
**TECHNICAL ASSISTANCE TO
HAKUPU COCONUT OIL ENTERPRISES**

NIUE

January 2001

Prepared for: South Pacific Biodiversity Conservation Program
Apia, Samoa

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Appreciation

My warm thanks go to the members of the Hakupu Coconut Oil Enterprise for their gracious welcome and for the farewell feast they gave me. We worked hard together and learnt a lot from each other. It was a most rewarding experience. Thank you.

I also want to thank the Department of Community Affairs for their evident support and interest in the success of the Project.

1. EXECUTIVE SUMMARY

This Technical Assistance visit to the Hakupu Direct Micro Expelling (DME) unit was undertaken between 27th November and 8th December 2000. The Terms of Reference are set out in **Attachment A**.

The key component was the relatively poor performance of the drier. Because the necessary materials were not available, the drier had not been built to specifications. As a result, the batches of grated coconut were taking in excess of two hours to dry as against a typical time of less than one hour. Also, it was found that the drier smoked excessively.

During this visit the drier was stripped down, repaired and rebuilt. The original flat iron was reused but mesh was purchased to replace the corrugated iron under the flat iron. The drier was only ready to be tested on the last day at Hakupu. It heated up very quickly and although only 2 batches of grated coconut were processed, Masani and Logo expressed great satisfaction with the improved performance of the drier. Because of the greater heat of the drier, Masani allowed the second batch to over-dry. She was unaware of, and surprised by, the “wetting-up” procedure described in the *Trainer’s Manual*.

There was some minor work to do to finish off the reconstruction. Logo is easily able to complete this work himself.

The Press was in reasonable condition but had not been operated correctly which indicated that the instructions in the *Manual* had not been followed. For example, the cylinder was placed in the press upside-down. Minor adjustments were made and the correct operating procedures emphasised. However, this was inevitably rushed and it will require Logo to pass on this information to the actual operators of the Press.

The training in soap-making was a great success. One batch of soap was made using half the quantities given in the recipe in **Attachment D**. The soap from the bar moulds was cut into small cakes on the day after production and had hardened very nicely in a further 48 hours. Even at this point it lathered well in the local bore water. It should be excellent after the month necessary for full maturation. The Associated Minister of Community Affairs spoke of the making of this local soap as being an historic event.

The other major success was the expelling of oil from Candlenut (*Tuitui* local, *Aleurites moluccana* L.). A group of local women had cracked about 8 kg of nuts, semi-dried them in the sun, and cut and grated them into small pieces. Final drying and heating was done on the renovated drier. We pressed two 1-kg batches and obtained 930 ml of oil. Unfortunately, the oil has very little aroma – it is similar to linseed oil. Extraction of fragrances from leaves, bark and flowers probably requires a steam still.

The time assigned and available for the commissioned tasks was too short. A particular problem was the unavailability of key personnel at critical times. The end result was that there was no opportunity to have a complete training session with the full team of workers who operate the unit.

While we were involved in the final stages of reconstruction on Monday, I was summoned to a Cabinet meeting to discuss the project and the full potential of such small processing plants for the island.

2. IMPLEMENTATION

The Hakupu Direct Micro Expelling (DME) unit had been installed and the training undertaken by a team from the **Women in Business Foundation** of Apia, Samoa. For various reasons the Hakupu unit was not performing as well as had been expected from Samoan experience. Following the recommendation of a Feasibility Study conducted by **Parr & Associates Ltd** in July 2000, I, the inventor of the DME system, was asked to examine the technical operation of the unit as set out in the Terms of Reference in **Attachment A**.

I was met on arrival (Tuesday 28/11 at 16:50) by Mr Logo Seumanu and taken to the Matavai Resort. He collected me next morning for a meeting with Ms Phyllis Richmond-Rex, Director of Community Affairs. I also borrowed the records of production of the Unit for the year to date. Since the Division's vehicle was not available and the distances between the hotel, Alofi and Hakupu were considerable, I had to rent a car for the week. This done, Logo and I visited the site. At Hakupu, I met Mrs Masani Togiamana & her husband Easter and discussed the condition and operation of the existing drier.

a. The Drier

The Samoan builder lacked a number of the materials specified in the *Trainer's Manual* for the construction of the drier. He was innovative in trying to overcome the problems. Thus, instead of using mesh (unavailable) to support the *umu* stones used for thermal storage, he used galvanised iron sheet loaded with sand. Unfortunately, this actually insulated the drying surface and allowed the heat from the furnace to escape too fast. The innovation would probably have worked had the builder punched rows of holes along the ridges of the corrugated iron sheeting. In addition, the furnace drums were placed in a position that did not allow air to flow around the drum as intended. Furthermore, the chimney, again due to the lack of materials, was too short and of only 100 mm diameter rather than 150 mm specified in the *Manual*. Given the circumstances at the time of construction, this was the best that could be done. However, the combined effect was an inefficient drier which smoked excessively even when using the most readily available fuel – the coconut shells and husks.

The **Table 1** compares the drier performance with that of a unit in Tonga installed in April. This comparison is not a criticism of the Hakupu operators but to show the impact of the faulty drier. The contrast is stark in terms of production, days operated and daily output. Taking the daily recorded starting and completion times, it turns out that Hakupu averaged 2 cylinders per hour as against 5 cylinders/hour in Tongatapu over the whole period. Since it started in April, the Tonga unit had gradually improved from 4 cylinders/hour to 6 cylinders/hour. Hakupu showed no such improvement

Another way of expressing this result is that Tonga is pressing a new cylinder every 10 to 12 minutes while the interval between cylinders in Hakupu is 30 minutes. This difference in throughput makes a fundamental difference to the economics of a DME unit. The relative efficiency of the driers is likely to be the main cause of the difference in performance. However, the contrast in wage structures should also be noted. In Tonga, in addition to a basic wage of \$15 per day, bonus payments of \$2/day are paid for production in excess of 25 litres per standard 8 hour working day.

Table 1. Production Performance of Two DME units

Month	Hakupu			Tongatapu		
	Litres	Days	Lt/day	Litres	Days	Lt/day
January	47.91	6	7.99	N/A	N/A	N/A
February	38.06	5	7.61	N/A	N/A	N/A
March	74.42	10	7.44	N/A	N/A	N/A
April	25.86	3	8.62	81.72	5	16.34
May	48.73	7	6.96	237.86	10	23.79
June	14.36	1	14.36	190.48	8	23.81
July	112.77	7	16.11	272.29	9	30.25
August	19.01	2	9.51	358.73	12	29.89
September	0	0	0.00	409.58	11	37.23
October	35.63	3	11.88	463.59	14	33.11
November	0	0	0.00	428.80	11	38.98
TOTAL	416.75	44	9.47	2,443.05	80	30.54

Having located a source of reinforcing mesh on Wednesday, I worked with the local community to strip the drier back to the walls, removing the corrugated iron sheets and the severely scorched wooden ‘beams’ on top of the concrete walls. On Thursday, concrete beams were built on top of the walls so that there would be no internal wood. Extra pipe cross-beams were also put in place. The furnace drums were repositioned and the mesh ordered. Both Friday and Saturday were community “half-days” for shopping and for garden work. [Also, on both days Logo was unavailable because of a significant “hair-cutting” ceremony in his home village of Liku.] Sunday is not a working day. However, I had useful discussions at a lunch arranged for two new Deacons inducted into the Hakupu church.

On Friday afternoon, while the concrete was still setting we had the soap making session – see below.

On Saturday, the form work was removed and two layers of mesh positioned and a full layer of *umu* stones were collected and put in place. The original galvanised flat iron sheeting was repaired, put back in place, re-riveted together and scrubbed down on Monday. On Tuesday, external wooden battens were used to seal the sides, the chimney was extended by a further 1.5 m, a grate placed in the furnace and a new temporary door was fitted to run horizontally across the face of the furnace. The lack of concrete nails prevented us from completing the external wooden battens completely but Logo understands what needs to be done and has the skills to finish the task.

It was nearly mid-day on Tuesday before we were able to light the furnace. The flue drew much better and there was very little smoke coming out the sides. The drier now appeared to work as originally intended. However, much greater attention will have to be paid to managing the furnace since the fire burns much more efficiently with the new grate and

door we fitted. Twice, during the trial the fire went out because nobody was making sure that there was adequate fuel.

Again because of a lack of familiarity with the hotter drier, the second batch of grated coconut was allowed to dry out too much. Here I emphasised the “wetting-up” process described in detail in the *Trainer’s Manual*. Masani was astonished at this procedure and initially said that she “would never do that”. She seemed not to have grasped the essential key to the Direct Micro Expelling system – the skill of getting the moisture content of the semi-dried material into the range (9% to 12%) at which low-pressure expelling is possible. In retrospect, it was a very useful “accident” to have happened. As a result of the over drying and wetting-up it took a total time of 1½ hours to produce 1,250 ml of oil from the two 2 ½ kg (wet) batches.

In the short time we were able to operate the drier, I observed a major shortcoming in the drying procedures that they had apparently been taught. Initially, only cloths were used to move the batches of coconut along the drier. No use was made of the metal scoop provided with the DME kit. The original scoop was recovered from the store and I hurriedly made another spatular from some flat iron so as to demonstrate the importance of turning and tossing the coconut to speed up and even out the drying process. The cloths are only useful in ‘sweeping’ remnants of coconut along the drier. It appeared that the operating *Manual* had not been consulted at all. The Hakupu copy of the *Manual* was locked in a Community Affairs desk drawer and the key was “not available” (lost?).

b. The Press

The SAM press was well mounted and in reasonable condition with the exception of the ratchet lock, the base-plate location and a very slight bend in the rack.

- The ratchet-lock grub screw had been screwed in with an instrument which had distorted the Alan key hole. This prevented the proper tightening of the screw and the ratchet working in the automatic way intended by the design. I will be sending Logo a replacement grub screw.
- The weld on the base plate (on which the base piston sits) had broken at some point and been re-welded in a slightly incorrect position so that it was likely to break again. This was simply adjusted.
- The bend in the rack cause a slight jerk when winding the rack up and down. Logo believed that there was equipment in Alofi to straighten the rack and would get this done.

The operation of the Press bore no relation to the instructions in the *Manual*. I was told that the operators were simply following the instructions of the WIBF trainers. The cylinder was placed in the press upside-down with the ring that secures the cylinder in the holder placed at the bottom rather than at the top. This could have damaged both the cylinders and the Press. It is not surprising that the operators found the Press difficult to use. Secondly, the operators were not taught to operate the Press with the use of the stirrup. The stirrup is particularly useful when women are using the unit. I demonstrated the stirrup while producing both oil and coconut cream (where I also showed how a 1.5

litre plastic Coke bottle can be cut to make a very guard around the cylinder when pressing coconut cream).

c. Filtering

Filtering was posed as a major problem. While in the early days of the DME system, we recommended using a sand and charcoal filter, we found that it was very difficult to keep such a filter clean. Subsequently we have recommended the simple method of “filtering” by sedimentation. This procedure requires the operator to pour the oil from the measuring column through fine polyester or cotton cloth into a bucket and to keep each day’s production in its own container(s) without it being disturbed for a period of time – usually, between 3 days and a week. This technique was discussed with Masani and Logo and some suitable polyester cloth was given to Masani.

For this system to work, the site must have multiple containers. This is essential for **quality control**. 20 litre buckets with lids are ideal since a sample of oil can be drawn off the top with a glass jug or beer-mug and checked. Only when the oil has settled and been tested for clarity, colour, smell and taste (*Manual* p.31 & 39), should it be bulked up into a large barrel or drum. Oil that remains cloudy, is yellow (usually because of roasting some coconut) or has an off-smell (e.g. smoky), or taste, should be assigned to soap manufacture.

d. Soap making

The procedure we used for making soap with coconut oil is very simple (**Appendix D**). The resultant soap is ideal for all types of water – particularly as it will lather in salt water and the hard ground water typical of the public water supply on Niue.

The inputs are simply rainwater, caustic soda (NaOH), coconut oil and fragrance. The tools can be as simple as a wooden spoon and a couple of plastic buckets. Because soap making could represent a substantial local market for the oil, we provided Hakupu with an adjustable speed electric drill, a drill press, a suitable stirring tool, a 20 litre bucket, 2 kg of caustic soda and a set of moulds. We also provided protective goggles and rubber gloves.

The soap-making exercise was undertaken on Friday afternoon. We used half the quantities shown in the recipe – so, based around 0.5 kg of caustic soda, we produced 4.7 kg of soap. We poured the soap after an hour of stirring. 600 ml of the coconut oil we used had a mild lime fragrance. This gave the final product an almost totally neutral aroma. On Saturday we cut up the bars of soap from the moulds into cakes of 70 to 80 gm each and stacked them to cure.

Everybody was delighted with the result. The Associate Minister for Community Affairs, Hon. Naea Michael Jackson, referred to the making of this soap on Niue as an historic occasion.

For coconut oil soap making to become a viable cottage industry, arrangements will have to be made for the importation of semi-bulk caustic soda. It is considered to be a “hazardous good” for shipping purposes and has to be declared as such. In NZ, 25 kg bags can cost NZ\$1.50/kg. However, in 500 gm plastic jars it can cost ten times as much.

e. Fragrances

The most popular fragrance in the DME “Lolo Tonga” sold in Tongatapu is “Candlenut fragrance” or *tuitui* as it is called locally. Candlenut (*Aleurites moluccana*) is very widely available in Niue. For both these reasons, it was decided to try and extract the oil from the nut using the DME drier and SAM Press. Masani and a group of women spent many hours while the drier was being rebuilt, collecting and cracking open the candlenuts which are very similar in size and shape to Macademia nuts. Over 8 kg of kernels were collected and partially dried in the sun. The semi-dried nuts were crushed and final drying and warming of two batches of 1 kg each was done on the reconstructed drier on Tuesday (6/12). Each batch of prepared material was loaded into a polyester bag that had been placed in a cylinder. This was then pressed in the normal way. A total of 930 ml of oil was extracted from the 2 kg of kernel.

A follow-up internet search did not give any up-to-date information on Candlenut. The **Handbook of Energy Crops** by James A. Duke. (Centre for New Crops and Plants, Purdue University, 1983 unpublished) quotes an oil content of 63%. This suggests that we extracted about 70% of the available oil. This reference says that the

‘seed yields 57–80% of inedible, semi-drying oil, liquid at ordinary temperatures, solidifying at -15°C, containing oleostearic acid. Oil, quicker drying than linseed oil, is used as a wood preservative, for varnishes and paint oil, as an illuminant, for soap making, waterproofing paper, rubber substitutes and insulating material. Seeds are moderately poisonous and press cake is used as fertilizer. Kernels when roasted and cooked are considered edible; may be strung as candlenuts. Oil is painted on bottoms of small crafts to protect against marine borers.’

There is no mention of any aromatic compound. The oil we produced had a bland, linseed-like, aroma. There was certainly no “fragrance” to it. It turns out that the actual fragrance being used in Tonga is an imported commercial product. Any actual connection to *Aleurites moluccana* may well be fictitious.

Masani has collected information on some two dozen local plant varieties that provide fragrance and/or flavour from flowers, seeds, fruit, leaves or bark. Among these, vanilla had proved to be a popular fragrance. The extraction of fragrances from different plant components is a complex subject. Given the range of indigenous flora which may be common in many locations across the region, I suggest that a thorough library search be undertaken for documentation that would help local communities to extract aroma concentrates that can easily be added to oil and soap. In all probability this will require the purchase or local construction of a simple three-stage steam still.

3. CONCLUSIONS & RECOMMENDATIONS

The prime technical problem with the Hakupu Coconut Oil operation had been correctly identified as lying with the drier. Consequently the main task was to remove defective components in the units and replace them with appropriate parts. This was done together with the local community and resulted in a dramatic improvement in the heat generated on the drying surface.

- The performance of the drier should be monitored to see if it is necessary to increase the diameter of the flue to further improve the combustion in the furnace.
- The Press rack is very slightly bent and needs straightening. I need to send Logo a replacement grub screw for the ratchet lock lever.
- The *Trainer's Manual* needs to be readily available to the operators and supervisor as a reference. A second copy needs to be sent to Masani.
- The site needs a set of 20 litre buckets in which to allow daily production to clear by sedimentation.
- Specific advice and instructions on the extraction of fragrances should be sought and sent to Masani Togiamana.
- For soap to be made on regular ongoing basis, the operators of the unit will have to order a supply of caustic soda.
- Given the success in extraction of candlenut oil, there is a need to research the potential market for this oil.
- The renovations to the building need to be completed as soon as possible. It was good to see that the necessary materials for this work are now on site.

There were a surprising number of major misunderstandings regarding operational procedures of the DME system and handling of the Press. Unfortunately, time did not allow these all to be worked through thoroughly. It would be good if it were possible to arrange a follow-up visit to focus on these issues.

The Parr Report showed that profitability of the unit has been highly compromised by two factors: low throughput and high fixed wages. The reconstructed drier should allow for a substantial increase in throughput. However, this might be greatly assisted by an incentive wage scheme that gives bonus payments to the workers for daily production exceeding some minimum standard – say 20 litres per day.

**SOUTH PACIFIC REGIONAL ENVIRONMENT PROGRAMME
S.P.R.E.P.**

ATTACHMENT A

**TERMS OF REFERENCE FOR
CONSULTANCY AGREEMENT**

**Technical assistance and advice to the Hakupu Coconut Oil Enterprise of
the Huvalu Forest Conservation Area, Niue**

Background

The DME trial project included the set-up of a Direct Micro Expelling coconut-oil press to be purchased from the inventor company, KOKONUT PACIFIC Pty Ltd of Australia, the set-up of a press shelter, the building of a coconut drier, the training of a team of community members from the village of Hakupu by specialist trainers and a builder from Women In Business Foundation (Samoa).

DME coconut-oil processing was selected by the communities as an appropriate trial project for income-generating activities for Hakupu village as part of the Huvalu Forest Conservation Area project. A full feasibility and marketing study was included as an integral part of a six-month trial in Hakupu village. The DME trial was initiated in November 1999 and concluded in June 2000. The feasibility and marketing study was completed in July 2000. The DME trial has been successful because it has gathered information that is critical to enable a thorough evaluation of the trial to be completed.

Part of the findings showed that the design of the dryer was compromised during the construction phase because of some materials not being available on time, and this has had a significant, and continuing impact on the viability of the operation, in terms of throughput.

The feasibility assessment confirms that, although the operation did not achieve financial sustainability during the trial, technical issues relating to yield and throughput were the main contributors, and these can be resolved with some additional input and support. Overall, the DME operation in Niue, and in the Hakupu village context, is feasible but there is a need for improving both production and quality mainly through resolving several technical issues related to the dryer operation and efficiency that have a major impact on the Oil Extraction Efficiency as well as the filtering process and equipment among others.

In the draft report to SPREP, it is strongly recommended to fund a short term technical assistance consultancy by the inventor of the DME to visit Niue and provide appropriate technical back-stopping, advice and training.

Objective

The purpose of this consultancy is to undertake a technical assessment of the DME equipment and operation, and provide advice to improve the efficiency of the operations and the quality of the coconut-oil product.

Tasks

The consultant is the inventor of the DME press and designer of the coconut-oil production process, Dr. Dan Etherington of Kokonut Pacific Pty Ltd. He will work in close collaboration with the Hakupu Coconut Oil Enterprise manager and staff, the Huvalu Forest Conservation Area staff, the Department of Community Affairs and the Hakupu village committee on the following tasks:

1. Work in close collaboration with the Hakupu enterprise operators, in reviewing the DME press operation and the design and operation of the dryer with a view to improving the yield and throughput rates. Where possible take appropriate corrective measures while on island and make appropriate recommendations for further improvements and repairs.
2. Provide additional on-the-job training in the use of the DME press and the dryer in order to improve the Oil Extraction Efficiency.
3. Provide on-the-job training in the correct filtering of coconut-oil to improve the quality of the coconut-oil product.
4. Provide training in the scenting of coconut-oil using local flowers and plants.
5. Provide information on the production of soaps from coconut oil.
6. Establish and document quality control procedures and quality standards to be followed by the Hakupu enterprise.
7. Provide general advice for the improvement of the DME coconut oil operation and processing.
8. Discuss in the form of a debriefing the outcomes of the technical assessment and back-stopping visit with the Hakupu enterprise and members of the CA staff involved.
9. Upon completion of the visit and return to Australia, provide technical back-stopping directly to the Hakupu Enterprises to ensure adequate follow-up on recommendations.

Expected Outputs

The consultant will provide a final report incorporating the findings and outcomes of the above tasks with appropriate recommendations.

Photographs taken as part of this assignment should be developed and provided to both CA and SPBCP on CD-ROMs format.

Time Schedule and Itinerary

The consultancy will be conducted mainly in Niue over a period of 8 days to start on Monday, 27 November 2000. The total number of consultant-days is set at **12 working-days**. The work and time allocation for this consultancy are estimated as follows:

- 8 days: technical assistance in Niue
- 2 days: report writing
- 2 days: technical back-stopping from Australia

Reporting schedule

A draft report should be provided to the Hakupu enterprise, the Huvalu CA project and the SPBCP for comments within one week of the completion of the visit to Niue.

The final draft report incorporating comments from Niue and SPBCP staff should be provided in 5 hard copies to the Huvalu CA project and Hakupu Enterprise in Niue, in 5 hard copies to the SPREP and on Disk/electronic copy (Windows 95) to the SPREP no later than one week following the return of comments from SPBCP.

The report would follow the SPREP guidelines as stipulated in Attachment B of this contract.

ATTACHMENT B

NIUE ITINERARY

Dan ETHERINGTON

Leg	Date	Route	Flight	ETD	ETA	Note
1	Mon 27 NOV	CBR - SYD	AN 5956	0900	0945	
2	ditto	SYD - AKL	QF 043	1130	1625	
3	Tues 28 NOV	AKL - TBU	WR123	0830	1220	
4	Wed 29 NOV	TBU - IUE	WR 571	1330	1700	-1 day
5	Tues 5 DEC	IUE – TBU	WR 572	0700	1030	+1 day
6	Fri 8 DEC	TBU - SYD	WR 200	0620	0905	
7	Fri 8 DEC	SYD - CBR	QF 815	1045	1135	

ATTACHMENT C

LIST OF PERSONS CONSULTED

Hakupu Coconut Oil Enterprise

Masani Togiamana, Manager

Easter Togiamana, Administrator

Clendon Hanisi, Chairperson

Kau Sekene, Nigel, Fernandes

Government of Niue

Premier's Department,

PO Box 40, Alofi, NIUE. Phone: 683 4200; Fax: 683 4206/4344

Hon. M. Y. Vivian, Deputy (and Acting) Premier, Minister for Community Affairs.

Hon. Robert Richmond-Rex, Minister for Health, Justice, Lands & Survey, Police & Immigration.

Hon. Dion Paki Taufitu, Minister for Agriculture, Fisheries & Forestry, Public Works and Administrative & Employment Services.

Hon. Naea Michael Jackson, MP, Associate Minister for Community Affairs.

Mrs Phyllis Richmond-Rex, Director, Community Affairs.

Mr Logo Seumanu, Manager, Huvalu Conservation Area.

ATTACHMENT D

PURE COCONUT OIL SOAP

DME MULTI-PURPOSE SOAP (as taught in Niue in December 2000)

Resources for a batch of Niue soap	
2.4	Litres of rain water
1	Kg Caustic Soda
6	Kg oil (about 6.5 Litres)
50	ml Fragrance

This should make 9.4 kg of soap. It will almost fill half a 20 litre pail. Just over 8 kg will fit into the 4 rectangular moulds and can be cut into 64 bars of 125 gm each. These could be cut in half to make 128 bars of 60+ gm “guest” soap for resorts. Resorts will require the soap to have fragrance in it.

Equipment:

Essential	Optional
2 20 litre plastic pails	Electric drill with slow speed setting
Safety goggles	Drill stand
Rubber gloves	Paint-type stirrer
Wooden stirring “paddle”	

Safety precautions: Always wear the goggles and gloves when working with caustic soda. In case of an accidental “splash”, keep some **vinegar** in the soap making room.

Method:

- Put the water in a 20 litre plastic pail or bucket. (Preferably use rain water)
- Slowly mix the Caustic soda into the water (**NEVER put water into the caustic always caustic into water**) stirring it in with a wooden spoon.
- The water will get hot, let it cool (about 1 hour) until it is about the same temperature as the oil you are going to use or until you can easily hold your hand on the outside of the bucket where the liquid is.
- Measure the correct quantity of oil into a pail, then add the oil to the caustic and keep stirring (with the wooden spoon **or with the drill stirrer at its slowest speed**) while you do this.
- The oil will get a little bit thick straight away. Keep stirring until it gets really thick. It can take anywhere from 15 minutes to a few hours. It took us one hour with the drill at Hakupu.

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- The thickening stage is called “saponification”. The mixture will get thick on the mixing stick until it leaves grooves in the mixture where it is mixed.
- If you are going to use fragrance, add it to the oil now. The amount will depend on the quality and concentration of the fragrance.
- Now pour it into the plastic soap moulds provided. And leave it set for one or two days then break it out of the moulds and, if necessary, cut it up into the sizes that you finally want.
- Stack the soap on shelves and allow it to dry out and **cure for 4-6 weeks**.
- It is ready for general use and sale when you put some on your tongue and its not strong like acid.

Note you can use the soap much earlier and it will wash off the dirt but it will sting if you have cuts or scratches.

ATTACHMENT E

Photographs



1. Hakupu DME Centre



2. The DME drier as built



3. above and 4. below. The DME drier opened up to show the use of corrugated iron and sand to provide the heat bank. The corrugated iron was used because of the unavailability of mesh to hold the *umu* stones specified in the **Training Manual**





5. Form work for construction of concrete beams on drier walls to replace burnt wooden beams



6. Shows the completed concrete beams with mesh between them to hold the *umu* stones. The furnace has also been raised.



7. Loading the stones on the mesh to provide the heat bank



8. Easter Togiamana at work



9. Clendon, Logo & Nigel rebuilding drier top



10. Drier chimney (too thin & too short)

11. Soap making equipment given to the Project



12. Testing the soap after 3 days.
(Note that a number of different containers have been used as soap moulds)

13. Drier side battens being fixed in place. Note the door to the furnace. This slides horizontally.



14. Finishing touches to the drier



15. Girl, Masani and Logo testing the drier. (Note candlenut in front LH corner followed by 2 batches of coconut)

16. Cracking open Candlenut (*Aleurites moluccana*) locally called *tuitui*.



17. Cleaning and crushing the candlenut kernels