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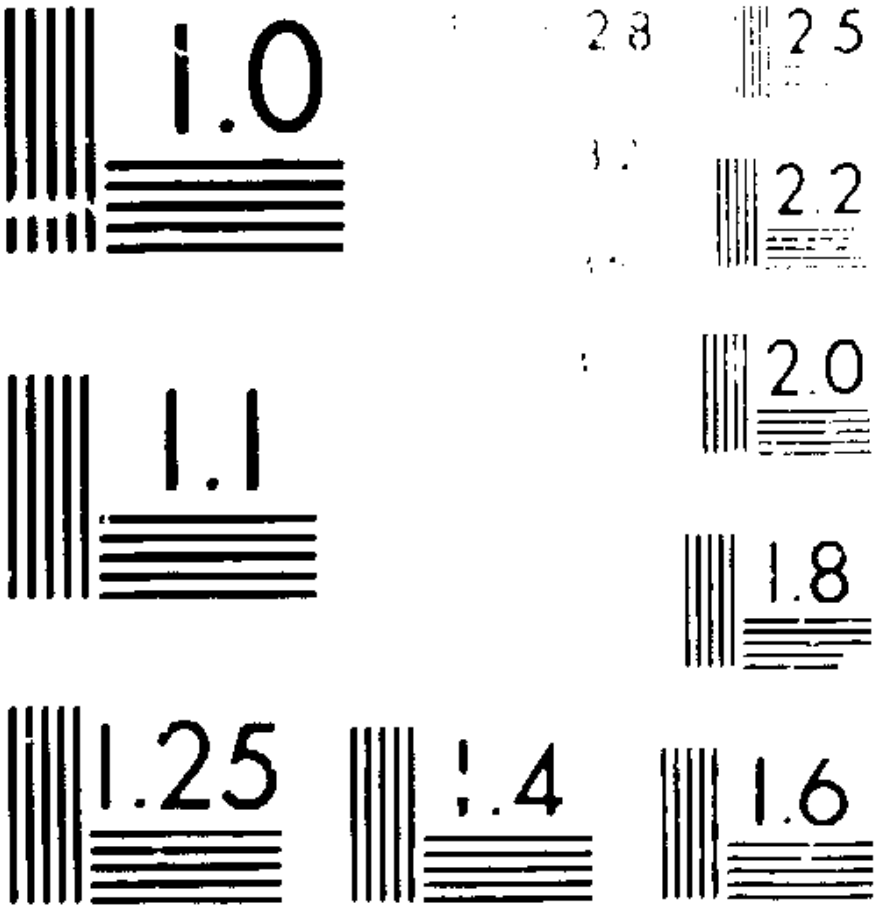
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UNIDO-Czechoslovakia Joint Programme
for International Co-operation in the Field of Ceramics,
Building Materials and Non-metallic Minerals Based Industries
in Pilsen - Czechoslovakia

11941

ESTABLISHMENT OF A CERAMIC PILOT PLANT IN BOTSWANA

REDUCED PRODUCTION PROGRAMME
(ASSESSMENT OF FEASIBILITY)

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C O N T E N T S

LIST OF TABLES

1. INTRODUCTION

In the Final Report (ref.1) submitted to UNIDO in 1977 relating to the Project No. SM/BOT/73/001 the Research Institute for Ceramics, Refractories and Raw Materials at Horní Bříza, Czechoslovakia recommended among others the establishment of a pilot plant for the manufacture of 50 000 sq.m. of wall tiles and experimental production of 5 000 sq.m. of floor tiles per year near Palapye in Botswana. The expected local consumption was estimated at 20 000 sq.m. per year (15 000 sq.m. white wall tiles and 5 000 sq.m. in plain uni colours). As such a small production would not be economically feasible the team of the Institute searched at that time for solutions taking into account the requirements of the Ministry of Commerce and Industry for promotion of the mutual trade with adjacent countries and extending assortment by export of wall tiles decorated with local motives in small series as required by the architects designing tourist hotels.

The Final Report was accepted by UNIDO, the Ministry of Commerce of Botswana, however, refused any manufacture of wall tiles for export at varience with their earlier attitude and requested the pilot plant sized for local market only (ref.2) without dislocing their ideas of undertaking such a venture which definitely cannot be profitable. With this problem has now been faced the team of the UNIDO-Czechoslovakia Joint Programme. To avoid the loss in manufacture of 20 000 sq.m. wall tiles for local market and to obtain at least the equation sales = costs they have proposed an extension of the plant sized for 20.000 sq.m.

of wall tiles (Pilot Plant II) by a combined manufacture of 50 tons of earthenware products per year to be produced by using the capacity reserves of the machinery for wall tiles manufacture and requiring only low additional investment in shaping and firing capacities (Pilot Plant III).

2. COMPARATIVE STATEMENT AND ECONOMIC ASSESSMENT

In the table No 1 economic parameters of the following proposals are compared: Pilot Plant I proposed within the Final Report in 1977 (ref.1) - Pilot Plant II of the reduced capacity requested by the Ministry of Commerce and Industry of Botswana in 1978 - Pilot Plant III the combined manufacture of wall tiles and earthenware for local consumption.

The indications of the Pilot Plant III have been calculated on the following bases:

Investment cost of buildings and civil engineering work being a local delivery remains at the same level as in the Final Report of 1977 (ref.1/ /p. 125,172) The team had no possibility to verify present prices in this sector in Botswana. This part amounts to 16% of the total investment only.

Cost of machinery and equipment was calculated in close co-operation with machinery producers and exporters.(ref.3,4) Prices are at the present level.

Operation costs of the main imported items (glazes, stains) are based on the present price level. This applies also to the depreciation derived from the present prices of machinery. The other operation costs, above all the present prices of fuel oil in Botswana would have to be verified.

The present prices of the 20 000 sq.m. of wall tiles to be produced in Botswana were estimated by 10% higher as compared to the prices of 1977. The estimated average prices of the earthenware products are likely to correspond to prices of similar goods imported to Botswana.

Table No 1 Comparative statement of economic parameters

Economic parameters	Pilot Plant I (1977) 000 P	Pilot Plant II (requested 1978) 000 P	Additional sales and costs-brought about by earthenware manufacture 000 P	Pilot Plant III combined manufacture of wall tiles and earthenware 000 P
Total investment	1288	614	88	702
Yearly sales (full production)	621	122	110	232
Yearly production costs (full production):				
a) costs without depreciation	279	130	42	172
b) depreciation	108	50	5	55
c) total costs	387	180	47	227
Yearly profit/loss	+ 234	- 58	+ 63	+ 5

The demand for the proposed 50 tons of earthenware would have to be verified. All foreign prices quoted in US dollars were converted in Pulas at the rate 1 Pula = 1,20 US Dollar.

In spite of the fifficulties in cost pricing the comparative statement gives a picture for further decisions. On the one side the corrections in operation costs may after verification still worsen the results, on the other hand the price level of the relevant products may have risen more in the past two years than calculated. In any case the pilot plant will not be a profit yielding venture.

As far as the simplification of machinery is concerned it was carried out to such a degree as not to deteriorate the quality of products. It is hardly possible to eliminate ball mill, filter press, mechanical press or a progressive kiln. Mainly the mechanical transport in the phase of body preparation was replaced by manual work. A potential way to lower the investment cost might be the use of secondhand machines. In such a case, however, the delivery would be without guarantee.

The comparative statement (table No 1) and comparative specification of sales (table No 4) prove that small sized plants for wall tiles manufacture cannot work effectively unless their production programmes of standard products comprise a manufacture of required stylish wall tiles produced in small series with a higher labour input and saleable at threefold or fourfold prices. The submitted alternatives (Pilot Plant II and Pilot Plant III) are far from being satisfactory from the economic point of view.

3. EXECUTIVE SUMMARY

The Government of Botswana should decide whether in view of the small local market and the unfavourable economic consequences they insist on the implementation of one of the two submitted alternatives (Pilot Plant II, Pilot Plant III) or if they would prefer to introduce ceramic industry by a more viable way.

In the case of implementation of a pilot plant the following measures should be taken:

- The Government should decide the financing of the investment cost as no profit is to be expected unless the investor would resign to create the depreciation fund for the renewal of machinery, buildings and civil engineering works.

- The location of the Pilot Plant should be planned at Palapye with regard to changed conditions (by the Final Report the location was considered on the Makoro deposit). Palapye (distance 12 km from the deposit) will be electrified by the time of erection, it has a railway station with sidings, further utilities and manpower would be locally available.

- The demand for earthenware should be investigated with special regard to tourist industry development

- Plastic clay imported to Botswana as addition for small scale earthenware manufacture should be subjected to laboratory and technological tests and a suitable earthenware body composition with the Makoro-Moralana clays should be researched.

- A suitable technology using the proposed machinery for wall tiles manufacture should be elaborated for the earthenware production.

- The local operation and investment costs for a pilot plant should be revised and final budget and cashflow prepared.

- Systematic drilling tests for the determination of the homogenity of the deposits aimed at their optimum opening should be carried out.

- Appropriate technical assistance before, during and after investment should be requested.

In the case the Government of Botswana would prefer to introduce the ceramic industry in an economically more acceptable way the following solutions are recommended for investigation:

- First of all efforts should be concentrated on bringing the industrial brick production on a higher technical level.

- Additional ceramic walling and flooring products based on brick body should be produced using partly the equipment of the brick factory or in an attached special line depending on economic situation (See also Versification of brickware production (ref.1/p.142)

- Samples of the clays used in the brick plant should be taken, laboratory and technological tests should be performed.

- Local consumption should be assessed.

- The Feasibility Study should be carried out based on a running or planned brick plant.

4. ANALYTICAL PART

4.1 Technology of Pilot Plant III

- combined manufacture of 20.000 sq.m. wall tiles and 50 t earthenware products

Technology of the yearly manufacture of 20.000 sq.m. wall tiles uses the same body composition as recommended by the Final Report (ref.1) Reduction of sizes of machinery could be done only partly as both the Pilot Plant I and the Pilot Plant III capacities are rather smal for industrial machines while laboratory equipment is not productive enough to cover them. In comparison to the Pilot Plant I (ref.1/p.167) the Pilot Plant III would work without any conveyors and elevators, the daily net production being only 1 ton per day. Clay crushers of over size grains were replaced by manual breaking. Also travelling pulley blocks were not applied. Channel driers for drying cakes were not planned and drying will proceed in open rake driers in the production hall. Pressed wall tiles are supposed to be dried stacked on kiln cars before firing. In the oil fired shuttle kiln both the biscuit and glazed biscuit will be fired. Hand glazing by waterfall system will be used instead of a glazing line. The technological flow is shown in table No 2.

The additional production of 50 t earthenware per year has not yet a definite technology with regard to absence of a suitable plastic clay in Botswana which is imported. It must be tested and a body composition researched. For economic reasons the production line for wall tile manufacture will be used. For cast products the slurry will be taken

from the cistern before the filter press, cast in moulds, open air dried and glazed by dipping. One-fire procedure will allow for using the capacity of the shuttle kiln for wall tiles. The body for turned earthenware products will be taken after being dewatered from the filter press, deaired then by the vacuum extruder and turned on a potter's wheel. Drying, glazing and firing will follow in the same way as with the cast products. Combined technological flow is represented in table No 2.

Table No 2

Technological flow of Pilot Plant III

Manual loading of extracted raw materials in the deposit

↓

Tractor with trailer - haulage of raw and other materials

↓

Manual breaking of oversize pieces of raw materials

↓

Balance: Weighing body components and filling ball mill (manually with buckets)

↓

Ball mill: Wet grinding of raw materials

↓

Vibrating screens and electromagnetic separator

↓

Propeller mixer suspended in a cistern

↓

Filter press with pressure pump

↓

Manual transport of dewatered cakes on pallets to open air rake driers (for wall tiles)

↓

Manual transport of dry cakes into the pan grinder - grinding (for wall tiles)

↓

Manual filling of the press hopper (for wall tiles)

↓

Mechanical press - pressing and stacking wall tiles

↓

Loading on kiln cars

↓

Shuttle kiln - firing

↓

Sorting and packing (glazed wall tiles, earthenware)

Manual casting o
in moulds

Open air drying
green products

Glazing and pai

Fired biscuit(wall tiles)

Manual casting of earthenware slurry
in moulds

De-airing filter pressed body
in vacuum extruder

Turning earthenware products
on potter s wheel

Open air drying of earthenware
green products

Glaze preparation

Glazing and painting

all tiles)

SECTION 2

Table No 3 List of technological equipment of Pilot Plant III completed by manual operations

20.000 sq.m. wall tiles + 50 t earthenware products		
Pos.	Pcs.	
1	1	Manual loading of extracted clays on the deposit
2	1	Tractor with trailer for haulage of raw materials to the plant
3	-	Boxes for raw materials (civil engineering work)
4	-	Manual breaking of oversize grains by hammers
5	1	Charging balance
6	1	Platform over the ball mill with stair
7	-	Water supply
8	1	Ball mill for wet grinding - capacity 1 500 kg of ground material
9	1	Vibrating screen 236 openings per sq.m
10	1	Vibrating screen 2 500 openings per sq.cm
11	1	Propeller blunger
12	1	Pressure pump for filling filter press

13	1	Filter press capacity 800 l
14	1	Manual cutting and loading of cakes on pallets
15	-	Manual transport of pallets to open air driers
16	1	Open air rake drier for dewatered body
17	-	Manual transport of dried body on pallets to pan
18	-	Pan grinder for dry milling
19	2	Vibrating screen 800x200 - manual screening
20	1	Mechanical press with 1 die
21	-	Manual stacking of green tiles on kiln cars
22	-	Open air drying of green tiles on kiln cars by applying waste heat from the kiln
23	12	Kiln cars
24	-	Shuttle kiln 12,5 cubic meters for firing temperatures up to 1 250 sq.m oil fired
25	1	Hand operated crossing transfer table for kiln cars
26	-	Rail transport system

27	1	Manual glazing of wall tiles by weterfall system Manual glazing of earthenware by dipping
28	1	Loading of glazed biscuits on kiln cars (wall tiles)
29	1	Platform truck for transport of goods to sorting table and to store
30	1	Table for sorting
31	1	Table for packing
32	1	Ball mill for glaze preparation capacity 200 l
33	1	Double vibrating screen coupled with electromagnetic separator
		Shaping of earthenware by casting into moulds
34	4	Equipment for casting - containers with lips
35	4	Rake driers for castings
36		Brushing of castings
37	1	Mixer for plaster slurry preparation
38	1	Pattern maker's lathe

		Shaping of earthenware by turning on potter's wheel
39	1	Vacuum extruder 0,1 t/h
40	1	Mechanical potter's wheel
41	1	Potter's wheel for manual shaping
42	1	Brushing wheel
43	1	Wheel for painting
44		Power distribution to machines in the production hall
45	1	Water distribution to ball mills
46		Oil handling system
47		Mechanical and electrical workshop
48		Laboratory

4.2 Fixed assets

Site development, buildings and civil engineering work

	Pula
Site development incl. price of land	2 000
Production hall 1 400 sq.m incl. attacked boxes for raw materials	91 000
Office premises and laboratory 100 sq.m	5 000
2 septic tanks incl. piping	800
Fencing 280 running metres	1 176
Water supply connection	1 200
Power line connection and transformer	5 000
Subtotal	106 176
Contingencies	10 824
Site development and buildings - total	117 000

Machinery and equipment

(asper specification) - FOB price	316 000
Sea transport, insurance, port dues	21 000
Terrestre transport to Palapye (by railway)	9 000
	346 000
Erection cost	58 000
	404 000
Locally delivered steel accessories and bricks for shuttle kiln	15 000
Contingencies	15 000
	434 000
Fixtures, laboratory and workshop equipment	30 000

Transportation	
1 tractor with trailer	11 000
Machinery equipment and transportation - total	475 000

Summary of fixed assets:

Site development, buildings and civil engineering work	117 000
Machinery, equipment and transportation	475 000
Fixed assets - total	592 000

+ Pre-investment and start-up expenses

Preliminary expenditure and lay-out plans	30 000
Engineering during construction	30 000
Trial run-costs	20 000
	80 000

Working capital - inventories

Raw materials (6 months)	1 622
Glazes and stains (2 months)	4 914
Fuel oil (1 month)	2 283
Auxiliary materials and spare parts (3 months)	3 000
Work in process (15 days)	3 583
Finished products (1 month)	14 098
Packing material (2 month)	500
Total	30 000

+ The pilot plant is considered to be financed without credit. Therefore no interest during construction is taken into account.

Summary of capital costs:

	Pula
Fixed assets	592 000
Pre-investment and start-up expenses	80 000
Working capital	30 000
Total investment	702 000

4.3 Sales and costs - Pilot Plant II, III

Comparative specification of sales — Table No 4

Commodity	Quantity	Sales Pilot Plant I Pula	Sales Pilot Plant II Pula	Sales Pilot Plant III Pula
White wall tiles	15 000 m^2	73 500	80 850	80 850
Coloured wall tiles (uni colours)	5 000 m^2	37 500	41 250	41 250
Coloured wall tiles (décors applied by silk-screen - small series for export)	5 000 m^2	60 000	-	-
Coloured wall tiles (manually applied rural décors - small series for export)	25 000 m^2	400 000	-	-
Earthenware	50 000 kg	-	-	110 000
		571 000	122 100	232 100

Exports are feasible to Common Customs Area (R.S.A., Swaziland, Lesotho).

Prices of Pilot Plants II and III (1979) are estimated 10% above prices of Pilot Plant I (1977)

Operating costs - Pilot Plant III /1st year of full production/

Raw materials

Raw materials for wall tiles

Raw materials	Quantity ton	Price P/t	Cost Pula
Mudstone grey MR /TS3/	63.56	7.	444.92
Mudstone dark Mr /TS4/	63.56	7.0	444.92
Sandstone background /TS33/	127.08	7.70	978.52
Pegmatite SP /TS18/	28.60	16.00	457.60
Crushed biscuits	28.60	1.70	48.62
	311.40		2374.58

Raw materials for earthenware products

Raw materials	Quantity ton	Price P/t	Cost Pula
Clay grey brown /TS5+6/	20.50	7.10	150.47
Clay grey-yellow /TS8+9/	20.50	7.10	150.47
Sandstone /TS33/	6.80	7.70	54.88
Pegmatite /TS18/	6.15	16.00	103.32
Plastic clay SA (not identified)	13.65	30.00	409.50
	67.60		868.64

Raw materials except pegmatite and crushed biscuits are supposed to contain 10% humidity. The price of the imported plastic clay was estimated.

Glazes and stains for wall tiles

	Quantity ton	Price P/t	Cost Pula
Glazes	20.00	1030	20600
Stains	0.15	8812	1322
			21922

Glazes and stains for earthenware products

	Quantity ton	Price P/t	Cost Pula
Glazes	7.50	850	6375
Stains for décors	0.15	7900	1185
			7560

Energy

Wall tiles 3 500 Mcal/t of net products (wall tiles)
Earthenware 11 000 Mcal/t of net products

3 500 Mcal x 200 = 700 000 Mcal (wall tiles)
11 000 Mcal x 50 = 550 000 Mcal (earthenware)
1 250 000 Mcal

1 250 000 Mcal : 9 231 Mcal = 135 t fuel oil

135 x 203 P = 27 405 P

Electricity

Power consumption is calculated on basis of the installed input of 61 kW with regard to operation times of particular machines: 111 000 kWh x 0.047 P = 5 217 P

Water consumption

250 x 1.5 m^3 for industrial use
250 x 1.0 m^3 for social consumption

250 x 2.5 m^3 = 625 m^3 x 3 P = 1 875 P

Summary

Fuel oil	135 t x 203 P	27 405
Electricity	111 000 kWh x 0.047 P	5 217
Water	625 m^3 x 3 P	1 875
		34 497 P

Operating supplies

(materials, spare parts and repairs provided externally)	Cost Pula
4% of 404 000 P	16 160
2% of 117 000 P	2 214
Maintenance of transportation and Diesel oil consumption	2 727
	21 101 P

Wages

Workers - manning table

Workers - manning table	Shifts 1st	2nd	3rd	4th	Total
Transport of raw materials and products	4				4
Crushing raw materials	2				2
Charging and discharging ball mills and filter pressing	2				2
Manuel transport of cakes to open drying rakes incl. transport to pan mill	2				2
Attendance of press and loading kiln cars	1				1
Handling kiln cars and furniture	1	1			2
Attendance of kilns	1	1	1	1	4
Glaze preparation	1				1
Glazing and painting	2				2
Sorting glazed wall tiles and earthenware, packing	1				1
Store of products	1				1
Machine workshop and maintenance	4				4
Guards, cleaners, etc.	3	1	1	1	6
Subtotal	25	3	2	2	32
Casting earthenware and drying	1				1
Preparation of plaster moulds and cases	1				1
Turning earthenware	1				1
Total	28	3	2	2	35

Profession	Number	Wages (Pula) per hour	per year	total
Foreman	2	1.40	2 800	5 600
Fitter	2	1.20	2 400	4 800
Electrician	2	1.20	2 400	4 800
Skilled worker	16	0.90	1 800	28 800
Unskilled worker	8	0.30	600	4 800
Driver	1	3.40 per day	850	850
Security guard	4	2.50 per day	625	2 500
Total	35			52 150

Wages are calculated on 250 working days and 2 000 working hours per year.

Other expenses connected with wages	Cost Pula
6 paid holidays, 15 days paid leave, paid sickness and medical care 14% of 52 150	7 301

Salaries of local personnel	Cost Pula
1 Chief	5 000
1 Bookeeper	3 960
1 Purchase and sales staff	3 400
Total	12 360

Summary of personal costs	Cost Pula
Wages	52 150
Other expenses connected with wages	7 301
Salaries	12 360
Total	71 811

Administrative expenses	Cost Pula
5% of personal cost	2 578
Housing allowances	1 800
Total	4 378

Sales costs	Cost Pula
Packing, travel expenses and publicity (excl. personal costs)	6 000

Depreciation	Cost Pula
Buildings 117 000/4%	4 680
Machinery 404 000/7%	32 480
Transportation 11 000/20%	2 200
Start-up expenses 80 000/20%	16 000
	55 360

Table No 5

Summary of costs of Pilot Plant II and Pilot Plant III

	Pilot Plant II	Additional costs on earthen-ware	Pilot Plant III
Raw materials	2 375	869	3 244
Glazes and stains	21 922	9 047	30 969
Energy	21 021	13 476	34 497
Operating supplies	18 021	3 080	21 101
Personal costs	58 815	12 996	71 811
Administrative exp.	3 728	650	4 378
Sales costs	4 000	2 000	6 000
Sub-total	129 882	42 118	172 000
Depreciation	49 970	5 390	55 360
Total	179 852	47 508	227 360

5. REFERENCIES

List of referencies:

1. Assistance in the Establishment of Clay Products and Non-metallic Materials Industries in Botswana (SM/BOT/73/001 - BOTSWANA) - Final Report, September 1977 - UNIDO Vienna Institute for Ceramics, Refractories and Raw Materials, Horní Bříza, Czechoslovakia

2. Letter CI 11/23 I (92) of 16 March 1978 addressed by the Permanent Secretary of the Ministry of Commerce and Industry of the Republic of Botswana to UNITED NATIONS Development Programme in Gaborone.

3. Pragoinvest, Foreign Trade Corporation, Praha

4. Přerov Machinery - producers of machinery and equipment for the building material and ceramic industries, Přerov, Czechoslovakia

5. Obchodní banka, Praha