom, which are always more concentrated.

PLAN



SECTION AA

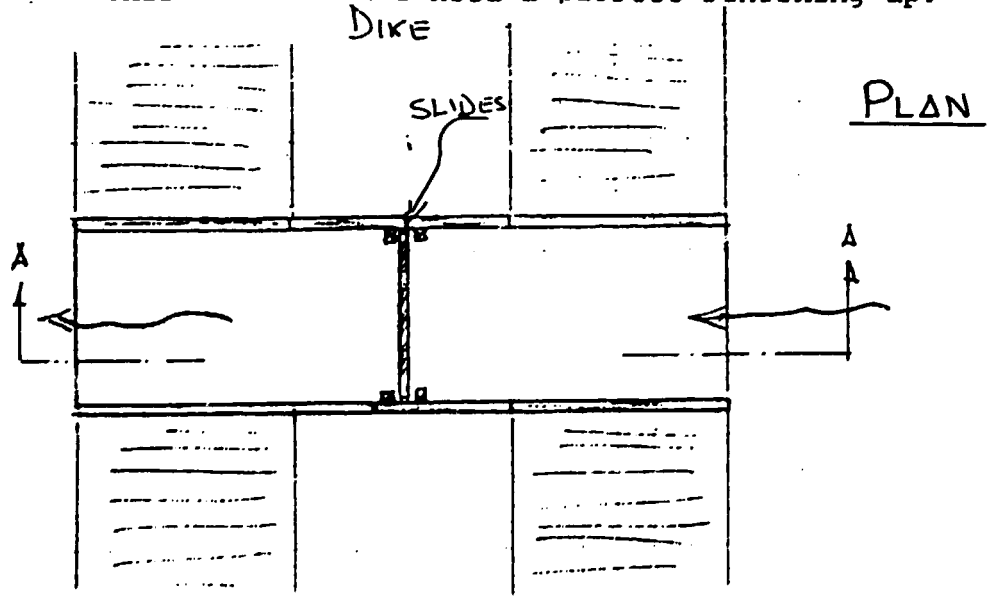


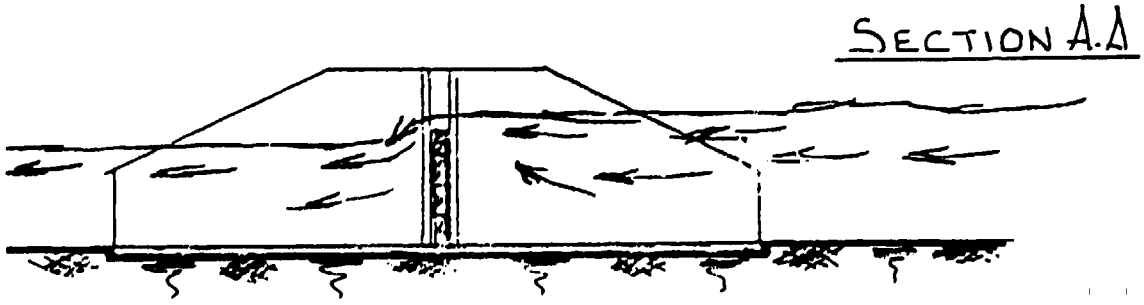
Because about 50% of the evaporation we need to concentrate the sea water from 3°Bè to 30°Bè happen to be from 3°Bè to 8°Bè, by that you can easily see that in the first lines of evaporating ponds the gain of even 1/2 Bè is a great success and important in terms of evaporated volume. These types of gates are normally built in concrete with a width of about 1 meter. The usefulness of these "siphon gates" is self evident. Once we have reached the gate regimen expressed in density (Bè) and water thickness (cm.) over the bulkhead, we shall also slowly increase the water thickness in the ponds acting simultaneously on the door and adding some wood strips on the bulkhead. We will create in this manner a stock of brine to be flowed ahead in case of breakage of pumping station simply by remuving the added wood strips. The water thickness in the ponds shall be increased up to the maximum security of the embankments.

In case of heavy rainfall over the saltworks it is enough to close all doors and put the saltworks in "stand by". After the rain through the spill ways (if existing) is possible to drain the fresh water and by reopening the doors the brine flow might be restored. If spill ways are not existing it is enough to keep doors closed until fresh water is evaporated and then reput the saltwork in his regime opening the doors.

Once you have understood this principle, we have to see how it shall be applied here in Matola, while we are awaiting the modernization of this unit in the project of salt production development in Mozambique.

Being not possible to build siphon gates here, I believe possible to increase in Matola the actual brine thickness of 3 - 7 cm up to 10 - 15 cm, just constructing wood gates with only bulkhead; the width of the gate should be about 50 cm. I point out again that gates must be sited not opposite one to the other but diagonally. Moreover it looks that the wood is a material easily available and this work doesn't need a perfect finishing up.





The increase of brine thickness in the ponds will allow us to recover all those surfaces that because of their difference in level, are today constantly in shallow, of course this recovery will allow us to benefit at the maximum the evaporation, increasing our actual production capacity.

The existance of the bulkheads will void the actual brine mixing created by the wind.

Moreover in case of heavy rainfall it will be enough to add on top of the bulkhead a strip of wood of 10 cm so to put the saltwork in stand-by and wait until fresh water is evaporated before to take it off and restore the brine flow.

But foremost, though the adoption of this betterment, we will increase our salt production in terms of quality and quantity, and the staff will acquire a good sensibility through his day-to-day routine following the natural phenomena that is evaporation, concentration and deposit of "salt", such a poor but extremely important element at the base of the modern industry and the human consumption. They will start to feel the saltwork as a modern production unit and not something artisan like it is now as a portughese heritage.

d-e) The actuation of the above items will give us a greater quantity of water normally concentrated at a 25°5 Bè (brine). I reapeat normally, in fact the highest content of calcium solphate has already precipitated and we are at the saturation point of NaCl (salt). This brine will feed crystallizers in greater volume than now and during period more regular so to extend the time from one harvesting to the other, so to leave necessary time to salt crystals to grow and finally to harvest greater salt crust.

It is imperative to drain out the bittern as soon as the concentration will reach the real 30°Bè, point of saturation of magnesium salts. These bitterns are to be discharged back to the sea, that is why I was stressing about the necessity to have a good drainage system in the saltwork.

It is obvious that all expressed in this notebook should be understood and supplied together as a single work so as to have some real benefit because the adoption of only part of the items discussed will not give the benefit that we are looking for.

Annexed to this note I have added some easy tables about evaporation, concentration etc., so to complete the

principles we have pointed out and to understand the necessities of these maintenance and betterment works to be done in this saltworks.

Summary of works to be done:

1. Ring channel
2. Maintenance and clearing of all channels
3. Reconstruction of damaged embarkments
4. Maintenance and repairing of all embarkments
5. Reconstruction and resisting of all gates
6. Establishment of daily control and collecting data system on brine flow and production.
7. General cleaning of all the saltworks and its services so as to have the usual aspect of all normal production units.

This field note book has been written in Italian language, as agreed with UDIS representatives, being this language easier to understand to them than English. Each item has been deeply discussed.

I do hope that these betterment works will be executed according to the management's possibilities in its day-to-day routine and of course according to the conditions of the country.

Finally, I sincerely wish to thank all those persons with whom I was in contact, for their amability and friendship

given to me, the workers and the management of UDIS, particularly Mr. Mota do Amoral which helped me a lot to have all the necessary contacts needed during my mission for the project.

I wish to stimulate once again the management to put all possible effort to apply all the suggestions given, so that our cooperation will achieve our wished desire, that is to develop the salt production capacity of Mozambique, placing this country in its natural place as one of the greater salt producer in SADCC area, with good income of foreign currency and economical independence from South Africa.

A N N E X "E"

PERFORMANCE REPORT ON TRAINING AND START-UP OF THE CHEMICAL LABORATORY AT "EXTTRASAL E.E." OF MATOLA - UDIS MOZAMBIQUE

FIMIANI Sabatino, Chemical Expert, was employed for the training and the start-up of the chemical laboratory near Extrasal E.E. of Matola under UDIS Maputo - Mozambique from February 17th to April 19th, 1986.

The trainee Mr. Arturo Massango is qualified as Chemical Engineer and is coming from an industry producing lining. He has some laboratory experiences and is a person of average cultural standard but he procedes very slowly in executing analysis, needs always to be directed and incited to execute simultaneous analyses.

We began the start-up verifying and making the inventory of all the chemical material.

We have checked the location of the laboratory and fixed the various equipments, glasses and reagents before to start the analyses.

We have performed the tests of the equipments always in presence of the trainees, who have been directed to repeat such test operations several times.

We were obliged to delay the beginning of the analyses for the following reasons:

1. lack of fresh water
2. lack of distilled water
3. " " gas cylinder

4. " " electric power during working hours

These lacks, particularly items 1, 2, 4 for several days have delayed the operational start-up of the chemical laboratory.

We have developped the training program starting from the simplest analysis, the preparation of the titled solutions, reagent solutions, knowledge of the various chemicals and their dangerousness, safety measures, uses of various equipments and glasses, reasons of such use, systems to wash glasses before the start of thye analysis.

I have also started to train the person on how to collect and prepare salt samples to be analysed, which precautions are to be taken in sampling the stocked salt, raw salt on tippers, raw salt in the saltworks, during washing operations, stocked washed salt.

Control on brine density during washing operations and in the settling ponds.

The executed analysis were:

- preparation of salt sample solution
- determination of moisture in salt
- " " insoluble matters in salt
- " " of calcium and magnesium in salt
- " " sulphates in salt
- sodium chloride in salt

For all the above determinations we have followed two different methods, the first is the one adopted by the Italian Monopoly, the second is adopting as reagent the

HCl (pure hydrochloric acid for analysis) and silver nitrate at 5%.

The scope to know two different methods is to allow the analysis not to stop the work in case some reagent are not available.

We were obliged in many occsions, during the analysis, to repeat the whole procedure, with loss of time and material, because of power black-out.

Prolonged lack of fresh water has also caused us losses of time in washing equipment and glasses, as far as the lack of distilled water necessary for the analysis.

The Extrasal management and the UDIS were always informed of the problems arising from the lack of such necessary raw materials and electric power.

I have also stressed the Management to provide a water tank to be fixed on the roof of the laboratory for the daily needs.

As I have said before, Mr. Massango is a qualified person, only missing of initiative and during my stay I have obtained from him to work simultaneously in various analyses.

It is my opinion that he should have made more training before he reached his best level.

The relationships with the Management were always good and they have done the maximum in the limit of their possibilities.

Conclusions:

The chemical laboratory is in very good conditions and well fitted to execute the necessary analyses.

When the water supply will be normalised there should be no other problem.

The analyses, as already said, should need some more training before starting them for good.

A N N E X "F"

PERFORMANCE REPORT ON START-UP OF THE WASHING PLANT IN 'EXTRASAL E.E' OF MATOLA - UDIS MAPUTO - MOZAMBIQUE

Personnel attending the start-up:

- Mr. Mota do Amoral - Technical Manager UDIS
- Mr. Zulu - Worker UDIS
- Mr. Celestino - " "

The above personnel has no other experience in salt washing systems and and they are all employed by UDIS.
During the first period we went along the plant so as to teach them the utility of each unit and the water/brine circuits.
After that we have explained the security measures to be taken and the precautions to be adopted during the start, production and shut-down of the plant.
We have summarized in an operation manual, very simple and complete, the necessary operations for the start; stop and the cleaning of the plant.
This manual has been easily understood by them. Moreover we have numbered in consequential manner all the start switches on the front panel of the electric board.

The first start-up has been done personally by our technicians in their presence, after that we made them repeat for several times the start-up operations, always in dry runs conditions.
As soon as we were sure of their ability, we left them

execute such start operations, but always in our presence. As soon as we received some raw salt we have shown the plant on load conditions, but with the following difficulties:

- not sufficient quantity of brine into the settling pond
- lack of fresh water to feed the cooling system of the slurry pump
- lack of fresh water to feed the shower system

To solve the scarcity of brine into the settling pond we have ordered the construction of a pit to collect the water-flow coming from the saltworks by infiltration and by means of a small portable pump we have fed the settling pond, avoiding the problem of plant stop due to the lack of brine.

About the lack of fresh water we have ordered the construction of a concrete water tanks of about 7 cu.m., to collect the fresh water necessary for the shower system and the slurry pump cooling system.

It was not possible to start to use this reservoir until now because of the lack of a presure pump.

Anyway, to use the sprinkler system, necessary to wash the salt, we have connected this system with a temporary PVC pipe to the brine circuit; this will remain until fresh water will be available.

We have suggested to construct a manhole on the casing of the suction fan which will allow to wash from the impeller

the salt scaling.

We have finally started to wash the existing raw salt which had a very poor quality. In fact we had a lot of difficulties due to the high contact of sand, stones and earth.

In spite of all that, the washed salt was very clean and white, but with a moisture of over 5 %, this moisture content is due to the necessity to keep the sprinkler system constantly operative.

Once finished the available raw salt we have stopped the plant and proceeded to the normal maintenance and cleaning. An abnormal deposit of sand and other matters has been found on the bottom of the washing cone.

From the 2nd April to the 19th April 1986, the washing plant was not started because of the total lack of raw salt due to the unavailability of transport means from the saltworks to the plant.

During this not productive period we continued to train the workers to the checking of the plant, start and stop operations and theoretical lessons on production, washing system safety rules, etc.

The workers have reacted positively also during the few hours of running of the plant, about 15 hrs in all; we should only verify their reactions during such normal difficulties that arise during the production cycle.

Relationships with Extrasal and UDIS Management were always good and the unavailability of raw salt did not

depend on their good will.

The plant, if well managed, will perform its foreseen output. We have deeply recommended never to forget the routine check, especially the water for the cooling system of the slurry pump; never run the vibrator when the feeding hopper is empty and always follow the hand manual.

A N N E X "G"

1. Salt production and demand. Today situation and its future development.

Being the Mozambique indicated in all SADCC reports as one of the greater sea salt producer (the other two are Angola and Tanzania), a marketing analysis on salt with the aim to develop such production in this country must take into consideration the future production/demand on all those countries that are potential consumers of the Mozambique salt.

We have extended this prevision up to the year 2000, also because the long period necessary to obtain a sensible incrementation of salt production. The following points were taken into consideration:

a. mankind needs a minimal rate of salt consumption equal to 5 kg/person/year;
b. the growth rate in SADCC area is foreseen to be as 2,5 - 3 % in average;
c. the industrial development in Mozambique, particularly in the basic chemical industry (chloro-soda and derivates) and in the general industry (pulp, plastic, soap, canning, etc) allows us to foresee a salt demand of 30.000 tons/year in the next few years and this demand will reach the 60.000 tons/year by 1995.

We have also considered the SADCC reports of Lesotho 1983 and previous reports UNIDO/UNDP.

The following Table 1 shows the population growth in SADCC area and the relative expected salt demand.

TABLE no. 1

- population per million
- salt per thousand tons

COUNTRY	1985				1990				1995				2000			
	Popul.	E salt	Z salt	I salt	Popul.	E salt	Z salt	I salt	Popul.	E salt	Z salt	I salt	Popul.	E salt	Z salt	I salt
Angola	8	40	2	6	9	45	2,25	6,75	10	50	2,5	7,5	11	55	2,75	8,25
Botswana	1	5	0,25	0,75	1,15	5,75	0,29	0,86	1,3	6,5	0,33	0,98	1,45	7,25	0,36	1,09
Lesotho	2	10	0,5	1,5	2,3	11,5	0,57	1,72	2,6	13	0,65	1,95	2,9	14,5	0,72	2,17
Malawi	7	35	1,75	5,25	7,87	39,35	1,97	5,9	8,75	43,75	2,19	6,56	9,62	48,1	2,4	7,21
Mozambique	15	70	3,5	10,5	15,75	78,75	3,94	30	17	85	4,25	30	18,75	93,75	4,69	60
Swaziland	1	5	0,25	0,75	1,15	5,75	0,28	0,86	1,3	6,5	0,33	0,98	1,45	7,25	0,36	1,09
Tanzania	20	100	5	15	22,5	112,5	5,63	16,87	25	125	6,25	18,75	27,5	137,5	6,87	20,62
Zambia	7	35	1,75	5,25	7,87	39,35	1,97	5,9	8,75	43,75	2,19	6,56	9,62	43,75	2,4	7,21
Zimbabwe	8	40	2	6	9	45	2,25	6,75	10	50	2,5	7,5	11	55	2,75	8,25
	68	340	17	50,5	76,6	[illegible]	19,1	75,61	84,7	423,5	21,2	80,70	93,3	462,1	23,3	115,9
		507,5				477,6				525,4				601,3		

E - edible salt
Z - zootechnical salt
I - industrial salt

The following Table 2 shows the real comparison between salt production and salt consumption.

COUNTRY	SALT x ths/Tons			
	Consumption		Production	
	raw	refined	raw	refined
Angola	22	n.c.	23	0
Botswana	5	0	2.5	0
Lesotho	6	0	0	0
Malawi	27	0.2	0	0.2
Mozambico	80	1	89	1
Swaziland	2,5	0	0	0
Tanzania	55	2	57	2,5
Zambia	30	5	0,3	5
Zimbawe	54	9,4	0	0
	281,5	17,6	171,6	8.7
	299.1		180.5	

It is very clear that, looking the two Tables, between the real consumption and the minimal consumption required for a well balanced human feeding, there is a negative gap of about 100.000 tons/year, by that we shall state the really existent heavy defficiency of marine salt which seems to be more suitable in thhe SADCC area.

Moreover from Table 2 it is evident that at least 120.000 tons/year are imported, mainly from South Africa. We shall at this point state that the total yearly

deficit of salt is equal to 220.000 tons.
This deficit will be around 400.000 tons/year on year 2000 if strong and urgent actions are not applied.

It is really evident the great market potentiality for such countries like Mozambique that if will develop properly their marine salt production might become main exporters for their neighbouring countries also for the follcwing reasons:

- economical cooperation between SADCC countries;
- import reductions from South Africa
- maximal use of local production capacity and local distribution facilities
- salt quality improvement.

2. Salt production in Mozambique

This country was already in the past a salt producer and exporter, with a well defined marine salt production all along its coastal line.

Actually there are about 200 saltworks, namely located around Maputo at the South and Nacala at the North but these saltworks are traditionally very small and actually are supplying only neighbouring areas, artisanly conducted they make use of heavy manpower employement.

2.1 Management of the saltworks

Mainly the largest saltworks are managed by the Government through the Ministry of Light Industries and Foods: the smallest are managed by local cooperatives.

There is also a certain number of private saltworks.

We shall divide the production as follows: 35% produced by government saltworks; 45% by private saltworks and 20% by the cooperatives.

Several actions were taken recently for the unification, where possible, of the saltworks. Practically this unification whose limited only in unifying the sea water intake station, replacing the pumps with new modern units both electrical or diesel.

2.2 Quantity of the salt

Statistically speaking the actual production almost reach the country self sufficiency in term of edibility, but in the reality this is not true due to the heavy difficulties in the distribution network which leaves many areas of the country in shortage of salt.

It is obvious that the present production is not enough to supply the salt that will be required in a short time by the developping industries as raw material. We shall foreseen that very soon there will

be an heavy shortage of salt if immediate actions are not undertaken to develop, in fact the production of the last year doesn't reach the 80.000 tons.

2.3 Quality of the salt

Being all the saltworks in Mozambique of "portuguese" type, which works with very low brines thickness, harvested almost daily and having not controls on the product or the brine movements, it is obvious that the salt actually produced appears of brownish colour with evident traces of sands sulphate and magnesium.

Local consumers looks to be well accustomed to this product which in any case is a below the minimal standard recommended by FAO.

2.4 Distribution of salt

The salt distribution is a responsability of the Ministry of Trade - Internal Affairs which collect redistribute pro-quota the whole production from government and cooperative saltworks; private shall sell their production to private distributors or to the Ministry.

Salt experts are under the responsibility of the Ministry of Trade - Foreign Affairs.

A N N E X "H"

PERFORMANCE TEST CERTIFICATE

SALT WASHING AND DEWATERING PLANT IN MOZAMBIQUE
PROJECT NO. TF/MOZ/82/001

DECEMBER 1986

TEST RUNS WERE CARRIED OUT DURING THE FIRST WEEK OF DECEMBER, PROVED THAT THE PLANT IN OBJECT HAS PERFORMED SATISFACTORILLY, AS STIPULATED IN THE UNIDO/IDECO CONTRACT AGREEMENT NO. 83/5 AND TF/01/32 OF 18 FEBRUARY 1983.....

Maputo, 5 de Dezembro, 1986

Signed by: IDECO

UNIDO

UDIS

A N N E X "I"

CERTIFICATE

This is to certify the specialized ability acquired in the field of

SALT PRODUCTION AND CONSTRUCTION OF HARVESTING & WASHING UNITS

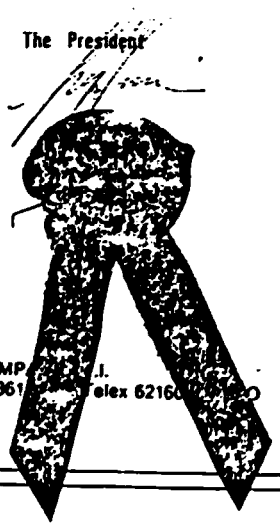
Conferred Upon

Luis Henriques da Cunha Molacio Amaral

In testimony that he has completed the prescribed training.

Rome, October 1st, 1986

The President



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00192 Roma - Italy - Viale Giulio Cesare, 14 - Teleph. (06) 3608716/361... Telex 6216...

IDECO

CERTIFICATE

This is to certify the specialized ability acquired in the field of

SALTWORKS MANAGEMENT & WASHED SALT PRODUCTION

Conferred Upon

José Alberto Zulo

In testimony that he has completed the prescribed training.

Rome, October 1st, 1985

The President

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