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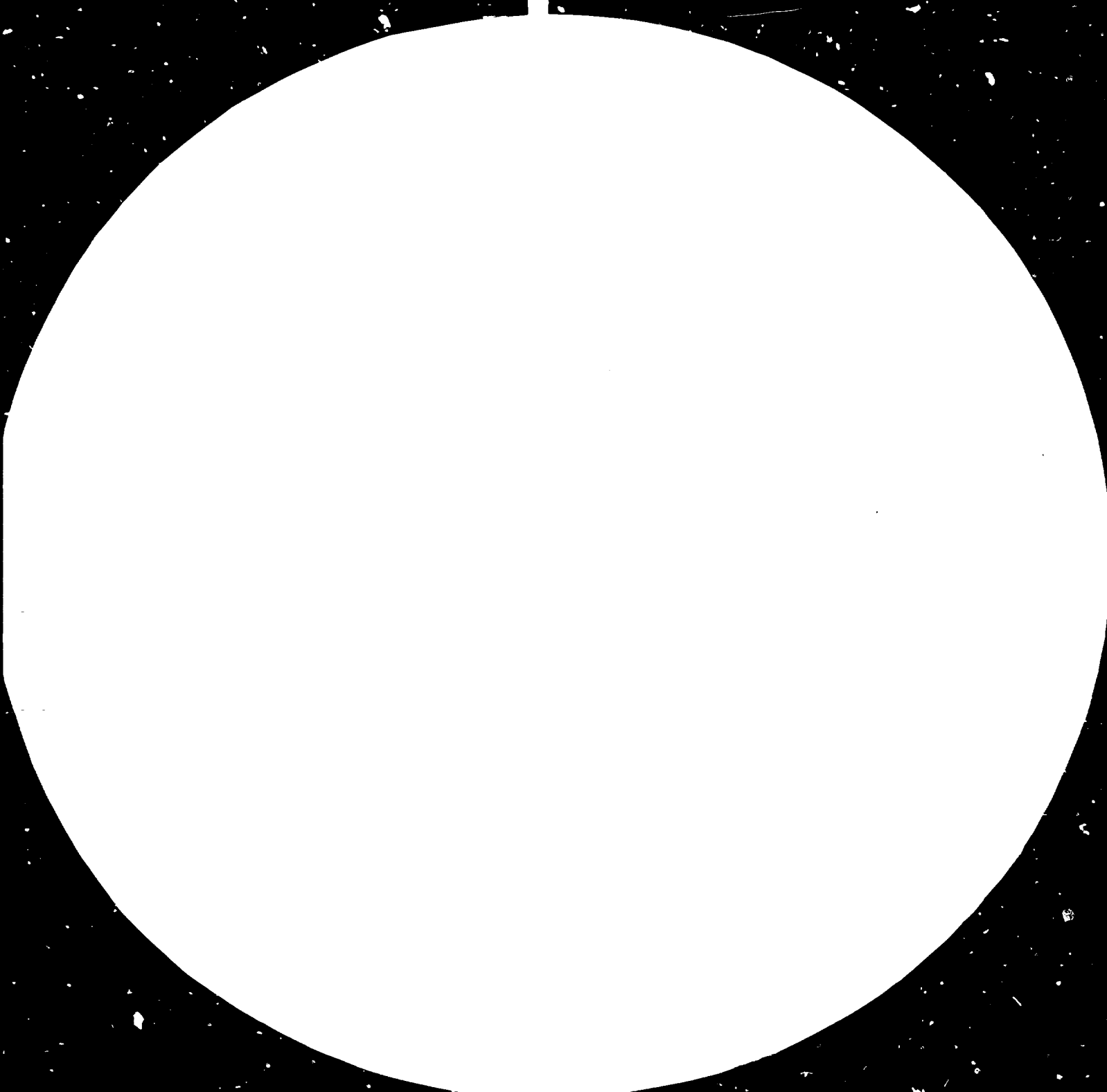

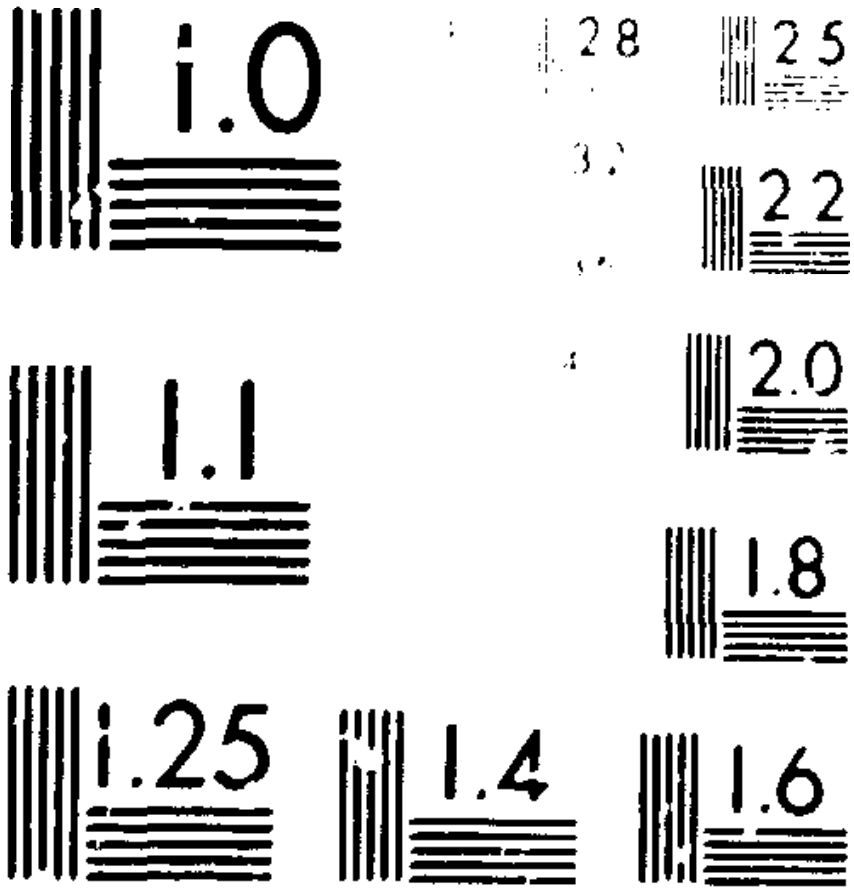
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UNIDO-Czechoslovakia Joint Programme
for International Co-operation in the Field of Ceramics,
Building Materials and Non-metallic Minerals Based Industries
in Pilsen - Czechoslovakia

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PROFILES OF BRICK PLANTS .

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November 1979

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I. INTRODUCTION

While the Profiles of Manufacturing Establishments, volumes I - III, published by UNIDO are concerned predominantly with economical parameters of industrial plants having been in operation for some years inclusive of brick plants, and the Brickmaking Plant - Industry Profile, published by UNIDO within the Development and Transfer of Technology Series, is dealing with the technology of brickmaking supplemented with a review of investment and manufacturing costs as well as sales revenues, the submitted paper is focused on a series of mechanized brickworks suitable for potential deliveries to developing countries. It should give the reader a more detailed view of the extent of manufacturing equipment, degree of mechanization and technical parameters of the brick plants and advise him on how to proceed with the preparation of such a project.

Explanatory Notes

Informative prices of machinery refer to quotations in November 1979.
References to tons are in metric tons.

II. BRIEF TECHNOLOGIES OF BRICK PLANTS DESCRIBED IN THE PROFILES

Technologies of brick manufacture in general

The technology of brick manufacture may be subdivided into partial technologies related to particular phases of the production process consisting of body preparation, shaping, drying and firing. The applied technologies may be summarized as follows:

Body preparation	- wet preparation process
	- dry preparation process
Shaping	- soft mud extrusion process
	- stiff mud extrusion process
	- semi-dry pressing
	- soft mud making process
	- vibration-compaction process
Drying	- artificial drying
	- natural drying
Firing	- continuous firing process
	- intermittent firing process

The series of the described brick plants comprises the following capacities:

Yearly output of a brick plant	Type of kiln
32 mill. bricks	Tunnel kiln oil-fired
20 mill. bricks	Annular kiln oil-fired
10 mill. bricks	Annular kiln oil-fired
5 mill. bricks	Annular kiln oil-fired
20 mill. bricks	Annular kiln coal-fired
10 mill. bricks	Annular kiln coal-fired
5 mill. bricks	Annular kiln coal-fired
2-3 mill. bricks	Annular kiln coal-fired

All the described brick plants use the wet process in the phase of body preparation and the soft extrusion process in the phase of shaping.

The brick plants of yearly output of 32, 20 and 10 millions of tons per year include artificial driers while in the plants producing 5 and 2-3 millions of bricks natural drying is applied.

The continuous firing process takes place in all the described plants. If specified, it is the moving ware continuous process conducted in the tunnel kiln in the variant of 32 millions of bricks per year and the moving fire continuous process in the annular kilns in the other cases.

In general, however, the applied technologies depend on the type of brickware to be produced (solid brick, cored bricks, blocks, tiles) and on the properties of available clays (soft clays slaking in water, non-slakable clays, harmful incretions).

Technology of brickworks producing 32 millions of bricks per year (Table No. 2)

Preparation shop and moulding shop

The raw material from the storage dump is conveyed into the box feeder. Hence an inclined belt conveyer feeds it into the edge runner mill where the raw material is disintegrated, wetted by adding water, partly homogenized and forced through the openings in the grinding path into a plate mixer under the mill.

The raw material discharged from the plate mixer is conveyed by means of an apron conveyer with closed pans into a fine-grinding roller mill. After being ground, the fine-grained material falls onto a short reversing belt conveyer which feeds either of the two large-capacity box feeders before two shaping lines by means of link-up inclined apron conveyers with closed pans. The feeders serve as a reserve before the shaping lines proper as well.

From every feeder the raw material is transported by an inclined apron conveyer with closed pans into a double-shaft mixer with steaming through, where it is plasticated, homogenized and the shaping consistency is finally corrected. The processed raw material then falls into the feed hopper of the vacuum auger machine. Here it is compacted and shaped into a column from which bricks are cut by means of a cutter. The further transport of green moulded bricks is provided by an automatic line setting them on metallic

laths and loading them onto a column storage receiver on the wet side of the drier.

Drying

From the storage receiver the bricks on laths are withdrawn by four-column finger trucks which again, after being transferred by electrical transfer tables to artificial driers, set them on ledges in drying chambers.

In every compartment, there are provided two aisles. The circulation of the drying medium is secured by means of rotomixers travelling between the aisles. The drying medium is the hot air generated in the heat exchanger by firing fuel oil and adding waste heat from the kiln. The mixture is delivered to particular compartments by a fan through distribution piping.

The anticipated drying cycle of a double-compartment should be 48 hours. Dried bricks are removed from the drier by means of four-column trucks on electrical transfer tables and are stored in the column storage receivers on the dry side of the drier. After being re-loaded on conveyer and after automatic release of laths, dry bricks are conveyed by means of apron conveyers with closed pans to loading places where they are loaded by hand onto kiln cars.

Firing

The dried bricks are fired in a tunnel kiln. They are set on kiln cars in packs so that they may be easily withdrawn by means of a high-lift truck after firing. The successive final drying and heating of dried pieces in the kiln is carried out by hot air which can be transferred from the kiln cooling zone.

It is necessary to charge the kiln with dried bricks of good quality only (i.e. free of cracks and other mechanical defects), lest unnecessary burning losses should occur. Dried pieces of poor quality should be separated and returned to the raw material storage.

The assumed firing cycle takes 40 hours.

Dispatching

Burnt products are taken from the kiln cars by means of a fork-lift truck and stored in the finished product store.

Rail transport

The motion of kiln trucks both with dry bricks to the kiln and with burnt bricks from the kiln to unloading places as well as the circulation of empty kiln trucks is provided for by means of a mechanized rail transport system.

Kiln truck repair shop

Defects on kiln trucks are removed on a storage siding in the kiln truck repair shop.

Oil system

The oil system equipment provides for continuous supply of fuel oil. It consists of storage tanks, pumps, distribution pipings and safety devices. A reserve for approximately 28 days of operation is stored in the tanks.

Emergency generator

The emergency generator provides for electric power supply to those units where serious damages could occur due to failure in power supply.

Technology of brick plants producing 20 and 10 millions of bricks per year (Table Nos. 3, 4 and 6,7)

This brief technology description applies both to the plants producing 10 and 20 millions of bricks per year, the manufacturing process being identical. The machinery equipment of the both variants is the same in the phases of body preparation and moulding. The double output is achieved by the larger plant running two shifts per day while the smaller one works 1 shift per day. In the phase of drying and firing there are two driers and two kilns to achieve the yearly output of 20 mill. bricks.

Preparation shop

The raw material from the storage dump is conveyed into the box feeder and then uniformly fed to the edge-runner mill by means of an inclined belt conveyer. In this mill the raw material is disintegrated, wetted by addition of water, partly homogenized, then forced through the holes in the edge-runner pan into a plate-type mixer located under the mill. From this mixer the raw material is conveyed into a roller mill for fine grinding. It is then conveyed by a steep conveyer into a box feeder, which serves for feeding uniformly the auger brick machine.

Brick moulding shop

From the box feeder the raw material falls into the charging hopper of the auger where the final correction of humidity, homogenization and density of the body takes place.

The auger extrudes a column which is cut by a circular cutter into bricks which are set automatically on laths and into a single-column loader. The columns are then pushed into a six-column storage receiver.

Drying

From the storage receiver always four columns are released by a column truck and transported on an electrically driven transfer table into artificial driers with impulse drying. The drier consists of particular chambers. Circulation of drying medium is ensured by rotomixers travelling between the aisles in the chambers. The drying medium is the hot air, heated in the oil-fired heat exchanger. Also the waste heat from the kiln is utillized. The hot air is delivered into individual chambers by means of a fan and distribution piping.

The drying cycle is assumed to be 48 hours. Dry bricks are withdrawn from the drier by the four-column

truck on an electrically driven transfer table and set in a six-column storage receiver on the dry side of the line.

Here the laths are released and the dry bricks are conveyed on a belt conveyer to three loading points. At these loading points the dry bricks are arranged by hand into packs and transported by high-lift trucks to the moving fire continuous kiln.

Firing

Dried bricks are fired in the moving fire continuous kiln of Hoffmann type. The kiln is situated in such a way that the transport routes are as short as possible. The kiln has 22 chambers, each of capacity 48 cu.m. The chambers are charged with packs of dry bricks by means of high-lift trucks. The packs are set on elevated supports arranged in such a way as to ensure the required pattern of setting.

The residual moisture content of dried bricks is up to 3%. The kiln should be charged only with dried bricks without cracks and other mechanical defects to avoid unnecessary losses during firing.

The principle of the moving fire is well known. At any time dried bricks are set in a chamber and fired bricks drawn from another chamber, while fuel is fed

to the firing zone. The combustion gases pass through the pre-heat zone warming up the unfired bricks before being exhausted to the stack. The heat recovered by cooling the fired products is utilized for preheating the combustion air and for the drier.

Fired bricks are withdrawn by means of high-lift trucks provided with hydraulic tongs.

Dispatch

The withdrawn products are deposited in the storage yard and then dispatched as required.

Note: Alternatives of brick plants with oil-fired and coal-fired kilns differ in some items in the chapters III, IV, V and VII of the Tabl

Technology of brick plants producing 5 millions of bricks per year (Table Nos. 5 and 8)

Preparation shop and pressing shop

The raw material extracted in a clay pit is delivered into a box feeder dosing it uniformly onto an inclined conveyer belt. The belt conveys the raw material to the toothed rolls where it is disintegrated. The dressed raw material is transported by an apron conveyer with closed pans into a two-shaft mixer. A further inclined conveyer serves to transport the mixture to fine rolls where it is ground to the size of 1.5 to 2 mm and passed by means of an inclined conveyer into a box feeder before a worm press. The final homogenization and compacting of the mixture are carried out in the worm press (= the auger).

The column leaving the press is cut-off by a wire cutter into bricks of required lengths which are transported to the column loaders on a horizontal conveyer belt. The moulded bricks are manually unloaded from the belt and are loaded on laths into the column loaders.

Drying:

Moulded bricks on laths are unloaded from the column loaders by column trucks and transported on transfer tables to through-pass natural driers.

Dried bricks are removed from the driers by means of column trucks and are loaded on the column loaders located on the opposite side of the driers.

Dried bricks with laths are lowered in the loaders on the bantam-wheeled trucks with swivelling platforms intended for the transport of dried pieces to the kiln

for firing. After the dried bricks have been set in the kiln the laths are transported back to the loaders for further loading.

Firing

Dried bricks are fired in the moving fire continuous kiln. The kiln is situated so that the transport routes are as short as possible. The kiln consists of 14 chambers of 38 cu.m. capacity each. The total capacity of the kiln amounts to 532 cu.m. When designing the kiln capacity the average batch of 235 pcs/cu.m., i.e. approx. 658 kg/cu.m. has been taken into account.

Bricks of 4 to 5% of residual moisture content are charged into the kiln. Slow after-drying and heating the dried bricks in the kiln is effected by hot air which can be supplied from the kiln cooling zone. For this purpose a set of piping with a connection to the transfer channel in the kiln body is installed on the kiln.

In order to avoid unnecessary losses during the firing only high-quality dried bricks are to be charged into the kiln, i.e. without cracks and other mechanical defects. Low-quality dried pieces must be separated and returned back to the raw material stockyard.

The stacking of products in the round kiln is carried out manually. The stacks must allow an easy passage of combustion products and gases generated during the ware firing in the kiln. Carefully stacked bricks secure a continuous and smooth firing process in the kiln.

After the whole chamber has been filled the filling hole is to be closed by two walls of bricks laid on clay mortar. Both the walls must be provided with clay plaster, too.

The walls are mutually separated by an air gap of approx. 20 cm which improves the insulation against the external atmosphere.

Special care must be paid to the entire firing process and the operation of the kiln because this technological section is of the maximum effect on the final quality of products.

Temperature in the kiln burning zone will be checked by an optical pyrometer as required.

Note: Alternatives of brick plants with oil-fired and coal-fired bricks differ in some items in the chapters III, IV, V and VII of the Tables.

Technology of brick plants producing 2 - 3 millions of bricks per year (Table No. 9)

The manually extracted raw material loaded on tractor tipping trailers is delivered to the plant, where it is filled into a box feeder. Discharged by the feeder it is conveyed by an inclined belt conveyer to idle toothed rollers. Here the raw material is crushed to the fineness of 10 - 15 mm and then transported by means of another belt conveyer to a fine roller mill, where it is ground with the gap between runners being approximately 2 mm. The raw material is then transported by means of a further belt conveyer to a two-shaft through-type mixer, where it is wetted and mixed with water thoroughly. It falls then into the charging hopper of an auger machine.

From the auger the raw material is extruded through the mouth in the form of a moulded column which is cut into bricks by means of a cutter. These wet bricks are transferred by hand onto platform trucks and conveyed to the drying area. The area must be flat, with a solid surface and rain water drainage. If the bricks are too soft, it is necessary to set them flat at first, after their partial drying and getting harder, bricks are stacked and dried.

Dry bricks are loaded on platform trucks and charged into the annular kiln. In the kiln bricks are arranged in patterns with gaps in between and fired.

The bricks are then transported to the stockyard or directly to the transport vehicles for dispatching.

III. PROFILES OF BRICK PLANTS

The Profiles comprise reviews of processing machinery based on actual projects, technical parameters, labour requirements, areas required for production premises and informative prices of machinery. The presented plants are mechanized and represent a rational manufacturing process. Nevertheless, the extent of machinery can be substantially reduced if e. g. labour is cheap and abundant in the respective country. Such a reduction, after a thorough economic calculation, may be applicable especially in the internal transport of materials and semi-products. There may be another case where the artificial drier may be excluded from a delivery to an arid country. On the contrary, an enterpreneur in a country with long-lasting periods of high air humidity will hardly dispense with such a drier.

The particular variants of brick plants with selected production factors are summarized in Table No. 1. The separation of plants with oil-fired kilns from those ones with coal-fired kilns in Table Nos. 1 to 9 was done intentionally. Although there are differences only in some items of parts III, IV, V and VII of the Tables with regard to this arrangement a clear survey from this point of view is obtained for parties interested either in fuel oil or coal basis. There is no doubt that with rising fuel oil prices there will be many developing countries unable to afford to fire bricks with fuel oil.

[illegible] No. 2 - SELECTED PRODUCTION FACTORS OF MECHANIZED BRICK PLANTS

[illegible] per output and type of kiln	Raw material consumption	Fired bricks gross output	Specific drying heat per kg of fired products +	Specific firing heat per kg of fired products +	Total specific consumption per kg of fired products
	ton/year	ton/year	MJ/kg	MJ/kg	MJ/
30 mill. bricks oil-fired annular kiln	143,000	93,100	0.945	1.464	2.4
20 mill. bricks 2 oil-fired annular kilns	92,140	59,572	1.230	1.172	2.4
10 mill. bricks oil-fired annular kiln	45,690	29,786	1.230	1.172	2.4
5 mill. bricks oil-fired annular kiln	22,900	14,900	- natural drier	1.172	1.1
20 mill. bricks 2 coal-fired annular kilns	92,140	59,572	1.237 —	- 1.339	1.2 1.3
10 mill. bricks Coal-fired annular kiln	45,690	29,786	1.237 —	- 1.339	1.2 1.3
5 mill. bricks Coal-fired annular kiln	22,900	14,900	- - natural drier	- 1.339	- 1.3
2-3 mill. bricks Coal-fired annular kiln	15,000	9,670	- - natural drier	- 1.465	- 1.4

+ Specific heat data are calculated per 1 kg of kiln gross output. The net yearly out and [illegible] rejects in the annular kilns. However, the actual percentage of rejects w discipline.

ES

et +	Total specific consumed heat per kg of fired products	Total fuel consumption per year	Electric power installed input	Electric power total consumption per year	Technol. water total consumption per year	Water for social conveniences consumption per year
	MJ/kg	ton/year	kW	GJ/year	cu.m/year	cu.m./year
	2.409	5,700 heating oil	1,464	11,340	29,300	1,450
	2.402	3,636 heating oil	489	4,455	17,000	1,075
	2.402	1,818 heating oil	454	3,240	8,500	700
	1.172	444 heating oil	203	1,544	4,100	1,050
	1.237 1.339	h.oil 1,872 5,014 coal	454	3,663	17,000	1,075
	1.237 1.339	h.oil 936 2,507 coal	424	2,585	8,500	700
	- 1.339	h.oil - 1,254 coal	113	852	4,100	1,050
	- 1.465	h.oil - 846 coal	150	486	1,800	950

yearly outputs are calculated on approx. 4% of rejects in the tunnel kiln
of rejects will depend on the quality of used clay and on the technological

SECTION 2

ic total ption ar	Technol. water total consumption per year	Water for social conveniences consumption per year	Direct production workers total	Required area of production premises	Estimated price of machinery free Euro-pean ports	TABLE
ar	cu.m/year	cu.m./year	number	sq.m.	000 US $	
0	29,800	1,450	58	10,000	3,552	2
55	17,000	1,075	43	6,400	1,548	3
0	8,500	700	28	4,000	986	4
4	4,100	1,050	42	2,400	459	5
63	17,000	1,075	43	6,400	1,445	6
35	8,500	700	28	4,000	932	7
	4,100	1,050	42	2,400	391	8
	1,800	950	38	1,000	192	9

in the tunnel kiln
the technological

SECTION 3

Explanatory notes to particular variants

a) Variant of 32 mill. bricks with oil-fired tunnel kiln - Table No. 2

Ad part III: The transport process of green moulded bricks between the extruder and the column storage receiver on the wet side of the drier as well as the transport of dry green bricks between the column storage receiver on the dry side of the drier and the laths releasing and bricks transloading station are automated.

The main purpose of this automated section is to eliminate defects on green bricks that would otherwise be considerable in manual handling.

The tunnel kilns are applied for larger outputs where they achieve a good fuel economy. They may be oil-fired or gas-fired. The uniform firing temperature in the cross-section of the kiln and the possibility of following the prescribed firing curve guarantee good quality of products and low percentage of rejects. Coal-firing is not applicable.

The contracts for deliveries of larger plants with considerable consumption of electric power include as a rule electrical substation and power distribution system.

b) Variant of 20 mill. bricks with oil-fired annular kiln - Table No. 3

Ad part III: Also in this case the transport of green bricks to and from the drier is partly automated for the purpose of a low rejects percentage. The two continuous annular kilns exhibit also a good fuel economy and the delivery is much cheaper in comparison with a tunnel kiln.
In this variant an electrical substation and power distribution system are not included in the delivery.

c) Variant of 10 mill. bricks with oil-fired annular kiln - Table No. 4

Ad part III: The transport of green bricks from and to the drier is partly automated for the purpose of a low rejects percentage. The kiln is of the same type and size as in the foregoing case.
An electrical substation and power distribution system are not included in the delivery.

d) Variant of 5 mill. bricks with oil-fired annular kiln - Table No. 5

In this variant a natural drier is applied and, consequently, there is no oil required for the drying process. The kiln is sized adequately to the required output. An electrical substation and power distribution system are not included in the delivery.

e) Alternative variant of 20 mill. bricks with coal-fired annular kiln - Table No. 6

Ad part III: The design of kilns is identical with oil-fired kilns. The main difference consists in the application of mechanized coal stokers instead of oil burners. The stokers feed ground coal through chutes in the top of kilns into the chambers of the firing zone. The oil-fired drier, however, requires also the oil system.

Ad parts III, IV: These parts include coal consumption for the kilns and fuel oil consumption for the driers.

f) Alternative variant of 10 mill. bricks with coal-fired annular kiln - Table No. 7

The same note as in the preceding paragraph applies to this variant.

g) Alternative variant of 5 mill. bricks with coal-fired annular kiln - Table No. 8

Ad part III: The design of kiln is identical with the oil-fired kiln of the same size. Oil burners are replaced by mechanical coal stokers.

Ad parts IV, V: With regard to the application of a natural drier only coal for kiln firing is consumed.

h) **Variant of 2 - 3 mill. bricks with coal-fired annular kiln - Table No. 9**

Ad parts I, IV, V: The plant can produce 2 - 3 millions of bricks per year. The applied calculation is based on 3 millions of green moulded bricks representing 2 675 000 fired bricks in the final net output.

Ad part III: The specification of machinery includes in this case also a transport equipment of raw material from the pit to the plant.

Only the phase of body preparation and moulding is fully mechanized. The drying is carried out on a flat, solid surface with water drainage. Therefore no drier equipment is listed in the specification.

Ad part VI: The manning table includes in this case also workers for clay winning and transport to the plant.

Table No. 2 PROFILES OF BRICK PLANTS

BRICKWORKS 32,000,000 bricks per year (with oil-fired tunnel kiln)

I. ANNUAL PRODUCTION CAPACITY 32,000.000 fired bricks

II. TECHNOLOGICAL FEATURES

Assortment: Perforated bricks (20% of volume) dimensions 240x115x72 mm
1 fired brick=2.8 kg

Raw materials: Supposed clay of average properties absorbing 20% of water of plasticity and losing 14% of dry substance in firing process

Time capacities:

Number of working days	300/year
Number of working shifts	2/day
Effective working time	7 hrs/shift
Operation time except drier and kiln	4,200 hrs/year
Operation time of drier	7,200 hrs/year
Operation time of kiln	8,400 hrs/year

III. SPECIFICATION OF MACHINERY

- in technological sequence

Preparation and moulding shop	Pcs
Three-compartment box feeder	1
Belt conveyer incl. iron particle indicator	1
Edge runner mill for wet grinding process	1
Plate-type mixer	1
Apron conveyer with closed pans	1
Fine roller mill incl. 2 machines for regrinding the rolls	1
Reversing belt conveyer	1
Apron conveyer with closed pans	2
Box feeder with rubber belt	2
Apron conveyer with closed pans	2
Two-shaft extrusion mixer	2
Vacuum auger machine with 2 mouthpieces	2
Automatic line providing transport of moulded bricks from the brick cutter, setting of bricks on laths and loading onto column storage receiver on the wet side of the drier; unloading dried bricks from the column storage receiver on the dry side of the drier, separating dried bricks from laths, reloading bricks for further transport and laths for recirculation.	2
Electric transfer table incl. four-column truck	2
Belt conveyer	4
Truck for four-column multi-stage trucks	1 set
Track for electric transfer table	1 set
Steel supporting structures and platforms	1 set
Steel chutes and feed hoppers	1 set
Metallic laths 50x30x1,540 mm as transport supports for moulded bricks during drying	44,800

Driers

Hot-air compartment type drier incl. inlet fans, exhaust fans, oil-fired hot-air exchangers, interconnection and exhaust piping, steel structure of drier stages, rail tracks in drier compartments, drier gates, transport and hoisting trucks of drier gates incl. rail track, drawing rotomixers, drawn rotomixers, measuring and regulation equipment, hot-air supply piping from tunnel kiln to drier.	2

Note:

Both the drier compartments proper and the mixing compartments built of brick masonry are usually supplied by the buyer.

Tunnel kiln	Pcs
Oil heated tunnel kiln of the gross output 93.000 t/year	1
The delivery consists of steel accessories, machinery, air handling equipment, kiln ironing and auxiliary equipment, burner system, insulation and coats, measuring and control system, electrical installation, structural and lining materials for tunnel kiln.	
Kiln cars incl. lining materials	115
Rail transport	
Electric cable-type transfer table	2
Drawing chain conveyer	3
Pressure chain-type conveyer	3
Hydraulic pusher	5
Cable-type pusher	5
Trackage of mechanized rails	1 set
Kiln car repair shop	
consisting of automatic dripping hammer, compressor, work bench, swivel vice, truck concrete mixer, hydraulic jacks, hand winch, vibrator, pulley block	1 set
Oil system	
Fuel oil storage tank of 125 cu.m volume	2
Two-filter battery	2
Collecting setting tank	1
Fuel oil service tank	3
Horizontal gear pump in the distribution system	12
Distribution piping	3 sets
Auxiliary materials	1 set
Insulation of storage and collecting setting tanks, of supply and circulating piping	1 set
Emergency generator	
Power generator 200 kVA driven by oil engine	1
Set of basic piping and equipment	1 set
Electrical Installation	
Transformer station containing two outdoor three-phase oil-immersed transformers each of 800 kVA, one switchgear, two compensating switchboards, one main LT switchboard and interconnections	1

Table No. 2 - continuation

PROFILES OF BRICK PLANTS

BRICKWORKS 32,000,000 bricks per year (with oil-fired tunnel kiln)

IV. TECHNICAL CHARACTERISTICS OF MAJOR UNITS

Moulding lines

Capacity	35,000,000 pcs/year 8,334 pcs/hour (green moulded bricks)

Driers

Gross throughput	35,000,000 pcs/year
Working capacity	7,200 hrs/year
Drying cycle	48 hours
Specific drying heat consumption per kg of fired products	0.945 MJ/kg
Fuel oil consumption	310.56 kg/hour 2,236 t/year

V. RAW MATERIALS AND ENERGY INPUTS

Consumption of raw material in extracted condition	143,000 t/year
Consumption of fuel oil	5,700 t/year
Installed electric power input	1,464 kW
Electric power consumption	11,340 GJ/year
Consumption of technological water	29,800 cu.m/year
Consumption of water for social conveniences	1,450 cu.m/year

VI. LABOUR

Production workers

Shifts	1st	2nd	3rd	4th
Preparation shop	2	2	-	-
Moulding shop + handling of laths	6	6	-	-
Drying incl. heat exchangers	2	2	2	2
Firing	2+2	2	2	2
Handling of products	6	6	-	-
Transport of dried pieces and products	4	4	-	-
Kiln car repair shop	2	-	-	-
Oil system	1	1	-	-
	27	23	4	4

In the total of 58 workers only direct production workers are included. The number of maintenance workers (electricians, fitters) should be determined with regard to their qualification in respective countries.

VII. SUPPLEMENT

Required area for production premises	10,000 sq.m
Informative price of machinery free European ports	3,552,000 US $

III. Continuation

	Pcs
Box-type subdistribution boards	10
Control desks and columns for machines on rail transport	10
Electrical installations from distribution boards to motors	1 set
Electrical installation of the production premises	1 set

Tunnel kiln

Number of installed kilns	1
Kiln design	Oil-fired tunnel kiln
Firing temperature	app ox. 1000°C
Fired ware	Perforated bricks 240x115x72 mm 1 brick=2.8 kg
Gross output	33,250,000 pcs/year 3,958 pcs/year
Gross weight output	93,100 t/year
Kiln overall dimensions:	
- length	143 m
- max. building width	5.80 m
- max. building height	3.60 m
Furnace dimensions:	
- height above kiln car deck	1.93 m
- width	3.60 m
Kiln car dimensions:	
- length	2.80 m
- width	3.60 m
Gross volume of storage	2 x 5.94 cu.m
Firing process:	
Firing cycle	40 hours
Number of burnt kiln cars/year /hour	10,673 1.270
Required number of kiln cars	51 in tunnel kiln 54 stand-by for 42 hours 10 reserve
Burners	Oil-fired ceiling mounted burners
Power and fuel consumption:	
Specific heat consumption per kg of fired products	1,464 MJ/kg
Calorific value of fuel oil	39.35 MJ/kg
Fuel oil consumption	412.38 kg/hour 3,464 t/year
Installed electric power input	180 kW
Electric power consumption	135 kWh/hour

Table No. 3 PROFILES OF BRICK PLANTS

BRICKWORKS 20,000,000 bricks per year (with 2 oil-fired annular kilns)

I. ANNUAL PRODUCTION CAPACITY: 20,000,000 fired bricks

II. TECHNOLOGICAL FEATURES

Assortment: Perforated bricks (20% of volume) dimensions 240x115x72 mm
1 brick=2.8 kg

Raw materials: Supposed clay of average properties absorbing 20% of water of plasticity and losing 14% of dry substance in firing process

Time capacities:

Number of working days	300/year
Number of working shifts	2/day
Effective working time	7 hrs/shift
Operation time except drier and kiln	4,200 hrs/year
Operation time of drier	7,200 hrs/year
Operation time of kiln	8,400 hrs/year

III. SPECIFICATION OF MACHINERY

- in technological sequence

Preparation shop

	Pcs
[illegible] feeder	1
Belt conveyer	1
Edge mill for wet grinding	1
Plate-type mixer	1
Through belt conveyer	1
Roller mill for fine grinding incl. 2 machines for regrinding the rolls	1
Apron conveyer	1
Box feeder with rubber belt	1
Trough belt conveyer	1
Supporting structures and platforms	1 set
Chutes and charging hoppers	1 set
Auxiliary materials	1 set

Moulding shop

Vacuum auger with 3 exchangeable mouthpieces	1
Cutting roller bed	1
Circulation chain-type cutter	1
Transfer table	1
Automatic setting machine	1
Roller bed	1
Feeder for the loader	1
One-column loader	1
Six-column storage receiver for wet bricks	1
Electric [illegible]-stage truck	1
Electric transfer table with [illegible]	1
Six-column storage receiver for dried bricks	1
One-column unloader	1
Distributing apron conveyer [illegible] with dry brick leveller	1
[illegible] and dry bricks [illegible] equipment	1
[illegible] conveyer for transport of laths	-
Laths storage receiver	1
[illegible] conveyer of released laths for recirculation	1
Belt conveyer for further transport of dry pieces to loading point for kilns	1
Metallic laths 50x30x1,540 mm	33,000

Drier

(heated by oil-fired exchangers and kiln waste heat)

	Pcs
Hot-air chamber drier	2

Chambers proper incl. mixing chamber are constructed of brick masonry and delivered in most cases locally. The drier machinery includes inlet and exhaust fans, hot-air exchangers, interconnecting and exhaust piping, steel structures of drier stages, rails in chambers, suspended insulated gates of chambers, trucks for hoisting gates, drawing rotomixers, drawn rotomixers, measuring and control equipment, insulation of piping.

Transship point

Engine-driven high-lift truck	4
Hydraulic fork incl. accessories	4

Annular kiln oil-fired

Moving fire top-fired barrel arch kiln with block charging, production capacity 10,000,000 bricks/year	2

The delivery of machinery includes all necessary fittings, fans, suction and exhaust pipings, 4 sets of mobile burners, complete oil piping station, measuring instruments, insulating materials and steel sliding gates.

Suction and delivery pipings to draw off hot air from the kiln to the driers — 2 sets

For the construction of the kiln building materials will be needed to be delivered by the buyer: fired bricks, cement, lime, sand, quarry stone, sawn timber, reinforcing bars, structural steel elements.

Refractory materials are included in seller's delivery.

Oil system

Fuel oil storage tank	3
Gear pumps for oil pumping	10
Two-filter battery	2
Collecting setting tank	1
Distribution piping	1 set
Auxiliary materials	1 set
Insulation	1 set

[illegible] 20,000,000 bricks per year (with an oil-fired annular kiln)

[illegible] CHARACTERISTICS OF [illegible] | [illegible]

Moulding line

Capacity	21,141,[illegible] pcs/year 5,343 pcs/hour (green moulded bricks)

Driers

Number of installed driers	2
Gross throughput	22,4[illegible]1,000 dried bricks/year
Charging capacity	150,000 pcs
Working capacity	7,200 hrs/year
Drying cycle	48 hrs
Specific drying heat consumption per kg of fired products	1.250 MJ/kg
Fuel oil consumption	258.61 kg/hour 1,862 t/year

Oil-fired annular kiln

Number of installed kilns	2
Further data refer to one kiln only.	
Kiln design	Moving fire top-fired barrel arch kiln with block charging
Fired ware	Perforated bricks 240x115x72 mm 1 brick=2.8 kg
Gross output	10,638,000 pcs/year
Gross weight output	29,786 t/year 3.54 t/hour
Kiln dimensions:	
Number of chambers	22
Width of channel	4.0 m
Chamber volume	48 cu.m
Kiln volume	1,056 cu.m
Charge values:	
Charge of a chamber	9,[illegible] pcs
Charge of kiln	21[illegible],[illegible]48 pcs
Average density of charge	582 kg/cu.m of setting
Firing process:	
Fire reversing rate	16[illegible] hours
[illegible] working days	350 days/year
[illegible] kiln turnings	50 turnings/year
	[illegible] transport [illegible]
[illegible]	[illegible] chambers, [illegible]
[illegible]ion:	
[illegible]	[illegible] 2 MJ/kg
[illegible]	[illegible] MJ/kg
	[illegible],60 kg/hour
	[illegible] t/year
	4[illegible] kW
	[illegible]4 kW

[illegible] for both the kilns:

Gross output	[illegible],[illegible]76,000 pcs/year [illegible],[illegible]72 t/year
Specific heat consumption	1.[illegible]72 MJ/kg
Fuel oil consumption	211.20 kg/hour 1,774 t/year

Consumption of raw material in extracted condition	92,1[illegible]6 t/year
Consumption of fuel oil	[illegible] t/year
Installed electric power input	[illegible] kW
Electric power consumption	[illegible] kWh/year
Consumption of technological water	17,[illegible]
Consumption of water for social conveniences	[illegible] cu.m/year

[illegible]

Production workers

Shifts	1st	2nd	3rd	...
Preparation shop	2	[illegible]	-	-
Moulding shop + lathe handling	[illegible]	[illegible]	-	-
Drying incl heat exchanger	1	1	-	1
Firing	2+1	2+2	[illegible]	
Handling of products	4			-
Transport of dried pieces and products	[illegible]	[illegible]	-	-
Oil system	1	-	-	-
Total	[illegible]	1[illegible]	[illegible]	

In the total of 4[illegible] workers only [illegible] workers are included. [illegible] workers (electricians, fitters, [illegible]) determined with regard to their qualification in respective countries.

[illegible]

Required area of production premises	[illegible] sq.m
Informative price of machinery free European ports	1,5[illegible]

Table No. 4 PROFILES OF BRICK PLANTS

BRICKWORKS 10,000,000 bricks per year (with oil-fired annular kiln)

I. Basic production capacity	10,000,000 fired bricks

II. Technological machinery

In technological sequence

Preparation shop	Pcs
Box feeder	1
Belt conveyer	1
Pan mill for wet grinding	1
Plate-type mixer	1
Trough belt conveyer	1
Roller mill for fine grinding incl. 2 machines for regrinding the rolls	1
Apron conveyer	1
Box feeder	1
Trough belt conveyer	1
Supporting structures and platforms	1 set
Chutes and hoppers	1 set
Auxiliary materials	1 set

Moulding shop	
Vacuum auger with 3 exchangeable mouthpieces	1
Wiring roller bed	1
Circulation chain-type cutter	1
Transport table	1
Automatic setting machine	1
Roller bed	1
Feeder for the loader	1
One-column loader	1
One-column storage receiver for wet bricks	1
Electric multi-stage truck	1
Electric transfer table with idle table	1
One-column storage receiver for dried bricks	1
One-column trimloader	1
Distributing apron conveyer provided with dry [illegible] roller	1
Device for moving and [illegible] pieces [illegible] device	1
Roller conveyer for transport of bricks	1
Brick storage receiver	1
Receiving conveyer of released bricks for recirculation	1
Belt conveyer for further transp. of dry pieces to loading point for the kiln	1
Metallic laths 900x500x1,540 mm	16,500

III. Technological equipment

Assortment: Perforated bricks (21% of volume) dimensions 240x115x72 mm 1 brick = 3.6 kg

Raw materials: Supposed clay of average properties absorbing 20% of water of plasticity and losing 14% of dry substance in firing process

Time capacities:

Number of working days	300/year
Number of working shifts	1/day
Effective working time	7 hrs/shift
Operation time except drier and kiln	2,100 hrs/year
Operation time of drier	7,200 hrs/year
Operation time of kiln	8,400 hrs/year

Drier (heated by oil-fired exchanger and kiln waste heat)	Pcs
Hot-air chamber drier	1
Chambers proper incl. mixing chamber are constructed from brick masonry and delivered in most cases locally.	
The drier machinery includes inlet and exhaust fans, hot-air exchanger, interconnecting and exhaust piping, steel structures of drier stages, rails in chambers, suspended insulating gates of chambers, truck for hoisting gates, drawing and drawn rotomixers, measuring and control equipment, insulation of piping.	

Transship point	
Engine-driven high-lift truck with accessories	3
Hydraulic fork with accessories	3

Annular kiln oil-fired	
Moving fire top-fired barrel arch kiln with block chambers, production capacity 10,000,000 bricks/year	1
The delivery of machinery includes all necessary fittings, fans, suction and exhaust piping, 4 sets of mobile barriers, complete oil piping equipment, measuring instruments, insulating materials, steel sliding gates.	
Suction and delivery piping to draw off hot air from the kiln to the drier	1 set
For construction of the kiln building materials are needed to be delivered by the buyer: fired bricks, cement, lime, sand, quarry stone, sawn timber, reinforcing bars, structural steel elements.	
Auxiliary materials are usually included in seller's delivery.	

Oil system	
Fuel oil storage tank	2
Gear pumps for oil pumping	3
Two-filter battery	2
Collecting, setting tank	1
Distribution piping	1 set
Auxiliary materials	1 set
Insulation material	1 set

Table No. 4 - continuation

PROFILES OF BRICK PLANTS

BRICKWORKS 10,000,000 bricks per year (with oil-fired annular kiln)

IV. TECHNICAL CHARACTERISTICS OF MAJOR UNITS V. RAW MATERIALS AND ENERGY INPUTS

Moulding line

Capacity	11,220,000 pcs/year
	3,343 pcs/hour
	(green moulded bricks)

Drier

Gross throughput	11,220,000 pcs/year (green dried bricks)
Charging capacity	75,000 pcs
Working capacity	7,200 hrs/year
Drying cycle	48 hours
Specific drying heat consumption per kg of fired products	1.230 MJ/kg
Fuel oil consumption	129.30 kg/hour 931 t/year

Oil-fired annular kiln:

Kiln design	Moving fire top-fired barrel arch kiln
Fired ware	Perforated bricks 240x115x72 mm 1 brick=2.8 kg
Gross output	10,638,000 pcs/year
Gross weight output	29,787 t/year 3.54 t/hour
Kiln dimensions:	
Number of chambers	22
Width of channel	4.0 m
Chamber volume	48 cu.m
Kiln volume	1,056 cu.m
Charge values:	
Charge of chamber	9,984 pcs
Charge of kiln	219,648 pcs
Average density of charge	582 kg/cu.m of setting
Firing process:	
Fire reversing rate	168 hours
Number of working days	350 days/year
Number of kiln turnings	50 turnings/year
Burners	4 transportable burner sets
Number of burners	12 burners/set

Fuel and power consumption:

Specific heat consumption	1.172 MJ/kg
Fuel oil calorific value	39.35 MJ/kg
Fuel oil consumption	105.60 kg/hour,847 t/year
Installed electric power input	46 kW
Electric power consumption per hour	34 kWh

Consumption of raw materials in extracted condition	45,[illegible] t/year
Consumption of fuel oil	1,[illegible] t/year
Installed electric power input	[illegible] kW
Electric power consumption	3,[illegible] kWh/year
Consumption of technological water	8,[illegible] cu.m/year
Consumption of water for social conveniences	[illegible] cu.m/year

VI. MANPOWER

Production workers

Shifts	1st	2nd	3rd	4th
Preparation shop	2	-	-	-
Moulding shop + baths handling	3	-	-	-
Drying incl. heat exchanger	1	1	1	1
Firing	2+2	2	2	2
Handling of products	4	-	-	-
Transport of dry pieces and products	4	-	-	-
Oil system	1	-	-	-
	19	3	3	3

In the total of 28 workers only direct production workers are included. The number of maintenance workers (electricians, fitters) should be determined with regard to their qualification in respective countries.

VII. SUPPLEMENTARY

Required area of production premises	4,[illegible] sq.m
Informative price of machinery free European ports	[illegible],000 US $

Table No. 5 PROFILES OF BRICK PLANTS

BRICKWORKS 5,000,000 bricks per year (with oil-fired annular kiln)

I. ANNUAL PRODUCTION PROFILE: 5,000,000 fired bricks

II. TECHNOLOGICAL FEATURES

Assortment: Perforated bricks (20% ov volume)
dimensions 240x115x72 mm
1 brick = 2.8 kg

Raw materials: Supposed clay of average properties absorbing 20% of water of plasticity and losing 14% of dry substance in firing process

Time capacities:

Number of working days	300/year
Number of working shifts	1/day
Effective working time	7 hours/shift
Operation time except drier and kiln	2,100 hrs/year
Operation time of kiln	8,400 hrs/year

III. SPECIFICATION OF MACHINERY

- in technological sequence

Preparation shop	Pcs
Box feeder	1
Belt conveyer	1
Idle toothed rolls	1
Apron conveyer	1
Two-shaft mixer	1
Apron conveyer	1
High speed rolls incl. roll grinder	1
Apron conveyer	1
Box feeder	1
Supporting structures and platforms	1 set
Chutes and charging hoppers	1 set
Auxiliary materials	1 set
Moulding shop	
Auger with 2 exchangeable mouthpieces	1
Circulation chain-type cutter	1
Belt conveyer	1
Floor-type column loader	2
Floor-type column transloader	2
Electric transfer table	4
One-column manually operated truck car	4
Natural drier	
Track for transfer tables on the charging side of the drier	1
Track for transfer tables on the discharging side of the drier	1
Track for multi-stage cars in drier cloles	1
Steel structures made of rolled sections and plates	1 set
Wooden laths /carriers of pressed pieces/ (size 40x60x1540 mm)	24,600
Protective netting of trolley line	1

Note:

Building materials for drier sheds such as timber, fastening and anchoring material, steel galvanized corrugated sheets and galvanized tinsmith's sheet as well as wooden laths are usually delivered locally.

Annular kiln oil-fired	Pcs
Moving fire top-fired barrel arch kiln of production capacity 5,000,000 bricks/year	1
The delivery of machinery includes all necessary fittings, fans, suction and exhaust piping, 4 sets of mobile burners, complete oil pumping station, insulating material.	
Steering car on bantam wheels for kiln charging	1
Steering platform car on tyres	1
For the construction of the kiln building materials will be needed to be delivered by the buyer: fired bricks, cement, lime, sand, quarry stone, sawn timber, reinforcing bars, structural steel elements.	
Refractory materials are included in seller's delivery.	
Oil system	
Fuel oil storage tank	1
Gear pumps for oil pumping	4
Two-filter battery	1
Collecting setting tank	1
Distribution piping	1 set
Auxiliary materials	1 set
Insulation	1 set

+Buyer's delivery.

Table No. 5- continuation [illegible]

BRICKWORKS 5,000,000 bricks per year (with oil-fired annular kiln)

IV. TECHNICAL CHARACTERISTICS OF MAIN UNITS

Moulding shop

Capacity	5,607,000 pcs./year 2,670 pcs/hour (green moulded bricks)
Natural drier	5,607,000 pcs/year
Gross throughput	(green dried bricks)

Oil-fired annular kiln

Kiln design	Moving fire top-fired barrel arch kiln
Fired ware	Perforated bricks 240x115x72 mm 1 brick = 2.8 kg
Gross output	5,320,000 pcs/year 633 pcs/hour
Gross output by weight	14,900 t/year 1.770 t/hour
Kiln dimensions:	
Number of chambers	14
Width of channel	3.5 m
Chamber volume	39 cu.m
Kiln volume	552 cu.m
Charge values:	
Charge of chamber	8,930 pcs
Charge of kiln	125,000 pcs
Average density of charge	658 kg/cu.m of setting
Firing process:	
Fire reversing rate	168 hrs=1 week
Number of working days	350 days/year
Number of working hours	8,400 hours/year
Number of kiln turnings	50 turnings/year
Burners	4 transportable sets
Number of burners	12 burners/set
Fuel and power consumption:	
Specific heat consumption	1.172 Mc/kg
Calorific value of fuel oil	38.35 Mc/kg
Oil consumption	53.66 kg/hour 444 t/year
Installed electric power input	24 kW
Electric power consumption per hour	17 kWh

[illegible]

[illegible] of raw material in unwrapped condition	24,[illegible] t/y ar
Consumption of fuel oil	444 t/year
Installed electric power input	183 kW
Electric power consumption	1,544 MWh/year
Consumption of technological water	4,[illegible] cu.m/year
Consumption of water for social conveniences	1,650 cu.m/year

[illegible]

Production workers

Shifts	1st	2nd	3rd	4th
Preparation shop	3	-	-	-
Moulding shop	11	-	-	-
Drying	6	-	-	-
Firing	7+2	2	2	2
Products handling	8			
	36	2	2	2

In the total of 42 workers only direct production workers are included. The number of maintenance workers (electricians, fitters, ...) should be determined with regard to their qualification in respective countries.

[illegible]

Required area of production premises	2,[illegible] sq.m
Informative price of machinery free European ports	[illegible]

Table No. 6

PROFILES OF BRICK PLANTS

BRICKWORKS 20,000,000 bricks per year (with coal-fired annular kiln)

I. ANNUAL PRODUCTION CAPACITY — 20,000,000 fired bricks

III. SPECIFICATION OF MACHINERY

- in technological sequence

Preparation shop	Pcs
Box feeder	1
Belt conveyer	1
Pan mill for wet grinding	1
Plate-type mixer	1
Trough belt conveyer	1
Roller mill for fine grinding incl. 2 machines for regrinding the rolls	1
Apron conveyer	1
Box feeder with rubber belt	1
Trough belt conveyer	1
Supporting structures and platforms	1 set
Chutes and charging hoppers	1 set
Auxiliary materials	1 set

Moulding shop	
Vacuum auger with 3 exchangeable mouthpieces	1
Tilting roller bed	1
Circulation chain-type cutter	1
Transfer table	1
Automatic setting machine	1
Roller bed	1
Feeder for the loader	1
One-column loader	1
Six-column storage receiver for wet moulded bricks	1
Electric multi-stage truck	1
Electric transfer table with turntable	1
Six-column storage receiver for dried bricks	1
One-column transloader	1
Apron conveyer provided with dry brick leveller	1
Laths removing and dry bricks transloading equipment	1
Roller conveyer for transport of laths	1
Laths storage receiver	1
[illegible] conveyer of laths for recirculation	1
Belt conveyer for further transport of dry pieces to loading points [illegible] kilns	1
Metallic laths [illegible], [illegible]	33,000

II. TECHNOLOGICAL FEATURES

Assortment: Perforated bricks (30% of volume)
dimensions 240x115x72 mm
1 brick = 2.8 kg

Raw materials: Supposed clay of average properties absorbing 20% of water of plasticity and losing 14% of dry substance in firing process

Time capacities:

Number of working days	300/year
Number of working shifts	2/day
Effective working time	7 hrs/shift
Operation time except drier and kiln	4,200 hrs/year
Operation time of drier	7,200 hrs/year
Operation time of kiln	8,400 hrs/year

Drier (heated by oil-fired exchangers and kiln waste heat)

	Pcs
Hot air chamber drier	2

Chambers proper incl. mixing chamber are constructed of brick masonry and delivered in most cases locally. The drier machinery includes inlet and exhaust fans, hot-air exchangers, interconnecting and exhaust piping, steel structures of drier stages, rails in chambers, suspended insulated gates of chambers, trucks for hoisting gates, drawing rotomixers, drawn rotomixers, measuring and control equipment, insulation of piping

Tranship point	
Engine driven high-lift truck	4
Hydraulic fork incl. accessories	4

Annular kiln coal-fired

Moving fire top-fired arch kiln with block charging, production capacity 10,000,000 bricks per year	2

The delivery of machinery includes all necessary fittings, fans, suction and exhaust pipings, coal stokers with accessories, control equipment, measuring instruments, insulation material, steel sliding gates.

Suction and delivery pipings to draw off hot air from the kiln to the driers	2 sets

For the construction of the kiln building material will be needed to be delivered by the buyer: fired bricks, cement, lime, sand, quarry stone, sawn timber, reinforcing bars, structural steel elements. Refractory materials are included in seller's delivery.

Oil system	
Fuel oil storage tank	3
Gear pumps for oil pumping	3
Double filter battery	2
Collecting sedimentation tank	1
Distribution piping	1 set
Auxiliary material	1 set
Insulation	1 set

Table No. 6 — continuation. [illegible] BRICK PLANTS

BRICKWORKS 20,000,000 bricks per year (with coal-fired annular kiln)

IV. TECHNICAL CHARACTERISTICS OF [illegible] KILNS

Moulding line

Capacity: 22,441,000 pcs/year (wet moulded bricks)
5,343 pcs/hour

Driers

Number of installed driers	2
Gross throughput	22,441,000 dried bricks/year
Charging capacity	150,000 pcs
Working capacity	7,200 hrs/year
Drying cycle	48 hours
Specific drying heat consumption per kg of fired products	1.237 MJ/kg
Fuel oil consumption	260 kg/hour 1,872 t/year

Coal-fired annular kiln

Number of installed kilns	2
Further data refer to one kiln only.	
Kiln design	Moving fire top-fired barrel arch kiln with block charging
Fired ware	Perforated bricks 240x115x72 mm 1 brick = 2.8 kg
Gross output	10,638,000 pcs/year 1,266 pcs/hour
Gross weight output	29,786 tons/year 3.54 tons/hour
Kiln dimensions:	
Number of chambers	22
Width of channel	4.0 m
Chamber volume	48 cu.m.
Kiln volume	1,056 cu.m.
Charge values:	
Charge of a chamber	9,984 pcs
Charge of kiln	219,648 pcs
Average density of charge	582 kg/cu.m. of setting
Firing process:	
Fire reversing rate	168 hours
Number of working days	350 days/year
Number of kiln turnings	50 turnings/year
Burners	54 coal stokers
Fuel and power consumption:	
Specific heat consumption	1.339 MJ/kg
Calorific value of coal	15.91 MJ/kg
Coal consumption	298.45 kg/hour 2,507 t/year
Installed electric power input	48 kW
Electric power consumption per hour	34 kWh

Summary of selected data for both the kilns:

Gross output	21,276,000 pcs/year 59,572 t/year
Coal consumption	596.90 kg/hour 5,014 t/year

V. [illegible] AND ENERGY INPUTS

Consumption of raw material in [illegible] condition	38,140 t/year
Consumption of fuel oil for the driers	1,872 t/year
Consumption of coal for the kilns	5,014 t/year
Installed electric power input	454 kW/year
Consumption of electric power	3,663 GJ/year
Consumption of technological water	17,000 cu.m/year
Consumption of water for social conveniences	1,075 cu.m/year

VI. LABOUR

Production workers

Shifts	1st	2nd	3rd	4th
Preparation shop	2	2	-	-
Moulding shop + [illegible] handling	3	3	-	-
Drying incl. heat exchanger	1	1	1	1
Firing	2+2	2+2	2	2
Handling of products	4	4	-	-
Transport of dried pieces and products	4	4	-	-
Oil system	1	-	-	-
Total	19	16	3	3

In the total of 41 workers only direct production workers are included. The number of maintenance workers (electricians, fitters) should be determined with regard to their qualification in respective [illegible].

VII. [illegible] DATA

Required area of production premises	6,400 sq.m.
Informative price of machinery free European ports	1,445,000 US $

Table No. 7 PROFILES OF BRICK PLANTS

EXAMPLE No 10,000,000 bricks per year (with coal-fired tunnel kiln)

I. ANNUAL PRODUCTION CAPACITY	10,000,000 fired bricks

II. SPECIFICATION OF MACHINERY

- in technological sequence

Preparation shop	Pcs
Box feeder	1
Belt conveyer	1
Edge mill for wet grinding	1
Plate-type mixer	1
Trough belt conveyer	1
Roller mill for fine grinding incl. 2 machines for regrinding the rolls	1
Apron conveyer	1
Box feeder	1
Trough belt conveyer	1
Supporting structures and platforms	1 set
Chutes and hoppers	1 set
Auxiliary materials	1 set

Moulding shop	
Vacuum auger with 3 exchangeable mouthpieces	1
Tilting roller bed	1
Circulation chain-type cutter	1
Transport table	1
Automatic setting machine	1
Roller bed	1
Feeder for the loader	1
One-column loader	1
Six-column storage receiver for wet bricks	1
Electric multi-stage truck	1
Electric transfer table with turn table	1
Six-column storage receiver for dried bricks	1
One-column transloader	1
Distributing apron conveyer provided with dry brick leveller	1
Laths removing and dry pieces transloading device	1
Roller conveyer for transport of laths	1
Laths storage receiver	1
Feeding conveyer of released laths for recirculation	1
Belt conveyer for further transport of dry pieces to loading point for the kiln	1
Metallic laths 50x30x1,540 mm	16,5[illegible]

I. [illegible]	
[illegible]: Perforated bricks [illegible] 1 volum.) dimensions [illegible] 1 brick = 2.1 kg	
Raw materials: Proposed clay of [illegible] properties [illegible] % of water of plas. [illegible] and [illegible] % of dry sieviate in drying process	
Time capacities:	
Number of working days	[illegible]/year
Number of working shifts	2/day
Effective working time	7 hrs/1 shift
Operation time except drier and kiln	3,[illegible] hrs/year
Operation time of drier	7,[illegible] hrs/year
Operation time of kiln	8,400 hrs/year

Drier (heated by oil-fired exchanger and kiln waste heat)

	Pcs
Hot-air chamber drier	1

Chambers proper incl. ramming checker are constructed from brick masonry and delivered in most cases locally.

The drier machinery includes inlet and exhaust fans, hot-air exchanger, interconnecting and exhaust pipes, steel structures of drier stages, rails in chambers, suspended insulating gates of chambers, truck for loading cars, draught and dra[illegible] controllers, measuring and control equipment, insulation of piping.

Ironcloth point

Engine-driven high-lift truck with accessories	1
Hydraulic fork with accessories	3

Tunnel kiln coal-fired

Moving fire top-fired barrel type kiln with block chamber, production capacity 10,000,000 bricks/year	1

The delivery of machinery includes all necessary fittings, fans, suction and exhaust pipings, coal scales with control equipment, measuring instruments, insulation material, steel sliding gates.

Suction and delivery piping to [illegible] oil hot-air from and kiln to the drier 1 s

For the construction of the kiln [illegible] materials will be mainly delivered by the buyer: fired bricks, sand, lime, sand, quarry stone, [illegible] timber, refractory bricks, structural steel elements. Refractory materials are included in seller's delivery.

Oil system (for heating the drier)

[illegible]	1
Oil pump for oil pumping	2
[illegible] delivery	1
Boiler [illegible] heating tank	1
Distribution piping	1 set
Auxiliary materials	1 set
Insulation materials	1 set

Table No. 7 - continuation PROFILES OF BRICK PLANTS

BRICKWORKS 10,000,000 bricks per year (with coal-fired annular kiln)

IV. TECHNICAL CHARACTERISTICS OF MAJOR UNITS

Moulding line

Capacity	11,220,000 pcs/year (green moulded bricks)

Drier

Gross throughput	11,220,000 pcs/year (green dried bricks)
Charging capacity	75,000 pcs
Working capacity	7,200 hrs/year
Drying cycle	48 hours
Specific drying heat consumption per kg of fired products	1.237 MJ/kg
Fuel oil consumption	130 kg/hour 936 t/year

Coal-fired annular kiln

Kiln design	Moving fire top-fired barrel arch kiln with block charging
Fired ware	Perforated bricks 240x115x72 mm 1 brick = 2.8 kg
Gross output	10,638,000 pcs/year 4,966 pcs/hour
Gross weight output	29,787 t/year 3.54 t/hour
Kiln dimensions:	
Number of chambers	22
Width of channel	4.0 m
Chamber volume	48 cu.m.
Kiln volume	1,056 cu.m.
Average values:	
Charge of a chamber	9,984 pcs
Charge of kiln	219,648 pcs
Average density of charge	562 kg/cu.m. of setting

Firing process:

Fire reversing rate	168 hours
Number of working days	350 days/year
Number of kiln turnings	50 turnings/year
Burners	54 coal stokers
Fuel and power consumption:	
Specific heat consumption	1.339 MJ/kg
Calorific value of coal	15.91 MJ/kg
Coal consumption	298.45 kg/hour 2,507 t/year
Installed electric power input	24 kW
Electric power consumption per hour	17 kWh

V. RAW MATERIALS AND ENERGY INPUTS

Consumption of raw material in extracted condition	48,690 t/year
Consumption of fuel oil for the drier	936 t/year
Consumption of coal for the kiln	2,507 t/year
Installed electric power input	424 kW
Electric power consumption	2,565 GJ
Consumption of technological water	8,500 cu.m/year
Consumption of water for social conveniences	700 cu.m/year

VI. LABOUR

Production workers

Shifts	1st	2nd	3rd	4th
Preparation shop	2	-	-	-
Moulding shop + laths handling	3	-	-	-
Drying incl. heat exchanger	1	1	1	1
Firing	2+2	2	2	2
Handling of products	4	-	-	-
Transport of dry pieces and products	4			
Oil system	1			
	21	3	3	3

In the total of 33 workers only direct production workers are included. The number of maintenance workers (electricians, fitters) should be determined with regard to their qualification in respective countries.

VII. SUPPLEMENTS

Required area of production premises	4,000 sq.m
Informative price of machinery free Eastern European ports	932,000 US $

Table V- 8 PROFILES OF BRICK PLANTS

BRICKWORKS 5,000,000 bricks per year (with coal-fired annular kiln)

I. ANNUAL PRODUCTION CAPACITY 5,000,000 fired bricks

II. SPECIFICATION OF MACHINERY

- in technological sequence

Preparation shop	Pcs
Box feeder	1
Belt conveyer	1
Idle toothed rolls	1
Apron conveyer	1
Two-shaft mixer	1
Apron conveyer	1
High speed rolls incl. roll grinder	1
Apron conveyer	1
Box feeder	1
Supporting structures and platforms	1 set
Chutes and charging hoppers	1 set
Auxiliary materials	1 set
Moulding shop	
Auger with 2 exchangeable mouthpieces	1
Insulation chain-type cutter	1
Belt conveyer	1
Floor-type column loader	2
Floor-type column transloader	2
Electric sfer table	4
One-co[illegible] ually operated truck	4
Natural drier	
Track for transfer tables on the charging side of the drier	1
Track for transfer tables on the discharging side of the drier	1
Track for multi-stage cars in drier aisles	1
Steel structures made of rolled sections and plates	1 set
+Wooden laths (carriers of pressed pieces) size 40x60x1540 mm	24,600
+Protective netting of trolley line	1

Note:
Building material for drier sheds such as timber, fastening and anchoring material, steel galvanized corrugated sheet and galvanized tinsmith's sheet are not included in the delivery.

+ Buyer's delivery

III. TECHNOLOGICAL PARAMETERS

Assortment: Perforated bricks (20% of volume) dimensions 240x115x72 mm, 1 brick = 2.8 kg

Raw materials: Supposed clay of average properties absorbing 20% of water of plasticity and losing 14% of dry substance in firing process

Time capacities:

Number of working days	300/year
Number of working shifts	1/day
Effective working time	7 hours/shift
Operation time except drier and kiln	2,100 hrs/year
Operation time of kiln	8,400 hrs/year

Annular kiln coal-fired	Pcs
Moving fire top-fired barrel arch kiln of production capacity 5,000,000 bricks/year	1
The delivery of machinery includes all necessary fans, fittings, suction and exhaust piping, coal stokers with accessories and control equipment, measuring instruments, insulation material.	
Steering car on bantam wheels for kiln charging	1
Steering platform car on tyres	1

For the construction of the kiln building materials will be needed to be delivered by the buyer: fired bricks, cement, lime, sand, quarry stone, sawn timber, reinforcing bars, structural steel elements. Refractory materials are included in seller's delivery.

With regard to the applied natural drier there is no need of fuel oil and oil distribution.

Table No. 2 - continuation PROFILES OF BRICK PLANTS

BRICKWORKS 5,00 ,000 bricks per year (with coal-fired annular kiln)

IV. TECHNICAL CHARACTERISTICS OF BRICK WORKS

Moulding line

Capacity	5,607,000 pcs/year (green moulded bricks)

Natural drier

Gross throughput	5,607,000 pcs/year (green dried bricks)

Coal-fired annular kiln

Kiln design	Moving fire top-fired barrel arch kiln
Fired ware	Perforated bricks 240x115x72 mm 1 brick = 2.8 kg
Gross output	5,320,000 pcs/year 633 pcs/hour
Gross output by weight:	14,900 t/year 1.770 t/hour
Kiln dimensions:	
Number of chambers	14
Width of channel	3.5 m
Chamber volume	38 cu.m
Kiln volume	532 cu.m
Charge values:	
Charge of chamber	8,930 pcs
Charge of kiln	125,000 pcs
[illegible] density of [illegible]	658 kg/cu.m of setting
Firing process:	
Fire reversing rate	168 hours = 1 week
Number of working days	350 days/year
Number of working hours	8,400 hours/year
Number of kiln turnings	50 turnings/year
Burners	30 stokers
Fuel and power consumption:	
Specific heat consumption	1.339 MJ/kg
Calorific value of coal	15.01 MJ/kg
Consumption of coal	148,28 kg/hour 1,254 t/year
Installed electric power input	12 kW
Electric power consumption per hour	9 kWh

V. [illegible] [illegible] MATERIAL [illegible]

Consumption of raw material in terms of condition	22,900 t/year
Consumption of coal	1,254 t/year
Installed electric power input	113 kW
Electric power consumption	892 GC/year
Consumption of technological water	4,100 cu.m/year
Consumption of water for social conveniences	1,050 cu.m/year

VI. LABOUR

Production workers

Shifts	1st	2nd	3rd	4th
Preparation shop	2	-	-	-
Moulding shop	11	-	-	-
Drying	6	-	-	-
Firing	7+2	2	2	2
Handling of products	8			
	36	2	2	2

In the total of 42 workers only direct production workers are included. The number of maintenance workers (electricians, fitters) should be determined with regard to their qualification in respective countries.

VII. [illegible]

Required area of production premises	[illegible] sq.m
Informative price of machinery free European ports	391,000 US $

[illegible] No. 9

PROFILES OF BRICK PLANTS

[illegible] 2 - 3 millions of bricks
(with coal- or wood-fired annular kiln)

[illegible] CAPACITY: 2,575,000 fired bricks

([illegible] calculations refer to this amount of [illegible] production)

[illegible]

- in technological sequence

[illegible] transport of raw material	Pcs
[illegible]	1
[illegible]	1

[illegible] preparation and moulding	
[illegible] feeder	1
[illegible] conveyor	1
[illegible] rolls	1
[illegible]	1
[illegible] mill incl. machine for [illegible] rolls	1
[illegible] conveyor	1
[illegible] mixer	1
[illegible] incl. [illegible] mouthpieces	1
[illegible] cutter	1
[illegible] truck	20
[illegible] structural platforms	1 set
[illegible] hoppers	1 set
[illegible] materials	1 set

[illegible] annular kiln	
Moving fire top-fired barrel arch kiln of production capacity 2 - 3 mill. bricks per year	1

The delivery of machinery includes [illegible] fan, hot-air fan, flue fans, [illegible], all necessary fittings, piping.

[illegible]	5

For the construction of the kiln [illegible] materials will be needed to be delivered locally: cement, sand, [illegible] bricks, lime, quarry stone, [illegible], reinforcing bars, structural steel elements.

[illegible] chutes and [illegible] of the vault are included [illegible] delivery.

[illegible]

[illegible]

[illegible]	1st	2nd	3rd	4th
[illegible]	10	-	-	-
[illegible]	1	-	-	-
[illegible]	1	-	-	-
[illegible]	1	-	-	-
[illegible]	1	-	-	-
[illegible] pieces	[illegible]	-	-	-
[illegible]	[illegible]	-	-	-
[illegible] in kiln	[illegible]	-	-	-
[illegible]	[illegible]	-	-	-
[illegible] transport to kiln	[illegible]	-	-	-
[illegible] discharging	3	-	-	-
[illegible]	[illegible]	-	-	-
[illegible]	[illegible]	-	-	-
[illegible]	1	-	-	-
	35	1	1	1

III. TECHNOLOGICAL FEATURES

Assortment	Solid and/or perforated bricks dimensions 240x115x72 mm weight 3.4/2.8 kg
Raw materials	Supposed clay of average properties absorbing 20% of water of plasticity and losing 14% of dry substance in firing process

Time capacities:

Number of working days /Seasonal operation - approx. 9 months per year/	250/year
Number of working shifts	1/day
Effective working time	6 hrs/shift
Operation time except drier and kiln	1,500 hrs/year
Operation time of kiln	6,636 hrs/year

IV. TECHNICAL CHARACTERISTICS OF MAJOR UNITS

Moulding line

Capacity	3,000,000 pcs/year (green moulded bricks) 2,000 pcs/hour

Coal-fired annular kiln

Kiln design	Moving fire top-fired barrel arch kiln
Fired ware	Bricks 240x115x72 mm 1 brick = 3.4 kg
Gross output	2,844,000 pcs/year 72,000 bricks/week
Gross output by weight	9,670 t/year

Kiln dimensions:

Number of chambers	16
Width of channel	2.0 m
Height in the vault central line	2.5 m
Length of 1 chamber	5.2 m
Chamber volume	23.6 cu.m
Kiln volume	380 cu.m

Fuel consumption:

Specific heat consumption	1.465 MJ/kg of fired products
Calorific value of coal	16.747 MJ/kg
Coal consumption	127.49 kg/hour 846 t/year

V. [illegible] ENERGY INPUTS

Consumption of raw materials in [illegible] condition	15,000 t/year
Consumption of coal	846 t/year
Installed electric power input	150 kW
Electric power consumption	486 GJ/year
Consumption of technological water	1,800 cu.m/year
Consumption of water for social conveniences	950 cu.m/year

[illegible]

[illegible] area of production premises	1,000 sq.m
Informative price of machinery free European ports	192,000 US $

IV. THE PROCESS OF ESTABLISHMENT OF A BRICK PLANT

The technological equipment of which various variants have been described in the preceding chapter is only one production factor. It forms together with engineering works, raw and auxiliary materials, energies, labour and managing staff the physical substance of a brick plant. The preparation of the establishment of a plant is an exacting process consisting of many activities planned within the framework of a project.

Successive phases of a project

A. Activities aiming at decision-making

- Geological research
- Preliminary testing of raw materials
- Pre-feasibility study
- Laboratory testing of raw materials
- Pilot plant testing of raw materials
- Elaboration of technology
- Feasibility study

B. Project engineering

- Engineering design and preparation of books of tender for equipment
- Evaluation of tenders for equipment
- Preparation of books of tender for civil engineering works
- Evaluation of tenders from civil engineering contractors
- Co-ordination of construction, equipment delivery, erection and supervision

- Supervision during construction
- Supervision of start-up and commissioning

Activities in particular phases of a brick plant project

Geological research

In most cases there will be no extensive prospecting for clay necessary. There are viable and time saving ways how to find clays for brick-making.

The investigation should start with a visit to the Geological Survey of the respective country. There would be few reports in the library dealing with clays but there may be more reports on prospecting for coal, oil, metals, etc. These reports often contain hints to clays in the upper layers of the overburden. The pits exploited by the existing handicraft brick producers are also a promising guide to clay deposits. Contractors of road building are sure to possess information on clay occurrences as well.

The geologist looking for clay suitable for brick manufacture should be assisted by a brick plant technologist. The identification of size of deposit, calculation of reserves, thickness of overburden, taking of representative samples and proposal of the mining method should be their job.

The extent of the taking of samples depends on the purpose for which they are needed (preliminary, laboratory, pilot plant tests) and on the required quantity of clay in the deposit. Drilling sinking shafts into the ground and taking samples from clay outcrops are the applied methods. If the homogenity of the deposit

has not been sufficiently investigated in the initial phases an adequately intensive drilling should be repeated before opening the pit.

Conclusion:

The samples taken successively in particular phases are delivered to a testing institute for preliminary, laboratory and pilot plant tests.

Preliminary testing of raw materials

The objective of the preliminary tests is the identification of the tested raw material by ascertaining its basic properties. The preliminary tests should provide for the basic information regarding the application in a certain product. They are carried out in the following sequence:

- Description of samples
- Experimental firing and assessment of fired corpuscles
- Preparation of laboratory briquettes
- Determination of water of plasticity
- Drying shrinkage
- Firing shrinkage at three firing temperatures
- Water absorption
- Bending strength
- Assessment of colour and appearance of fired laboratory briquettes

Conclusion:

If the preliminary tests are positive, a preliminary technology may be drafted within and for the purpose of a pre-feasibility study.

Pre-feasibility study

The pre-feasibility study comprises the investigation of raw materials as per preliminary tests, the market possibilities and a draft of the establishment of a brick plant inclusive of its location with estimates of capital requirements, investment costs, production programme, sales and revenues, production costs and profitability.

The pre-feasibility study should say, in this early stage, before further steps are made and further costs incurred, whether the venture is economically viable.

Conclusion:

If the result of the pre-feasibility study is positive laboratory and pilot plant tests may follow.

Laboratory testing of raw materials

First of all the preliminary tests are repeated on a larger amount of samples representing the pattern of

homogenity of the deposit. Technological tests are extended by drying sensitivity (by Bigot), extrusion test, bulk density, cold crushing and bending strength tests. Further important laboratory tests are sieve grading, chemical analysis, X-ray analysis or thermal analysis.
Conclusion: See next paragraph

Pilot plant tests

Pilot plant tests are selected laboratory tests applied on raw materials, semiproducts and fired bricks manufactured on industrial scale. They reflect harder conditions of the industrial brick manufacturing process in comparison to laboratory conditions. The results of pilot plant tests should be in compliance with respective national standards.

Conclusion:

If laboratory and pilot plant tests are positive the definite technology of brick manufacture can be elaborated.

Elaboration of technology

Based on the laboratory and pilot plant tests and with regard to the outlined production programme as estimated in the pre-feasibility study, the production technology is devised. Operations and outputs in particular

phases are described so as to give a sufficient back-ground for choosing suitable machinery. If the brick plant includes the clay pit as well the mining technology is to be elaborated.

Conclusion:

The technology is completed for its application in further steps of the project.

Feasibility study

The structures of a pre-fiasibility study and a feasibility study are identical. However, the back-ground is more precise and more detailed in the latter case. While the pre-feasibility study was based on preliminary tests of raw materials and estimates of market and economic data the feasibility study takes into account the results of laboratory and pilot plant tests and the devised technology. It comprises a deep market research with verified prices, instead of estimates of investment costs price lists and offers from producers of equipment and from contractors of civil engineering work are at hand. Also production costs are corrected on the basis of the definite technology.

The results of the feasibility study are expressed in terms of profitability, internal rate of return of equity, break-even point of sales and costs related to production volume and further economic parameters as requested by the entrepreneur, the bank or the government

authorities.

The feasibility study is conducted by an industrial economist and a market expert.

Conclusion:

If the results of the feasibility study are accepted the implementation of the project may be started.

Engineering design and preparation of books of tender for equipment

On the basis of the feasibility report the over-all design of equipment and the books of tender are prepared. The latter serve as a background information for the tenders of equipment suppliers. The objective of this procedure is to receive comparative offers which can be easily evaluated. The over-all engineering design as well as detailed designs in further stages should be elaborated by a designer experienced in brick manufacturing equipment.

Conclusion:

The books of tender are sent out to potential suppliers of equipment.

Evaluation of tenders for equipment

The received tenders are compared and evaluated. Technical characteristics of equipment, completeness, required over-all dimensions of production premises, delivery period, price, supplier's credit and guarantees are taken into account. The most suitable tender is selected and the supplier contacted for the purpose of concluding a contract. The contents of a model contract for delivery of equipment are enclosed. (See Appendix No. 1)

An entrepreneur unexperienced in brick manufacture should prefer contracting the delivery and erection of the whole production equipment with guaranteed output (as per contract) and quality of products. Still more secure is a turn-key contract comprising the delivery and erection of equipment as well as the construction of civil engineering works.

The preparation of books of tender for equipment as well as the evaluation of tenders should be entrusted to an expert in brick manufacturing equipment and technology.

Conclusion:

After the conclusion of the contract (or concurrently) books of tender for civil engineering works may be prepared.

Preparation of books of tender for civil engineering

First a detailed lay-out of manufacturing equipment should be elaborated by the client (if not contracted to be delivered by the supplier of equipment) where not only the foundations of machines but also participation of civil engineering contractors in the construction of production equipment is specified (e.g. brickwork of driers and kilns). A specimen of bills of quantities for such a purpose is enclosed (See Appendix No. 2). The above background information should be included in the books of tender for civil engineering works. They should include required types and parameters of production premises, administrative buildings and other civil engineering works such as power, water and sewerage lines, roads, fencing, etc.

Conclusion:

Books of tender for civil engineering are sent out to potential contractors.

Evaluation of the tenders for civil engineering work

The received tenders are compared and evaluated and the most suitable one is accepted. It is the matter of the contract whether the detailed designs and lay-outs will be elaborated by the client, the contractor or an architect. After the conclusion of the contract preliminary measures are taken for meeting local regulations and ensuring a smooth start-up of realization.

The preparation of the books of tenders for civil engineering works and the evaluation of tenders is an assignment of a team of specialists in various professions.

Conclusion:

After evaluation of the most suitable tender a contract is concluded between the entrepreneur and the building contractor.

Co-ordination of construction, equipment delivery, erection and supervision

For the purpose of organizing the pre-investment and investment activities the entrepreneur should establish an independent group consisting at least of a managing director, secretary and cashier-bookkeeper. The counterpart engineer, manufacturing foreman, clay pit foreman, chief of quality control and tests, draughtsman and warehouse clerk should be assigned since the start-up of construction. This staff may become a permanent one after the completion of the brick plant construction.

A master chart is prepared indicating the schedule of construction, equipment delivery and erection as well as trial runs as stipulated in the contract. The supervision is organized and the deadlines of contracted obligations are to be regularly checked.

Conclusion:

After the successful completion of this phase the start-up and manufacture commissioning follows.

Supervision during construction

The objective of the supervision of civil engineering construction is to check the process of construction of buildings and installation of power, water and sewerage lines.

The supervision of manufacturing equipment includes deliveries of equipment, erection and connection.

The construction of civil engineering works is mostly supervised by specialists in various trades who participated in the evaluation of the tender. The manufacturing equipment and its erection is supervised by the counterpart engineer or by an invited expert.

Supervision of start-up and commissioning

In compliance with the guarantees stipulated in the contract functional tests of particular machines are performed by a representative of the equipment supplier and under the supervision of the counterpart engineer. If the tests are satisfactory the whole plant is commissioned and its guaranteed output as well as performances of particular sections are tested. As a rule also the quality of products is guaranteed and checked. The testing results are summarized in take-over protocols and signed by both parties.

Use of the presented publication

An entrepreneur considering to establish a brick plant may be well experienced in brick manufacture and will probably know how to proceed with the establishment of a new brick plant. He will probably read with interest the Profiles of Brick Plants and compare the referred data with his own. He may be also interested in some of the described plants and require the information from the sellers.

To an entrepreneur who is not yet familiar with this line of manufacture this booklet should be more useful. He will follow the sequence of activities in Chapter No. IV and invite consultants accordingly. If he is not sure about the extent of demand for bricks and if there is no previous information available about the quality of the clay deposit to be exploited he will satisfy himself by ordering preliminary tests of raw materials, the review of which he finds in the same chapter, along with the elaboration of a pre-feasibility study to obtain the primary technical and economical orientation. In this phase the Chapter Nos. II and III should be of a considerable use, giving the information on technologies, technological equipment, consumption of raw materials, fuels, water, labour requirements and informative prices of equipment delivery. The indicated extent of the required production area is a basis for a preliminary price estimate of the production premises. If the size of none of the referred brick plants compares with the size of brickworks considered by the entrepreneur, the required data may be calculated by extrapolation. In case the mechanisation of the plant is to be substituted partly by manual labour the data must be recalculated accordingly

and equipment sellers contacted if need be.

If the conclusions of the pre-feasibility study show good prospects the laboratory and pilot plant tests referred to in Chapter No. IV should follow. The next step then is the feasibility study which again may apply some data and technologies from the Chapter Nos. II and III.

If a previous information on quality of the deposit is available and the scope of demand for brick products is warranted, the pre-feasibility study may be committed. The laboratory and pilot plant tests are made successively and the feasibility study follows.

In the further phases of the project dealing with project engineering the booklet will not only be a guide. Its technologies and parameters may be applied in the preparation of books of tender for equipment and the Contents of a model contract for a brick plant equipment may serve for checking the completeness of a contract.

Appendix No. 1

Contents of a model contract for a brick plant equipment

Enclosure II	Guarantee on the part of the seller
Enclosure III	Guarantee on the part of the buyer
Enclosure IV	Technical documentation to be delivered by seller
Enclosure V	Technical documentation to be delivered by the buyer
Enclosure VI	Conditions for works conducted on site

Appendix No. 2

List of building materials for brick plant kilns

(usually delivered locally by buyers)

Item	Material	Unit	Required quantities for annular kilns producing per year		
			10 mill. bricks	5 mill. bricks	2-3 mill. bricks
1	Solid bricks compressive strength P 150, 250/120/65 mm	pcs	617,000	373,000	320,000
2	Two-cavity bricks compressive strength P 25 290/140/65 mm	pcs	21,000	13,000	-
3	Portland cement 325	t	193	63	60
4	Slaked lime	t.	41	31	28
5	River sand	cu.m	368	213	224
6	Gravel sand	cu.m	380	251	210
7	Quarry stone for foundations	cu.m	180	110	105
8	Sieved clinker without organic admixtures	cu.m	890	392	250
9	Auxiliary sawn timber	cu.m	11	6	-
10	Reinforcing bars	t	2.5	1	-
11	Structural steel	t	5	3	3

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