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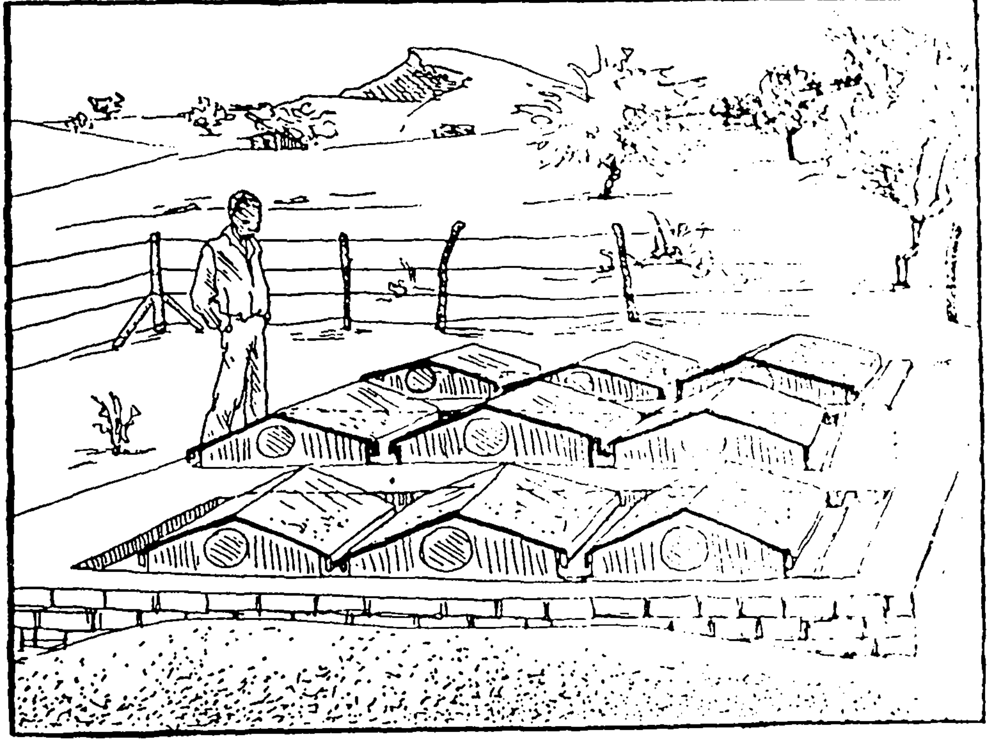

Small-Scale Desalination Seminar

10th - 14th August 1987
Kanye, Botswana

— SOLAR ENERGY —

TABLES OF CONTENTS

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INTRODUCTION

The Seminar on the Small-Scale desalination project findings in Kgalagadi - Botswana was organized by Rural Industries Innovation Centre (RIIC) - Kanye. The main objective of this seminar was to present some of the major findings of the project to the concerned authorities both in and outside government circles. In addition to the above, this seminar was also aimed at coming up with resolutions on the future of the project in particular, and also the potential future role of Small-Scale desalination technology in rural Botswana in its present state-of-the-art.

In the past three years, RIIC has been carrying out a Small-Scale desalination research project in some select remote area settlements in Kgalagadi district. The aim of this project was to field test small desalination units which could be suitable for remote applications in Botswana. This project, even though it was research oriented, was carried out in very close cooperation with Kgalagadi District Council authorities especially the Remote Area Development and the Water Unit offices. At the end of the research period, it was decided that the two pilot project installations in Kgalagadi district be passed on to that particular council. But before this could be done, this particular seminar was convened in order to share our experiences and pass on the information to other authorities who might need the technology.

Generally, projects are basically a management tool and a means of action for implementing sectorial and national development plans in many of the third world countries like Botswana. In this particular case desalination did fit in quite well with the overall water programme in the desert. However, a development approach based on projects has on numerous occassions come up against severe criticism, as in many cases results have not come up to expectations. In very few instances, the final results and/or achievements do not at all match the original objectives of any one particular project. Given the experience of project implementation and management, one would observe that the obstacles and difficulties which projects face are seen to be constraints which retard other people's conceptions of any particular project. In so doing, this hinders the administration and successful implementation of development research projects.

The desalination project does meet some of the above criticisms. According to the initial proposal, the project was to serve mainly mobile and semi-mobile hunter gatherers with portable desalinators. Because of the absence of any such communities, the project evolved to the stage where it is now serving permanently settled communities of about 200 people and the technology itself is of established community based systems. Thus, while some critics might assert that the project has failed to meet its original conceptual objectives, one would on the contrary argue that indeed this is so but because of the changing nature of life in the desert. Changes instituted have so far been for the better, and not for the worse. Had the project failed to cope with the overall developments in the desert, it would have completely been a failure.

The desalination project has so far been one of RIIC's most successful projects. This is so because at the end we are able to show the results of the three years' work done in the desert. In addition to this, the Small-Scale desalination technology seems to have a bright future in Botswana. This is so in view of the amount of interest shown by various district councils and donor organisations in this particular technology. Hopefully, any reader of this report will appreciate the findings of this project and in so doing contribute towards the future use and continuity of the desalination technology in Botswana.

BY

Teedzani Woto (Jr)
RIIC - KANYE
September, 1987

SMALL SCALE DESALINATION SEMINAR

DAY ONE: 10TH AUGUST 1987

CHAIRMAN: P. P. MARIBE
SECRETARIES: J. MALEKE

TIME	SUBJECT	PERSON RESPONSIBLE
10.00 - 10.20	Opening Address	K. V. Morei: General Manager, RIIC.
10.20 - 10.40	Introductory Address	Mr J.Kgobe : Director Services Department, B.C.C.
10.40 - 11.00	TEA	RPC
11.00 - 11.30	Projects Objectives & Summary of Findings	R. Yates: Project Leader Solar Research.
11.30 - 12.30	Comments, Questions & Discussions	Reference Group.
-12.30 - 14.00	LUNCH	RPC
14.00 - 14.30	Talk on RIIC activities	M. Mosimanyane: Technical Director, RIIC.
14.30 - 16.30	Tour of RIIC	Resource Person: M. M. Moetse, Extension Officer. Tour Guides: D Manning, Senior Infor. Officer J. Maleke, Infor. Officer.

DAY TWO: 11TH AUGUST 1987

CHAIRMAN: MORNING: M. G. KENOSI
AFTERNOON: M. MOSIMANYANE

SECRETARIES: G. G. HOLONGA
J. MALEKE

TIME	SUBJECT	PERSON RESPONSIBLE
8.00 - 8.30	Desalination: A Choice in Appropriate Technology.	T. Woto, Sociologist RIIC.
8.30 - 9.15	Discussions	Resource Group.
9.15 - 9.30	Salt Production as an Income Generating Opportunity.	J. Tlhage: Field Officer.
9.30 - 10.00	Discussions	Resource Group.
10.00 - 10.15	TEA	RPC
10.15 - 10.30	Acceptance of Appropriate Technology by End Users.	M. M. Moetsi, Extension Officer.
10.30 - 11.15	Group Discussions on Problems of Acceptance - Three Groups.	Resource Group
11.15 - 11.45	Acceptance of Desalination in the Kgalagadi District.	M. M. Moetse: Extension Officer.
11.45 - 12.30	Discussions.	Resource Group.
12.30 - 14.00	LUNCH	RPC

DAY THREE: 13TH AUGUST 1987

CHAIRMAN: MORNING: M. T. MORAPEDI
AFTERNOON: S. STUART

SECRETARIES: G. G. HOLONGA
J. MALEKE

TIME	SUBJECT	PERSON RESPONSIBLE
8.00 - 8.30	Construction & Design of Stills	J. Tlhage
8.30 - 9.15	Discussions on the above	Resource Group.
9.15 - 9.30	The importance of the Wordburning stills and Reverse Osmosis.	M. M. Moetse.
9.30 - 10.00	Discussions	Resource Group.
10.00 - 10.15	TEA (Solar Yard)	RPC
10.15 - 13.00	Demonstrations	T. Moncho, J. Tlhage
13.00 - 14.00	LUNCH	RPC
14.00 - 14.30	Water Unit Operations in Kgalagadi District.	Water Unit Kgalagadi District. Mr A. Mmusi.
14.30 - 15.00	Discussions	Resource Group.
15.00 - 15.15	TEA	RPC
15.15 - 15.45	Costs and Economic Analysis of Solar Stills	R. Yates.
15.45 - 16.45	Discussions	Resource Group

EVENING BRAII

DAY FOUR: 14TH AUGUST 1987

CHAIRMAN: K. V. MOREI

SECRETARIES: G. G. HOLONGA
J. MALEKE

TIME	SUBJECT	PERSON RESPONSIBLE
8.00 - 8.30	The Role of Management in Small Scale Desalination.	T. Woto
8.30 - 9.30	Discussions	Resource Group
9.30 - 9.45	TEA	RPC
9.45 - 10.15	Future of Desalinatic	T. Woto
10.45 - 11.00	Discussions	Resource Groun
11.00 - 11.15	TEA	RPC
11.15 - 12.00	Resolutions	Seminar Participants
12.00 - 12.45	EVALUATION	G. G. Holonga
12.45 - 13.00	Closing Remarks	Mr M. T. Morapedi, Research Fellow - NIR.
14.00 - 16.30	JAGDRA and Hand Pump Meetings.	

OFFICIAL OPENING OF THE SMALLSCALE SOLAR DESALINATION SEMINAR BY KITSISO MOREI

Mr Chairman, Distinguished Guests, Ladies and Gentlemen, it is always a priviledge to be asked to conduct an official opening of a seminar or a conference because the ultimate deliberations that follow are usually focussed on points highlighted in the official opening speech. This does not make officiating an easy task. There are two distinct possibilities that one can choose from and these are either to ignore the issues at stake or to prescribe a deliberate and objective platform for participants. In the cause of my address, I hope to be able to explain what the Small Scale Solar Desalination Seminar is all about.

Before I dwell on the subject, I would like to welcome our distinguished guests from the private sector, parastatal organisations, church and religious communities, central and local government for accepting our invitations to attend this morning's ceremony. I would also like to welcome the participants representing various organisations and to wish them a successful week of deliberation. Our facilities here at the RPC are modestly designed to reflect the rural reality of Botswana. I think you will find the environment here ideal for discussion in that Kanye is far from government ministries and the mall thus minimizing absentism from the Seminar by participants. Finally, I would like to extend a warm welcome to members of the public who have found the time to be present here today.

This seminar has been made possible by the collaborative involvement of the Joint Advisory Group on Desalination for Remote Areas (JAGDRA) for coordination of desalination activities on one hand and on the other by the International Development Research Centre (IDRC) for providing financial assistance to run the seminar. I wish to express my sincere appreciation to the people involved. It is not customary to mention people by names in seminars such as this one, however, for once I will depart from the tradition and single out Mr Kgobe of the Botswana Christian Council for providing the needed leadership to the desalination project on JAGDRA over the last four years as its chairperson. He has been and continues to be a source of inspiration to our young scientists and who have been involved with the project to ensure that the set objectives are being achieved.

There is something natural about this seminar. Don't you think so?

Consider this statement "Solar Desalination for Remote Areas". This suggests the use of sun energy to distill saline and brackist water to meet drinking water needs of remote area dwellers. This is exactly what the desalinaiton project is all about. The natural thing about this seminar is that we are talking about the sun, something that we have known about throughout our lives.

The ideas was conceived about five years ago when Rural Industries Innovation Centre (RIIC) was asked to come up with an immediate solution to convert salty water into portable water as a matter of urgency to alleviate the problem of drinking water shortage in the desert due to drought. The requests came from Kgalagadi and Southern District Councils. A team of technologists here at RIIC met and made the conclusion that among the options that were available for consideration the sun energy was the most abundant.

As a matter of fact, 300 days out of 365 days are on the average sunny days in Botswana. Therefore an emergency programme was mounted to supply survival stills to remote area dwellers.

At this point, let us remind ourselves of what we know about the sun. For all practical purposes the sun can be assumed to be a hot gas with a temperature of 5 762 K. This temperature is maintained by nuclear fusion reactions in which hydrogen fuses into helium. The sun radiates in all directions and a small part of the radiation reaches the earth. The distance between the sun and the earth varies by : ± 3% during the year. The average distance is 1.5 x 10 km. An area of 1 m perpendicular to the beam receives 1 353 W or 1 353 J/Sec. This amount is called solar constant.

Not all solar radiation has the same wavelength. We observe a whole range from infrared to x-rays. The earth is surrounded by the atmosphere, containing all sorts of gas molecules and dust. In the highest layers, the ionospere, absorption of the x-rays takes place (fortunately). By the time solar radiation reaches the surface of the earth much radiation has either been reflected, absorbed or scattered. When the sun is not perpendicular above, the solar radiation has to penetrate a thicker layer of gas. The pathlength depends on the place on earth, the time of the year and the hour of the day.

The desalination process therefore involves a method whereby saline or brakish water is heated to a point of evaporation leaving salt behind. The water vapour collects on glass cover where is condenses into liquid form and is harvested as a distillate or distilled water. Because of the nature of the problem we were faced with when we initiated the small - scale desalination programme, our approach was to be a multifaceted one. Firstly, it was necessary to develop the technology to meet immediate/urgent needs. Secondly, it was important to develop technological hardwares/equipment to be utilised in the long term. Thirdly, it became apparent that in order to pursue the second objective it was necessary to undertake technology assessment programme in which we were to ensure that the technology is socially acceptable, technically possible for local manufacture and economically viable. It is the aim of the seminar to discuss the various findings of each of the stages that I have just referred to. The specific objective of this end-of-the-project seminar is to discuss and evaluate the results of the project and to prepare plans or to make recommendations for large scale manufacture and distribution of the desalination units.

At the end of the seminar, your task as participants, will have been achieved if you will have provided pragmatic answers to the following questions. Your answers should be based on the prevaling socio-economic and political rationalisation.

Does a desalination problem exist?
Does the bottleneck lie with salty water or sweet water is accessible?
What alternatives are available to this option?
Are district councils or central government committed in principle to supply drinking water to the target groups?
Do the target group accept the technology?
Is the demand large enough and will the system be economically viable?
Does locally available management and technical skills match the level demanded by the equipment?
Can local manufacturing competences and capacities be developed?
Can technical backup support be provided.

To this end, I can assure you that the discussion will cover the relevant questions that have been raised.

RIIC has a mandate to develop appropriate technolgies to meet local needs and to transfer those technologies to be manufactured by local industries. In this regard, we believe that the research and development work on small scale desalination has been completed. It is up to this seminar to concur or refute this position.

On this note, I have the pleasure to declare the Small Scale Desalination Seminar officially open. Once again I wish you a successful week of deliberations.

INTRODUCTORY ADDRESS ABOUT JAGDRA BY MR J. KGOBE

Mr Chairman, Ladies and Gentlemen, it is indeed a great pleasure that I have been accorded this opportunity, although at such a short notice to address the participants of this important seminar on the history of JAGDRA.

For those of you who might not be familiar with the Desalination project JAGDRA stands for Joint Advisory Group on Desalination for Remote Areas. Government had in its effort to provide Basarwa with water drilled some boreholes in the remote areas. Water was struck but it was found to be very salty and hence unfit for human consumption. An immediate and practical answer to this salty water had to be found. As a result JAGDRA was set up to spearhead the endeavour to solve this problem. JAGDRA is composed of Rural Industries Innovation Centre, Ministry of Local Government and Lands, Botswana Christian Council, Water Affairs and District Councils. This group was therefore responsible for pushing through the desalination project albeit admittedly, the bulk of the project work was carried out by the Rural Industries Innovation Centre. I would therefore like to commend RIIC on the beautiful job they have done on the research phase of solar desalination. The big question that now hovers over our heads is who takes over the desalination programme now that RIIC has completed the research.

Lest I forget, let me inform this seminar that this project has been wholly funded by International donor agencies. Currently an attempt is being made to get government involved in funding. My suggestions is that central government or councils should now take responsibility for the solar desalination programme.

Thank You.

PROJECT OBJECTIVES AND SUMMARY OF FINDINGS BY R. YATES

ORIGINAL OBJECTIVES OF IDRC PROJECT

The overall objectives of this project, is to conduct technical and socio-economic research on the suitability of prototype small scale desalinators for groups of Remote Area Dwellers living in the Kalahari Desert. The specific objectives are to:

a) manufacture, install and field test 60 to 80 prototype small scale desalinator stills, representing the six designs currently being developed at the RIIC laboratory, as well as one commercial model in five RAD Communities;

b) identify and develop pedagogical materials and methods appropriate for teaching RADs the basic principles of desalination, and how to operate and maintain their stills;

c) train, monitor and evaluate the RADs in the operation and maintenance of their skills;

d) monitor and evaluate the technical performance, cost characteristics, user acceptability, preference and utilization patterns of the stills; and,

e) disseminate the results of the project and prepare the groundwork for the large scale manufacture and distribution of desalinators to RAD Communities throughout Botswana.

METHODOLOGY

Five RAD Communities, three of which are nomadic, will be selected as study groups from among fourteen communities in the Southern, Kgalagadi and Ghanzi Districts. The type and number of stills to be provided to each community will depend upon its population size, mobility patterns community needs, and an assessment of the capacity of the RADs to utilize this technology. The capabilities of the still operator trainee selected by the community will also be taken into account.

An expert in the field of solar desalination from the Brace Research Institute in Montreal will be engaged on a short-term basis (four weeks) at the beginning of the project to assist the research team in refining the designs, in particular for the Tunnel solar desalinator. He will also assist the team in designing a program for the introduction of desalination units to RAD communities.

Desalinators will be constructed at RIIC or under contract by local producers. They will be transported to the RAD sites by RIIC or the District Council heavy duty vehicles. Both the small scale household units and the larger communal units will be assembled and installed in the field by the project team members supervising local volunteer labourers. Reverse osmosis (R.O.) handpump/desalinator units will also be installed at four locations. Local authorities will participate in setting up the larger communal modular and tunnel installation. They will also be responsible for obtaining saline borehole rights, providing borehole equipment where necessary, as well as salt water storage tanks and fencing. Distillate collection, storage and dosing tanks will be provided by the project.

Three PVC handpumps resistant to saline corrosion will be purchased from the University of Malaya, Kuala Lumpur. These handpumps will be installed and maintained by the project team at salt pans where the water source is below ground. This PVC handpump is currently being developed and tested under the Centre - supported project Water Pumping Technology - Phase II (Malaysia) Centre File: 3-P-82;0162. Instruction and maintenance manuals will also be included.

A training program to teach RADs the principles of desalination and the selected trainee in the operation and maintenance of the desalinators will be developed and conducted with the University of Botswana, the RIIC Extension Department, the Remote Area Development Program at MLGL, and the RADs themselves. Desalination units will be introduced sequentially to the RAD Communities at a rate commensurate with the absorptive capacity of each community. The research team will remain with each group for several weeks until satisfied that the RADs are comfortable with the technology and understand how to operate and maintain their stills.

Samples of the source water will be collected by the research team and a chemical analysis conducted at the Geological Survey Department laboratories. The need for and extent of dosing the distillate with mineral salts will be based on these analyses. The RAD operators will be shown the correct method of dosing the distillate by the field officer. Random samples of dosed distillate will be collected and analyzed to ensure that WHO standards for salts in drinking water are met.

Data on the technical performance, cost characteristics, community acceptance, user preferences, and utilization patterns will be collected over the course of the project by the research team and the RAD operator. The data will be analyzed by the RIIC Extension Department, with assistance from the University of Botswana and the National Institute of Development Research. An evaluation of the potential for introducing small scale desalinators in other RAD communities in Botswana will also be conducted.

An end-of-project seminar with participants from RIIC, JAGDRA and other interested parties in Botswana will be held to discuss the results of the project and prepare plans for the large scale manufacture and distribution of desalination units.

B. RIIC DESALINATION PROGRAMME AND RESEARCH FINDINGS

Origins:

Request for assistance from Kgalagadi DDC 1981.

Reasons:

Many boreholes and handug wells in remote settlements were too salty to drink, hence water had to be trucked in by Council.

Government RAD programme encouraged settlements hence making fuller use of desert land.

RIIC Response:

1. A project to develop still designs at RIIC site Funded by BRET and USC Canada from 1983.

2. An emergency implementation project funded by HIVOS (Holland) 1984-1986 to install the best available solar and woodburning stills to the most needy settlements.

3. A 3 year field research programme to examine the suitability of solar desalination for remote areas of Botswana. Also to develop training methods to ensure their acceptance. (See project objectives and methodology -above) funded by IDRC (Canada) 1984-1987.

Change of Research Methodology:

After initial work and consultancy it was decided to limit research programme to only three sites (Khawa, Zutshwa and Lokgware, all in Kgalagadi District) and to work only with settled communities.

Philosophy of Project Research and Development Work:

To design stills that would be robust and reliable enough for the desert.
To ensure that construction and operation could be reliably carried out by unskilled labour.
To maintain extensive presence in target settlements.
To involve as many people as possible from each community.
To inform and train people at all levels of the administrative infrastructure about the technology.

Achievements:

PROJECT 1:

12 different types of still were built and tested. Three designs were field tested and could be recommended for further implementation. These are the mexican still, the brick still and the Ghanzi woodburning still. The mexican still is the design most suited to conditions in Botswana.

PROJECT 2:

Woodburning stills were given to 9 communities and people instructed in their use. Solar stills were installed in 2 communities. Extensive tours of remote areas were carried out to identify sites.

PROJECT 3:

(IDRC Field Research) 100 stills were installed at three sites, though 20 were later removed from one of those sites. 3 workshops were held for RADs and 4 more for council staff.

Findings (IDRC Field Research):

1. Solar desalination is suitable for use in remote areas in Botswana.

2. Stills should be communal installations operated by Council paid pumpers.

3. Sites for desalination should have a reliable supply of salty water available, be more than 20km from a sweet borehole and be of approximately 300 people.

4. The stills must be reliably maintained by the operator and the council water unit. The stills must ALWAYS have water in.

5. Training of operators and council employees is essential to the successful use of the stills.

6. The technology itself is readily accepted by the RADs.

7. The investment in desalination will be paid back in less than four years (actual time depends on the location of the settlement).

8. Fair rationing and distribution of the sweet water is essential.

9. The solar stills must be well fenced to keep out animals.

10. Solar stills have no moving parts and so cannot "break down" for mysterious reasons. Even if they are damaged they can continue to function with reduced efficiency.

11. A solar still installation can also be used as a catchment for rainwater, hence increasing the amount of available water.

12. Desalination is not a suitable technology for stock-watering or for irrigation.

13. Local labour can be used to install the stills, and they can be fabricated in Botswana.

14. Desalination leads to improved health in a community.

15. Desalination allows further developments in health and education. These developments attract further settlers.

16. The amount of distilled water is small and so does not in itself attract many settlers as a sweet borehole would.

17. Salt can be produced as a bi-product of desalination and this provides a cash income for a settlement.

18. Salt water must be mixed with distilled water for drinking. Distilled water does not contain the few salts that the body does need.

19. There is no limit to how salty water may be for desalination.

20. Stills given to individual households were unsatisfactory because of the lack of individual salt water supplies, the problems with many fences and the lack of backup in the event of a breakage.

21. Woodburning stills are suitable only for occassional use in emergencies, as a backup to trucked water or solar stills.

TRAINING

Introduction

When introducing a new technology, it will only be accepted once people at every level have been told about it.

The RADs themselves must be aware of what thing is in their settlement and what they must do to ensure its working.

The operators must be thoroughly instructed in their jobs of filling, cleaning and maintaining the stills, as well as the water distributing.

The Council water unit must be taught how to check and repair the system, as well as to oversee the operator's job.

The RADP staff must know about this addition to their settlements, and how to check that it is being properly used. Also they must know when water will need to be trucked to the settlement.

Other Council officers, especially planning officers and Council Secretaries must know the technology and its importance so that they can support the projects in the district and make informed decisions about them if necessary.

The Councillors must know of the possibilities for development that this presents so that they too are not asked to make decisions without sufficient knowledge.

And in government the Ministry of Local Government must be able to support Council work the Ministry of Water Affairs must know of the possibiilties for saline boreholes and the Ministry of Finance must know about what they may be asked to pay for.

Finally other interested parties such as schools, game scouts, brigades and farmers must be informed to allow them to exploit the possibilities that this technology presents, and funding agencies must be aware in case they are asked to fund projects in this field.

I will give an account first of what we did, then we should work out together what the policy should be for future installations.

It takes a long time for a technology to become common knowledge especially when its applicability is mainly restricted to very remote areas of the country.

It can only happen if all the above target groups are systematically approached and informed, not once but several times.

Our original brief was to develop pedagogical methods for teaching RADs the fundamentals of evaporation and hence know the stills work.

Although we tried to do this, it soon became obvious that it would be fruitless to try to teach such science to uneducated people, and also that it would be unnecessary.

The people only need to know what must be done to obtain water, and any practical matters relating to it.

In more developed areas people only need to turn on a tap to get water and it is not considered necessary for them to understand the principles of physics which put the water in the tap.

So it was decided to limit instruction of RADs to what was achievable, that is the practical not the theoretical aspects of desalination.

The RADs were first asked for their co-operation in desalination at kgotla meetings and throughout the project further meetings were held to publicly discuss matters that arose.

Next our policy was to involve as many people as possible in the construction work. At first people were aksed to work voluntarily on the project, but it was soon realised that productivity increased dramatically when people were paid a drought relief wage. Also this attracted people from more households rather than encouraging those from just a few HHs to take part and hence to have a greater claim to the stills.

At the end of each installation a worhshops was held for the people. A participant was chosen from every household so that nobody in the community could later claim to be unaware of the stills.

Several methods were used in these workshops the most successful being the group discussion using a tape recorder. For this, participants were split into groups and the first group were led into a discussion about the role of desalination. This was recorded - played back to the second group who could then discuss the recorded comments - hence take the discussion further.

Also popular theatre was used whereby a small drama about the introduction of desalination was prepared and performed by a group of RADs. In this way any reservations about the stills that people had could be expressed without their confronting us, they could speak as characters rather than as themselves.

Also during this workshop the people were addressed on the issue of water, health - sanitation, and instructed about water distribution and the need to mix salt water with distillate for drinking.

As the ratio for this mixing varies between settlements, various misture of salty and sweet water were prepared and a tasting panel asked to select those that were satisfactorily sweet. The saltiest mixture that was acceptable was then recommended for consumption.

The operators for the sites were selected by Council as pumpers, and their instruction was carried out on a one to one basis with our field officer.

An operator must be taught how to fill and clean a still, and how to mend leaks and repair broken glasses. Also he must know how to mix salty water with distillate and to distribute the water fairly and in what quantities.

It is his job to keep people and animals away from the stills as much as possible and to keep the fence in proper order. He is issued with tools and materials to do these jobs.

For future sites the process of selecting operators should be considered as the existing system has not worked well. This should be discussed after this talk.

One of the problems with training people within Councils is that they are transferred quite frequently. Therefore it is essential to inform as many Council officers in a district as possible and to do so several times.

We held workshops in Tsabong and Hukuntsi with separate sessions for Councillors officers and water unit. These were to explain in general terms what we were doing and to demonstrate the operation of stills.

A separate one day presentation was made for the entire RADs staff of Kgalagadi District in Khawa so that any of them would know what to look for when they reach a site to make sure that the stills are being properly used.

The Councillors themselves were addressed both in Tsabong and at two settlements during this visit to the remote areas.

To inform water technicians from around the country, they were addressed together at their seminar in Gaborone.

To teach water unit and RADP staff about the maintenance of stills in more detail, a workshop was held in Zutswa. Here the entire water unit and all the RADP staff of the district went systematically through the maintenance manual for stills and carried out each and every job mentioned.

They filled, emptied and cleaned stills they found and mended vapour and distillate leaks, they removed, cut and replaced glass and they learnt how to monitor stills and how to carry out a full maintenance inspection.

This last course was probably the most useful and certainly the most thorough but it would not have been so easy if most of those involved were not already aware of the desalination work.

But how many of these sessions should be carried out around future installations? And then there are the government officers based in Gaborone. Without their support it is unlikely that a council is going to adopt a programme of a new technology, even though the direct participation of central government is not so great.

The problem is that the Remote areas are so far from Gaborone that Gaborone based staff can easily have no idea of new work. The various ministries involved have been kept informed of the progress of the project through their nominated representatives on JACDRA, but during the later stages of the project it was necessary to approach some fo the more senior officers directly.

A report on one part of the project was prepared and printed and distributed among many of these officers. Also earlier on in the project a calender was produced to increase the awareness of people of the project.

No indepth training of government staff has been carried out their participation in parts of this seminar is as far as that goes. We should discuss whether that is enough or if not, then what sort of training should be given to government officers.

For other interested parties and for donor agencies we have prepared several publications. There were the calendar and report already mentioned and a technical bulletin published by BTC.

Also a radio programme and several newspaper and magazines articles and a public lecture at the museum have been done.

Although these all help to increase awareness, they do not constitute instruction or training. Those who want to know more still need to be able to approach someone (RIIC) to get more details.

After this seminar the final report on the project will be prepared, This should be a much more comprehensive document with all the relevant information in it.

Finally, a further report will be written a year after the end of the project following an evaluation of the programme.

Discussion

What forms of training are suitable?

Who should be trained and how much?

Who should pay for training?

How long are the best training programmes?

Are they practical or demos or theoretical?

How should operators be selected at what stage?

Should they only be trained in the settlements?

How much training should government officers be given.

RIIC ACTIVITIES BY MR M. MOSIMANYANE - TECHNICAL DIRECTOR - RIIC

OBJECTIVES:

The Rural Industries Innovation Centre (RIIC) located at Kanye in the Southern District is Botswana's national appropriate technology hardware centre. It identifies, adapts or designs, technologies geared to employment creation and renewable energy and also provides training to increase rural productivity.

RIIC is involved in a number of programmes of practical research and development, manufacture of appropriate technologies and training of which a brief summary of only a few examples is given here.

Sorghum Mill Dehuller System

Over forty sorghum mill/dehuller 'packages' have been installed in Botswana as well as in other African countries. The RIIC manufactured dehuller, which is the unique part of the system is the first small-scale device of its kind, enabling a decentralised rural milling industry to be established which has already created over two hundred jobs. Even more important are the benefits to the users (mainly women) and it has been shown that of the time saved by using the mill, over 40% is put into other new productive activities.

Wind Pumping

Many appropriate technology centres have windmill programmes, but we believe that our windmill, the 'Motswedi' is outstanding in that it operates reliably a rotary pump instead of the reciprocating pump that conventional windmills drive. The significance in Botswana is that most boreholes are deep wells using a rotary 'mono' pump. Another advantages of the Motswedi is that it will start pumping at a much lower wind speed than a conventional windmill.

Biogas Pumping

RIIC biogas systems convert cattle dung into gas which is then used to operate a diesel engine, with the gas replacing the diesel fuel. The system operated by the Diphawana cattle syndicate in Southern District is a good example, and it is now operated entirely by the local community who were involved in its construction.

Animal Powered Pumping

RIIC's animal driven pump is a very cost-effective means of pumping, which nevertheless produces a high output of water. Donkies, oxen or mules can be used to turn the pump, which is designed for a very long life with low maintenance. Sixteen units are currently being built and installed for final testing prior to the pump becoming available on a larger scale.

Desalination

Nomadic bands and others living in the Kgalagadi Desert have severe problems of access to water, and in many cases rely heavily on desert plants for moisture - a source which is not so readily available during periods of drought such as the one Botswana is currently undergoing. However often brackish or salty polluted water is available and RIIC has developed a number of portable low-cost desalinators, most of which use the distillation principle. These systems are already being introduced in some of the worst affected areas of the desert as an emergency measures, whilst in the meantime research is continuing into relative efficiency and cost-effectiveness.

Extension and Training Activities

The RIIC extension team acts as a link between the rural communities served by RIIC and the Centre, ensuring the relevance of the technical and training operations to rural development and increased living standards. It also acts as the link with government extension workers, who cooperate with the Centre in a variety of ways, including the identification of potential trainees and follow-up services.

RIIC's 'Village Artisan Training Programme' is geared to increasing productivity in the so-called 'informal' sector. Maximum use is made of local materials, and teaching trainees to make their own tools and equipment. The courses cover tanning, blacksmithery and village mechanics, harness-making, carpentry and baking. Courses are flexible in timing and content, and accommodation is provided at the RIIC Seminar Centre which can also be hired for conferences and other development functions.

DESALINATION AND VILLAGE WATER SUPPLY IN KGALAGADI A CHOICE IN APPROPRIATE TECHNOLOGY BY TEEDZANI WOTO

REMOTE AREA DEVELOPMENT PROGRAMME - AN OVERVIEW

Perspectives on Remote Area Dwellers:

a) Those who wish to maintain a human zoo in Botswana - hence view development attempts with cynicism.

b) Those who are interested in perpetuating a romantic image of primitive people - hence fail to understand the actual implications of present-day developments.

c) Apologists - those who see RADs as suffering, under priviledged, and neglected.

d) Pragmatists - official view of eliminating allegations of separate development and ethnic bias. Those who accept the situation as it is and try to respond to it accordingly.

The last line of thinking is infact the one we should take much more seriously into consideration. It purports that those interested in the future of RADs need to look at the issue from the point of view of the RADs themselves, within the society that is today Botswana.

Therefore, development is so far as the RAD programmes is concerned, would be the provision of basic socio economic, and political services with the ultimate objective of creating new modes of production which are compatible with modern/existing societal structures in Botswana.

Government Policy towards RADs:

a) Social services - extension services - education, health, drinking water, vulnerable group feeding programmes.

It was within the above objective that this particular project was initiated and instituted.

b) Economic - access to land, water rights, income earning opportunities e.g. salt production as is now the case in Zutshwa.

c) Political - social integration, rights awareness, dependency reduction.

How does the small scale desalination project fit into the above RADP objectives?

* Provision of clean drinking water.
* Alleviation of saline water/health related problems.
* Reduction of RAD dependency on outside controlled and unreliable water supply system especially water trucking.

THE WATER SITUATION:

The call for a reliable water supply system was aggravated by the promotion of permanently settled communities where basic services could be extended e.g. water, education, health and food.

The response to this was the convergence by RADs (around boreholes/and wells most of which turned out to be salty. The above situation was also aggravated by the drought situation.

Government/Council response(s) to the above situation:

- Wide scale borehole drilling programme.
- Trucking water to settlements.

Other influencial factors on the settlement pattern:

- Tribal Grazing Land Policy
- Mineral Prospecting
- Institution of hunting regulations.

THE CALL FOR WATER SUPPLY OPTIONS:

The fast expansion of the RADP was accompanied by the fast growth of settlements as more and better services were provided.

The result then was strain on some of the resources especially trucks/ vehicles used for trucking water.

Hence a call by KDC to RIIC for ways of utilizing salty borehole water found in most settlements for drinking purposes - desalination.

Original projectives:

- Develop and test small scale desalinators for purpose of clean drinking water for mobile and semi mobile RAD bands.
- Train RADs on principles of desalination and how to operate and maintain the stills.

- Help foster acceptance of the technology by RADs.
- Help in overall social itergration of RAD into the overall Botswana society.

Field implementation and experiences:

- Existence of permanently settled communities hence any desalination done had to be on larger scale than originally anticipated.
- The need to actively involve council and incorporate the project into the overall water programme.
- The need to address ourselves to the health aspects - water dillution: a situation which is still on-going.
- Need to diverse training to include council staff.

Re-defined project objectives:

- Move from potable to non-potable desalinators.
- Promotion of community self sufficiency.

A COMPARISON OF OTHER OPTIONAL WATER SUPPLY SYSTEMS:

a) Drilling - expensive but with no guarantee of finding potable water. Utilization of already available boreholes/wells - desalination.

b) Water reticulation - Expensive and not possible in particular areas. Not for small communities - figures?

c) Re-settlement - possible but is counter to the political aspirations and objectives of the RADP.

d) Trucking - Expensive, unreliable.
   - Creates situation of dependency by RADs.
   - Not a long term solution to the problem.

e) Desalination - High initial capital costs.
   - Simplicity
   - Reliability
   - Self Reliance
   - Employment Creation.

DESALINATION AS A VIABLE OPTION:

Benefits

a) Expand areas of settlement
b) Help curb deteriorating water supplies in the desert

c) Improvement of health standards
d) Promote self reliance
e) *Income* generation - salt production
f) Use of salty water sources.

Limitations

a) Technology is capital intensive
b) Requires changes in traditional life styles
c) Suitable for limited applications - communities of up to 300 people.
d) Not for livestock applications.
e) Fluctuating *yields* depending on seasonal variations.

POINTS TO NOTE:

- The need to fundamentally develop remote areas.
- The extent to which the desalination projects fits into the RAD objectives.
- Emergence of RAD settlements and the problem of water supply.
- Different options available.
- Desalination as a research project.
- Desalination as a viable option.

SALT PRODUCTION: AN INCOME GENERATING ACTIVITY FOR RADs BY J. TLHAGE

INTRODUCTION:

Participants have already learnt from the previous speakers about our experience with desalination in the remote areas i.e. about its advantages and disadvantages. Among the advantages of desalination is salt production and this is particularly true at Zutshwa.

PRODUCTION OF SALT AS A BI-PRODUCT:

Salt in Zutshwa came to being as a result of desalination. What happens is that the salty (saline) water is poured into the black tray with glass as a roof. The device is airtight enough not to allow any heat to escape. Underneath the device is an insulation which keeps all the heat inside the still. This results in water heating up and releasing some vapour that is trapped by the glass rood. The vapour condenses and trickles into the distillate gutter. After all the water is finished from the still, the salt crystals remains behind as residue awaiting to be scraped out. This salt is then cleaned with fresh saline water to remove dirt from it and then placed on drying trays.

After 3 to 5 days in the trays, the salt can then be packed in bags for sale. One can realise that not only potable water is provided through desalination but salt is also produced for domestic use e.g. tanning skins, food and for livestock.

The salt has been tested in the laboratory and has passed as pure salt i.e. 98% NaCL (Sodium Chloride). The salt only need to be produced at a better scale and to meet this standard the RADs should have proper tools and storage. They cannot reach this goal without your help i.e. both materials wise and your moral support.

PRESENT PRODUCTION AND MARKETING ARRANGEMENTS:

For now, salt is just used for domestic purposes by the Zutshwa residents. Every time one gets to the desalination site he/she is attracted by the white snow-like salt on trays and in bags. In order to be given the salt, residents help the pumper to clean and fill the stills.

It was suggested during the last maintenance and operation workshop in Zutshwa that the sale of salt should be vested upon the settlement development committee (S.D.C.). Nobody is sure whether this arrangement will be successful but your suggestions as participants in this seminar shall be very much appreciated. Although the price of salt is 20 thebe per mug in Zutshwa it does not get enough market. A 50 kg bag of salt sells for P4.00 or P8.00 depending on the bargain and this is just a way of getting rid of the salt. If at all among you ladies and gentlemen, there is somebody who can assist with transport for the salt to the market e.g. to Hukuntsi which is about 60 km from Zutshwa the help will be appreciated by the RADs.

FUTURE POTENTIAL AND PROPOSED ARRANGMENTS:

The present salt production rate per still is 3.75 kg of salt per week. This gives an output of 480 kg of salt per month for sixteen mexican stills. We have installed a total of sixty four stills in Zutshwa and with this number of stills the Zutshwa RADs can produce about 960 kg of salt per month. This raises yet another appeal to you to help them with the market for such a lot of salt.

Proposed arrangements are that the Livestock Advisory Centre in Tshane-Northern-Kgalagadi buys the salt from Zutshwa. This could help the two parties equally i.e help the RADs to get a good market and help the government from a burden of trucking salt from Lobatse to Tshane which is a distance of 500 km. For the RADs to produce salt for this big customer they have to meet the quality standard, and this means having all the reasonable apparatus. The following are cost estimates for a small project suitable for Zutshwa:

a)	i) Storage hut (delta hut at Gantron)	= P 810.00
	ii) Installation, concrete floor and transport	= P 250.00
b)	Two scales to weigh 50 kg bags @ P47.00	= P 94.00
c)	Bags for packing salt 1 000, needles and thread	= P 500.00
d)	Tools e.g. 2 shovels, 2 trowels, 10 scrapers, 10 plastic gloves, 3 rakes	= P 300.00
e)	Drying trays 2 m x 4 m concrete with 50 cm wall coated with crystic fibreglass resin	= P 700.00
		P2 654.00

CONCLUSION:

I won't be wrong to say that salt production in Zutshwa came into being not because we had it in mind, but that through luck it came as a bi-product. I would in conclusion like to seek your suggestions and comments on this topic with special reference to the following questions:

i) What need to be done about salt in Zutshwa?

ii) Should salt production be carried out on commercial basis or just left as a bi-product and not something to worry about?

iii) In the Zutshwa case who should be responsible for salt sales, i.e. should it be left in the hands of individuals like the case is now or be given to the syndicate or village development committee?

iv) Where is the best market for the Zutshwa salt?

ACCEPTANCE OF APPROPRIATE TECHNOLOGY BY END USERS BY M. M. MOETSE - EXTENSION OFFICER

APPROPRIATE TECHNOLOGY:

Could be referred to as technology which is most suitably adapted to the conditions of a given situation.

It uses the human, financial and material resources which surround its application.

COMMON CHARACTERISTICS OF APPROPRIATE TECHNOLOGY:

- Labour intensive (usually available and cheap).
- Simple (ideas have to be understood by unskilled people or semi-skilled).
- Small scale (should be based on locally available materials not imports in addition people should be in a position to understand how to operate the technology and should afford it.
- Low cost (should not depend on expensive imported materials which drain or wash away foreign exchange or require high cost energy sources)

IMPORTANT FACTORS WHEN CONSIDERING PROJECTS:

- Should benefit as many people as possible.
- Flexibility (Adaptable to the needs of the community and to regional national and or international levels.
- Should not conflict with people's daily activities.

One should not only look at the technical aspects but consider the inter-relationship between the technology in whatever form it takes and the users, their attitudes and values.

ACCEPTANCE:

A basic need of an appropriate technology is that it should be accepted by the people who are going to use it. This is a difficult task to define because people have different reasons for rejecting a technology. If the users are not willing to use the technology introduced it can never be successful.

OPTIONS WHEN SEARCHING FOR AN APPROPRIATE TECHNOLOGY SOLUTION TO A PROBLEM:

i) Improving the traditional technology:

This helps in introducing technologies which are relevant to the needs. If taken into consideration one can improve their efficiency and productivity.

ii) Accepting a modern technology:

In limited instances the modern technology may be accepted but this happens in industrialized sectors.

iii) Adaption of an old technology:

Sometimes helps as a guide to achieving a successful technology e.g. windmills, milling machinery.

iv) Adoption of modern technology:

A more suitable tool for a certain use may be easily put into practice, mainly because it saves labour or time e.g. electric motor to run a mill etc.

v) Developing a new Technology:

This consists of both new and old ideas combined to develop a new innovation.

vi) Transfer of Technology:

In some instances a technology used in the other part of a region may easily be applied in the other and gain popularity e.g. sorghum dehuller which was developed by RIIC and is used in Mali, Tanzania, Zimbabwe, Kenya, Malawi and some other countries.

The main factor here is that when considering projects one has to involve the users as much as possible.

The ideas introduced should be simple for people to understand.

The other factor to focus on is the user's attitude towards the idea introduced.

- People have to decide for themselves.
- Give comments/or suggestions.
- Involve the people as much as possible from the initial stage up to the final stage.
- Give them enough time.
- Show their importance in the field.

ACCEPTANCE OF DESALINATION IN THE KGALAGADI DISTRICT - BY M. M. MOETSE

INTRODUCTION:

After several talks with the authorities, RIIC carried out three communal installations in three places within the district. The places were Khawa, Lokgware, Zutshwa.

The above settlements differed in many ways like population, vegetation and social structure.

STEPS CARRIED OUT BEFORE THE INITIAL STAGE:

Meetings were held with the authorities the communities and all concerned to explain the details of the projects.

Pre Installation: Household surveys were carried out to find out the peoples feelings towards the idea introduced.

STEPS CARRIED OUT DURING INSTALLATION:

Community members were encouraged to participate as much as possible during installation. They were asked to contribute as much labour as possible. Workshops were conducted in all the three areas and committees formed.

The communitees were responsible for organizing the people to help and arrange distribution etc.

STEPS CARRIED OUT AFTER INSTALLATION:

Follow ups:

- to check on the status of the existing projects.
- Get people's response towards the projects.

EXPERIENCE IN THE FIELD AND ALTERNATIVE FINDINGS - LOKGWARE:

Population 143.

Most of the residents originated in Lokgware. They welcomed the idea introduced and helped a lot during installation of the communal stills. Committees were formed during the workshops and their responsibilties were to organise people to help when ever there was work to be done at site e.g. fetching salty water and distributing the distillate.

After the workshops follow up trips were made to Lokgware to check on the status of the project and to advise and assist the community.

COMMON FINDINGS:

The stills were well looked after for a few months and then the participation went down as time went on despite the fact that people were asked to take care of the stills.

People were approached on the matter and they mentioned the following points as causes of the failure:

i) Irregular pumping.
ii) Borehole too far from the site.
iii) Misunderstanding/poor organisation.
iv) People could easily get sweet water from Kokong which was only 17 km in addition they would visit relatives and do some shopping.

ALTERNATIVE TO THE ABOVE:

It was after some considerations that a household survey was carried out to determine whether people needed the stills at communal level and or on individual basis and it was discovered that 75% of the people wanted to keep the stills at their homes. They said that way the stills could be better looked after.

RESPONSE TO THE ABOVE:

Ten households were given 21 stills ranging from 1 - 4. It was discovered that even after installations of the communal stills, few were used, the reasons for not using the stills were as follow:

i) Stills were time consuming i.e. one has to take care of the sites and fetch salt water etc.
ii) Shortage of repair materials e.g. silicone glass in case one is broken.
iii) Shortage of stills.

RIIC staff in return provided the people with steps carried out as at Lokgware and repair materials only to find that there was no improvement. In one instance it was discovered that only 3 out of the 21 stills were used.

ACTION TAKEN:

After informing the concerned (Council, RAD) RIIC decided to remove the stills and take them to other places where they could be better utilized. A meeting was held with the residents to inform them of the decision. They agreed with RIIC's decision to remove the still. The reason for this being as follows on:

i) The stills were said to be demanding (need too much care) and thus time consuming.
ii) To avoid injuries to kids and animals from broken glass etc.
iii) People needed some better services which are supplied to other villages boreholes or a truck based in Lokgware to serve the settlement.

DISCUSSIONS:

Steps carried out were they necessary?
Why are they necessary?
Which of the two methods would you recommend?
Why?
Is there anything you can think of which we could have done?

KHAWA:

Population 263.

The residents are composed of the Batlhwaro and people of mixed races. There is very little crop production due to poor rains. Few of the residents own cattle and small stock.

COMMON FINDINGS:

Nine stills were installed and the Council pumper was asked to take care of the stills with the help of the community members and the committee.

The people showed interest in the stills and demanded that RIIC staff increase the number.

PROBLEMS:

The pumper was not that active, he would leave the stills without water for long periods and this affected their performance. The pumper was advised on how to maintain the stills and some clear explanations were given but this could not get into his mind. So Council decided to put him aside and recruited a second person. The pumper's performance was good and the stills improved their performance. This led to the expansion on the site to have 37 mexican stills and brickstills.

DISTRIBUTION OF DISTILLATE:

The proposed distribution is 5 litres/per person when ever there is enough distillate. The pumper tries by all means to follow the principles but with lots of problems a few of which are:

i) It takes time for enough distillate to collect to meet the demand.
ii) Priority is giver to worker's i.e. 3 teachers, F.W.E. and some kids.
iii) In some cases the same people jump over the fence to get water without the pumper's permission.

The stills are generally performing well and are looked after very well. There is however less output during winter.

DISCUSSIONS:

Was Council discussion okay?
What do you think could be done to improve the distribution system?

ZUTSHWA:

The first 3 stills were introduced by Mr K. Irvine , a missionary with A.E.F. Mission.

RIIC followed later to install some 32 stills.

The steps carried out as on the above.
The site attendant has experience in operating the stills and has worked with Mr Iverne ever since the installation of the stills. The performance of the stills is satisfactory and distribution is fairly reasonable.

ADDITIONAL BENEFITS:

When cleaning the stills the salt scraped from the bases of the stills can be used for cooking, curing skins and can also be sold. There is a proposal that the Livestock Advisory Centre buys salt from the stills to sell it to farmers.

DISCUSSIONS:

Compare the three sites.
Can you see difference between the three?
List of differences.
Any ideas on salt.

What do you think it should be used for?
Is the stated proposal fine?

GROUPS DISCUSSIONS ON PROBLEMS OF ACCEPTANCE - BY M. MOETSE: EXT. OFFICER:

"Three groups will be formed each with a leader"

Points to focus on will include:

- The importance of involving communities when introducing projects.
- The community's responsibilities:

  i) At the initial stage.
  ii) During installation.
  iii) After hand overs.

- Steps taken before the actual installation is carried out e.g. meetings with the authorities, the communities, surveys, are they necessary? Why are they necessary?

- Steps carried out during installation.
  Household visits, surveys, training, are they necessary?
  Why are they necessary?

- Steps carried out after follow ups.

  Why are they important?
  Back up support to Council to the users.
  Why is this needed?

DESIGN AND CONSTRUCTION OF STILLS BY JUDGE T. TLHAGE - DESALINATION FIELD OFFICER

INTRODUCTION:

Rural Industries Innovation Centre has been since 1982 engaged in research and development of desalination devices. The earliest being the poverello still which costed about P11.00 each. We have up to now developed and tested different stills, namely:

Cascade, Ferrocement still, Asbestos cement still, Poverello, Californan still, San Francisco, Night Sky radiation still, Ghanzi still, the brick still and the Mexican Still. The whole aim of coming up with so many prototypes was to get the easiest, cheapest and a reasonably long lasting still that will withstand the conditions in Botswana.

DESIGN PHILOSOPHY:

As stated above about prototypes, all the complications were avoided as much as possible to allow easy construction by the available staff in the district. The latest design which is the brickstill uses readily available materials in the districts, in the exception of where we use vermiculite blocks to build it. This only serves as an insulation and increases efficiency by 5% when compared with cement blocks for the walls.

DEVELOPMENT OF THE MEXICAN STILLS:

This type is the one commonly seen in our sites. It has been modified a lot to where it is now. We have in the process used tedlar plastic to avoid breakages and heavy loads of glass to remote areas. Tedlar proved to be very inefficient, reduces efficiency by 15% and needed a high angle of about 20 or more. On tedlar the vapours form drops instead of a thin film like on glass and this results in the distillate drops falling back into the basin. The initial higher gable even on the glass ones was to enable the tedlar to be used.

Glass (4 mm) is now being used because it allows radiation from the sun to go in but prevents heat from the still and the vapours to escape. The mexican still is now made with a very low gable of about 17° and this has increased the stills efficiency. Armaplate glass cost double the price of 4 mm glass and 3 mm breaks easily and is easily damaged by hail.

EFFICIENCY OF THE STILL:

The efficiency depends mostly on the quality of the insulation and the air-tightness of the still. Any vapour leaks will not only result in the loss of distillate but also in the loss of heat which has been captured inside the still. The efficiency is also increased by reducing the gable of the still to as low as possible i.e 300 mm.

Performance of stills around the world is at an average of 12% - 24% efficient whereas ours at RIIC which is a mexican is giving up to 55% and recently developed brick still is 30 - 35% efficient. Efficiency of a perfect still could go up to 60%, this is a still with good insulation, good materials used and during favourable conditions. It should however, be noted that efficiency drops with radiation.

OTHER TYPES OF RIIC STILLS:

The poverells still was the first one which was just a hole in the ground, lined with either plastic or canvas (just something that can prevent water from soaking), a black cloth to be used as a heat absorbent, a clean tedlar plastic to cover the top of the hole. Pour the water in the hole, put a distillate collector in the centre of the hole. The cover (clear tedlar or any other, plastic) should be placed on top of the hole and something heavy enough should be placed on its centre and the inward slope will lead the distillate into the container.

This had a very low output and was initially developed with the hunters and gatherers in mind. It was found to be too hard to assemble, easily damaged by rain, animals, gets very dirty and does not last long.

NIGHT SKY RADIATION STILL: (see illustration page 67)

This was made of a traditional three legged pot with coiled copper pipe acting as the condenser. It was an air-cooled condenser and was just over the fire, so it could not produce much so we changed it to straight pipe. The average output was .750 l per hour and the cost was P60 each. The problem with it was that a good seal between the pot and the lid was difficult to get and it was too risky for families with children sitting around the fire.

GHANZI STILL:

This one was made out of two drums and a straight galvanised pipe. One drum 100ℓ was used as a boiler and the other one 200ℓ with a coiled copper pipe inside it was used as a condenser. The still could produce within 8 - 10 mins 1ℓ of distillate and it cost more.

P150.00. The problem with this still was that it needed too much firewood and a lot of water to start it i.e. about 250 l of salty water. The drums could not stand the salt for long and had a very short life span.

THE BRICKSTILL:

These are built out of ordinary bricks and others with vermiculite blocks. This still can be built by any builder provided he has the sketch plan. The difference between the cement block one and the vermiculite block one is that the vermiculite blocks can serve as a wall and insulation at the same time whereas the cement one serves as a wall only. For the brickstill, paint selection is very important i.e. a paint that can withstand heat and be waterproof. We therefore recommend cretecoat and not bitumen because it smells and gives water a bad taste. The distillate picks up tastes very easily. With cretecoat it only needs 12 hours to dry and the smell disappears.

CONSTRUCTION STEPS:

This refers to the installation of our mexican stills. Materials used are cement, concrete, bricks, sand - good sand is needed here, water and all the necessary building tools e.g. trowels, shovels, etc. Steps are as follows:

1. Fence the area where stills are going to be installed and make sure the fence is goat proofed and high enough.

2. Clear the ground, mark the size of the plinth which should be 10m x 6m set your pegs and start digging for the footings.

3. Mix the required amount of concrete, cement, sand and water and level the footings for your concrete mixture. (1:3:6 cement:sand :concrete:ratio).

4. Pour footings of about 15 cm minimum depth and allow to dry for two (2) days.

5. Build the wall of 3 to 4 courses of stock bricks right round the plinth area. Allow to dry for two (2) days.

6. Fill with sand, level and stamp it, pour water, for compactness. The compacted ground should leave 10 cm space above it for concrete slab.

7. Mark the still position and pour some vermiculite mixture under the still for insulation. The vermiculite should be a thickness of not less than 40 mm. Set the still and make sure it is level-

led to avoid dry portions. A mixture of 1:6 is recommended, 1 cement: 6 vermiculite.

8. Pour a concrete slab around the stills, making it slope into the rain gutters which are set before concreting to enable the plinth to be used as a rainwater catchment.

9. Set the ridge poles on the still when step no. 8 has been left to dry for 2 - 3 days then glaze, pour water and close the hatch-holes.

10. The distillate outlets are connected to one pipe leading to the container as shown on the pictures attached.

BRICKSTILL CONSTRUCTION STEPS:

1. Clear ground, mark the size, set pegs and start digging for the footings. The standard design size of a brickstill is 5 m x 5 m.

2. Pour footings and leave them to dry for 2 days.

3. Build one course of stockbricks around the footing and pour the slab. This should be reinforced with primed round bars and a mixture of concrete, cement and sand applied. Allow to dry for 1 day.

4. Build the back wall about three (3) courses of blocks leaving two holes towards ends to be used for filling or cleaning the still. Set in a drain nipple of 40 mm diameter at the bottom of the courses. On each course 4 1/2" brickforce should be placed.

5. The two side walls should be slopping downwards to the distillate gutter. A single course of stockbricks should be built on the front end to accomodate a ready made fibreglass gutter which can also be made out of stainless steel.

6. Plastr the walls and allow to dry for 1 day. This needs very good sand because desert is too poor for it.

7. Set in the insulation i.e. vermiculite mixture of 40 mm thickness minimum with a cement screed to seal/close the pores on the vermiculite floor (cement vermiculite ratio of 1:6)

8. Set in the gutter and make a slopping finish to the floor of the still with a vermiculite cement mixture. Allow to dry for about three months before painting.

9. After 3 months cretecoat can be applied to the walls and the floor. Two or more coats should be applied to each area with a difference of 24 hours between coats. On the base black cretecoat is used and on the walls a white one to reflect heat onto the base.

10. Glazing the still and closing the hatch poles. On the hatch hole's a line of weatherstrip should be fitted around before putting the lids on.

Drawings of all the above stills are attached and their performance data.

During construction of stills, salty water can be used as long as it is 10 000 mg/l. There should be enough supply of water to mix the cement/sand for building. If the sand is not good enough especially for plastering, you should be prepared to go and haul it from the nearest goods and spot.

DISCUSSION TOPICS:

i) How much do you know about salt water and cement i.e. making mortar for building? There might be some people among you with greater experience of cement and salt water i.e the reaction that comes out.

ii) Which is the best tank for storing rainwater, salty water etc? At RIIC we build a brick tank under the ground and plaster it inside with cement mortar for rainwater and for the salt water we use a p.v.c. lined galvanised tank from Hydrocon.

THANK YOU LADIES AND GENTLEMEN.

WOOD BURNING STILLS BY M. M. MOETSE, EXTENSION OFFICER

REASONS FOR INTRODUCING THEM:

i) They provide short term help to places which receive trucked water irregularly, especially places where there is little salty water and solar desalination is not applicable.

ii) Can also be useful in places which need short term help before drilling of boreholes which qualify for long term investment of solar.

iii) Easy to operate and are economically reasonable.

HISTORY OF THE RADIANT STILLS:

After several experiments in Kanye few stills were taken to different sites in the Kgalagadi and Ngwaketse District.

The places of distribution were Mathathane, Ukwi, Zutshwa and Make. The stills were demonstrated before the communities and distributed to individuals all in the performance showed low yields? The other common problem with the stills was that they were easily damaged during transportation. Since the cooling system required air it was necessary for the stills to have a separate fire prepared for them.

DEVELOPMENT OF THE STILL DESIGN:

In order to improve the few limitation listed above the Ghanzi still was introduced. The Ghanzi still was found to be bigger and more reliable.

ADVANTAGES OF THE GHANZI STILLS:

i) Produce reasonable amount of water in a short period (8 - 17 lts/hr).

ii) Could be made locally by the existing workshops.

iii) uses wood as its source of energy, which is easily obtainable.

iv) Easy to operate.

DISADVANTAGES:

i) May lead to deforestation and soil erosion.
ii) Time Consuming.

iii) Risky e.g. children tipping the pot and getting burnt.

FIELD EXPERIENCE:

In general the performance was satisfactory in all the places of operation. The stills are used for different purposes at different places e.g.

a. Zutshwa

The residents use the stills to get the distillate which they drink and water the donkeys during hunting seasons.

b. Mathathane

The distillate is used for drinking by over thirty people.

c. Kokotsha

The community was using the stills till they got enough sweet water.

COMMON FINDINGS:

1. The boilers could not last long cause of the excessive heat and salt especially when they dry.

2. The people become lazy or a bit reluctant to fetch wood from a distance.

REVERSE OSMOSIS (RO):

This is a process by which salt is removed from Salty water by using a special porous membrane.

This membrane allows water molecules to pass but not salt molecules. It works when the salty water is forced against it at high pressure (80 atmospheres).

This method is successfully used around the world especially in larger plants.

Before the water enters the membrane chamber, it must be pre-treated and filtered so that the membrane is not damaged. It is this pretreatment that generally causes problems in desalination plants.

If the water is not properly treated the membranes get clogged and the output drops. Replacement membranes are very expensive and difficult to obtain.

Service of reverse osmosis units needs trained personnel who are not available in Botswana.

So if a remote settlement has an RO unit and that unit fails it will take many months to have it properly repaired.

OTHER TECHNOLOGIES:

Reverse Osmosis: Hand Operated

A complete set was delivered at Lokgware to be used by individuals at their homes. After demonstrations it was handed over to the villagers.

The people appreciated its performance since one could produce enough water for drinking, the other advantage was that all the work was carried out at one's home so it was convenient.

Lastly it was simple and easy to handle.

Pedal Powered Type

The second type which we were willing to introduce was the pedal powered one which is from Germany and could supply 200 people with enough water if fully utilised.

It was P4 000 one and half years back but at present the price has gone up to P16 000 which is too expensive and comparitive to drilling.

WOOD BURNING STILLS:

DISCUSSIONS:

Are they of any importance?
Do you think they should be further used?
Can you recommend them to say wildlife, camps or new sites proposed for desalination as back ups?
If you compare the two wood stills and reverse osmosis which would you recommend?

WATER UNIT OPERATIONS IN THE KGALAGADI DISTRICT PRESENTED BY ARCHIE MMUSI

In the Kgalagadi District Remote Area Dwellers have severe problems of access to water and rely heavily on plants for moisture. In many cases, salty on polluted water is available from boreholes which were drilled with intention of providing water to settlements. Due to lack of potable water, council is transporting water to these areas but this is expensive and unreliable since Council does not have the capacity to carry water on a regular basis. A truck has to make two trips of 68 to 150 km on heavy sandy and bumpy road to reach arable water. Lack of sufficient vehicles and vehicle breakdowns interfere with the delivery which sometimes leads to settlements going without water for some weeks.

At present, Council is serving the following settlements Ncaang, Monong, Ukwi, Huhunkwe, Make, Zutshwa, Lotlhake, Ngwatle and Lokgware all found in Northern Kgalagadi.

Although the situation is critical in these areas, eforts are being made to utilise the small amount of salty water found in these areas.

A research of separating salt from water has been carried out by RIIC team using desalinators whereby principles of distillation and solar power are being practised. Experiments started at Lokgware, zutshwa and some other settlements. In Lokgware it was unsuccessful because people seemed to be demotivated whereas in Zutshwa where the community viewed the project as a relief to the water crisis the project has succeeded and reduced costs of transporting water to this areas. Council used to make three to four trips of delivery in a month. Now this has been reduced to once a month or after two months depending on climatic conditions in that particular month.

Desalination is a new system to rural village water supplies but it has proved beneficiary to settlements by converting salty water into potable water. This may be looked at as low yielding process but it is a relief both to council and remote area dwellers. If the stills are carefully looked after and maintained, people will always be sure of something to drink while awaiting the next delivery.

During the last field seminar held in Zutshwa, it was suggested that the service of this kind be extended to Ukwi, about 150 km from Hukuntsi. It was agreed that officials from the water units, RADs department and RIIC members visit the place to identify sites and workout costs of equipping a borehole. Despite this agreement the trip has never been made due to some other commitments. If this could be done immediately after this seminar it will be a great help to council since the settlement is likely to face serious water shortage in the coming summer season because of unsufficient transport.

COSTS COMPARISONS ON POTABLE WATER SUPPLY TO KHAWA

STANDARD ASSUMPTIONS:

1. 1985 Population figures used, 270 people.

2. Water demand calculated at the rate of 2,3ℓ person/day, ± 20250ℓ.

3. Distilled/saline ratio 2:1.

4. Transport costs calculated to deliver water, Tsabong-Khawa-Khawa-Kruis x 5, Khawa-Tsabong & P1.20/km on 7 ton, (dep: 30t/km, maint. 40 t/km, fuel 30t/km.

5. Per diems/wages at Government rates.

6. Installed Mexican still costs P600.00 including all ancillary costs.

7. Average potable water production, for 9 months at 3.5ℓ mixed to 5,25ℓ, 3 months winter production at 2.5ℓ/day, mixed to 3,75ℓ.

8. In 10 year cummulative comparison nett present values used.

	TRUCKING		DESALINATION
Water Demand 1/p.a.	242 400		242 400
Water supplied 1/p.a	242 400	Summer	210 816
		Winter	43 920
EXCESS/(SHORTFALL)1/p.a.	-		12 336

ANNUAL PROJECT COSTS:

	TRUCKING	DESALINATION
CAPITAL:		
On-Site tanks x 3	4 000	-
Mexican Still x 128	-	76 800
TOTAL CAPITAL	4 200	76 800

RECURRENT COSTS:

Kilometrage, 1 500 km/mth	21 600	-
Tank Replacements liners	3 600	600
200 1 drums x 40	2 600	-
Per Diems/Wages	380	-
Maintenance, 85%	-	3 840
CONTINGENCY 10%	2 918	444
ANNUAL RECURRENT COSTS	30 998	4 884

CUMMULATIVE COSTS:

	YEAR 1	YEAR 2	YEAR 3	YEAR 4	YEAR 5	YEAR 10
Trucking	35 198	66 196	97 194	128 192	159 190	314 180
Desalination	81 684	86 568	91 452	96 336	101 220	125 640
Savings Acrrued From Desalination	-46 486	-20 372	5 742	31 856	57 970	188 540

COSTS OF MEXICAN STILL INSTALLATION AT ZUTSHWA

MATERIALS:

Number	Stills	Unit Cost	Total Cost
32	Fibreglass basins	205.00	6 560.00
70 m	Glass	28.26	1 978.20
8	6 m lengths 20 mm galvanised pipe	8.55	68.40
37	Silicone sheet	9.55	305.60
6	Rolls weatherstrip	13.00	78.00
			8 990.20

FOUNDATION:

74 Bags	Vermiculite	10.00	740.00
2 000	Bricks	.20	400.00
65 Bags	Cement (average price)	6.50	422.50
75 lengths	Asbestos gutter	8.25	618.75
2 kg	Epoxy	19.00	38.00
			2 219.25

PIPING:

22 lengths	20 mm galvanised pipe	8.55	187.00
64	Nipple	0.25	16.00
64	Tee Joint	1.17	74.88
10	Elbow Joint	0.83	8.30
8	Union	2.05	16.40
2	2 m rubber lined tanks	450.00	900.00
			1 202.58

FENCING: 30 X 30 m

	Bolts and fastenings	-	50.00
2	Gates	60.00	120.00
6	Corner Poles	28.50	170.00
8	Supporters	10.00	80.00
4 rolls	Mesh Wire	47.00	188.00
56	Poles	9.50	532.00
1 roll	Barbed Wire	70.00	70.00
2 rolls	8 gauge wire	73.00	146.00
			1 356.00

Total Cost of Materials	13 768.03
Cost of Labour employed @ P2.00 per day	508.00
Cost of RIIC labour @ P10.00 per day	1 140.00
Cost of transport of materials from Kanye @ .75/km	3 420.00
Cost of trucking water and bricks from Hukuntsi @ .75/km	1 625.00

Total cost of installation P20 461.03 faction of total cost

Total cost per still P 639.41

Cost of materials but not fencing per still	P 387.86	61%
Cost of all materials per still	P 430.25	67%
Cost of materials and labour per still	P 481.75	75%
Cost of transport per still	P 157.66	25%

N.B. 1. Fencing and tanks etc. were used for a further 32 stills with room for further expansion.

2. Transport costs would be lower for future sites now that construction procedures have been streamlined.

COST OF 10 M BRICK STILL INSTALLATION

Materials	Unit Cost in Kanye	TOTAL
16 Bag Cement	5.00	80.00
200 Blocks	.20	40.00
50 Bricks	.08	4.00
10 Bags Vermiculite	6.00	60.00
5 l Eposy paint	68.00	68.00
10.5 m glass	30.50/m	320.00
15 tubes silicone	9.00	135.00
Fibreglass gutter	60.00	120.00
50 m brickforce	3.50/roll	35.00
1 l Zinc primer	5.00	15.00
3 m weatherstrip	13.00	13.00
2 m Brass rod + nuts etc.	10.00	10.00
		890.00

LABOUR:

4 skilled men days	10/day	40.00
13 unskilled men days	5/day	65.00
		105.00

TOTAL COST	P995.00
	=======
So total cost/m	P 99.50

Transport costs vary with distance and size of installation.

THE ROLE OF MANAGEMENT IN SMALL SCALE DESALINATION BY T. WOTO

The concept of management in relation to small scale desalination projects. Good management has from our experience in the field been found to be a necessity/pre-requisite for the success of small scale desalination and ultimately its acceptance and proper use.

Different lines and levels of management involved in desalination.

- Community level
- Council/local government
- Central government/ministerial level

Factors affecting good management.

- Awareness of an unsatisfactory situation e.g. in this case the need for potable drinking water and the prevailing attempts to alleviate the need - water trucking and problems involved.
- A desire to improve the situation leading to an examination of prevalent options - desalination as one of the options.
- A clear conception of the situation as improved.
- Knowledge of necessary resources to achieve the improved situation.
- Commitment to implement and support the chosen option.

Obviously, the different parties involved (government, council, RRIC, RAD, Communities etc.) do not have the same view of the situation e.g.:

a) the absence of good quality drinking water may be perceived by a health/council officer but villagers or RADs but its actual implementation was found to be far from easy. Council has the means to foster such a pre-requisite through health extension workers.

b) particularly in desalination, the need to dillute the distillate has been highly perceived and promoted by RIIC but its actual implementation was found to be far from easy. Council has the mans to foster such a pre-requisite through health extension workers.

c) the high but unavoidable problems of trucking water to settlements might be obvious to the implementing council workers, but not necessarily so to other council sectors, and to the RADs who continue to indiscriminately use the water while continuing to demand more. Thus a need for a common conception of the problem.

Well defined responsibilities with council of how to implement desalination projects:

- Who should construct stills?
- Who should maintain stills?
- Supervision of still operators.

In the communities:

- Daily operation and maintenance of stills.
- Ensuring good water distribution systems which are water saving.
- Ensuring dillution of distilled water with salty water.

The awareness by all categories that a situation is unsatisfactory is therefore a first step towards action because the different actors involved have neither the same priorities nor the same motivations.

The role of the Joint Advisory Group on desalination for Remote Areas (JAGDRA) over the past 3 - 4 years.

POINTS TO NOTE:

- Role of Management in desalination.
- Different levels of management.
- Role of Coordination and dialogue among the different levels.
- Need for a common conception of the problem.

THE FUTURE OF DESALINATION IN BOTSWANA BY TEEDZANI WOTO

Perceived future role of RIIC.

- Will provide technical support in the form of active involvement in the building of the next three (3) new sites, training of council staff and community based site attendants.

- Will conduct two post project evaluation exercises after 1 and 5 years consecutively.

- RIIC will not in future be in a position to instigate new projects.

The role of Councils:

Depending on whether a district council accepts desalination, the following are some pre-requisites for a successful application of this technology in any district:

- Councils will be responsible for site identification.
- Managemnet of new and existing sites - especially Kgalagadi district Council.
- Liaise with RIIC for technical support.
- Raise funds for new sites.
- Construction of new sites - with RIIC help where possible.
- Liaison with central government.
- Carry out supplementary winter water trucking where necessary.
- Institution of a reliable and water - saving distribution system in the settlements.

The role of Central Government:

- Department of Water Affairs should, when drilling boreholes, always take into consideration that salty boreholes have a potential usable value. This is especially so with desalination hence one (1) borehole should at least be drilled and cased in any particular settlement and should be located in or as near to the settlement as possible.

- Government should be in a position to budget and allocate funds for purposes of desalination.

- Government should morally support any desalination activities started/initiated by councils. This could help in promoting the success and acceptance of this technology.

- All the government departments directly or indirectly involved with desalination should always be aware of the situation - National

Drought Coordinating Committee, Water Affairs, RADP etc.

Potential Funding Sources:

- The basic issue here is whether private organizations should be involved in desalination or not. If so, what should be their role and how can they be incorporated into the overall local and central government water programme(s). In the case of their being involved, their role is to be informed of the situation and be prepared to fund projects. Examples: NORAD, L.W.F., U.S.C., B.C.C., etc.

Joint Advisory Group on Desalination for Remote Areas (JAGDRA):

- Enclosed is the terms of reference spelling out its original nature and objectives as a coordinating body of initial people involved and controlling body of the project.

- Given the possible involvement in the project of central government, councils, RIIC and other interested parties, should JAGDRA continue as it is or should it be absorbed under the water reference group.

  - Should it continue but under a different form - if so what form etc.
  - Continue under whose control.

Private Use:

- Apart from its use as a village water supply system, desalination can be considered for other forms of use especially private and institutional use. These include the following:

  - School laboratories.
  - Garages.
  - Individuals e.g. at remote cattle-post for people.
  - Clinics etc.

<u>POINTS TO NOTE:</u>

- What should be the role of RIIC in desalination?
- Does desalination as a technology have any future potential in Botswana?
- Role of Councils and limitations.
- The role of central government.
- The role of concerned communities.
- Should private bodies play any role in any future desalination work and if so what form should their role assume?

RESOLUTIONS ADOPTED AT A DESALINATION SEMINAR HELD AT THE RURAL INDUSTRIES INNOVATION CENTRE IN KANYE FROM 10TH - 13TH AUGUST 1987

1. That solar desalination be adopted as a viable technology where water is undrinkable due to high salt content.

2. That the production of salt as a bye-product of desalination be supported by local authorities.

3. That Ministry of Local Government and Lands should make a waver to the existing legislation and establish local authorities within the remote area settlements and that this process be initially carried out through a gradual education programme by Extension Officers until the communities are ready to nominate their leader on a democratic basis.

4. Resources for solar desalination be sought from any and all cooperating agencies e.g. Accelerated Rural Development programme, Drought Relief etc.

5. That the Ministry of Health carry out a study on the effects of saline water on peoples' health and come up with suggestions related to the use of desalinated water.

6. That Department of Water Affairs must consult with local populations and their representatives (Extension Officers) when determining drilling sites.

7. That resources be sought to further develop the desalination technology.

8. Depending on the success of the existing project, RIIC will be in a position to further carry out research and development work on stills suitable for communities of between 500 - 900 people.

9. That Water Affairs policies (regarding equipping) be examined and modified to take into account the availability of the technology for the use of saline water boreholes.

10. That training be the responsibility of Councils and that RIIC provides technical assistance and professional guidance.

11. That RIIC should continue to disseminate the technology through its extension programme.

12. That desalination be given consideration under the water hygiene campaign.

13. That the Ministry of Local Government and Lands provide a Secretariat for Joint Advisory Group on Desalination for Remote Areas as soon as possible.

CLOSING ADDRESS BY MR M. T. MORAPEDI - RESEARCH FELLOW - RURAL DEVELOPMENT - NATIONAL INSTITUTE OF RESEARCH - UNIVERSITY OF BOTSWANA

Mr Chairman, Ladies and Gentlemen, I feel greatly honoured to have been asked to perform the official closing of the Small Scale Desalination Seminar. As one of the Seminar participants, I have been following the deliberations of the seminar very closely. This has instilled in me great confidence and made my task this afternoon quite simple.

Before closing the seminar, perhaps it would be appropriate to reflect on a few issues.

First I would like to thank the Rural Industries Innovation Centre for organizing the Seminar which has apparently greatly enlightened us, the participants, on some aspect of development in this country. It is my strong and honest belief that the participants have tremendously benefited from the Seminar based on the heated but highly intellectual and friendly debates that followed each paper presented.

The integration of the solar desalination project into RIIC's Research and Development Programme was indeed a step in the right direction and at the right time in that it has now been laid evident that solar desalination is an appropriate and effective water supply system for the remote area dwellers, particularly at Zutshwa and Khawa in the Kgalagadi District.

Mr Chairman, I am quite aware that this mammoth task was accomplished through sheer persistance and hardwork on the part of RIIC. Transport problems, long distances to be covered on very bad roads and manpower constraints were but some of the impediments that bedeviled the implementation of this project. In this connection I would like to urge the authorities to leave no stone unturned in finding funds to address the aforementioned problems.

Finally I would like to call upon you the participants to share your experiences with the top brass in your various organizatins and persuade them to see reason and thus support the desalination programme.

Mr Chairman, Sir, before actually closing this seminar I would like to inform the participants that in November this year the National Institute of Research will host a workshop on Energy which will attract participants from SADCC Countries. I have no doubt, institutions like RIIC will be invited to submit papers on their experiences.

With that Mr Chairman, I now declare the Small Scale Desalination Seminar officially closed.

PULA PULA

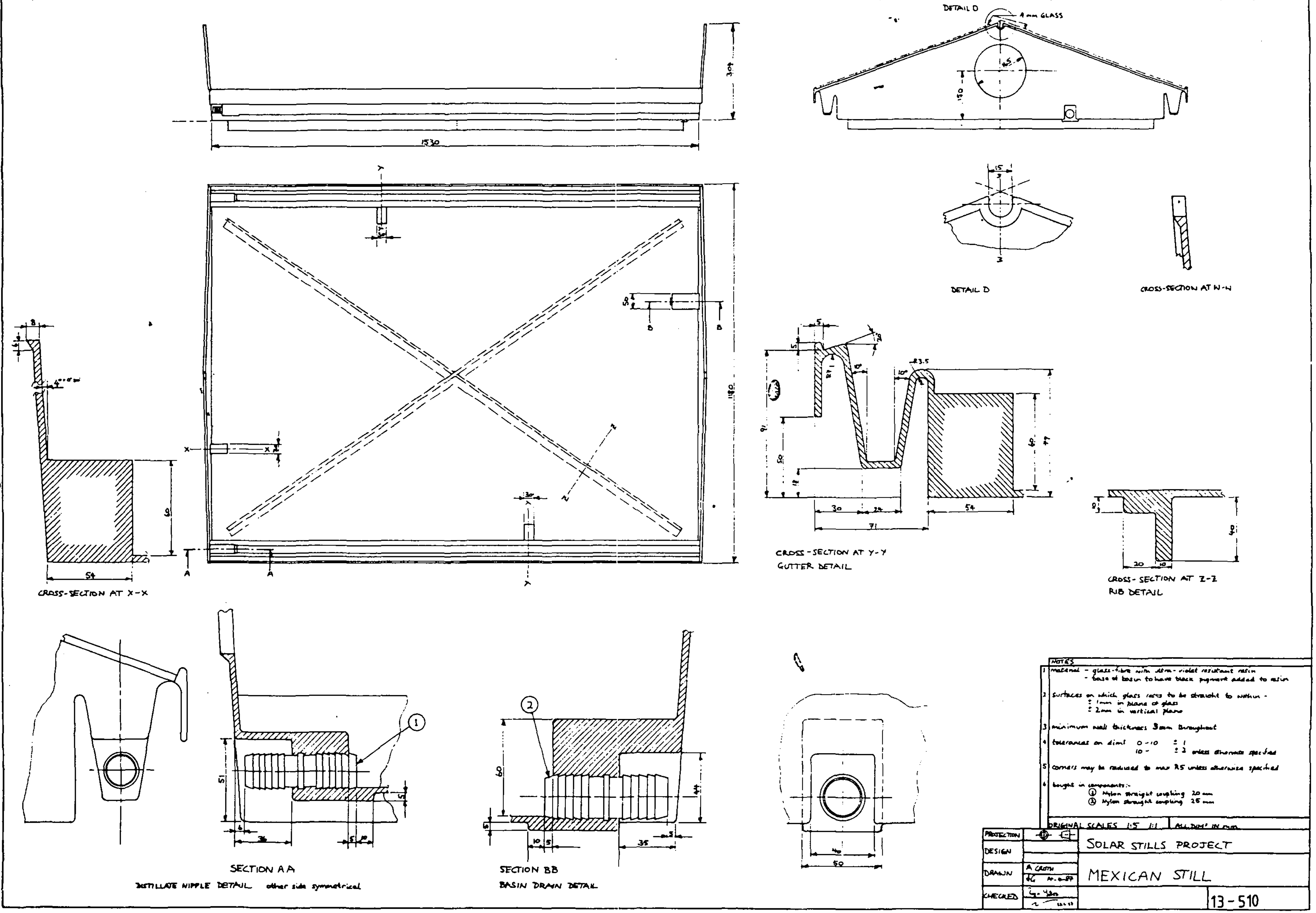
<u>PARTICIPANTS TO THE DESALINATION SEMINAR AUGUST 10TH - 14TH 1987</u>

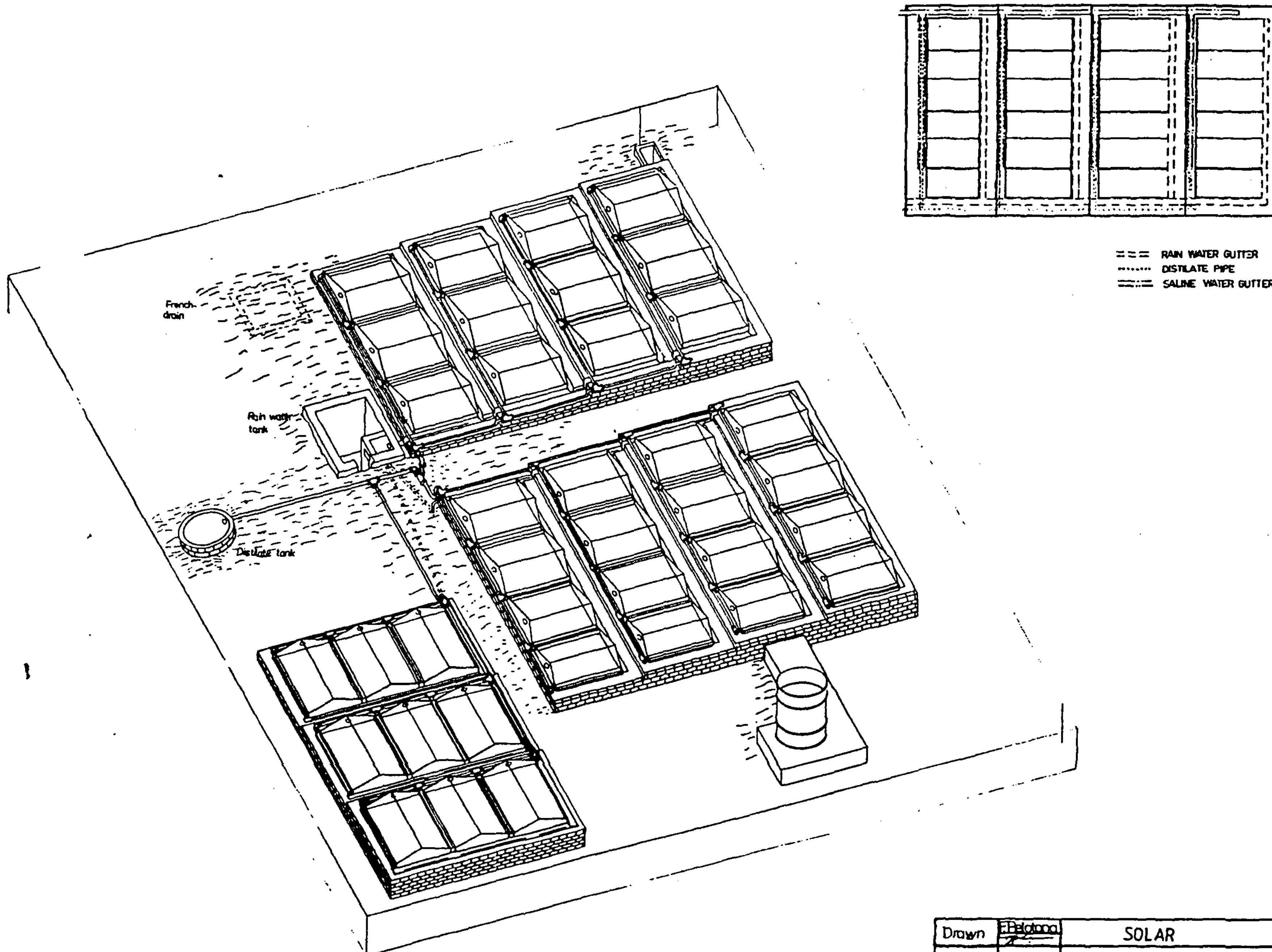
NAME	DESIGNATION	ADDRESS	ORGANISATION	LENGTH OF STAY
1. J. Kgobe	Director, Service Dept.	Box 355, GABS	Botswana Christian Council	3 days
2. G. Broekema	Water Technician	Box 169, GANTSI	Ghanzi District Council	4 days
3. T. Chaney	Drought Relief Officer	Box 1, TSABONG	Kgalagadi District Council	4 days
4. L. Elvenes	Project Officer Hand-dug Wells	P/Bag 01, MAUN	North West District Council	1 day
5. S. Rider	Ambassador, Self-Help Fund Coordinator	Box 90, GABS	U.S.A. Embassy	1 day
6. B. Mogotsi	Renewable Energy Activities Coordinator	Box 0018, GABS	MMRWA	4 days
7. A. Mmusi	Water Technician	P/Bag 5, TSABONG	Kgalagadi District Council	4 days
8. M. G. Kenosi	RADO	P/Bag 5, TSABONG	Kgalagadi District Council	4 days
9. P. K. Tain	Lecturer (Physics)	P/Bag 0022, GABS	U.B.	4 days
10. S. Stuart	Drought Technical Officer	P/Bag 1, KANYE	Southern District Council	4 days
11. I. Sentle	RADO	P/Bag 2, KANYE	S.D.C.	4 days

NAME	DESIGNATION	ADDRESS	ORGANISATION	LENGTH OF STAY
12. R. Lekaukau	SRADO	P/Bag 5, TSABONG	Kgalagadi District Council	4 days
13. J. Jacobs	Drought Relief Technical Officer	P/Bag 1, MOCHUDI	Kgatleng District Council	1 day
14. K. B. Mogalakwe	Council Secretary	P/Bag 11, MOCHUDI	Kgatleng District Council	1 day
15. T. D. Morobane	Chief Technical Officer	P/Bag 11, MOCHUDI	Kgatleng District Council	1 day
16. M. Mogalakwe	Researcher	P/Bag 006, GABS	MLG & L	1 day
17. N. Ndlovu	Senior Admin. Officer	P/Bag 006, GABS	MLG & L	1 day
18. C. Limblom	Water Engineer	P/Bag 006, GABS	MLG & L	4 days
19. M. Mookodi	Education Attache Botswana Embassy - U.K.	P/bag 005, GABS	Ministry of Education	1 day
20. G. M. Hetolang	Technical Officer	P/bag 1, MAUN	N.W.D.C.	4 days
21. K. B. Mpowe	Water Technician	P/Bag 11, MOCHUDI	Kgatleng District Council	4 days
22. J. Foley	Systems Engineer	P/Bag 0082, GABS	B.T.C.	1 day

NAME	DESIGNATION	ADDRESS	ORGANISATION	LENGTH OF STAY
23. N. Miller	Retired Field Officer (IVS)	Box 471, GABS	I.V.S.	1 day
24. G. Maikano	Assistant Engineer (Design)	P/bag 0029, GABS	Water Affairs	4 days
25. M. T. Morapedi	Research Fellow	P/Bag 0022, GABS	N.I.R.	4 days
26. L. Kaye	Director: Agric. & Industrial Implements	Box 1327, GABS	Agric & Industrial Imple.	1 day
27. C. Granthan	Director: Agric. & Industrial Implements	Box 1327, GABS	Agric & Industrial Imple.	1 day
28. S. Senthoe	Tirelo Sechaba Participant	Box 60, KANG	RADO	4 days
29. W. R. L. Motsaa-tlhobolo	RADO	Box 2, HUKUNTSI	RADO	4 days
30. S. N. Ditlhobolo	RADO	Box 2, HUKUNTSI	RADO	4 days
31. T. S. Mphele	Health Educator	Box 992, GABS	Health Education Ministry of Health	1 day
32. J. Maleke	Information Officer	P/Bag 11, KANYE	RIIC, KANYE	4 days

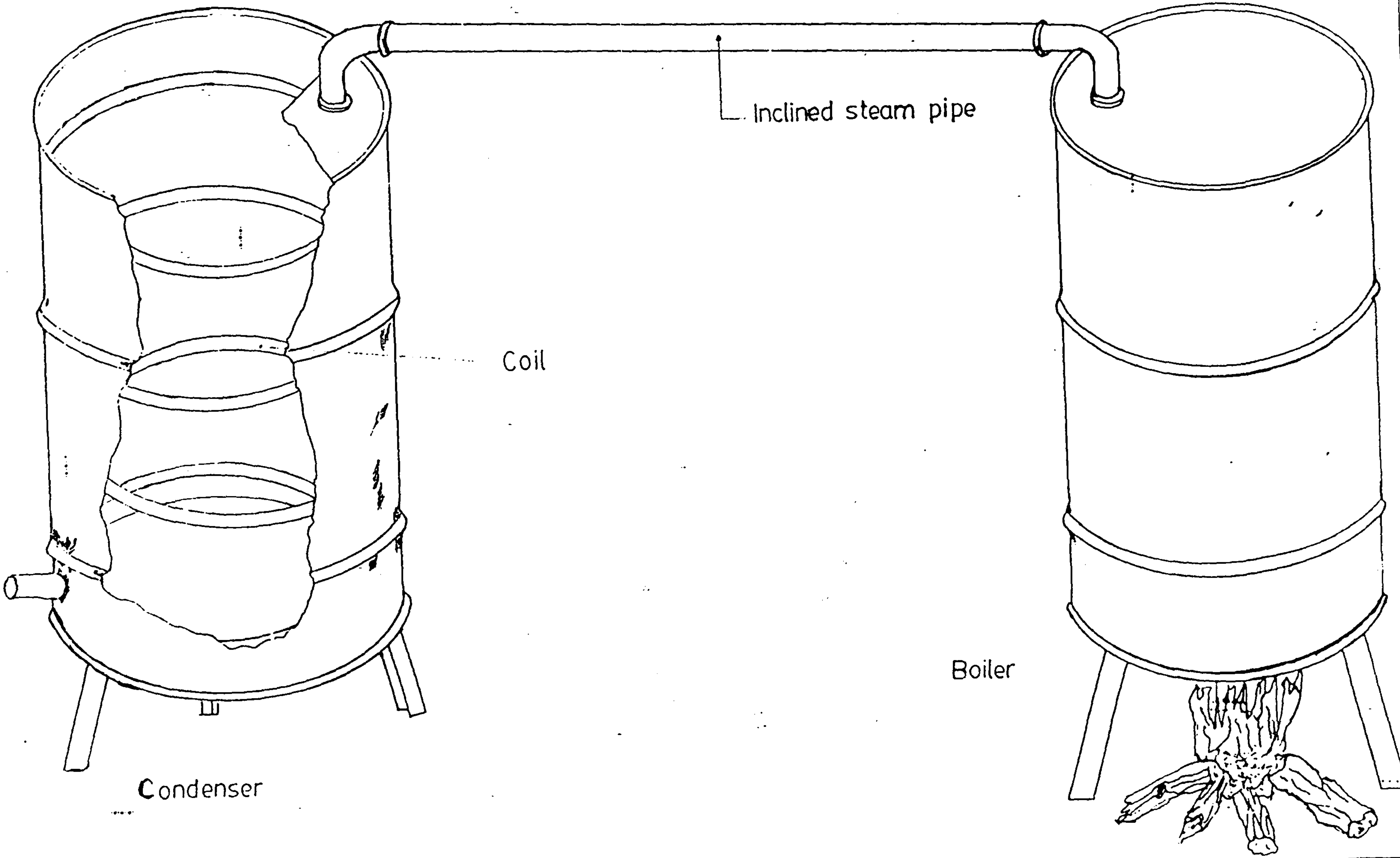
NAME	DESIGNATION	ADDRESS	ORGANISATION	LENGTH OF STAY
33. G. G. Holonga	Information Officer	Box 2088, GABS	R.I.P	4 days
34. R. Yates	Research Officer, Solar	P/Bag 11, KANYE	RIIC	4 days
35. T. Woto	Sociologist	P/Bag 11, KANYE	RIIC	4 days
36. J. Tlhage	Field Officer	P/Bag 11, KANYE	RIIC	4 days
37. Mooka Moetse	Extension Officer	P/Bag 11, KANYE	RIIC	4 days
38. P. Maribe	Chief Extension Officer	P/Bag 11, KANYE	RIIC	1 day
39. K. Morei	General Manager	P/Bag 11, KANYE	RIIC	day
40. M. Mosimayane	Technical Director	P/Bag 11, KANYE	RIIC	1 day
41. J. D. Nyatanga	SRADO	P/Bag 5, TSABONG	Kgalagadi District Council	1 day
42. L. Motsisi	Chief Technical Officer	P/Bag 0029, GABS	Dept. of Water Affairs	2 days
43. N. K. Mosimakoko	RADO	Box 334, BOBONONG	Central District	2 days

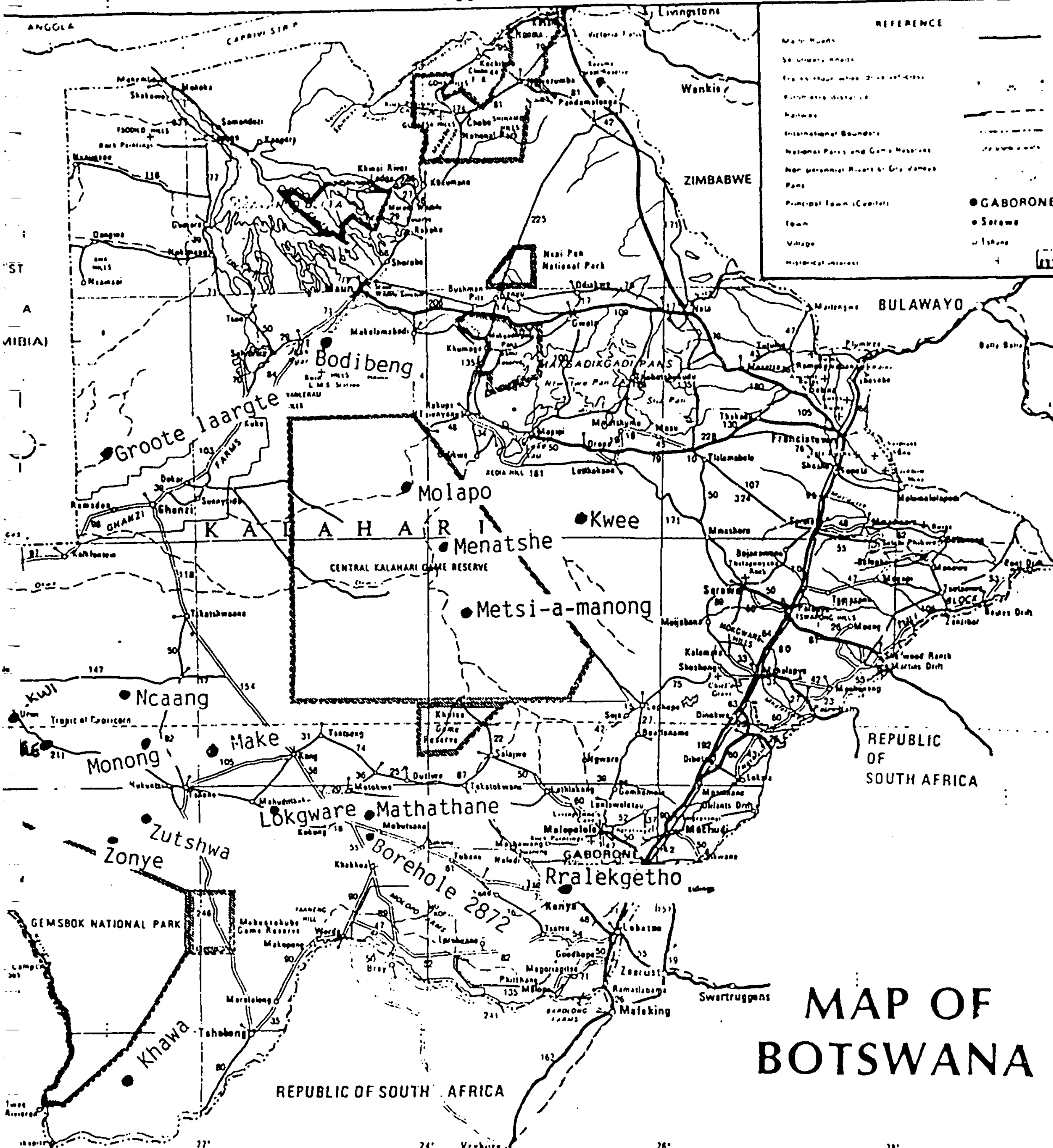

DETAIL D
4 mm GLASS
1530
304
1180
150
CROSS-SECTION AT X-X
DETAIL D
CROSS-SECTION AT W-W
CROSS-SECTION AT Y-Y
GUTTER DETAIL
CROSS-SECTION AT Z-Z
RIB DETAIL
SECTION AA
DISTILLATE NIPPLE DETAIL other side symmetrical
SECTION BB
BASIN DRAIN DETAIL
NOTES
1 material - glass-fibre with ultra-violet resistant resin
- base of basin to have black pigment added to resin
2 surfaces on which glass rests to be straight to within -
± 1mm in plane of glass
± 2mm in vertical plane
3 minimum wall thickness 3mm throughout
4 tolerances on dim! 0 - 10 ± 1
10 - ± 2 unless otherwise specified
5 corners may be radiused to max R5 unless otherwise specified
6 bought in components:-
① Nylon straight coupling 20 mm
② Nylon straight coupling 25 mm
ORIGINAL SCALES 1:5 1:1
ALL DIM' IN mm
PROJECTION
DESIGN
DRAWN
A GROTH
CHECKED
SOLAR STILLS PROJECT
MEXICAN STILL
13 - 510



Drawn	E.Belotona	SOLAR
		THE KHAWA INSTALLATION
		APRIL 86
Signed	Yates	13-305

THE GHANZI STILL





Proposed Sites		RIIC Minimal Involvement	RIIC Major Involvement
1. Zutshwa	11. Bodibeng	1. Manong	1. Khawa
2. Monong	12. Groote laargte	2. Make	2. Zutshwa
3. Make	13. Metsi-a-manong	3. Ncaang	3. Lokgware
4. Ncaang	14. Menatshe	4. Metsi-a-manong	
5. Ngwatle	15. Molapo	5. Kwee	
6. Ukwi	16. Kwee	6. Mathathane	
7. Zonye	17. Lokgware	7. Kokotsha	* Shows site distribution
8. Khawa	18. Kokotsha	8. Rralekgetho	
9. Mathathane	19. Rralekgetho		
10. Borehole 2872			

A MAINTENANCE MANUAL FOR SOLAR STILLS PRESENTED BY R. YATES

ILLUSTRATIONS BY T. TAU

CONTENTS PAGE

MAINTENANCE MANUAL FOR SOLAR STILLS

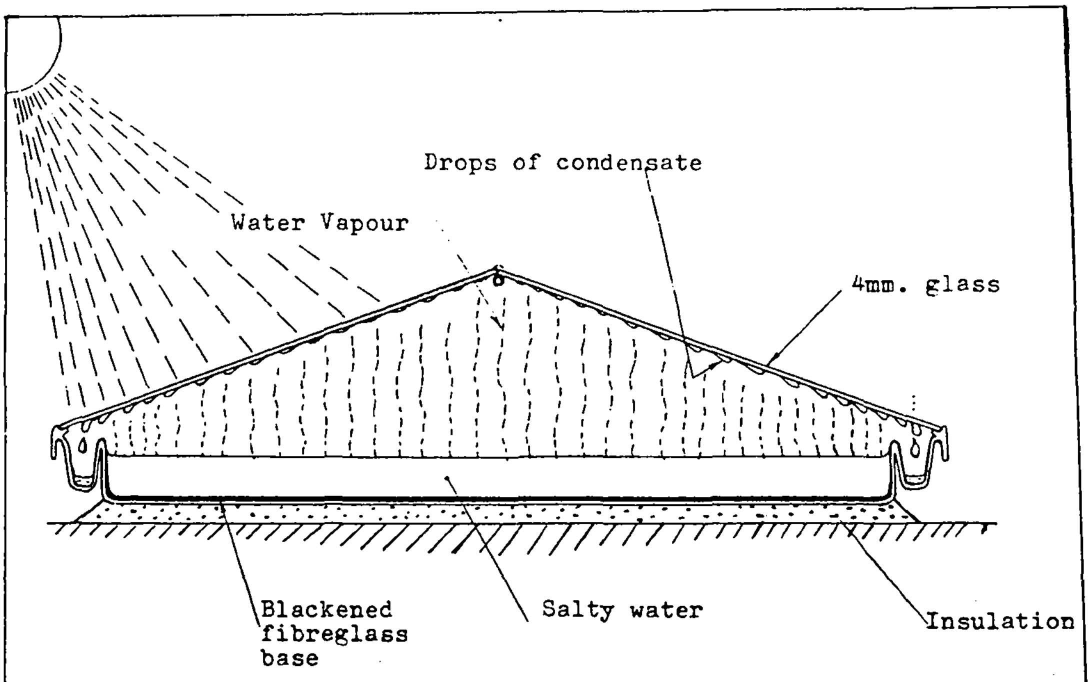
INTRODUCTION

Solar stills are devices which allow water to be collected after it has evaporated from an open basin. This collected water will be pure (distilled) and contains no dissolved salts.

By the nature of their use, these stills must be kept in very harse conditions, subject to high levels of solar radiation, high and low temperatures and high salt concentrations. To ensure that they last for long time it is essential that they are reliably maintained and correctly operated. If they are neglected even for a matter of weeks they will quickly deteriorate and need major attention to repair them. If these instructions are followed the only major repair will be due to accidental damage.

1.0 HOW THE STILLS WORK (See figure 1)

A still consists of a basin of salty water about 60 mm deep with a sloping glass cover and sealed within low walls like a house with a glass roof. At the bottom edge of the glass, on the inside, runs a gutter.



1. MEXICAN STILL

The bottom of the basin is coloured black and is well insulated underneath, so when the sun shines the heat is attracted by the black surface and heats up the water. As the water heats up, it evaporates. The hotter it is, the faster the evaporation, so the insulation is essential to prevent heat being lost to the earth.

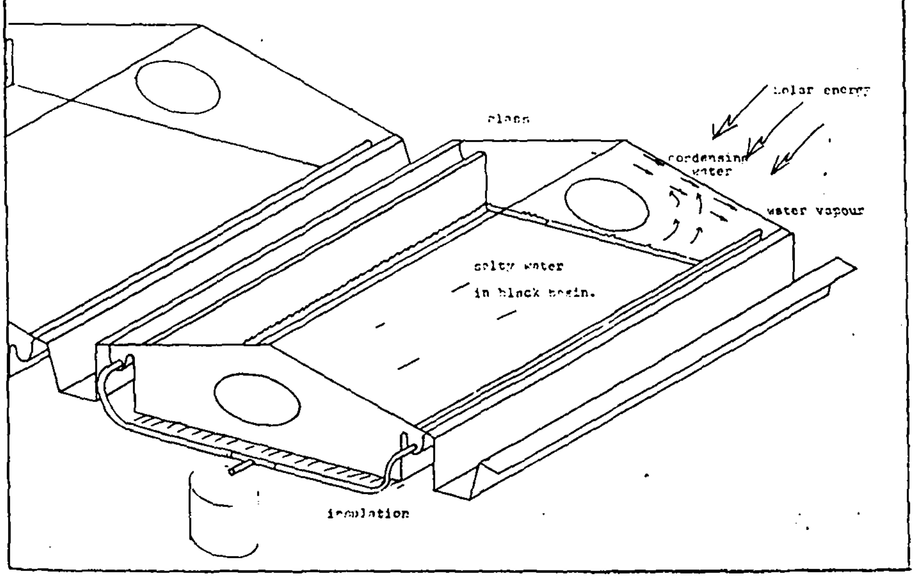
Because the whole unit is sealed, the water vapour has nowhere to escape to, so it condenses on the coolest available surface which is the glass. The condensing water flows down the inside of the glass as a thin flim and collects in the gutter. From there it is directed to a storage tank. The glass must be set at an angle so that the water does not drip off and fall back into the salt water basin. Any dirty patches or cracks will also make drops of water fall back into the basin. Each still has access doors which allow the inside of the stills to be properly cleaned. When closed these must not leak or water vapour will leak out and cause a drop of inefficiency.

2.0 MEXICAN STILLS

2.1 Description: (See figure 2)

These stills are made from a fibreglass moulded basin set on a bed of insulation. The shape is like a tent with 2 glasses for the roof. This design is easy to install, transport or replace because the waterproof basin comes complete and should not leak. Fibreglass is very strong and resistant to salt, heat and sunlight. The black surface of the base can be made into the fibre-glass so that it cannot be scraped off.

2. MEXICAN STILL



2.2 Operation:

2.2.1 Filling the Stills

The stills need only to be filled with salt water, closed and left in the sun for them to work. Water should cover the whole of the basin to a depth of 40 mm (two fingers width) when freshly filled. At no time should any part of the basin dry out.

It is best to fill the stills early in the morning when the water is already cold. In this way no production is lost because of the cooling effect of the cold water. The stills should be topped up with water every two days (more often if dry areas appear in the basin). The maximum depth for water in the stills is 70 mm, as beyond this the water will leak through the cleaning hatches. To fill, loosen the wingnut on the hatch and open it without damaging the sealing ring. Fill with a hose through the hatch, and when filled, make sure that the hatch is resealed.

2.2.2 Cleaning the Basin

At least once a fortnight they should be drained completely, flushed out, scrubbed clean with a soft brush or rubber scraper, then re-filled. If salt is crystalising in the basin then they should be cleaned sooner. After cleaning, the basin should appear black when wet.

2.2.3 Cleaning the Class

The glasses should be wiped clean every week. If available, windowlene or some other commercial product should be used. Otherwise they can be washed with salty water, but the water must be scraped off with the rubber scraper before it dries and leaves salty traces on the glass. If necessary, distillate can be used, this does not leave salty traces.

Always take care of the glass. Do not scratch it by rubbing with sandy cloth, and do not break it by pressing too hard or treating it carelessly. If a glass is broken, refer to section 2.3.1 for how to replace it.

2.2.4 Keep the area around the stills free from debris.

2.3 Inspection and Running Repairs:

Every month the whole installation should be inspected by the operator and minor repairs carried out.

The following points should be checked and faults rectified:

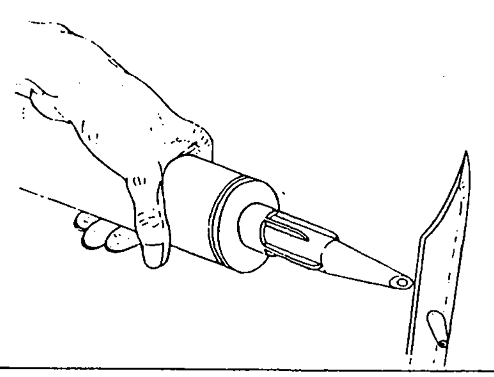
2.3.1 Glass

Are there any traces of water leaking along the bottom edge of the glass? If so, cut away the silicone around the lead, dab the area dry with a cloth then resilicone.

Are there any vapour leaks around the sides of the glass or the end of the ridge pole? Look for any traces of sand inside the still as these show where leaks are. Watch for any changing patterns of vapour on the glass as these also imply leaks. Once it is obvious that there is a leak, look very carefully from below to see exactly where it is, then re-seal with silicone.

Silicone sealant - comes either in 210 ml pressurised canisters or in 315 ml cartriges which fit into guns. For easy application it is best to cut the plastic, nozzle at a 45 angle. (See figure 3).

figure 3, silicone sealant canister



If any glasses are broken they should be replaced. To do this first cut away silicone around the old glass and remove it. Scrape all the surfaces on the still clear of old silicone. Lay a new piece of glass in place then resilicone around it. Avoid pressing the silicone between glass and still, instead try to seal around the edge of it with a bead of silicone direct from the canister. (See figure 4)

If the broken glass can be cut parallel to the sloping (62 cm) edge to give a rectangle, then this should be done. The piece can then be stored for future repairs. (See figure 5).

Any crack or joint across the glass face will cause drips to fall off, put joints running up and down the glass are not a problem. (See figure 6).

figure 4. silicone around edge of glass

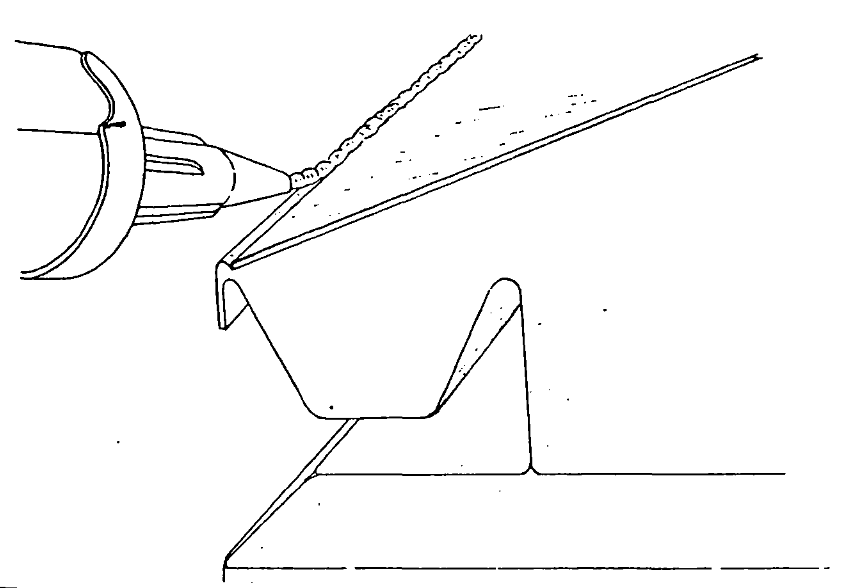


figure 5. cut broken glass for re-use

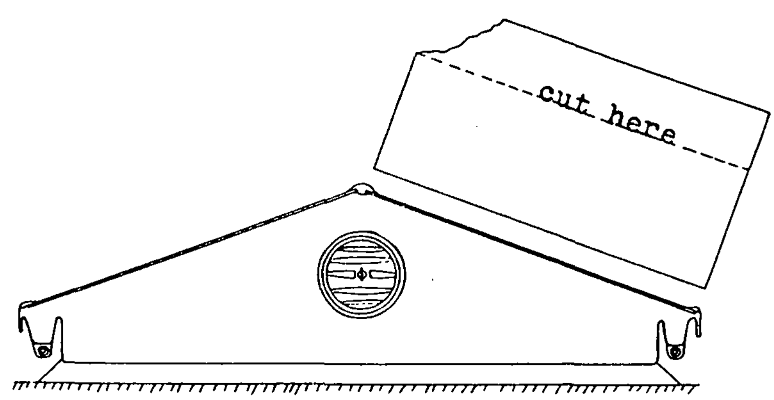
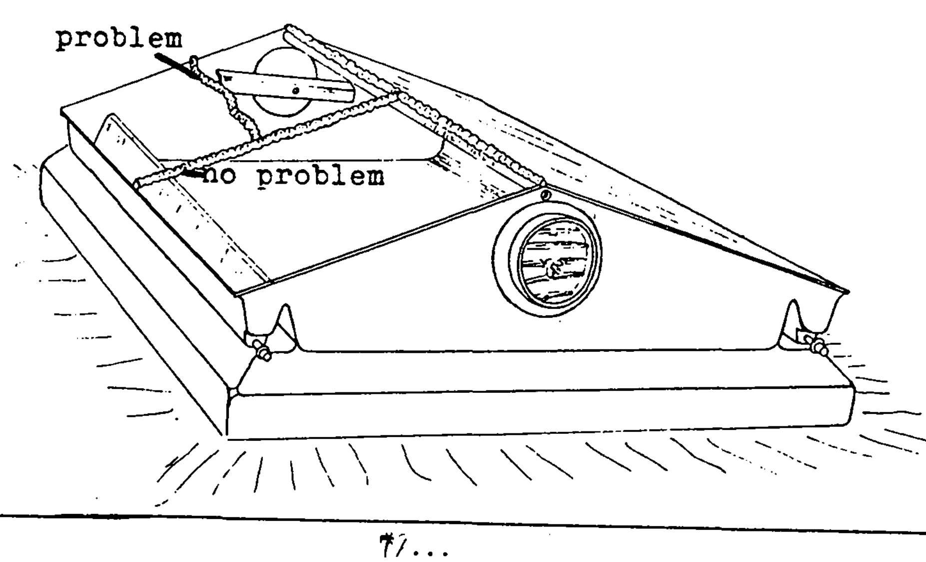


figure 6. joints in the glass



If sealing between two sheets of glass, run the silicone gently over the joint and look closely for any leaks.

After repairing a glass extra care should be taken to look for leaks at the next inspection as the silicone will initially shrink and this may cause leaks.

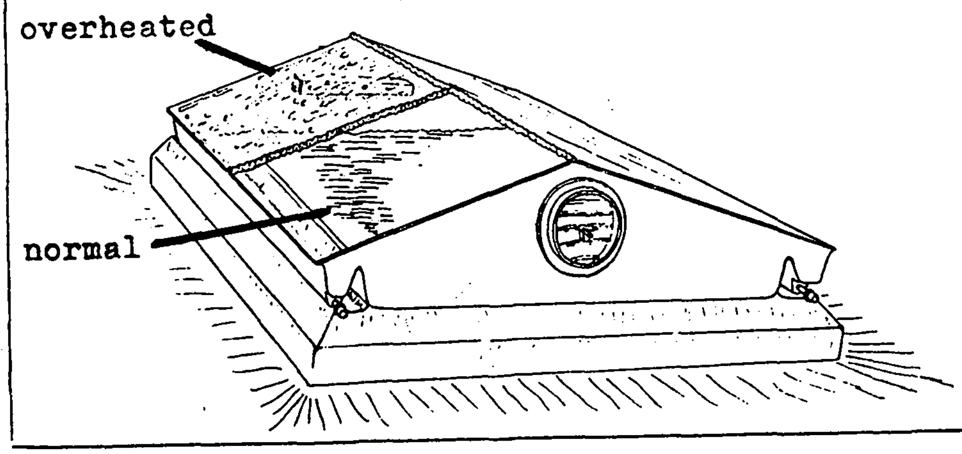
When fitting glass the following standard precautions should be taken:-

1) Never leave glass out in the sun, as overheating will affect the performance. Also do not leave glass anywhere it can get blown over the wind.
2) Avoid leaving fingermarks on the inside surface of the glass. Handle the glass by its edges as much as possible.
3) If the glass to be fitted needs cleaning, wipe it gently with a soft cloth. Wipe up and down the glass, not in circle or across it.
4) If any glass is broken the pieces should be cleared up and buried immediately.

<u>Overheated Glass</u>: Is caused by the still being left dry or the glass being left in the sun. When water condenses on over heated glass it forms droplets instead of a thin film. This reduces efficiency and can lead to loss of distillate if drops fall back into the brine. If drops of water can be seen on glasses at an installation it implies that the still have been left to go dry. (See figure 7).

Overheated glass will tend to go back to normal with time and use. The process can be speeded up by adding a small amount of ammonia to the salty water. The ammonia should be left in the water for at least two days, and

figure 7. overheated glass



during this time the distillate should not be used. Alternatively the glass can be gently wiped with up and down strokes using a mild abrasive cleaner. In practice neither of these solutions are recommended except in severe cases.

2.3.2 Cleaning Hatches

With Mexican Stills, it is best to leave one hatch untouched and to do all filling and cleaning through the other one.

The hatches should be sealed with airtight seal. Whenever a hatch is opened care should be taken to make sure that the wingnut is sufficiently loosened so the hatch falls open and does not have to be slid aside. The sliding will tend to tear off the sealing strip. (See figure 8).

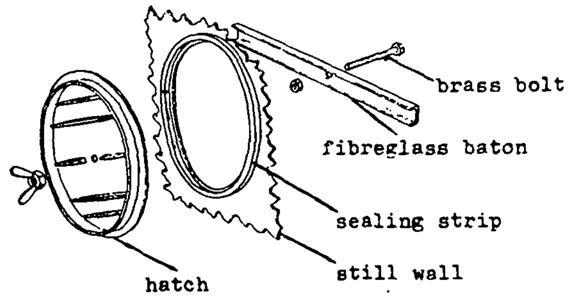


figure 8. cleaning hatch assembly

At each monthly inspection, check:

i) that the hatches are properly sealed.
ii) that the sealing strip is still stuck to hatch cover.
iii) that the threads on the brass bolt are greased.
iv) that the brass bolt is securely fastened in the fibreglass baton.

Sealing Strip

The best material for use as a sealing strip is black foam Weatherstrip. This is a rubber foam strip with an adhesive backing. The optimum size is 1/2" wide and 3/8" thick. There is a cheaper grade of white weatherstrip available but this is not very durable. If no weatherstrip is available then a ring of plastic tube about 10 mm thick can be fixed on with silicone. The sealing strip can be fixed either to the still or to the hatch door itself. It has been found best to fasten weatherstrip to the door, as this prevents it from getting soaked when the still is being cleaned. If a plastic tube is used it can be fastened to the still wall.

2.3.3 **Outlet Nipples**

There are 3 nipples on a mexican still, 2 for distillate of 20 mm each, and one drain of 25 mm. In early installations galvanised iron nipples were used, but these have now been replaced with plastic ones. Any remaining galvanised nipples should be replaced as soon as they give any trouble.

On a monthly inspection make sure:

i) that there are not leaks of distillate around the distillate nipples. Any leaks should be repaired immediately.

ii) that all the nipples are securely fastened. If any are loose use fibreglass resin or epoxy resin to reset them.

Drain Nipples: are extended from the recessed position under the still so that any salt water drained from them goes directly into the gutter. Slow leaks from the end of the this are not important as the salt will tend to seal them automatically. Any leaks which allow water to go under the still are to be sealed immediately to prevent the unsulation from being soaked. (See figure 9).

2.3.4 **Piping**

All the piping is made of high grade polypropylene which is resistant to sunlight. This pipe tends to warp when it gets hot, and if care is not taken, this can prevent water flowing to the tank. (See figure 10 and 11).

The pipe should be held in place using holderbats and should be lain in a snaking fashion so that any warping takes place sideways not up and down. (See figure 12).

When carrying out a monthly inspection check:

i) that none of the joints in the pipework are leaking.

ii) that the pipes are not warped upwards and preventing flow to tank. This can be checked simply by looking at the gutters in the stills. If an distillate gutter is full it implies that the pipe is holding up the flow. If this is the case the pipe should be moved until water can flow again. If this is not successful then look for a blockage in the pipe.

Figure 9. Drain nipple and Extention

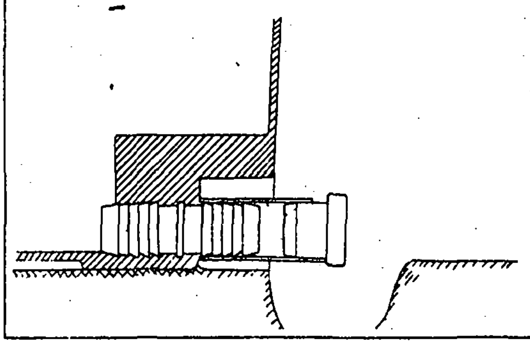


Figure 11. Water can flow in pipes correct

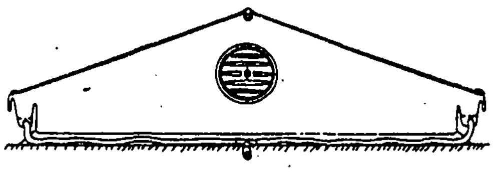
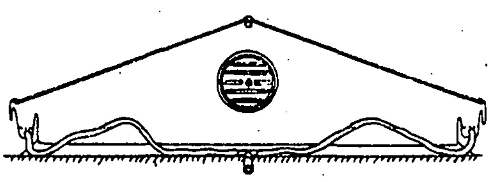
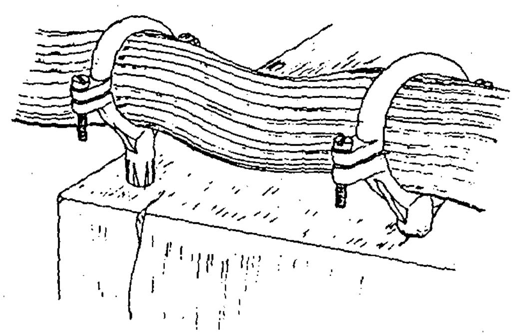


Figure 10. Water trapped in pipes



The pipes can be warped and contain some water without interfering with the flow.

Figure 12. Pipes clamped with holder bats



2.3.5 **Gutters**

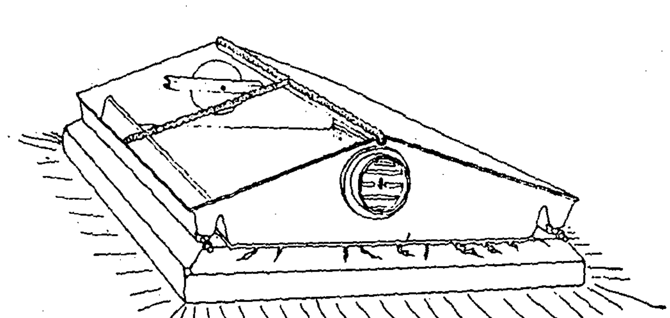
There are two sets of gutters on standard installations. One set for rainwater, the other for reject brine. At the monthly inspection check:

i) that the gutters are not blocked by sand or debris.
ii) that the joints between the gutter sections are intact. If there is a gap so water is leaking through, clean the area well and seal with epoxy resin or cement mortar.

2.3.6 **Plinth**

The plinth as the base for a group of stills. It consists of a low rectangular wall filled with impacted sand. The stills are set on vermiculite cement pads on the sand and the area not covered by stills or gutters is concreted over. The whole plinth can then act as a rainwater catchment. Also is serves to raise the stills as they do not get covered by sand. (See figure 13).

Figure 13. Concrete breaking away from still



At the monthly inspection check:

i) that there is no gap between the stills and the concrete. If there is, water may leak down and soak the insulation, hence reducing efficiency. If there is such a gap, seal it with strong cement mortar or epoxy resin.

ii) clear away any sand that is building up around the stills or the plinth.

2.3.7 **Fencing**

It is essential that the fence is properly maintained and that the gates are kept closed at all times. If animals get into the yard, they will cause damage to stills and other equipment. Every month check:

i) that any gaps under the fence are blocked.
ii) that there are no breakages in the fence. Mend any damaged wires immediately.

2.3.8 **Tanks**

Every site will have a tank for distilled water sunk below the level of the stills. Care must always be taken to ensure that this tank is not damaged and does not leak.

If possible the distilled water will be pumped out, but if no pump is installed the water should be removed using a plastic not a metal container. The tank should remain covered at all possible times.

Most sites will also have a rainwater catchment tank and salt water storage tank. These too should be kept covered at all times.

Every month check that none of the tanks are leaking and remove any rubbish that may have fallen in.

2.4 <u>PREVENTIVE MAINTENANCE:</u>

If the above instructions are reliably followed the stills should last a long time. There are a few occasions when extra precautions should be taken.

2.4.1 If there is a big storm with high winds, it is best to open the cleaning hatches. This will prevent a pressure difference between the air inside and outside the stills which could lead to breakages.

2.4.2 Also make extra sure during stormy weather that there is nothing in the yard which may be blown into the stills. Sheets of corrigated zinc are particularly dangerous, and if any are used to cover the tanks make sure they are well weighed down.

2.4.3 If the stills have to be left dry for any reason, then leave the hatches open so they do not get too hot. If the stills will be unused for long, then the glass should be removed and stored out of the wind and sun.

2.5 REPAIRS:

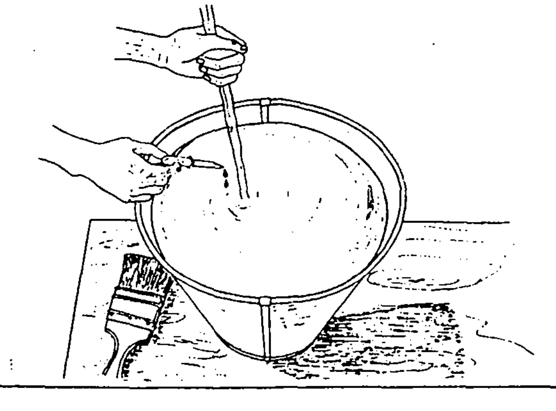
If any repairs are carried out on the stills they should be done bearing in mind the important features of the still i.e.:

- that the basin should not leak water,
- that the still should have no air leaks,
- that the distillate will not drip off the glass and back into the brine,
- that no distillate should be lost by leaks in pipes and tanks, and
- that the insulation under the stills remains dry.

Any repairs to brickwork or pipework are self-evident. Repairs to glass have already been detailed. The only other repairable items are the fibreglass stills themselves.

Fibreglass can easily be patched and repaired. If there is any structural damage to the still it should be mended as soon as possible. If the damage is inside the still then begin by draining and drying the basin and removing the glasses necessary to reach the damage. Clean the damaged area thoroughly and if possible wipe with acetone. Next cut a piece of glass fibre mat to cover the damaged area. Mix enough resin to soak this mat with just one or two drops of catalyst. (see figure 14). Mix the two well then begin work immediately. Depending on the amount of catalyst used the mixture will harden in a few minutes to a few hours.

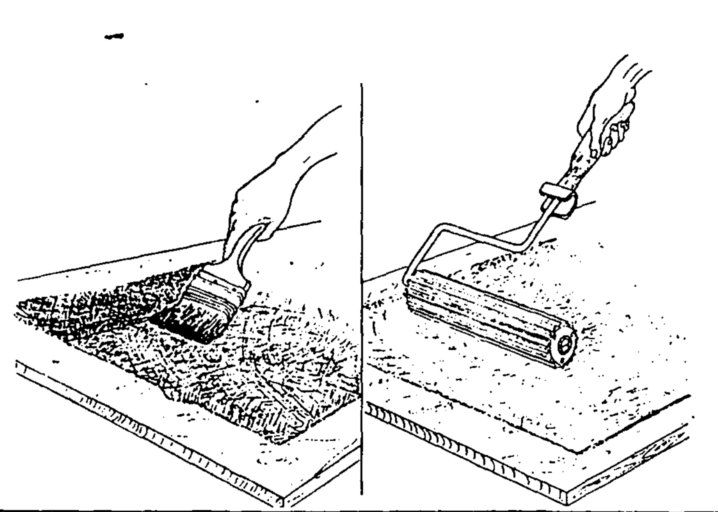
Figure 14. Mixing fibreglass resin and catalyst



Apply a layer of resin with a brush over the area to be patched, put the patch over this, then cover the mat with more resin and leave it to cure. Make sure the glass fibres are smoothed down in the resin to get a smooth finish, and that any air bubbles are forced out of the mixture. (See figure 15). Acetone should be used to clean brushes, tool or hands after the work.

Figure 15

Applying fibreglass resin and forcing air bubbles out.



If the black coating on the stills peels off, nothing can be done to replace it. This will lead to a slight drop in efficiency of the still, but will not prevent it working. A coating of black enamel paint can be applied to the outside of the still and the blackness will show through the resin.

MAINTENANCE OF BRICK STILLS

3. BRICK STILLS:

3.1 Description

These stills consist of a long, insulated concrete basin covered with a single sloping glass roof that is supported on brick or block walls. A single gutter runs along the bottom edge of the glass to collect the distillate. This is considerably cheaper to construct on a larger scale than the mexican still. (See figure 16).

The floor or the still is made up of a reinforced concrete slab with a 50 mm layer of vermiculite cement insulation and finished with a thin screed of strong cement mortar. The basin is then painted with epoxy enamel paint which is resistant to salt and heat.

The walls are made either of standard cement/sand blocks, or of blocks made from vermiculite cement. The latter give slightly improved performance, but extra care should be taken to ensure that they are not exposed to water as they are absorbant.

Hatches are constructed in the back wall for cleaning and filling.

3.2 Operation

Operation of brick stills is exactly the same as for mexican stills. Ensure that water always covers the whole base and that salts are cleaned out at least every two weeks. These stills can be filled with deeper water than the mexican ones, but this will result in lower efficiency.

3.3 Cleaning

As with the mexican stills. Keep the glass clean and the basin black.

3.4 Inspection every month

3.4.1 **Glass:**

Look for leaks of vapour and distillate. In particular watch for leaks along the joints between the glass sheets.

3.4.2 **Hatches:**

Make sure the hatches are sealing properly and that the threads on the fasteners are greased. Also that the weatherstrip is properly stuck on.

3.4.3 **Nipples:**

Make sure there is no leak of distillate from the nipple at the end of the gutter, and that no salt water is leaking from the drain. Also that the drain is secure in the wall.

3.4.4 **Piping:**

Check for leaks in all piping joints.

3.4.5 **Paint Work:**

The paintwork should be kept in good condition inside and out. As soon as any paint begins to peel, it should be stripped off, left to dry and then re-painted. As soon as the black paint inside the basin starts to tear or flake the whole still should be unglazed, stripped and re-painted. This should be especially checked by water unit staff every year.

3.4.6 **Fencing and Tanks:**

As for Mexican stills.

3.5 Repairs:

If any repairs are needed to the brickwork, the new cement or concrete should be left for at least one month before repainting. This is because any moisture that comes out of the cement will be trapped under the paint and will cause blistering.

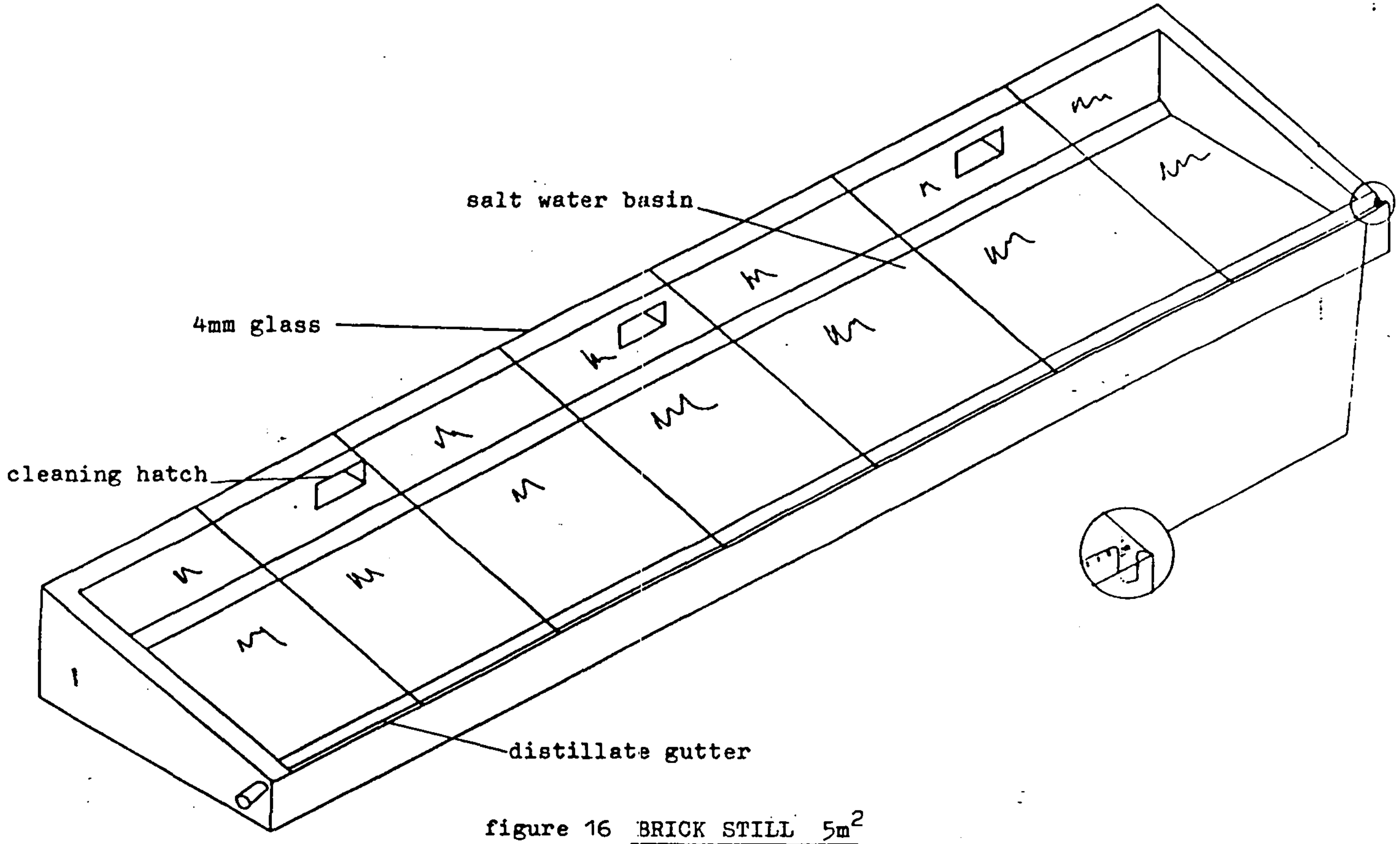


figure 16 BRICK STILL $5m^2$

SUGGESTED TOOLS NEEDED FOR SOLAR STILL SITE

1 trimming knife and spare blades
1 hacksaw and blades
2 glass cutters
1 medium screwdriver
1 strong pliars
1 adjustable spanner
1 paint brush 50 mm
1 paint brush 20 mm
1 paint scraper
1 wire brush
1 garden trowel

SUGGESTED LIST OF SPARES FOR SOLAR STILLS

8	sheets glass 630 x 800 x 4 mm for each 16 mexican stills.
1	sheet glass of appropriate size for each brick still.
2 l	fibreglass resin and small amount of catalyst.
1 m	fibreglass mat.
1	x 500 gm each epoxy resin and hardener.
10	x 315 ml silicone sealant cartriges or 12 x 210 ml canisters.
10	Hose clamps for 20 mm pipe.
3m	20 mm Polypropylene pipe.
2	Nylon elbow joints (20 mm).
2	Nylon tee joints (20 mm).
6	x 8 kg bags vermiculite.
2	x 50 kg pkts cement.
30m	8 gauge fencing wire.
3	x 3 m rolls weatherstrip 1/2" x 3/8" for each 16 mexican stills.
10	each 6 mm x 50 mm brass bolts, 6 mm brass, nuts, washers and wing nuts.
4	cleaning hatches and fibreglass fastering batons.
10	x 20 mm holder bats.
4	20 mm nylon plugs
2 l	Acetone
2 l	Thinners.
5	sheets sandpaper.
5 l	Epoxy enamel paint white)
5 l	Epoxy enamel paint black) for brick stills only.

INSPECTION CHECKLIST FOR MEXICAN STILLS

SITE: ....   DATE: ....

STILL REFERENCE:

1	Block
2	Row
2	Still
2.3.1	Glass
2.3.1	Vapour
2.3.1	Distillate Leaks
2.3.2	Hatch bolts
2.3.2	Weatherstrip
2.3.2	Leaks around hatch
2.3.3	Leaks on drain
2.3.3	Leaking distillate nipples
2.5	Still basin
2.5	Back base
2.3.4	Cement around still
2.3.5	Gutters
2.3.4	Pipes

ANY OTHER COMMENTS: (EXAMPLE)

Tick space if item has been checked and found satisfactory

Mark with a circle, o if a fault is identified then tick through the circle when it has been rectified.

Still Reference: At each block of 16 stills is given a number. Within a block the rows are numbered 1 to 4 starting nearest the distillate tank. Along each row the stills are numbered 1 to 4 left to right looking from the end nearest the distillate tank.

The numbers after each inspection item refer to the sections in the maintenance manual.

CHECKLIST FOR BRICK STILLS

SITE: ....   DATE: ....

Still NO.

3.4   1 Glass
3.4   1 Vapour leaks
3.4   1 Distillate leaks
3.4   2 Hatches
3.4   3 Drain
3.4   4 Distillate pipes
3.4   5 White paint
3.4   6 Black paint
3.5   Walls

SITE INSPECTION CHECKLIST

SITE: ....   DATE: ....

Check the following items, write down any repair work needed and tick the jobs when completed.

ITEM	WORK NEEDED	COMPLETED
Saltwater tank		
Distillate tank		
Rainwater tank		
Gutters		
Gates		
Fencing		
Storage shed		
Handpump		

Any other Comment:

JOINT ADVISORY GROUP ON DESALINATION FOR REMOTE AREAS (JAGDRA)

A. Terms of Reference

1. To adivse guide the research and implementation team working on small scale desalination for remote areas. The team's objectives are given under B. below.

2. To aid the flow of information between the RAD desalination project and bodies represented by JAGDRA members.

3. To help to integrate the RAD desalination work into the larger context of:

   a) Central and Local Government plans for Remote Area Development
   b) Other programmes of assistance or RADs (e.g. AEF Mission work).
   c) Water Affairs Department initiatives for desalination in rural areas.

   It is expected that JAGDRA will meet about 4 times a year.

B. Objectives of Desalination Work

1. To develop and provide portable and semi-fixed desalinators to RADs who have a known need for drinking water coupled with a source of saline water.

2. Identify other RADs with the same need and saline water supply.

3. Integrate project activities into Government Remote Area Development objectives.

4. Take into account Government Resettlement Policy.

5. Work towards Government assuing responsibility for small scale desalination for remote areas.

6. Liaise with Water Affairs Department on technical aspects of desalination to ensure consistency with any larger scale desalination developments.

7. Maintain contact with all other bodies working to help RADs and co-operate closely.

8. Refer any other RAD needs to appropriate bodies (Local Government BCC, Missionaries, etc.) for consideration and action if necessary

9. Through education and training, foster "desalination self help expertise" among RADs.