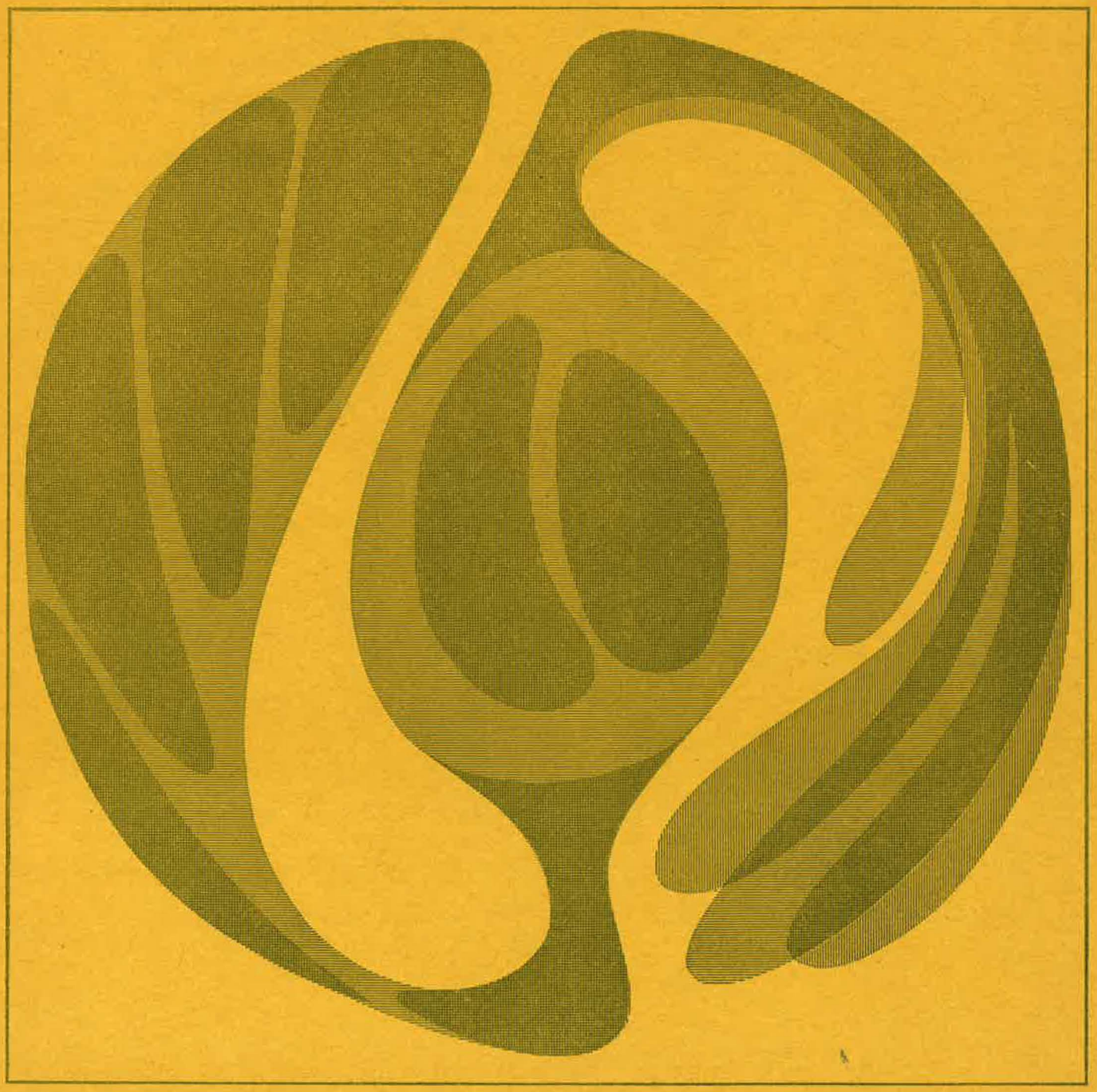
Tropical Products Institute

G141

An industrial profile of wood wool/cement slab manufacture



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An industrial profile of wood wool/cement slab manufacture

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Overseas Development Administration

This report was produced by the Tropical Products Institute, a British Government organisation that co-operates with developing countries in helping them to derive greater benefit from their plant and animal resources. It specialises in post-harvest problems and will be pleased to answer requests for information and advice addressed to the Director.

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NOTE

The Tropical Products Institute has published a number of studies of industries designed to facilitate investment decisions in developing countries. These usually deal in considerable detail with costs as well as physical inputs. This study is limited to the presentation of basic information about industrial processes such as a description of the process, machinery and equipment requirements, raw materials, power, labour requirements, an estimate of capital costs etc. The information provided is not sufficient to enable investment decisions to be taken. This can only be done in relation to the conditions pertaining to a particular geographical location and requires further investigation, taking into account costs and conditions. The study should enable potential investors, in the private or public sectors, to decide if further investigation in the form of a feasibility study, is warranted. Further information can be obtained from the Tropical Products Institute which may be able to carry out feasibility studies, on contract or under Technical Co-operation terms.

Summaries

SUMMARY

This profile describes a process developed at the Tropical Products Institute for the manufacture of wood wool/cement clabs. Unlike other commercially available processes this process involves the use of a cement slurry. The process is aimed at conditions in developing countries and significant features include minimum use of machinery, maximum use of labour, flexibility in production to suit market requirements and relatively low capital outlay. For a plant to produce 160 slabs per day, about £50,000 c.i.f. at September 1979 prices, excluding locally available items, is required. At least 28 employment opportunities are created. The profile includes a description of the process, a list of the machinery and equipment, components of capital cost, physical inputs and labour requirement.

RÉSUMÉ

On décrit un procédé mis au point à l'Institut des Produits Tropicaux pour la fabrication de plaques de laine de bois/ciment. A la différence d'autres procédés existant dans le commerce, le procédé décrit implique l'utilisation d'un coulis de ciment. Le procédé est prévu pour les conditions régnant dans les pays en voie de développement et des aspects importants comprennent une utilisation minimale d'appareillage, une utilisation maximale de main d'oeuvre, une souplesse de production pour s'adapter aux besoins du marché et un investissement relativement faible de capitaux. Pour qu'une installation produise 160 plaques par jour, environ 50.000 livres c.a.f. aux prix de septembre 1979, à l'exclusion des matériaux disponibles localement, sont nécessaires. Au moins 28 possibilités d'emploi sont créées. On donne une description du processus, une liste de l'appareillage et de l'équipement, les composants du coût, des exigences physiques et des besoins en main d'oeuvre.

RESUMEN

En este breve artículo se describe un método perfeccionado en el Instituto de Productos Tropicales para la fabricación de baldosas de lana de madera/cemento. A differencia de otros procedimientos comercialmente disponibles, este método incluye el uso de fangos de cemento. El método ha sido concebido con vistas a su utilización en países en estado de desarrollo y entre sus más importantes características se incluye el mínimo empleo de maquinaria y el máximo uso de mano de obra, así como flexibilidad de producción para satisfacer las necesidades del mercado, y también un desembolso de capital relativamente bajo. Para instalar una planta que produzca 160 baldosas al día serán necesarias unas 50.000 libras esterlinas c.f.s., de acuerdo con los precios vigentes en septiembre de 1979, y sin incluir los materiales que puedan ser obtenidos en la localidad. Se crearán por lo menos 28 puestos de trabajo. El artículo incluye una descripción del procedimiento y una lista de la maquinaria, equipos, componentes de costo principal, entradas físicas y personal obrero requeridos.

An industrial profile of wood wool/cement slab manufacture

INTRODUCTION

Wood wool/cement slabs are a product of the mixture of shredded timber (wood wool) and cement, shaped or formed by pressure into required thicknesses and sizes. The product has useful qualities such as relative lightness in weight, insulation, sound absorption, and good fire resistance and it can be nailed and sawn as required. These qualities lead to its consideration for use in schools, public buildings and low-cost housing where cheapness, insulation, sound-proofing and fire resistance are matters of public concern.

It is used as an infill or as a cladding for 'concrete post and beam' or 'wooden frame' structures for subsequent exterior weatherproof finishing. It is widely used in Europe as a roofing material weatherproofed with bituminous felt. It is used as insulation and/or sound-proofing over concrete or on its own. It is used as a permanent shuttering for poured concrete to form a solid and insulated wall. It is widely accepted as a reliable building component in the construction industry in most developed countries today. It should not be compared with fibreboard and particle board products which are aimed at general woodworking and furniture making applications even though these products might be used for partitioning and insulation in addition to their other applications.

WORLD PRODUCTION

Although the wood wool/cement slab is a well known product in developed countries no figures on actual production are available. Surveys attempted by the FAO in 1968 and 1970 were unfruitful and nothing on a comparable scale has since been attempted.

RAW MATERIALS

The basic raw materials are ordinary Portland cement (OPC), water, chemicals and wood. OPC is very widely available geographically. Water needs to be clean but not necessarily of drinking quality and it must be reliable in supply. Various chemicals can be used, the most popular being magnesium chloride, calcium chloride, and sodium silicate. The cheapest and most easily obtainable one would normally be used.

A large and regular supply of round timber which will provide billets of 50 cm long with a minimum diameter of about 10 cm is required. A cautionary note is that all cellulosic materials inhibit to one degree or another the setting of cement. It is therefore essential in every wood wool/cement slab project to test all timbers under consideration for such use before the overall feasibility of the project can be assessed.

PROCESSING METHODS

Several commercial processes are available worldwide, all showing similarities. This profile looks only at the process developed by the Tropical Products Institute which again shows similarities to other systems, but also differences. These differences are thought to be significant in that some features of the system are aimed at conditions in developing countries. Essential machinery for example has been reduced to a minimum. Furthermore much of the equipment is designed to be manufactured locally, thereby reducing substantially the import need in some countries. It is important to ensure the correct cement-water ratio and this is achieved by the use of a centrifuge and a cement slurry. The slabs are produced to finished sizes in fully enclosed moulds. Therefore no cutting and trimming is needed and hence there is no waste and there are no exposed bare ends which would be a starting point for any possible bio-deterioration. The system is fundamentally labour-intensive with basic process control ensured by the centrifuge.

DESCRIPTION OF THE PROCESS

Logs are de-barked.

De-barked logs are stacked for about 3 months in the open air for conditioning, and fermentation of sugars which inhibit the setting of cement.

De-barked logs are cut into 50 cm lengths with parallel ends.

These lengths are shredded by machine to produce wood wool.

The wood wool is forked by hand into a wire basket.

The wire basket is transferred by hoist into a tank containing a weak solution of calcium chloride, or the preferred chemical.

The soaked wood wool is transferred by hoist into an adjoining centrifuge.

Excess solution is spun off the wood wool in the centrifuge.

The basket of spun wood wool is removed from the centrifuge by hoist.

A slurry of two parts cement to one of water is prepared.

The wood wool and slurry are transferred to a mixer.

The cement slurry is mixed with the wood wool.

The mixture is emptied into a mould and evenly distributed in the mould by hand.

It is then pre-pressed to the approximate required dimensions.

The pre-pressed slabs still in their mould bases are stacked in batches weighing one tonne.

The batches are then final-pressed to the required finished dimensions and lashed to prevent spring-back or re-expansion.

Each batch is removed from the press and left for about 16 hours to allow the slabs to cure.

Straps are removed, slabs are de-moulded and stacked for about 4 days with battens between each pair to continue curing and facilitate dispersal of heat produced through exothermic action.

Slabs are close stacked or stored, without battens, for a minimum of 10 days for final curing after which they may be sold.

MACHINERY AND EQUIPMENT

Components which are not normally manufactured in most developing countries are given in Column A while Column B lists equipment which may be made locally:

	No. of units	
	A	*B*
De-barker with motor	1	
Cross-cut saw with motor	1	
Wood wool shredding machine	1	
Compressor	1	
Electric automatic cutter grinder for sharpening	1	
Preparation tools (forks, rakes, shovels etc.)	1	
Protective creams and clothing	1	
Mixing and soaking tanks and drums	1	
Glass fibre for container fabrication and repair	1	
Centrifuge with wire baskets	1	
Electric hoists and slings	3	
Runway systems with brackets and track	1	
Platform scale	1	
Trolleys	2	
Cement slurry mixer with motor and pump	1	
Wood wool and slurry mixer with motor	1	
Platform and access ways with hand rails	1	
Conveyor	1	
Hydraulic pre-pressing machine	1	
Hydraulic final pressing machine	1	
Moulds with surrounds and pistons		540
Battens		6,000
Spacers		400
Pallets		50
Pallet trucks	2	
Mould straps or lashings	80	
Moisture meter	1	
Maintenance and repair kit	1	
Spares kit	1	

The equipment in Column B is made from timber and should therefore be available in most developing countries, but some of the items in Column A, for example trolleys, clothing, conveyors, trucks and access ways should also be procurable in many countries. Depending on the existing workshop facilities other items in Column A could also be made locally, for example the centrifuge, slurry mixers and hydraulic presses, thereby saving on shipping costs and foreign exchange.

CAPITAL REQUIREMENTS

There are many components of capital requirements such as land costs, civil engineering (designs, drawings, site preparation and finishing etc) buildings, machinery and equipment landed on site, training of personnel, and working capital.

The area of ground needed for a site needs to be carefully estimated. Much more than the factory floor space is required. For a plant of the size specified here producing 160 slabs per day and including an office, an area of about 1,000 m^2 is needed but consideration should be given to the possible need for expansion of capacity, for canteens, toilets, access ways, gateways, reception areas, car parks, vehicle movement, safety, security, fire risks, effluent disposal and fencing. The area decided upon could be several times the factory floor space.

The cost of suitable sites will vary greatly from one country to another, from one location to another and little guidance can be given as to the capital requirements for this component.

Building costs also vary greatly according to location and type of structure. Several types of buildings might be deemed to be required, for example a separate office, canteen, product store, but in this case one overall open warehouse-type structure is envisaged with little in the way of special features beyond the normal local regulations relating to buildings. A fairly low cost structure therefore is assumed. Any outer or dividing walls can be infilled by using the first test runs of the new factory, thereby reducing building costs.

Civil engineering costs in this case, given a fairly normal site in terms of clearance requirements, proximity to infrastructural services such as electricity, water, sewage, and roads and the comparative simplicity of the site layout, should not be excessive. Although it is difficult to generalise, perhaps a rough guide to use would be a quarter of building costs.

Machinery and equipment costs landed on site include such elements as cost of imported machinery, its c.i.f. costs to the port of entry and subsequent transfer to site, import duties, cost of locally-made equipment and its transfer to site. Total costs are about £50,000 at September 1979 prices and a further cost should be allowed to land the equipment on site. The cost of locally-made equipment will vary from country to country.

Installation of machinery and equipment in this sort of plant is not a very complicated operation although some care is required in providing the foundations for the shredding machine. It would however require the services of specialist personnel during the installation and start-up period. Costs include such components as salaries of specialists throughout the period of possibly several months, their fares to and from site, local accommodation, local unskilled workers to assist them and local materials.

Training of local personnel in operational techniques is essential. In most circumstances this would involve the training of probably two people for up to six months in the United Kingdom as well as on site during the commissioning and hand-over period. Technical training can be provided at the Tropical Products Institute.

Working capital is an essential component of capital estimates. Various methods of estimating are used. The important consideration is that sufficient allowance be made.

PHYSICAL INPUTS

The principal physical inputs are wood, cement, water, chemicals, electricity. For a plant of this size the following are the inputs per tonne of wood wool output:

Wood	261 kg
Cement	524 kg
Water	262 kg
Chemicals	5 kg
Electricity	77 kWh

LABOUR REQUIREMENTS

This type of plant could be termed labour-intensive and in some circumstances therefore very suitable for developing countries. The following details the skilled (S) semi-skilled (SS) and unskilled (US) requirements for this size of plant:

Operation	*No.*	*Type*
Log yard	2	US
Cross-cut and debarking	2	S
Shredding	1	S
Basket loading	1	SS
Spinning	1	SS
Wood wool mixing	1	SS
Slurry mixing	1	S
Spreading	4	SS
Prepressing	2	SS
Final pressing	1	SS
Stacking	1	S
Demoulding	2	SS
Final stacking	1	S
Mould cleaning	3	US
General labour	1	US
Cleaner, sweeper	1	US

In addition a manager, foreman and clerk would be minimum requirements.

OTHER INFORMATION REQUIRED BY INTENDING PROCESSORS

For the completion of a feasibility study the following areas need also to be studied:

Availability of raw materials and their technical suitability for processing.

Availability of a reliable supply of water.

Market requirements in terms of the price, size and quality of the product.

Availability of transport.

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Figure 1
Plant layout for the Tropical Products Institute process