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UNITED NATIONS INDUSTRIAL DEVELOPMENT ORGANIZATION
Vienna International Centre, P.O. Box 300, 1400 Vienna, Austria
Tel: (+43-1) 26026-0 · www.unido.org · unido@unido.org

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REVISED REPORT ON THE POTENTIAL FOR CHARCOAL PRODUCTION IN OMARURU, NAMIBIA

PROJECT : XP/NAM/93/075

UNITED NATIONS INDUSTRIAL DEVELOPMENT ORGANISATION

Submitted by: I A GALLOWAY

Consultant

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1 INTRODUCTION

The purpose of this study is to investigate the state of the charcoal industry in Namibia, and the potential for supplying 12 000 - 15 000 tons pa of charcoal to a proposed ferrosilicon plant near Omaruru.

The study also explores sources of raw material for charcoal production; environmental issues in reaping the wood resources; technologies available for production and capital and working costs estimates.

2 BACKGROUND TO THE INDUSTRY AND THE ENVIRONMENTAL IMPLICATIONS OF CHARCOAL PRODUCTION IN NAMIBIA

Namibia is not a country endowed with large natural forests, and it does not possess a timber industry from grown plantations. However, the country has a pollution problem caused by thorn bush infestation, destroying the animal husbandry potential of the country. Invader bush infested about 10 million hectares of high potential pasture. This bush is worthless for farming purposes. Due to this infestation, about 30% to 60% of the grazing potential in different areas in the Central, Northern and Eastern parts of the country was lost. The Department for Agriculture estimates the current annual loss for the agricultural sector at N$100 million.

The possession of cattle is an integral part of the African culture. Cattle was and still is used in many instances for subsistence support and cultural aspects. Commercial cattle farming was introduced in Namibia by the turn of the century through the import of breeds from Europe and South Africa. The industry established itself over most of the country. The central, northern and eastern parts of the country became known as the cattle ranching areas, comprising the districts of Gobabis, Windhoek, Okahandja, Omaruru, Karibib, Otjiwarongo, Outjo, Tsumeb and Grootfontein.

Ignorance about the optimal usage of the available grazing in Namibia was the main cause of the gradual increase of bush densification, viz

- inadequate infrastructure on farms to allow optimum farm management, resulting in overgrazing;
- over estimation of the production capacity of the grazing;
- spreading of seeds of unwanted species by farm animals;
- elimination of veld fires that controlled bush densification as a normal occurrence in the ecology.

Charcoal production has therefore become an essential and natural means of pasture reclamation, turning the noxious bush to economic use. It must be noted that only the noxious species are harvested, leaving the natural bush species and the savanna in a state of equilibrium - appealing to the eye and with increased agricultural potential.

The environmental impact of charcoal production naturally depends on the technology selected to produce it, and whilst that decision is not made at this stage, an Environmental Impact Assessment cannot be done. (The brief for the charcoal study thus did not include a detailed Environmental Impact Assessment).

3 AVAILABILITY OF CHARCOAL

3.1 General

At present there are between 35 and 40 small producers in the country. Most of these are concentrated in the Grootfontein and Tsumeb districts, while there are isolated producers in Gobabis, Okahandja and Karibib.

The reason for the concentration in the north is twofold:

1 Serious problem of bush encroachment on farmland.
2 A stable market created by Tsumeb Corp Ltd (TCL).

A typical producer is a farmer who has one or two 'pipe kilns' and produces between 20 and 60 tons per month as a sideline to his farming operation.

Charcoal production provides a useful supplement to his cash flow, while having the added advantages of reducing the bush encroachment problem.

Estimated production is as follows:

Installed capacity:

37 No.X 1,5 kiln X40 t/mth X 12 = 26 640 Ton p.a.

Actual output:

37 No.X 1,5 kiln X25 t/mth X 11,5 = 15 956 Ton p.a.

Until recently a fairly large scale producer operated on the Omaruru townlands (200 ton/month), marketing mainly through an affiliate in South Africa. The operation failed due to poor management and labour problems caused by the high concentration of labour and the unstable political climate at the time.

3.2 Source of wood

Charcoal production is normally associated with forests or plantations of large, tall trees densely dispersed which gives easy access in the immediate vicinity to large volumes of raw feed.

This notion does not apply to most of Namibia: the terrain is dry continental savannah which has been encroached by a thornbush species which is no taller than 3 meters with a trunk diameter of 7-15 centimetres. This means that harvesting takes place over a much larger area for the same biomass, and also requires more effort than is normally associated with forest/plantation charcoal operations.

The economic utilisation of unwanted densified bush species in Namibia, depends on, inter alia, bush population density, size of the trees, distribution and composition of the bush community. Whilst Omaruru is not nearly as dense in bush as the North, the district still has a serious bush encroachment problem. Statistics are given below:

- The number of trees per hectare is 3500
- Average air dry mass per tree size:

Tree size	<0.75 m	0.75m - 2m	>2m
Kg/ tree	0.53	2.981	16.35
Average Height (m)	0.508	1.385	2.582

- Calculation of wood available per hectare:

Formula: Average number of trees per hectare x percentage tree size per height class x average air dry mass per tree size.

Omaruru = (3500 x 50% x 0.53) + (3500 x 50% x 2.981)
district = 6.144 ton/ha (614.4 ton/km2)

If one differentiates between thorn tree biomass and feeder tree biomass, and considers only the thorn trees for harvesting, the ton/ha bone dry biomass is halved to 3.35 ton/ha as the figures below indicate.

- Relative percentages of biomass: Categories

Tree size (m)	<0.75	0.75 - 2	>2
Thorn tree (%)	36.69	57.71	75.73
Feeder tree (%)	63.31	42.29	24.27

- Calculation of the average air dry thorn tree biomass per hectare

Formula = Average bone dry biomass per hectare for each of the three breast heights x percentage of the thorn tree biomass for each of the three breast heights:

Omaruru = (927.5 x 36.69%) + (5216.75 x 57.71%)
= 340.29 + 3010.58
= 3350.87 kg/ha
= 3.350 ton/ha (335 ton/km2)

3.3 Summary of wood source around Omaruru

- Available biomass (tons) ('000)

OMARURU	10 KM	20 KM	30 KM	40 KM	50 KM
Thorn and feeder trees	193	772	1737	3089	4827
Thorn trees only	105	420	947	1684	2631

Within a radius of 50 km around Omaruru, there is a total availability of 4827000 biomass (tons) of wood for charcoal production, or if only thornbush species were counted 2631000 biomass (tons.)

At a yield of 30%, this gives 1.45 m and 790 000 tons of charcoal respectively. At 15000 tons per annum, that is 96 years and 52 years respectively. At 50% farmer participation, this gives 48 and 26 years availability respectively.

There are alternate ways of calculating available wood, for example

A Consider segment 100km radius (1/4 circle) to N-E of Omaruru.

Area: pi r2/4:		7 854 Km2
	=	785 398 Ha
@ 3 ton/ha	=	2356 194 tons wood
@ 20% yield	=	471 239 tons charcoal
@ 15 000 tpa	=	31 years supply
@ 50% farmer participation	=	16 years supply

Note: Assuming that all charcoal requirements are sourced locally, i.e. within 100 Km to N-E of town (conservative).

B Consider segment of 150 km radius (1/4 circle) to N-E of Omaruru.

Area: pi r2/4 :		11 781 km2
	=	1178 097 ha
@ 3 ton/ha	=	3534 292 tons wood
@ 20% yield	=	706 858 tons charcoal
@ 15 000 tpa	=	47 years supply
@ 50% farmer participation	=	24 years supply

Whichever way one calculates the availability of timber from this thorn tree source, there is adequate supply for the life of the ferrosilicon plant.

4 COMMERCIAL INFRASTRUCTURE TO SUPPLY CHARCOAL

4.1 Ownership of land

The land around the town Omaruru upon which the charcoal wood is located, is substantially privately owned. The farms are large 3000-5000 ha, and previously cattle and sheep producing. There has, however, over the past 10 years been a substantial decline in stock numbers of about 60%.

Due to this erosion of income for the farmers they are actively searching for economic ways to:

- eradicate the invader bush species
- replace their lost income

As TCL created a market and stimulated local production in the north, it can be anticipated that a similar situation could occur in the Omaruru region.

The agricultural economy is experiencing difficulties at present with low meat prices and ever increasing costs. Farmers, in general, are having cash flow problems, and can be expected to be receptive to any proposal which would improve their situation; provided the initial reservations due to the failure of the large producer and the present marketing problems, are overcome.

A survey was done of potential producers in the district, selected randomly in the telephone book. The results are as follows:

	%
% Who considered bush to be a problem on their farm:	73
% Who showed an immediate interest in charcoal production:	73
% Who were against any bush cutting/ charcoal production:	27

If these results are interpolated for 200 farms in the area as discussed above (ave farm 4000 ha), the following can be deduced:

100 farmers (say 2 farms ea)	73%	= 73
Say 50% actually go ahead		= 36
@ 25 ton/mnth		909t/month
x 11,5 month:		10455 ton p.a.

From these results it can be seen that the potential exists to supply the entire requirement from local production, both in terms of availability of raw material and in terms of willingness of farmers to produce.

In practice it will require considerable effort in terms of technical and financial assistance to farmers to develop a reliable source of supply.

The process will be a gradual one whereby a few of the more adventurous will be willing to start producing, while most of the others will wait for signs that the project is in fact financially feasible before climbing on the bandwagon.

It may therefore take two to three years before a local supply is assured. In the interim, the oversupply in the north (if this continues), could be used.

4.2 Potential for large scale "own production"

Several factors mitigate against large scale capital intensive methods of production.

Raw Material

Unlike other charcoal producing areas, the bush is spread relatively 'thinly' here, causing transport of wood to become a major cost and thus favouring decentralised production.

Labour

Profit margins are such that only the lowest paid labour can be used. These are less likely to be dissatisfied if employed in the rural farming atmosphere of low wages, than in a "factory" setup where better conditions are expected.

Management

While co-ordination of producers will require a sound management and administrative structure, day to day management of workers in the veld is done better by individual producers on their own farms than by foremen in a big firm.

Cost

As benefits derived from economies of scale are restricted by item 1 above, small producers with small overheads are able to produce at lower costs than large scale producers.

In addition to this, farmers tend not to allocate the full cost of, say tractors and trailers, which they may already use on the farm, to the charcoal operation. They remain happy as long as a positive cash flow is achieved.

The obvious advantage of "own production" is control of the source of supply. It could be possible to achieve a measure of control by tying up producers with financial assistance and supply contracts etc.

A further alternative would be a combination of the above, whereby a number of medium scale plants are operated on farms whose owners want their bush cleared but do not want to make charcoal themselves. Production at these plants could then be used to cushion the effects of under or over production by small producers.

This could be the most practical approach to the charcoal supply aspect.

4.3 **Recommended commercial infrastructure to produce charcoal**

There are naturally several ways in which to organise the charcoal industry to serve the ferrosilicon plant.

- The ferrosilicon plant can let the industry organise itself to meet the supply. However, due to shortage of capital and expertise it is not a recommended approach.

- The ferrosilicon plant can set up and manage the various production units itself, paying farmers royalties only.

- The ferrosilicon plant can provide capital and expertise to individual farmers and tie them into a long term supply contract. The farmers are assured of a stable market the year round and the ferrosilicon plant is assured of supply. In this instance it is envisaged that the ferrosilicon plant assists farmers to export a portion of their production to increase their average sales price and enhance earnings.

To this effect the ferrosilicon producer plans to enter into a 50:50 joint venture with the Okahandja charcoal producer who will provide the expertise and management for the venture.

This joint venture company will in turn provide loan assistance and expertise to individual farmers to set-up charcoal producing units.

This joint venture will also assist individual farmers to export excess production.

It is suggested that a separate company be formed to act as go-between between the producers and the buyer. It is important that the producers feel that their interests are being protected and that they are not at the mercy of a monopoly.

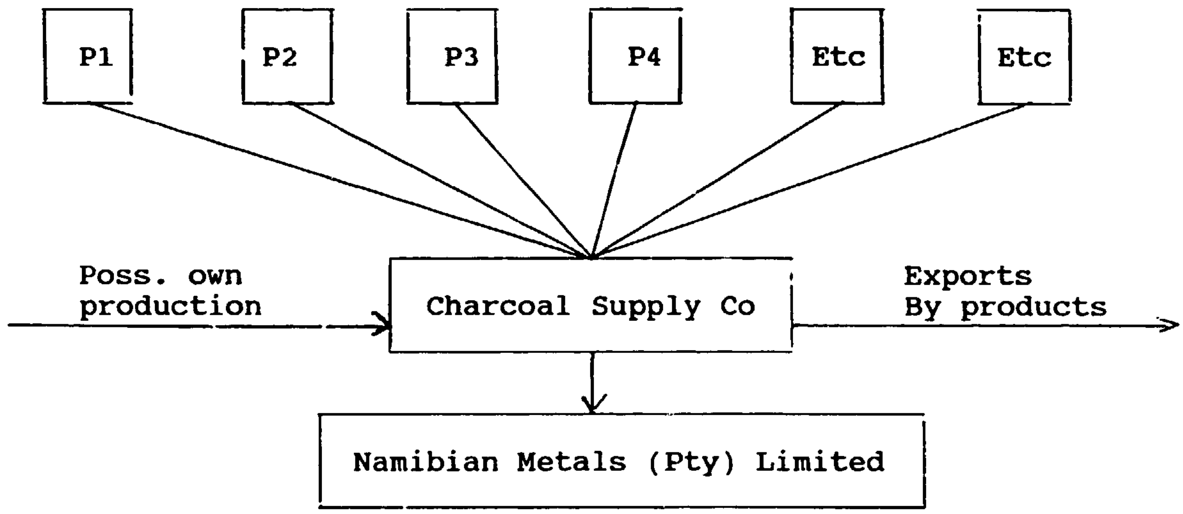
It may be a good idea to allow them a shareholding in the "Charcoal Supply Co" to encourage loyalty towards it.

The responsibilities of the company would be as follows:

- Recruitment and establishment of producers

- Technical and managerial backup for producers
- Quality control
- Marketing of export component
- Marketing of by products - if any
- Liaison between producers and buyer

PRODUCERS



4.4 **Agreement of the farmers**

As the ferrosilicon study is a pre-feasibility study NO FORMAL AGREEMENTS can be made with individual farmers until a decision is made to go ahead with the ferrosilicon project.

However, 73% of the 31 farmers canvassed in telephone interviews, were keen to fall into the scheme proposed. This is considered a high enough percentage to give the project a sound footing as it confirms farmers' needs to generate cash income.

For purposes of this study, it is presumed that only 50% of land owners either wish to produce charcoal, or will permit bush clearing on their properties.

This brings the available timber from thorn bush species alone, to a 26 year life of production.

5 CHOICE OF TECHNOLOGY

5.1 General

The technology presently used by most farmers is extremely wasteful. A substantial increase in efficiency can be made if they use the right type of technology. Theoretically, a recovery rate of 33% of charcoal with a fixed carbon content (FC) of ± 85% can be achieved. In practice this should be about a 25% recovery rate with a FC of 80%-82%. This means that producers will have much lower production costs per ton of charcoal and a higher market price. The industrial market bases the price on quality, ie. the fixed carbon content (FC) of the charcoal, percentage of volatiles and percentage of ash. A high ash content of between 6%-8% seems characteristic of the bush species of Namibia. A high ash content of charcoal is unacceptable to some industries.

5.2 The central problem

The state of art in charcoal manufacturing technology in Nambia cannot satisfy the requirements of the conditions for economic charcoal manufacturing in Namibia. A wide range of technologies, patented or not patented, is available. The problem is that the patented and proven technologies are too expensive for local farmers or manufacturers to purchase. Prices for plants with a capacity of 4 000 tons of charcoal per annum range from N$2,5 million to N$4,5 million each. These plants are also inappropriate for local conditions as it cannot be repositioned frequently enough in optimal relation to the raw material source. Large scale plants, for the briquetting of fines, cost about N$3 million each.

Some constraints that exist in the present state of industry, are listed below. These constraints will also determine, to a large extend, the appropriateness of technology that should be applied:

- a low yield per hectare and material that is difficult to handle: the harvesting and handling of large volumes of this material in the time required by high volume production systems with a fixed location, is unachievable;

- high "fines" (<2cm diameter) percentage of charcoal is produced because of a high percentage of small material introduced into the carbonizers. Inefficient technology is applied which results in fragmentation of hot coal and increases the "fines" content.

- intensive supervising of operations is required. The unskilled and unproductive labour cannot handle sophisticated technologies;

- high costs of overland transport;

- farmers lack capital and knowledge to manufacture or buy more efficient and consequently expensive technology;

- market requirements in terms of quality, quantity, continuity of production and delivery, result in high production costs.

5.3 Criteria for plant design

Subject to the constraints mentioned above, the charcoal manufacturing plant could be designed with two main alternatives in mind:

5.3.1 Manufacturing of charcoal lumps:

The target is the barbecue market and the industrial market. The latter requires lump charcoal as a reduction agent in smelting processes. The process must not be sensitive to a high ash content or the mineral composition of the ash. In this process:

- the wood charge must consist of wood pieces of 1-2m lengths with a diameter of 100-200mm. The process does not allow for more than 30% of sizes between 50mm and 100mm. This requires an expensive harvesting process where suitable wood must be selected manually.

- thus specified, we expect a wood yield of not more than 5 tons per hectare.

- workers load the harvested wood manually and transport it to the carbonizer by tractor and trailer. Transport cost is minimised by the movability of the carbonizer to limit the transport radius to a maximum of 1 km. If transport exceeds this distance by tractor and low bed trailers, the volume to be transported and the amount of equipment needed becomes unbalanced. If so, the more expensive transport mode of trucking must be used. The manual loading of logs for transport by trucks is too slow to be economical.

- the process uses a retort for carbonizing. A retort differs from a kiln therein that it uses an internal heat source, ie. volatiles from the same process. This results in a higher charcoal yield from the same wood charge.

- the "fines" will be lost in the process. If feasible, it may be sold at a much lower price than that of lump charcoal or briquettes if a market exists. The percentage fines should be 5% of total charcoal produced. The technology, used by farmers, produces about 50% of total production as "fines".

- manual labour packages the lump charcoal in bags provided by the distributor and which is then exported.

5.3.2 Manufacturing of briquettes

In this process

- the wood charge is wood chips. Chippers chip the entire bushes to minimise manual labour and maximise the harvested wood yield. Efficient whole tree chippers are expensive;

- a harvested wood yield of about 10 tons/ha can be expected with substantial labour saving through less material preparation;

- cost of material handling will be minimised. The chipper loads the chipped material directly onto the trailer;

- the cost of chipping will be added to the harvesting cost, but could be off-set by less manual handling;

- chipped material can be transported more economically over longer distances by truck because of automatic loading and higher payloads;

- the volumetric density ratio between chipped wood and whole logs is about 1:4. Theoretically, therefore, the retort for charcoal production from chips will be four times smaller than that for whole logs or, conversely, can yield four times more charcoal in comparison with unchipped wood from the same size of carboniser. The cost of the retort, though, will be higher than that of a similar log wood retort;

- an external heat source, ie. volatiles from the charring process, will be used to increase efficiency and ensure that the highest possible charcoal recovery is achieved;

- the total production may be briquetted or the charcoal will have to be screened and the fines briquetted;

- suppliers verbally quoted the cost of a briquetting plant at about N$3 million. I find it difficult to see why this process cannot be done manually or at least in part. We must also investigate this as relatively low cost labour, mainly women, could be employed for this purpose. I inquired about this possibility. The chances are good that a much less capital intensive process can be implemented, as proposed by one of the consultants;

- if briquetting is done, "fines" produced by farmers and which is now wasted, could be bought and processed;

- the price for packaged charcoal briquettes is higher than that of lump charcoal.

5.4 Current production methods

5.4.1 Three basic methods of production are currently used in Namibia:

1 Pipe kiln (See sketch in Appendix)

This is by far the most widely used method. A pipe kiln consists of a steel cylinder, often made from old oil tanks, with a diameter of between 1,2 and 2m and length 5 to 8m, mounted in a vertical position with an airtight sliding gate at the bottom end, and a hopper system to load wood in at the top. The kiln can be operated on a continuous basis, with wood being dropped in at the top, being carbonized in the top half of the kiln and then falling down into an oxygen starved zone in the bottom half of the kiln. Charcoal is drawn off at the bottom and then cooled down in sealed drums.

Output : 1 - 2 ton per day

Advantages:

Low capital cost - ± R12 000
Simple operation
Continuous process

Disadvantages:

Inefficient - yield about 20%
High fines content ± 50% fines -20mm
No by products recovered
Pollution

2 Gaylard Retort (Sketch in Appendix)

This is a batch type retort and has been used by two of the larger producers. It consists of a double walled chamber into which the wood is packed. A fire is made in the fire box and the wood heated to 350 degrees. Airtight doors are then closed to seal the retort for the cooling cycle.

Output: 1-1,5 ton/day depending on the type of wood

Advantages:

High quality can be controlled - temperature is

monitored
High lumps ratio, 80% +20mm

Disadvantages:

High cost R80 000
Complicated operation
No by products recovered
Pollution
Batch system
Not mobile

3 **Inert Gas Method (Sketch in Appendix)**

This system is based on the designs of more sophisticated retorts and makes use of an external heat source to heat the gasses given off by the wood in a closed recirculating system. As the gas heats up, excess hot gas is bled off and used to fuel the external fire, which in turn heats the gas through a simple heat exchanger. This system has been developed and used by one producer in Namibia. However, the system is widely used in Eastern Europe. The life of the plant is expected to be 15 years.

Output: 1 - 3 ton/day

Advantages:

Quality can be controlled - temperature is monitored
High lumps ratio, 90% + 20mm claimed
High yield - 30% + claimed
By products can be recovered
Non polluting operation
Can easily be re-positioned

Disadvantages:

High cost R40 000 - est
Complicated operation
Engine driven fan
Batch system

5.4.2 **Discussion**

Of the three systems in use, the pipe kiln seems on the face of it to be the most cost effective and suited to local conditions.

Its major drawbacks are its inefficient operation both in terms of yield and in terms of wastage of energy and by products. The low lump/fines is also a disadvantage.

The carbonizer should be a small mobile system which can be moved easily. Operation and maintenance should be simple, while the yield should be as high as possible. It should also be possible to recover the by-products.

With this mind then, the inert-gas retort is in actual fact more suitable. This system is widely used in Eastern Europe and a detailed study should be made of its use there.

The recovery of by-products which generates extra income, and the higher yields makes this plant more competitive.

A small increase in yield results in a significant reduction in the raw material cost component. For example an increase in yield of 5% from 20 - 25% results in a 25% reduction in the cost of raw materials. This has a significant effect on the feasibility of an investment in a charcoal producing facility.

5.5 Summary

It is clear that mobile plants will have to be employed in charcoal production of any scale in Namibia. This is due to the thinly spread availability of raw material. The decision to invest in low cost/low yield plants or higher cost/higher yield plants, is governed by the availability and cost of capital for this investment. As the international financial community has indicated support and the availability of low interest loans for the establishment of this industry, it is herewith recommended that the inert gas method of production be standardised in the cooperative of farmers which will serve the ferrosilicon plant.

6 PRODUCTION

6.1 General

The 15 000 tpa charcoal required by the ferrosilicon plant, can be produced by Namibian Metals itself, or by subcontracting to various interested farmers. The concept would be to have mobile production units, and as the veld is cleared of noxious bush, the harvesting and the plant moves on to other regions.

For the purposes of this study, it is considered that farmers will produce the charcoal and sell it on to Namibian Metals. The company will play a role in setting farmers up in the production and will offer capital assistance and a secure and even offtake. A selling organisation will be established to assist farmers in selling a portion of their production abroad at higher prices.

In order to produce 15 000 tons of charcoal, 13 production units will have to be established, each producing 100 tons per month.

As insufficient labour exists and the farms upon which production will take place, it is envisaged that the woodcutters will come in form other regions and spend 3 month contracts on the producing farm. After this period another contract lot will take over. At any one time then, 23 workers will operate a 100 tpm production unit.

6.2 Method of production

6.2.1 Wood Harvesting

- The wood will be harvested by hand by the contract workers who will work with basic equipment only.

- Each worker will pile a 1 ton lot of wood per day which will be collected by a truck with a trailer, and taken to the charcoal plant.

- The wood is then put through a chipper, and air-dried for 3 weeks before it is placed in the kiln.

6.2.2 Charcoal Production
As described in 5.4.

6.2.3 Packaging
The production scheduled for export will be packed in 25 kg paper bags. Production scheduled for the ferrosilicon plant will be trucked in bulk.

6.3 Labour required in production

6.3.1 Wood cutting: One man is able to cut 3 m^3 of wood per day. This equates to 1 ton of wet wood. It is presumed that as insufficient labour exists on the farms for wood cutting, contract labour will be employed as is the norm in the industry at present. As the wood cutting is essentially manual and hard work in the hot climate of Namibia, the contract labour is hired in at 3 month intervals. For a production unit of 100 tons per month of charcoal, 333 tons of wood is cut, requiring 15 men working 22.2 days per month.

6.3.2 Wood transport: Four labourers are required for wood transport, ie. Driver/Foreman, and three maintenance repair people.

6.3.3 Production: Four labourers are required to manage the production of charcoal at the kiln, which includes loading and packing the product for export.

6.3.4 Labour summary: Thus approximately 300 labourers will be active in the production of charcoal at any one time. However, if one considers the rotation of the contract workers cutting wood, then employment and a source of cash will be given to 884 workers in this charcoal operation, per annum.

6.4 Quality

While quality is not a major factor in the existing local and export barbecue markets, most of the charcoal produced in the country is regularly tested. Typical results are as follows:

	Typical Value	Range
Fixed carbon content	78%	70% - 86%
Volatiles	14%	10% - 20%
Ash	7%	3% - 10%
Moisture content	2%	1% - 5%

The charcoal is generally not suitable for industrial use where an ash content of less than 2% is required.

The high ash content is typical in the Acacia species used in production, and is generally higher in limestone areas than in others.

A sample of charcoal originating in the Omaruru area was tested and the ash analysed. The results are as follows:

ANALYSIS OF CHARCOAL PRODUCED FROM BUSH SURROUNDING OMARURU

Moisture % = 2,72

<u>Proximate analysis - % on dry basis</u>

Volatiles	=	14,09
Fixed Carbon	=	81,60
Ash	=	4,31

<u>Triability Test</u>

Bulk Density	=	0,32
+ 6mm Fines	=	94,62
- 6mm Fines	=	5,38

<u>Ash Analysis - % in</u>

Fe	=	0,70	coke as	Fe_2O_3	=	1,00
Al	=	0,75		Al_2O_3	=	1,40
Ca	=	26,50		Ca O	=	37,08
P	=	0,53		P_2O_5	=	1,22

6.5 Summary of production parameters

	Production Unit	Co-operative total
Wood required per month	333 tons	4330 tons
Wood required per annum	4330 tons	51950 tons
No. of wood cutters	15	195
(Rotation 4 times p/a)	60	780
No. of transport labourers	4	52
No. of charcoal production labourers	4	52
Yield	30%	30%
Total output	100 tpm 1200 tpa	1300 tpm 15600 tpa
Production breakdown:		
- Lumps + 20 mm	90 tons	1170 tons
- Fines 10-20 mm	4 tons	52 tons
- Fines -10 mm	6 tons	78 tons

7 CAPITAL FUNDING

Fixed capital to set-up the pipe kiln and inert-gas system of production, is as follows:

	Pipe kiln	Inert-gas
Fixed capital	70 000	125 000
Working capital	45 000	45 000
	$115 000	N$170 000

International funding organisations have indicated that they will be prepared to fund this venture at interest rates of 4% per annum, whilst working capital can be funded at 11% per annum. The total interest bill is thus N$645 pm for a pipe kiln and N$833 pm for the inert-gas method.

Repayment of fixed capital can be arranged over 48 months, which amounts to a repayment of N$2 615 per month for a inert-gas retort and for a pipe kiln N$1 460 per month.

8 PRODUCTION COSTS

A comparison is made of production costs for two systems of production, namely the pipe kiln and the inert-gas facility:

8.1 Production costs for a pipe kiln

ASSUMPTIONS			Price	N$/ton
Ton/mnth/kiln	:	25	Lumps	265 Export
No of kilns	:	2	Fines	130 TCL (N$160-less N$30 tpt)
Tot output	:	50	Total	198 N$/ton on farm
Yield : %	:	20		
Lumps +20mm %	:	50		
Fines -20mm %	:	50		

CAPITAL OUTLAY

ITEM	No.	Price N$	Amount N$

Kilns	4	10 000	40 000
Tractor	0	25 000	0
Trailer	1	10 000	10 000
Sieve	2	2 000	4 000
Housing	4	3 000	12 000
Shed	0	10 000	0
Tools	50	60	3 000
Bag closer	0	3 000	0
TOTAL			70 000
WORKING CAPITAL			45 500
TOTAL CAPITAL REQUIRED			115 000

OPERATING COSTS

Wood Cutting:	N$/ton Wood	N$/ton Charcoal	N$/mnth
Labour: 1 ton (3 M3) p/man p/day. ie monthly earning N$250	15	75	3 750
Tools:	1	3	125
Wood Transport			
Driver/Foreman:	1	5	250
Fuel	1	5	250
Maint.& Repair	3	15	750
Production:			
Wages 2 labour/kiln		15	750
Maint. & Repair		2	100
Bulk Packing : 20kg used bags			
Bags @ N$/bag : .20		10	500
Marketing & Administration		17	1 700
TOTAL PRODUCTION COSTS		147	6 475

CASH FLOW TO FARMER	P/MONTH
Sales: 50% (50 tons) @ N$130 (TCL @ N$160-N$30 tpt)	N$6 500

	: 50% (50 tons) @ N$250	12 500
		$29 000
Less:	Operating costs (100 tons x R147)	14 700
	Loan repayments: - 4% on N$70000 = 2800 - 11% on N$45000 = 4950	645
	Capital repayment over 48 months	1 460
NETT CASH FLOW (per month)		$12 195

8.2 Production costs for an inert gas method

ASSUMPTIONS

Ton/month/retort	:	100
No of retorts	:	1
Yield	:	30%
Lumps +20mm	:	90%
Fines -20mm	:	10%
Fines -10mm	:	6%

CAPITAL OUTLAY

ITEM	No.	Price	Amount
Retorts & diesel engine	2	100 000	100 000
Tractor	0	25 000	0
Trailer	1	10 000	10 000
Sieve	1	2 000	2 000
Housing	2	3 000	6 000
Shed	0	10 000	0
Tools	30	50	1 500
Bag closer	0	3 000	0
TOTAL			125 500
WORKING CAPITAL			45 500
TOTAL CAPITAL REQUIRED			170 500

OPERATING COSTS

Wood Cutting:	R/ton Wood	R/ton Charcoal	R/mnth

Labour: 1 ton (3 M3) p/man p/day. ie monthly earning N$250	15	50	5 000
Tools:	1	3	300
Wood Transport			
Driver/Foreman:	1	3.33	333
Fuel	1	3.33	333
Maint.& Repair	3	10	1 000
Production:			
Wages 2 labour/retort		15	1 500
Maint. & Repair		2	200
Bulk Packing : 20kg used bags			
Bags @ N$/bag : .20		10	1 000
		96.66	9 666
Accounting for fines $96.66 \times \frac{100}{94} =$		$103	$10 300
Marketing & Administration		$ 17	$ 1 700
TOTAL PRODUCTION COSTS		N$120	$12 000

CASH FLOW TO FARMER		P/MONTH
Sales Price: N$250 mt x 100 tons		25 000
Sale of By-products (tar, etc)		8 300
		$33 300
Less:	Operating costs	12 000
	Interest on loan	833
	Capital repayment	2 615
NETT CASH FLOW (per month)		$17 852

8.3 Transportation Costs

Typical transport rates at present are as follows:

Grootfontein - Walvis Bay N$110-/ton N$/tonkm

(Return load only if available) @ 700km	=	.16
Okahandja - Walvis rail Special rate (N$450 -/6m container @ 6500kg)	=	.21
Okahandja - Walvis rail Std rate (N$900 - /6m container @ 6500 kg)	=	.42
Cattle trucks N$4,00 /km @ 16 ton	=	.25

It is recommended that the following rates be used for the purpose of this report:

			N$/ton
a	Grootfontein - Omaruru: 20c /tonkm @ 400km		80
b	Local - ie. 100km radius: 25c/tonkm	=	25

9 THE MARKET

Tsumeb Corp. Ltd. TCL provided the first stable market and until recently bought about 750-900 ton/month of fines (-20mm) and unsifted charcoal.

Due to various factors, they have now cut back to about 250 ton/mnth with a possibility of further cutbacks in the near future.

Local and Republic of South Africa (RSA) Barbecue Market. This market takes +20mm charcoal, packed in 2,5; 3 or 5 kg bags.

The local market is insignificant at 50-60 ton/mnth, while estimated export to the RSA is 250 - 300 ton/mnth.

Western Europe. Exports to Western Europe are also mainly for the barbecue market packed as above. Problems are being experienced with this market as it is highly seasonal and depends on the weather during the European summer.

At present no shipments are being made. Orders are usually finalised towards the end of the year with most deliveries occurring between January and June.

The present state of the market, both export and local, (TCL) has led to an oversupply of charcoal and is causing many producers to consider closing down. It would therefore be an ideal time for a new large scale buyer to enter the market.

An investigation is already underway to erect a briquetting plant to absorb the excess production.

Summary:	ton p.a.	Surplus/ (shortage) ton p.a.
Production total:	15 956	
Production fines - 20mm	7 978	
Market TCL: Previous	9 600	
		-1 622 **
Market TCL: Present	3 000	
		-4 978 **
Production Lumps +20mm (50%)	7 978	
Market:		
Barbecue Local & RSA (+20mm)	3 300	
Export Western Europe	3 500	
		1 178 **

** Note: TCL buys unsifted charcoal from farmers who do not export. The apparent surplus has thus previously been taken up by them, balancing supply and demand.

The present situation therefore represents an oversupply of ± 5000 ton pa of fines, assuming that exports to Western Europe recover shortly.

The willingness of producers to supply to Omaruru will obviously depend on the price offered by other markets. While producers can be 'tied' into a supply contract at a given price, problems can be expected if other producers are consistently getting a better deal. It is therefore necessary to look briefly at the proposed project in relation to other markets for producers:

Export market

- Advantages

  Better price. (Can improve if Rand/N$ weakens)
  Export advantages
  Large potential - as yet not penetrated by local producers

- Disadvantages

  Seasonal
  Packaging required
  Marketing - difficult and expensive
  Cash flow problems
  Sophisticated procedures - beyond the reach of small producers

Local Market: Omaruru

- Advantages

  Less transport, handling and packaging
  Faster payment - better cash flow
  Stable market

- Disadvantages

  Price
  No export advantages

Prices:

Export prices fetched in 1993 by Jumbo Charcoal of Okahandja, amounts to:

	N$550 pmt FOB Walvis Bay
Less:	
Transport & FOB Charges	N$200
Commissions	N$ 55
Net receipt FOR Omaruru	N$295

This receipt is for + 20mm product, the minus 20mm fetching N$160 at Tsumeb, ie. N$160-N$30 at FOR Omaruru. The price which Tsumeb pays for charcoal depends on the grade supplied. Prices range between N$160-N$190 PMT (delivered), with the lower amount being paid for fines. A ferrosilicon plant will be able to utilise the 10-20mm fraction at full prices.

It can be anticipated that producers will be prepared to give a "discount" on local sales due to the benefits listed above. It is however unlikely that they will drop below the prices given above, as the small income generated is simply not worth the effort required to produce.

It is estimated that farmers around Omaruru will be amiable to prices of N$200-N$250 FOR Omaruru, particularly in the light of:

1 assistance with financing;
2 a stable non-seasonal market
3 long term contracts

For the purposes of this study, it is suggested that prices of N$250 FOR Omaruru be used.

10 CONCLUSIONS

The conclusions reached from this study are as follows:

1 That although a charcoal production industry exists in Namibia, this industry is presently too small to serve the ferrosilicon plant's needs of 15 000 tpa. This industry is also established in the Okahandja and Grootfontein/Tsumeb areas which are a little distant from Omaruru with a consequent transport cost implication for the ferrosilicon plant of getting the (bulky) charcoal there.

2 That sufficient timber exists in the immediate area around Omaruru to produce charcoal over the life of

the ferrosilicon plant. Although this timber is on privately owned farms around Omaruru, 73% of the farmers in the area are keen to have their timber harvested, either by themselves or by others.

3 That the soil conditions and chemical make-up of the trees around Omaruru is such that a low ash charcoal can be produced, giving the opportunity for high quality ferrosilicon production.

4 That whilst harvesting natural forests generally has a strong environmental implication, the timber around Omaruru is in fact a thorn shrub which has invaded the natural savannah lands, and which is categorised by the Government as noxious. The harvesting of this shrub falls within the Government's eradication policy which serves to restore the land to its natural state.

5 That the technology exists in Namibia to produce the charcoal, but that mobile producing units will have to be used, thereby negating the use of the Gaylard Process.

6 That although the capital costs for a kiln using inert-gas is substantially more than a pipe kiln, it is nevertheless more economic to use this method, due to higher yields of 30%, with low fines production of ± 6% - 10mm (10% - 20mm). This compares to a yield of 20% on the pipe kilns.

7 That there are several ways in which to organise the commercial structure of the charcoal production for the ferrosilicon plant, but that a joint venture with a management company seems to be the most cost-efficient way. To organise the charcoal industry would clearly have to be the initiative of the ferrosilicon company.

8 That whilst FOB prices for charcoal appear high at ± N$550, farmers are individually not sufficiently skilled and do not have the capability to exploit the export market. This is particularly true as this market is seasonal. However, an arrangement could be made with individual producers for the ferrosilicon company to export a certain percentage of their production.

9 That the number of labourers employed in the charcoal production (15 000 tons) will at any point in time be ± 300; but that because labour would probably be brought in from the north on short term contracts of 3 months, around 780 labourers will be able to earn an income via thisindustry, per annum.

10 That the raw material, technology and sound commercial incentives exist to establish a charcoal industry which can supply the ferrosilicon plant in the quantities and qualities it requires, and at attractive prices to both supplier and the ferrosilicon plant.

11 RECOMMENDATIONS

That, should the ferrosilicon project go ahead:

1 the ferrosilicon plant management undertake the initiative to establish and structure (commercially) the charcoal industry.

2 the inert-gas method of production be further studied with particular reference to its application in Eastern Europe, in order to confirm this technology.

3 a buy-in figure for charcoal into the ferrosilicon plant, be used of:

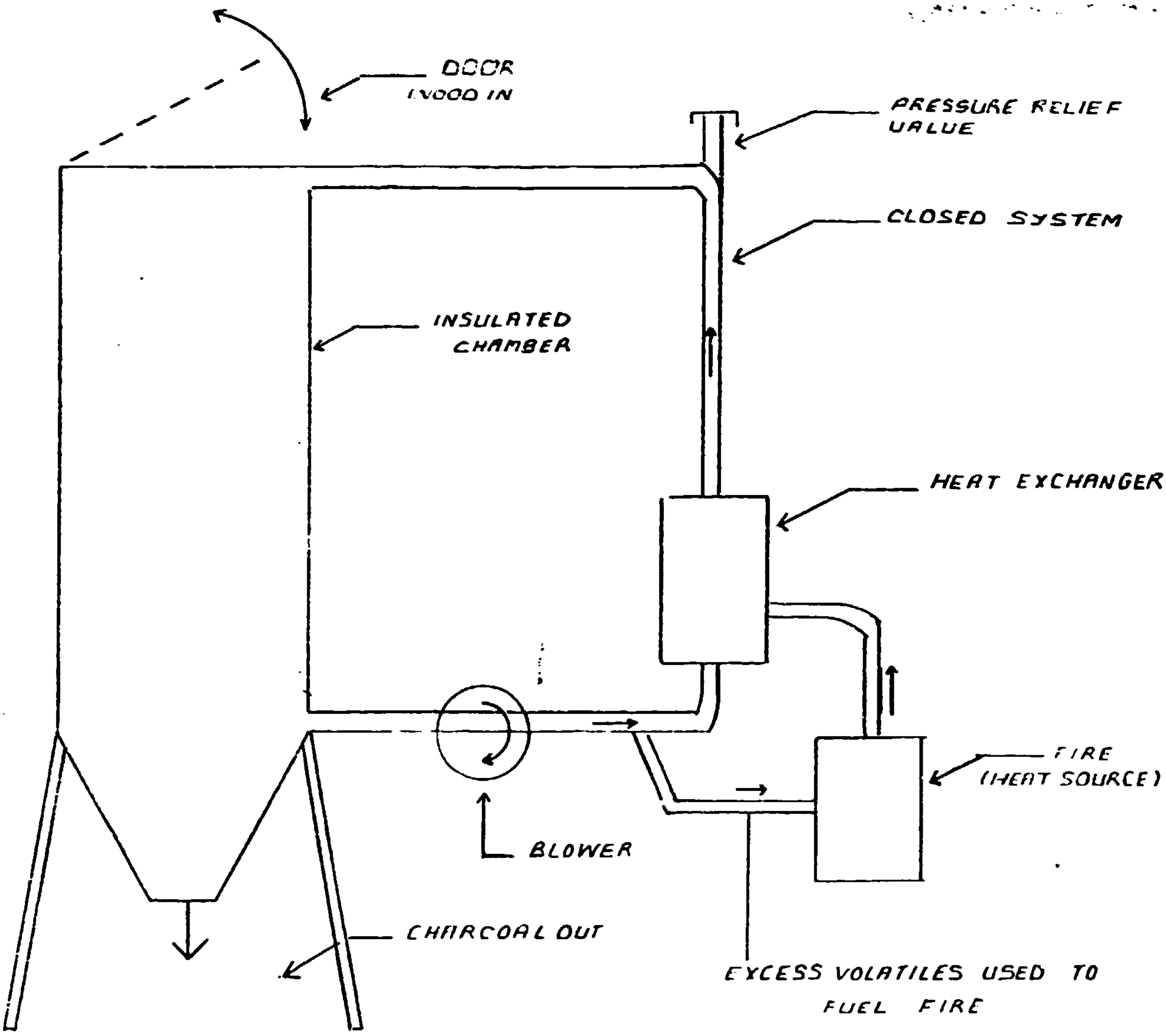
FREE ON TRANSPORT FARM -	N$250/ton
TRANSPORT COSTS -	N$ 25/ton
LANDED COST PLANT	N$275/ ton

4 more work be done on delineating the dolomite sub-soil regions around Omaruru, from which low ash timber can be harvested to ensure high quality ferrosilicon production.

May 1994

NFV-CHAR.R94

A P P E N D I C E S



METHOD

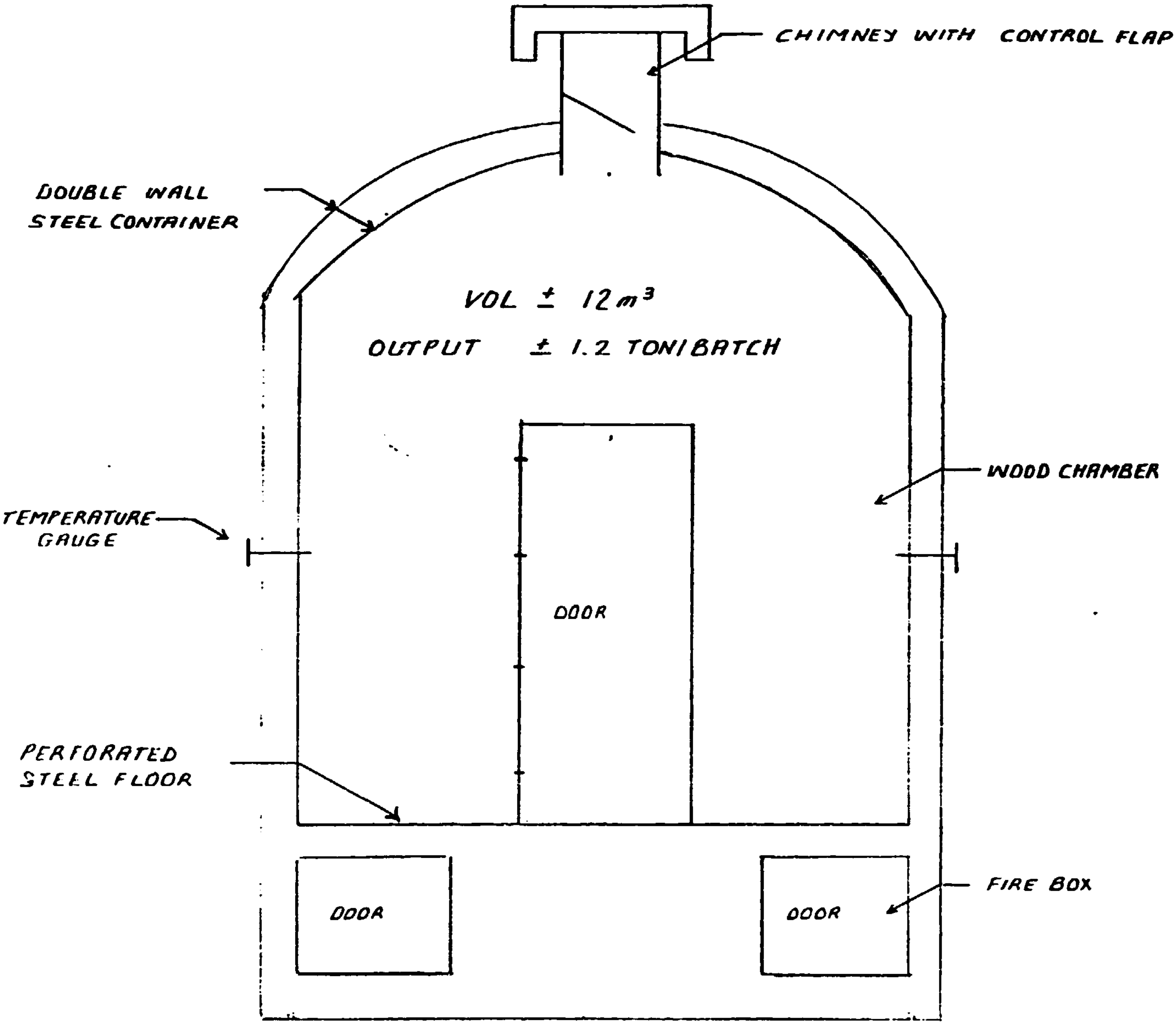
1 Wood loaded through top door

2 Fire is started and blower starts heating up system by blowing heated gas through the wood in a closed system

3 Once sufficient temperature is reached, excess volatiles from the wood are used to fuel fire

4 Once the rquired temperature is reached, the system is stopped and allowed to cool - Batch Process

INERT GAS PROCESS



METHOD

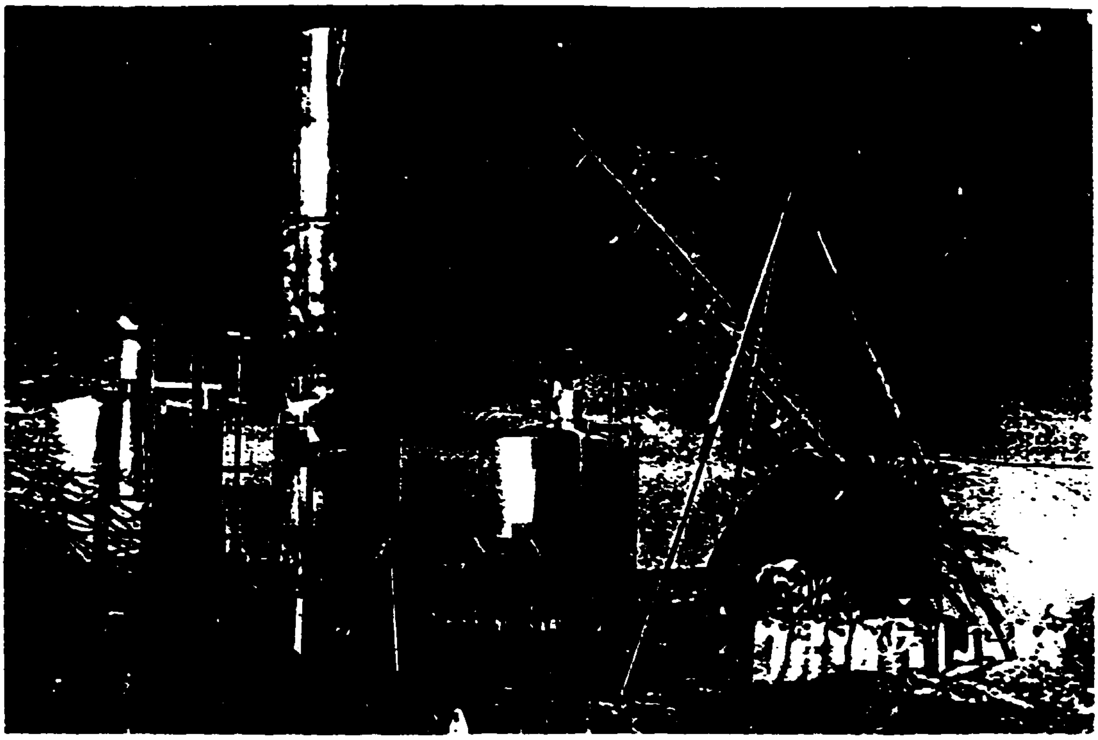
1 Wood is packed into wood chamber

2 Fire is started in fire box

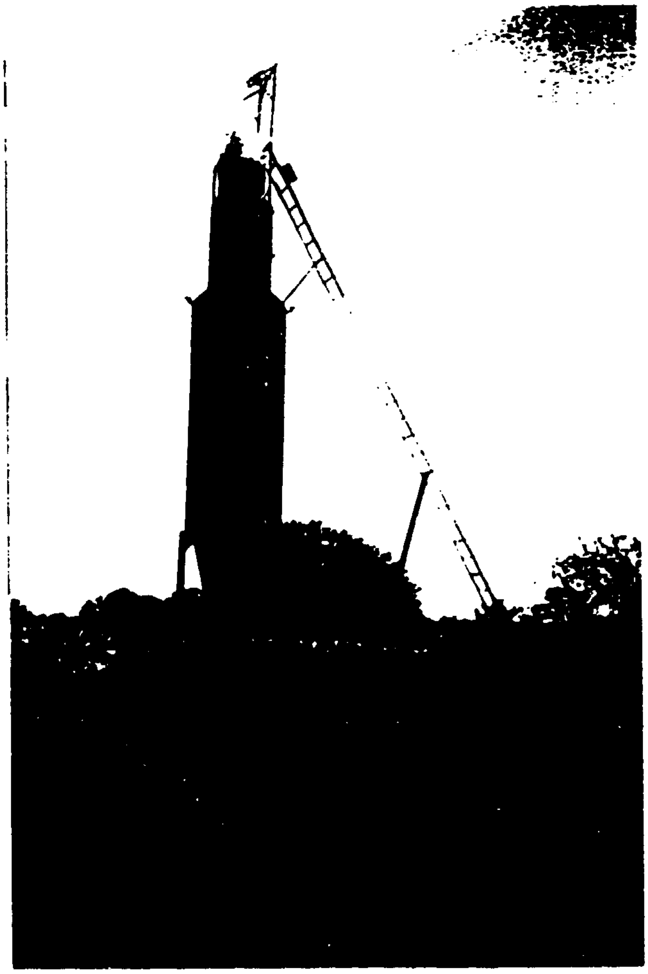
3 This heats up the wood, driving off moisture and volatiles

4 When the required temperature is reached, all doors are closed to avoid further combustion

GAYLARD RETORT (SIMPLIFIED SKETCH)



JUMBO CHARCOAL production plant in Okahandja
"Gaylard Retorts" and pipe kiln.



Typical "pipe kilns" from small Namibian charcoal producers.