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INTRODUCTION OF MOBILE BRICKMAKING TECHNOLOGY

RP/URT/85/606

TANZANIA

Tanzania.

Technical Report: Acceptance Trials of the Mobile Brickmaking Facility delivered by Messrs. Simmering-Graz-Pauker AG*

Prepared for the Government of United Republic of Tanzania
by the United Nations Industrial Development Organization
acting as executing agency for the United Nations Development Programme

Based on the work of V. Buchanan,
Expert in Mobile Brickmaking

United Nations Industrial Development Organization
Vienna

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I. INTRODUCTION

1.1 In September 1984, the Consultant evaluated the technical feasibility of mobile brickmaking technology in Tanzania. The evaluation indicated that such technology could be feasible in Tanzania [1] and the Government subsequently requested that UNIDO implement a project to introduce and evaluate the operation of a mobile brickmaking facility (MBF).

1.2 Following standard purchasing routines to define a supplier, UNIDO awarded the contract for manufacture and supply of a MBF to Simmering-Graz-Pauker AG. The MBF was manufactured and prepared for field trial on 22 and 23 October 1985.

1.3 The Government designated the Building Research Unit (Prime Minister's Office) as the Government Implementing Agency. As part of planned project activities a staff member of the BRU was selected for a study tour in Austria to participate in the initial trials of the MBF and to gain experience in the operation and maintenance. The Consultant was engaged to assist in the trials and to evaluate the operation of the equipment.

Acknowledgements

1.1 Within UNIDO, the Consultant liaised with Mr. Biering, Industrial Development Officer, Building Materials and Construction Industries Unit, Chemical Industries Branch of the Division of Industrial Operations (IO/CHEM).

1.2 The supplier's representative, Mr. Josef Mayerhofer, Simmering-Graz-Pauker AG

1.3 From the B.R.U. (Tanzania), Mr. H.H. Kitundu, assisted with the production trials and evaluation of the equipment.

II. FINDINGS

1. From a practical point of view, the main questions were:

   a. Would the MBF perform satisfactorily using clay material of proven quality?

   b. Using the above clay material, which alterations or modifications are required before the MBF is shipped to Tanzania?

   c. What alterations or modifications would be required taking into account the fact that the MBF will be expected to process different types of materials in Tanzania?

   d. What changes to the design should UNIDO consider for future MBFs, bearing in mind that a final assessment should be completed after the pliot plant phase in Tanzania?

   e. What spare parts and other equipment are likely to be required for a more effective and reliable project implementation?

   f. What other considerations should be taken into account for the current or future project(s)?

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[1] See first Technical Report by this Consultant, UNIDO Vienna, 23 April 1985

2. The immediate needs are to define which modifications must be made to the MBF before shipment and to list those equipment items and spare parts which should be supplied to the project in Tanzania. Those are detailed below.

2.1 Diesel Electric Generator (DEG) and Electrical

2.1.1 The DEG is powered by a Scania diesel engine for which service is available in Dar es Salaam.

2.1.2 The DEG is said to be tropicalized (ref. conversation Buchanan - Mayrhofer) but UNIDO should request written confirmation of this from the supplier.

2.1.3 The actual spare parts list is not available in detail but should include at least the following:

- 1 complete set of water, air, and fuel hoses with matching clamps
- 1 spare wheel, tyre, and tube
- 4 paper element air cleaners/filters
- 2 each of all other filters
- 1 Voltmeter to check chassis-earth potential difference
- sufficient oil for 4 000 hours of operation; sufficient coolant (water), anti corrosion additive for two complete changes of coolant.
- 1 set of rear light glasses and safety triangle
- 2 complete sets of spare fuses
- 1 complete set of "V" belts
- 3 maintenance manuals for the diesel motor and alternator.

2.1.4 Alternations required before the trailer is shipped are: Removable steel mesh guards to be fitted to rear lights.

2.2 Conveyors

2.2.1 The adjustable belt scrapers should be extended to equal the overal width of the drive rollers. At present, the scrapers are only equal to the belt width and any lateral belt movement will result in spillage of material.

2.2.2 Some positive method should be considered for locating the conveyors at the crusher inlet and the mixer inlet. If possible, this should be installed and tested before the MBF is shipped.

2.3 Rolls Crusher

2.3.1 The triangular shaped side plates which are to stop spillage off the sides or/and of the rolls, were noted to be bearing on the roll faces. This is only a matter of adjustment, i.e. to correct the problem but one roller was grooved by this fault and grinding it smooth would provide a useful exercise for the Tanzanian student (Mr. Kitundu).

2.3.2 Two complete sets of "V" belts should be supplied as spare parts.

2.4 Mixer - Extruder

2.4.1 It should be noted that the first technical report by the Consultant specified a double shafted mixer. The type supplied is a single shafted mixer which, by virtue of restrictions on length, cannot give the same degree of mixing/ blending. Mr. Mayrhofer stated that a double shaft mixer would be too big for the trailer, would lead to less stability since it must sit above the extruder, and would substantially increase the loaded trailer wieght. It was deduced from this that Simmering-Graz-Pauker AG (SGP) do not make a suitably small (short) double-shaft mixer - it does not mean that such a mixer could not be available. With respect to stability, the extruder can be lowered to the trailer floor level to improve stability. With respect to using (possibly) a longer mixer, the drive mototr and gearbox might be largely parallel with or underneath the mixer. Another alternative might be to consider a different type of mixer, e.g. some form of vertical mixer feeding out through a perforated plate. These alternatives are considerations for the future since it is necessary to evaluate the (cheaper) single shaft mixer under field conditions.

2.4.2 There were problems of spillage at the exit end of the mixer. The side plates of the mixer will be raised at the exit end to 200 mm higher than at present, over a 500 mm length. This will be done by SGP before shipping.

2.4.3 The water supply system at the mixer shoudl be changed to incorporate a flow meter. Also, the water pipe at the mixer can foul the feed conveyor and suggestions have been made such that the pipe can be located on either side of the mixer. These alternations should be made before the MBF is shipped.

2.4.4 The extruder - mixer should have an ammeter fitted in view of the operator that he can gauge the moisture content-effect of the material being processed. During the field trials one man was constantly in attendance at the water valves but this is not desirable in normal production.

2.4.5 The brick sizes chosen by Tanzania were based on fired sizes of 288 x 90 x 65 mm and 190 x 90 x 90 mm. Only one die has been made for the extruder based on the larger brick and allowing for 6% volumetric shrinkage and 5% perforations. The actual die-mouth size is 305 x 95 mm. To enable such a large brick, 305 length, to be produced from a 300 mmm extruder, it has been necessary to have an expansion section between the extruder and the die. The single die size does not permit any alternations for different clays which will likely have different shrinkages. The brick sizes given in the Tanzania Bureau of Standards Draft Specifications for Common Burnt Clay Bricks and Blocks are:

Designation	Work Size in mm		
	Length	Width	Thickness
300 x 100 x 100	288	90	90
200 x 100 x 100	190	90	90
300 x 100 x 75	288	90	65
200 x 100 x 75	190	90	65

2.4.6 Based on the above, it is seen that there is a need for a die to make a brick of cross-section 190 x 90 plus allowance for shrinkage and that the brick cutter must be such that it can be changed from cutting three bricks of about 65 mm thickness to cut three bricks of about 90 mm thickness. SGP should confirm that the cutter has the required versatility and the following arrangements should be made for supplying new dies:

a. A die size of 209 mm x 99 mm should be supplied together with a suitable bridging section from the extruder to the die, i.e. not an expansion chamber as is used with the larger brick. To enable varying drying shrinkages to be created for, face plates should be supplied, to be bolted on to the die, of the following sizes with respect to the aperture:

   205 x 97 mm
   201 x 95 mm.

   Two die cores should be supplied to make 3 holes per brick, centered according to the smaller size above 9i.e. 201 x 95 mm) to give 10% perforation, one core set having 6 pins and one core set having three pins. The pins of the six-core set should be circular and the pins of the three core set eliptical with the long axis of the elipse being vertical as viewed from the front of the die.

b. With respect to the larger die and expansion chamber currently supplied it was noted that difficulties in achieving a good extruded column were caused by unequal pressure due to the core bridge and probably exaggerated by the expansion section behind the die. SGP will make alterations to the bridge to overcome this problem, but two unaltered bridge core sets should also be supplied such that they can be altered in Tanzania.

c. Two perforated plates should be supplied, one for the large die and one for the small die. The perforations should be 20 mm diameter. These plates will be used to gauge the balance of the clay column and cores. These plates can be made of mild steel or aluminium since they will only be used intermittently for test purposes.

2.5 Wire Cutter

2.5.1 The wire cutter was not of the side pushing type as recommended in the first tchnical report. It was a well designed radial cutter, manually operated. However, as with any new design there were problems with its initial operation. The main difficulty was that with hand formed loops on the high tensile wires, the wires stretched at the loops and there was insufficient adjustment available to the system of fixing the wires. It must be expected that the cutter will have to be tested under more realistic conditions in Tanzania. SGP should also examine the possibilities for developing a 10-brick side cutter.

2.6 MBF Trailer

2.6.1 The trialer is well constructed and the only modifications required are that steel mesh guards should be fitted over the rear lights.

2.6.2 Spare parts for the trailer should include rear light covers and safety triangles, foot pump with pressure gauge, one spare wheel with tyre and tube, complete tyre -tube repair outfit, two heavy duty tyre levers, and the matching couplings for brake and light connections such that these can be fitted to the towing vehicle.

3. Equipment and Spare Parts

3.1 The following spare parts are recommended for purchase. The list is in addition to the list indicated on the SGP list attached to their letter S/PH/A/MH/PR 7435 21/274 of 28 March 1985. The list below includes those parts already mentioned in this report, but does not include alternations to equipment.

3.1.1 One set of air, fuel, water hoses, with clips, for diesel electric generating unit (DEGU)

3.1.2 One of spare wheel, tyre, tube for DEGU

3.1.3 Four of paper element air filters for DEGU

3.1.4 Two each of fuel and oil filters for DEGU

3.1.5 One of Voltmeter, tong tester type, 500 Volt scale

3.1.6 Quantity of radiator corrosion inhibitor - additive sufficient for two complete water changes, for DEGU

3.1.7 Quantity of engine oil sufficient for 4000 hours operation of DEGU

3.1.8 One set of rear light covers and safety triangles for DEGU

3.1.9 One only complete set of "V" belts for DEGU

3.1.10 Self Regulating Alternator Series GSCA ref. "Mecca Alte Spa" handbook in SGP manual, page, five.

3.1.10.1 Rotating diodes

3.1.10.2 Printed circuit diodes

3.1.10.3 Set of bearings (front and rear).

3.1.11 One complete set of V-belts for rolls crusher

3.1.12 Two sets of spare light bulbs for both trailers

3.1.13 One thermometer, mercury in glass, reading to 100°C, with protective metal sheath, class B.

3.1.14 Water flow meter for mixer water supply, in metal guard/sheath to be fitted by SGP, with bu=pass and valves.

3.1.15 Ampmeter, to be fitted by SGP, connected to mixer-extruder motor in a position easily seen from extruder exit. Scale to be selcted by SGP.

3.1.16 One brick die to give extruded column of 209 x 99 mm corss section with provision for fixing die adaptor plates (3.1.17).

3.1.17 One each die adaptor to give column sizes of 205 x 97 and 201 x 95 mm

3.1.18 One extension piece for fitting between and of extruder and brick die. The extension piece should not be of conical section as for the one used to get the "290" mm brick (23. 10. 85).

3.1.19 One each sets of cones to produce 6 holes and three holes. See main report for "190 x 90 " brick size.

3.1.20 One each perforated plates, 20 mm diater perforations set in regular rectangular pattern, in three rows acrosss the plate, to suit "290 x 90" and "190 x 90" brick dies. These are test plates to gauge uniformity of extrusion and may be made in steel, aluminium or brass, whichever is least expensive.

3.1.21 2 rolls x 100 meters high tensile wire for brick cutter

3.1.22 One each of matching couplings fitted with 5 meters electric cable, for MBF trailer brake system and tail/stop/indicator system.

3.1.23 Two minor tubes for MBF trailer wheels.

3.1.24 Suitable lifting device (e.g. devit type) to remove - replace conveyors on MBF trailer. To be supplied/fitted by SGP.

3.1.25 Set of two batteries for DEGU, supplied dry and in boxes

3.1.26 One of grease gun, side lever type, suitable for all grease points on MBF and DEGU.

3.1.27 5 kg of each type of grease required for MBF and DEGU

3.1.28 Spare washers (fibre) for all water and fuel valves.

3.1.29 Two each valve handles for each water valve at mixer (one stopcock and two needle/gate valves)

3.2 The following additional equipment items are recommended:

3.2.1 Ten of "crowding"wheelbarros suitable for both wet bricks and fired bricks. Ibstock Building Supplies might be possible suppliers (UK). Pneumatic tyred wheels.

3.2.2 10 stock moulds 190 x 90 x 65

3.2.3 Two each standard sieves to BS 410, of aperture sizes 4 mm, 500 micron, 75 micron. The 500 micron and 75 micron sizes should be stainless steel.

3.2.4 One only cover and receiver set for above sieves.

3.2.5 Two x 100 meters rolls electrical cable, 3 cone for 220 volt 13 amp. Suitable for external use. To be used for emergency lights and/or evening work.

3.2.6 Four of electric plugs to suit spare sockets/outlets on MBF central board, external use.

3.2.7 Four floodlights, external use, 150 watts, each with two spare light bulbs.

3.2.8 If not already supplied one spare L.P.G. bottle for project caravan, 10 kg size, with regulator.

3.2.9 Laboratory oven, simple type, with controller, to heat to 110°C, approx. inside size 300 x 300 x 300 mm, with temperatur indicator.

3.2.10 Six of beakers, stainless steel, 800 ml capacity, tall from (600 acceptable is 800 ml not available)

3.2.11 Laboratory balance, 150gm capacity, simple rugged type, not electric in case with weights if necessary, accurate to 0.1 gm.

3.2.12 Single pan scale, for weighing bricks, capacity, 5 kg, accurate to 1 gm. Mechanical operation, not electric

3.2.13 One set Vernier calibers, to 150 mm

3.2.14 Two sets caliber, 350 mm (minimum) accurate to 1 mm

3.2.15 TV set, portable, 220/240 volt, 50 Hz.
Note: Object is to film brickmaking operations (video) and to use the films in training. W. Buchanan will supply video camera when assigned to the project. The TV set should not be ordered until details of camera are known.

3.2.16 Four "Tilley" lamps, each with two spare mouths suitable for use with paraffin (kerosine) or diesel oil (if possible)
To be used for night time security lighting.

3.2.17 One spirit level, 1 metre long. To be used for checking level of MBF trailer and brick cutter

3.2.18 One First-aid Kit, industrial type, suitable for 15 persons, with first aid instructions in English.

3.2.19 One filler-funnel, large, metal. Inlet about 200 mm, exit about 20 mm diameter

3.2.20 One set of 3 stop switches for stopping the three feed conveyors. To be supplied and fitted near extruder-mixer by SGP. Note that the re-start only to be from control panel.

3.2.21 One stop switch each, at mixer to stop mixer-extruder in emergency, at crushing rolls to stop both rolls in emergency. To be supplied fitted by SGP in easy accessable locations taking into account safety needs.

3.2.22 The DEGU must have electrical connection supplied -fitted to the main trailer for traffic lights.

3.3 In the light of operating experience it should be possible to determine the spare parts requirements of a normal production unit. The operation of the first MBF, in Tanzania, is a pilot plant exercise and in the limited time available for the project there is insufficient time to order and receive spare parts from Europe.

4. The essence of this MBF is that it has been manufactured within a limited budget and cannot hope to fulfill all the requirements of every eventuality which may arise under field conditions. It then rests with operating practice in the field to establish if and how the MBF can produce effectively and efficiently under diverse operating conditions.

4.1 The limited commissioning trials in Austria have indicated some problems already, e.g. the limited mixing in the short single shaft mixer and the refinements needed to provide a better locating-installation system for the brick cutting table and to alter the wire locating devices such that they are effective. Indeed, there is an opportunity for SGP as the first suppliers, to improve upon the design whilst keeping costs down.Four obvious areas are

a) a ten brick side cutter
b. a short double shaft mixer
c. a textering machine
d. a simple single tile press for interlocking tiles and ridge tiles.