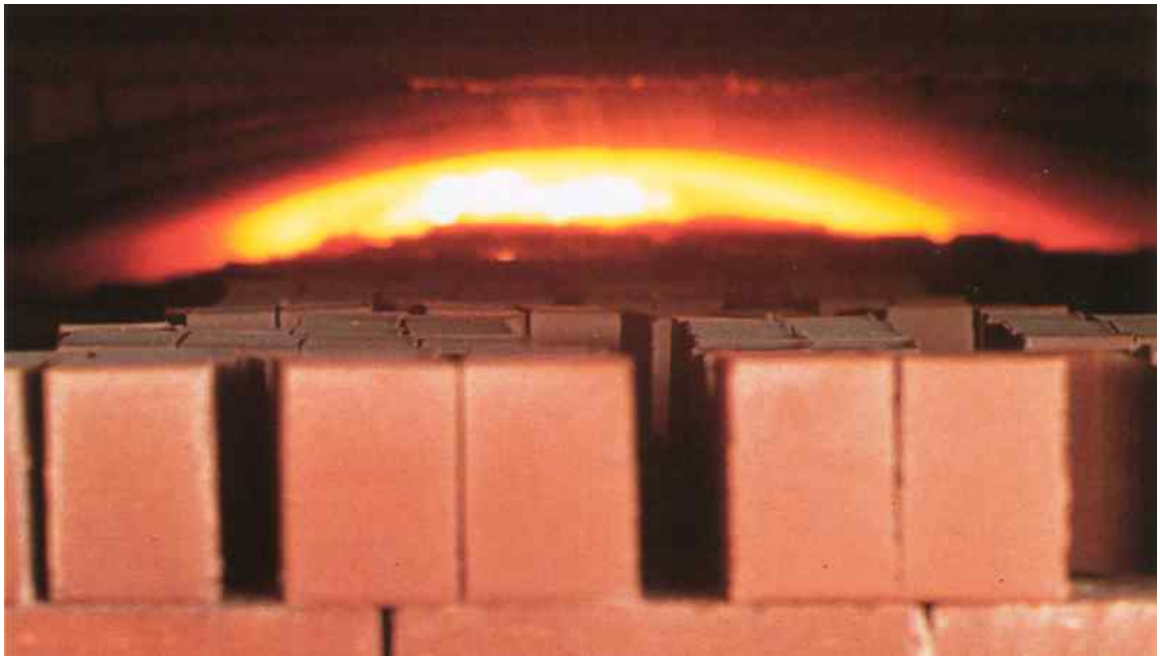
自动工业工程有限公司

IA ENGINEERING SDN. BHD.



About I A ENGINEERING SDN BHD

IA ENGINEERING SDN. BHD. was incorporated in Malaysia in 1989. The Company is specialized in engineering and construction of production plant for heavy clay industry. Through years of practical experiences involving in the industry, the Company is capable of offering a total solution to clients for a complete project ranging from feasibility study, raw material testing, plant layout design, equipment and machinery design and fabrication, installation, commissioning and after sales consultancy services.

Our scope of supply and service covers :

- Clay Preparation Machinery - Belt Conveyor System, Box Feeder, Crusher/Hammer Mill, Fine Roller Mill, Wet Pan Mill, Circular Screen Feeder, Double Shaft Mixer etc.
- Shaping Machinery - De-airing extruder, Automated Brick Cutting Machine
- Handling and Haulage Machinery - Automated Brick Setting Machine, Automated Kiln Car Haulage System, Transfer Car
- Drying System - Productive and efficient Tunnel Dryer
- Firing System - Productive and efficient Tunnel Kiln completed with computerized Firing System for gaseous, liquid and solid fuels
- Solid Fuel Processing System - Complete processing equipments for solid fuels including Vibration Screen, Pulverizer, Dryer, Delivering and Storage system
- Unloading Machine for Finished Products
- Industrial training and consultancy services for the production management and technical solution.

Since its inception, the Company was aware of the escalating cost factor of energy faced by the heavy clay industry and the associated environmental pollution problems. Our R & D program has been focusing on the technological innovation for using cheaper sources of fuels as alternatives for the industry. After years of research and practice, we have succeeded in developing a fully automated firing system using industrial/agro solid wastes such as sawdust, coal powder, rice husk/stem, corn stalk, ground nut crust, oil palm shell or fibre etc. as fuels for firing both common and quality burnt clay products in a specially designed tunnel kiln. The usage of these cheap sources of energy helps to reduce the cost of energy drastically as compared to that using natural gas or fuel oil. Our firing system has been proven to be highly efficient, reliable, durable, clean, easy and inexpensive to maintain. It gives superior combustion results in full compliance with the environmental regulatory requirements and at the same time reduces the public pollution caused by disposal of these solid wastes. With our technology applied to an appropriate production system and a trained production team, a variety of quality products can be produced by using solid fuels for firing. As a rare example of the industry, we have assisted one of our clients, Claybricks & Tiles Sdn Bhd, to successfully produce quality products for exporting to the international market. For more information, please visit to http://www.claybricks.com

Our Philosophy

- To understand our clients needs and dedicate to provide excellence in engineering and services to our clients satisfaction.

Our Mission & Objectives

- To offer our expertise and professional services to our clients and ensure that every project completed is successful and meet our client's expectations.
- To deliver our clients the most cost effective solution and achieve optimum results of investment.
- To offer our clients our best technology through constant technical innovation.

Our Edges and Advantages

- Our staff maintain a high level of commitment to response to clients needs
- We communicate and cooperate closely with our clients to work out the most cost effective solution to minimize investment in their projects based on our experiences and know how.
- We provide after sales industrial training to ensure smooth plant operation and maintenance.
- We have good knowledge and are experienced in assisting our clients setting up production plant in the under developed and developing countries.

Major Projects completed by IA Engineering Sdn Bhd :

Year	Projects	Location	Monthly Capacity	Remarks
1992 **1995**	Claybricks & Tiles Sdn Bhd Extension Project	Johor, Malaysia	5.0 million pcs 5.0 million pcs	Leading manufacturer of high quality facing bricks, paving bricks and brick veneers in Malaysia. Products export to international market.
1993	Kim Ma Supertiles Sdn Bhd	Butterworth, Malaysia	4.0 million pcs	Most advanced brick factory in the northern territory of Malaysia
1995	Pt. Batu Bata Pulau Ladi	Batam, Indonesia	4.0 million pcs	Most advanced brick factory in Indonesia
1998	Greatwall Brickworks (M) Sdn Bhd	Johor, Malaysia	5.0 million pcs	One of the most advanced brick factories in Johor, Malaysia

Flow Chart of Production Process of A Modern Brick Factory

Clay Excavation

Dry hard raw materials such as shale, coal gangue, clay stone etc

Preliminary Crusher

Box Feeder for Proportionate Feeding

Wet Pan Mill for Lump Breaking and Kneading

1st Stage Fine Crushing to < 3mm

2nd Stage Fine Crushing to < 1mm

De-airing Extruder For Shaping

Automatic Multi-wire Brick Cutting Machine

Automatic Brick Setting Machine

Tunnel Dryer

Tunnel Kiln

Semi-Automatic Unloading Machine

Finished Products

I. Brick Making Technology

Plant Layout

In a modern brick factory, the daily production capacity is more than 500 metric tons daily. An integrated design approach should be applied to plant layout by taking into consideration of all operational and technical problems that may possibly arise in order to optimize the productivity and efficiency.

Listed below are some aspects relevant to the layout design :

- Ensure smooth operation by

  (i) eliminating the unnecessary steps &
  (ii) simplifying procedures in the process

- Minimize distance traveled

- Minimize interruption of production by providing

  (i) access to facilitate maintenance of machinery and equipment &
  (ii) extra space/tracks for material/wares storage during weekend or holidays.

- Provide effective use of people, equipment, space and energy

- Provide convenience, safety and comfort working environment for employee

- Provide for a cost effective installation

1. Raw Materials – Selection and Testing

The raw material for brick making is clay or shale which contains fine particles and exhibits plasticity when mixed with appropriate amount of water. The chemical composition of clay contains main silicon oxide (SiO_2, 35-65%) and alumina oxide (Al_2o_3, 15-24%) with other minor constituents such as iron oxide, sodium, potassium and titanium oxides and calcium carbonate etc.

Raw Material Quarry

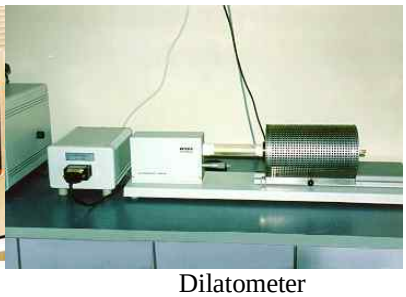
The selection and testing of raw material is of prime important before the plant is built. Unfortunately, it has quite often been neglected or overlooked, given rise to serious difficulties in product quality in subsequent production.

The testing of raw material involves :-

(a) Particle size distribution analysis to understand the physical properties such as plasticity, porosity, texture etc.
(b) Dilatometric measurement on the thermal behavior of dimensional variation on heating up and cooling down over the temperature range from room temperature to 1200C.
(c) Differential Thermal Analysis (DTA) and Thermogravimetric analysis (TGA) to gain knowledge on the evolution of heat and change of mass as a function of temperature during the firing process.

All these information are very helpful in determining the suitability of clay for making brick.

X-ray Particle Size Analyser



Dilatometer

DTA and TGA Analyser

2. Preparation of Raw Materials

As most clay for brick making are heterogeneous and sometimes contain hard granules such as silica sand particles, quartz, limestones, ferrites & etc., clay preparation which involves crushing, kneading, mixing and tempering, is of utmost importance if the quality of final product is to be assured. The purpose of clay preparation is not just to improve the mineralogical homogeneity and plasticity of the clay; it also helps to change the physical and chemical properties such as shrinkage, colour and the vitrifying temperature by proper mixing of two or more types of clays and additives. Well prepared clay will ensure better shaping and dry strength for the green wares, finer surface finishes and stronger structure for the products. Proper clay preparation also helps to eliminate problems during the production process thereby reduces the rejection rates.

Proper clay preparation process is vital for manufacturing of high quality products. The choice of processing machinery depends on the physical properties of raw materials used.

2.1 Proportionate Mixing – Box Feeder

To ensure consistency of quality and high productivity, strict control of the mixing proportion of suitably classified clays or additives to change the physical and chemical properties such as the vitrifying temperature, the linear shrinkage, colour and texture is a pre-requisite. Additives containing mineral flux can be added to lower the vitrifying temperature and the rate of shrinkage can be reduced by mixing non-plastic materials such as grog or fine sand in the clay bodies. The task of mixing different types of clay in appropriate proportions can be achieved by using two or more box feeders.

A box feeder is a rectangular box of appropriate size with a steel slat conveyor as base which moves the raw materials forward at an adjustable rate. The box feeder also serves as a buffer and temporary storage to avoid unnecessary interruptions.

2.2 Preliminary Crushing – Wet Pan Mill

Clay raw material usually contains large lumps or aggregates which need to be reduced to smaller sizes by preliminary crushing to facilitate subsequent fine grinding.

Jaw crusher combined with Hammer mill are used for hard raw materials such as shale, clay stone, coal gangue etc with moisture content less than 10%. Normally, particle of sizes larger than 1 mm are screened off and recycled back to the hammer mill for further grinding so as to improve size reduction efficiency.

Wet pan mill is used when raw material contains higher moisture content (>20%). The machine performs functions of disintegrating, kneading and homogenizing.

2.3 Fine Grinding – Fine Roller Mill

The granules of hard materials such as quartz, stones and shale contained in the raw material are crushed down to sizes less than 3 mm and 1 mm in 2 stages by 2 fine roller mills. This fine grinding process is vital for quality control. It helps to eliminate surface cracks caused by the differential thermal stress between particles and the clay body, thus improving the surface smoothness of the finished products.

2.4. Homogenizing – Circular Screen Feeder

The refined clay is further tampered by blending, mixing and kneading in a circular screen feeder or a double shaft mixer. Such a homogenizing process will ensure uniformity in the colour and minimum cracks due to internal stress resulted from lack of uniformity in density of the clay body.

In some cases, forming of clay requires high plasticity, the processed clay is required to store in an aging house fore some period of time to further enhance the plasticity.

2.5. Shaping – De-airing Extruder

De-airing extrusion is used in most modern brick making. Basically, the extrusion process involves forcing of clay along a cylinder by means of augering action through a mould to form a rectangular column of given cross-section. Sometimes, the clay is forced through a die to form perforated column.

The extrusion process can be classified into three major types according to the moisture content of clay - soft extrusion for 25-30%, semi-stiff extrusion for 20-25% and stiff extrusion for 15-20% of moisture content. The choice of right type of extrusion, therefore, depends on the moisture content and plasticity of the raw material used.

A modern extruding machine usually consists of a single/double-shaft pug sealer, a de-airing chamber and an auger extruder. The refined clay from the fine roller mill is fed into the pug sealer before entering the de-airing chamber. In the de-airing chamber, the air trapped in the clay is removed. The de-aeration process will ensure that the clay column thus extruded is denser, stronger and free of air occlusion which, when exists, will cause blistering effect due to the expansion of air during the firing process.

For high quality products, especially perforated bricks or hollow blocks, a de-airing extruder is a must. A modern de-airing extruder is highly efficient, productive and flexible. It is capable of making a variety of products by simply changing the design of mould and die.

2.6 Brick Cutting Machine

The clay column shaped by extruder is cut to a measured length. It is then pushed through a multiple-wire cutting machine by a mechanical pusher arm precisely into bricks of required dimensions. The green bricks, if required, can be chamfered on edges or textured on surfaces. The cutting machine can be operated fully automatically.

2.7 Brick Setting – Manual or Automatic Setting Machines

The green bricks are transferred and stacked onto the deck of a kiln car either manually or by an automatic setting machine into square or rectangular hacks of predetermined patterns with sufficient void among the bricks for better drying and heat exchange.

(i) Manual Setting Conveyor

The setting conveyor provides a low-cost but very effective way for manual setting. It transports green bricks overhead the kiln cars to positions within reach of the workers without even moving their foot steps. It minimizes the distance of human motion to enhance the efficiency of work and at the same time reduces damages caused by multiple human handlings.

The manual setting system is most suitable for products of special sizes or shapes which may pose inconvenience and difficulty to an automatic setting machine. It is also used as backup when the automatic setting machine is stopped for maintenance or troubleshooting.

(ii) Automatic Setting Machine

Automatic setting machine can be most efficiently used for handling products of normal and consistent sizes at high production capacity.

The green bricks are first grouped into a fixed array on a platform. It is then gripped and transported by the overhead traveling gripper to be unloaded onto kiln cars layer by layer. The work is performed and monitored automatically by a PLC or a computer.

The loaded kiln car is then pushed into a dryer for drying.

2.8 Drying – Tunnel Dryer

The moisture content of green bricks must be reduced to less than 0.5% before burning is made possible. The traditional method of natural drying by open-air is unable to cope with the high productive requirement of a modern brick factory, where bricks are dried in chamber or tunnel dryers instead. Today, tunnel dryer is getting more popular due to its simplicity in operation, labour saving, high productive and high thermal efficiency.

A tunnel dryer is a long tunnel equipped with blowers and fans for supplying hot air and re-circulating the dryer draft and exhaust fans for removal of the water laden air. The green bricks loaded on the kiln cars are pushed into the entrance of dryer. The bricks are then steadily and progressively dried as the kiln car moved through the dryer at intermittent intervals in the direction opposite to that of the flow of hot air. Hot air of approximately 120C is blown into the dryer at the dry end and the moist air is exhausted from the wet end. The heat required by the dryer is drawn from the cooling section of the tunnel kiln to economize the energy cost. Sometimes supplementary heat is needed depending on the type of product and thermal property of clay.

2.9 Firing – Tunnel Kiln

Tunnel kiln is the most advanced and efficient kiln used in the brick industry today. Its operation can be fully automated with a centralized control system to ensure high productivity and consistency in product quality.

Structurally, tunnel kiln is a long horizontal tunnel through which the kiln cars loaded with green wares are moved on rails at regular intermittent intervals, entering at one end (entrance) and leaving as fired products at the other end (exit). The deck of kiln car is built with refractory materials to protect its steel frame from immense heat inside the kiln during the firing process. The kiln has a typical length of 130 to 150 meter and width up to 10 meter. It is sectioned into 3 zones, namely, (i) the preheating zone, (ii) the firing zone and (iii) the cooling zone according to their functions.

The loaded kiln cars are moved on rails inside the kiln at a fixed distance (normally 1/2 or 1/3 of car length) by a hydraulic pusher for every preset interval. The green bricks entering the preheating zone are steadily heated up from room temperature to ~750C by the counter-flow kiln draft as they reached the firing zone where the bricks are subjected to direct firing with fuel injected from the top of the kiln. In the firing zone, bricks are further heated to the vitrifying temperature at around 1150C, at which sintering process of the clay body takes place. The sintering temperature depends very much on the nature of the clay used. High speed burner nozzles coupled with high pressure air are sometimes used to create pulsating effect so as to improve heat exchange and uniformity of firing. The burners are monitored and regulated automatically by an electronic controlling system to maintain temperatures according to the preset values.

After the firing zone, the bricks are completely cured. It is then cooled down in the cooling zone by the incoming cold air entering from the exit of the kiln. The finished products leave the exit at almost room temperature. A large portion of the air in the cooling zone is drawn and supplied to the dryer as hot air for drying.

With the advent of modern electronic control technology and industrial management concept, the use of tunnel kiln in brick industry has become the popular choice for the following reasons:

1. The design of tunnel kiln allows a high degree of mechanization to save labour.
2. Fully automatic firing system requires less skill in the kiln operation.
3. It enables continuous production for high productivity.
4. Its central controlled firing system enable automatic monitoring and regulating the burners to maintain consistent kiln temperatures to ensure high product quality.
5. It gives the highest efficiency in fuel consumption due to (i) its best heat exchange among all types of kiln in brick industry. (ii) re-utilization of waste heat extracted from the cooling zone for drying.
6. It enables the efficient use of solid fuel for firing to save cost.
7. Its flexibility in operation enables production of a variety of products.

The design of tunnel kiln depends on largely the property of raw material, types of product, production capacity, and fuel used for firing.

2.10 Unloading Machine

The fired products on the kiln cars can be unloaded efficiently onto wooden pallets by using an unloading machine. It saves labour power substantially and minimizes damage of products by human handling. It also helps workers to refrain from stepping on the refractory decks, thereby causing unnecessary damages.

2.11 Product Value Enhancement

Finished products can be further processed to enhance their values. They can be cut into smaller or thinner sizes, grinded to form round edges or surface texturing by hacking or shot-blasting.

2.12 Burnt Clay Products of Different Colours, Sizes, Shapes, and Textures

3. PRODUCTS

3.1 Box Feeder

It consists of a rectangular box supported by robust mild steel frame and completed with :

- High tensile chain conveyor ribbed with apron plates as base, driven by heavy duty & high torque helical speed adjustable gear-motor to regulate the feeding rate
- Paddles fixed onto a rotating shaft mounted at the exit to serve as a disintegrator to break big lump of raw material and ensure an even material discharge
- Sliding gate at the discharge end
- Spring-loaded cleaning scraper at the discharge end
- Sensor as safety device for overloaded protection

Specifications

Model	Capacity (MT/hr)	Dimensions (LxW, mm)	Electric Motor Power (kW)	
			Base Conveyor (Hydraulic motor)	Paddle Shaft (Gear-motor)
IA-BF-200	20	4300x850	1.1	4.0
IA-BF-300	30	4300x1000	1.5	5.5
IA-BF-400	40	4300x1200	1.5	5.5

3.2 Belt Conveyor

The belt conveyor is built with five-ply fibre reinforced, oil resistant rubber belt supported by rollers on robust mild steel frame. It is driven by heavy-duty helical gear motor.

Specifications :

Width:	650 / 750 / 850 mm
Length :	Made as required
Power Supply :	Three phase 380~415V 50/60Hz
Motor Power :	1.1 ¨C7.5 kW, depending on load

3.3 Wet Pan Mill

Wet pan mill is a universal machine for disintegrating, grinding and homogenizing wet clay materials. It is designed with high throughput and driven by electric/hydraulic motor.

It consists of two runner wheels revolving together with a feeding chuck around a central shaft on bed made of wear resistant perforated steel plates. Clay, which is fed into the mill through a central feeding chuck, is distributed evenly on the pan to enhance processing efficiency. The mill is supported by concrete columns or steel frame and driven by frequency-controlled electric motor coupled to a heavy duty flange mounted planetary gear or a grounded bevel-spur gear unit via hydraulic coupling or pneumatic clutch. The machine is so designed to ensure all machine or wear parts are accessible for easy maintenance.

Through many years of practical experiences in the heavy clay industries, wet pan mill has been recognized and proven worldwide to be a highly productive, energy efficient, durable and low maintenance machine which is essential to the soft or semi-soft brick making process.

Specifications				
Model	Capacity (m^3/hr)	Runner Dia. x Width (mm)	Grinding Pan Dia. (mm)	Motor Power (kW)
IA-WPM-14/35	15M3/hr	1400 x 350	1900	30kw
IA-WPM-16/40	20M3/hr	1600 x 400	2700	45kw
IA-WPM-18/50	30M3/hr	1800 x 500	3200	55kw

3.4 Multi - Wire Cutting Machine

The multi-wire brick cutting machine is uniquely designed for high capacity and flexibility. It consists of a column cutter and a multi-wire cutter. The column cutter measures and cuts the clay column to a fixed length by a high tensile wire attached to a transverse cutting arm moving along with a horizontal frame carrying the clay column. The cut length can be adjusted mechanically.

The cut clay column is fed into the multi-cutter via oil resistant belt conveyors and force through parallel wires by a mechanical pusher arm driven by heavy-duty gear motor. The cutting wires are high tensile and exceedingly wear resistant. The wires are hold in place by pneumatic tensioning devices which are uniquely designed to ensure wires holding in constant tension and to facilitate replacement of broken wire and adjustment of wire positions. Bricks can be accurately cut into required sizes leaving minimum amount of waste clay. The bricks can be chamfered on edges by roller blades.

The wire cutting frame can be conveniently changed for cutting different product sizes.

Specifications :

Model	: IA-BCM-10K
Capacity, pcs/hour	: 10,000
Cut frequency	: 8~10 cycle/min
Pusher Distance	: 430mm
No. of bricks per cut*	: 20 pieces
Column Cutter Motor, kW	: 1.5
Pusher Arm Motor, kW	: 7.5
Belt Conveyor Motor, kW	: 3.3

- based on standard BS size (215x102.5x65 mm)

3.5 Automatic Brick Setting Machine

The setting machine is a fully automated system capable of continuous operation for a long period of time with minimum maintenance. Bricks are conveyed to the setting platform and arranged in a pre-determined array. The overhead traveling gripper, which is equipped with either vacuum sucking heads or mechanical arms, pick up the bricks and travels along rails mounting on the top of a heavily built supporting frame to some fixed positions overhead the kiln car and sets the bricks layer by layers on the deck. The traveling gripper can be accurately positioned by a servo motor working in conjunction with an encoder. The lifting of kiln car is achieved by means of 4 powerful hydraulic cylinders working in tandem. The positioning of gripper and the stacking pattern of each layer of bricks can be programmed by a Programmable Logic Controller (PLC).

Specifications

Model	IA-ASM-10K
Capacity, bricks/hr	8,000 - 10,000

Electric Motor Power	kW
Overhead Traveling Gripper Assembly	5.5
Hydraulic lift	20
Pusher	1.5
Vacuum Pump	15
Power Supply	380~430V 50/60 Hz

3.6 Manual Brick Setting Conveyor

Manual setting of bricks can be greatly eased by using setting conveyors, which are built of rubber belt or wear resistant plates bolted to high tensile chain conveyor. The conveyors can be positioned at upper and lower levels to facilitate manual setting for different heights of green bricks on kiln cars. The movement and positioning of kiln car under the setting belts is achieved by a hydraulic pusher.

Specifications :

Model	IA-MS2-4K
Capacity, each conveyor	4,000 pieces per hour
Electric Motor Power	1.5 KW x 2
Power Supply	Three Phase 380~430V 50/60 Hz

3.7 Tunnel Dryer

We design and construct complete tunnel dryer with a monthly production capacity ranging from 1.0 to 12 million bricks. It is designed for maximum efficiency and quality consistency.

The tunnel dryer is equipped with blowers for supplying hot air (120C) at the dry end (entrance) and exhaust fans at the wet end (exit). The distribution of draft temperature and humidity inside the dryer can be regulated and controlled by recirculation fans with valves and dampers according to the drying characteristics of the clays used so as to achieve the optimum drying rate and ensure high quality of drying.

3.8 Tunnel Kiln

We design and construct complete tunnel kiln with a monthly production capacity ranging from 1.0 to 12 million bricks. It is designed to achieve highest productivity and thermal efficiency. Operation of the kiln can be fully automated but is non-sophisticated for normal workers.

Our tunnel kiln can be designed to use gaseous fuels, liquid fuel oils (LFO, MFO) or solid fuels for firing, depending on the needs of clients. We are expert in using solid fuels such as sawdust, palm shells, coal or other industrial/agro wastes for firing, to save energy cost. Such saving is particularly important in view of today¡s situation of escalating oil price.

The kiln is built with complete operating equipments including hydraulic pushers for movement of kiln cars, servo-controlled valves and dampers for regulating kiln draft to achieve optimized temperature distribution, kiln car cooling system, thermal insulated ducts for hot air delivery and a centralized control system for automatic firing of products. In particular, our kiln is equipped with water seal to replace the conventional sand seal. The water seal system is our unique design which provides excellent sealing of heat from penetrating to the space underneath the kiln cars and prevents overheating of the wheel bearings. The flow of water in the seal also provides an effective means to cool down the steel frame of kiln cars.

The temperature of tunnel kiln is automatically controlled by microprocessor based temperature controllers coupled with fuel dosage controlling devices to regulate the feeding rate of fuels into the kiln. The kiln operates continuously for 24 hours in three working shifts. With automation and mechanization of the kiln, each shift needs only two workers for operation.

3.9 Automatic Solid Fuel Firing System

Automatic Solid Fuel Firing system

Central Control Panel

The firing system plays the most important role in tunnel kiln operation. It can be classified into three categories as gaseous, liquid and solid fuel firing systems. Generally speaking, solid fuel is economical to use but it is more difficult to manage and needs more costly equipment for processing, delivery, storage and firing.

Solid fuel such as sawdust and plant fibre requires pre-processing before using for firing. It is screened to get rid of the impurity contents and then dried to a moisture content below 5% in a dryer. In case the solid fuel contains coarse particles, it needs to be pulverized before drying. The dried fuel is then kept in a storage silos. The delivery and storage system of solid fuel must be dust-tight to prevent contamination of atmosphere and fire hazard. The system must be trouble-free, durable and requires only minimum maintenance for a long period of continuous operation.

During the firing process, solid fuel is fed through a specially designed dosage controlling feeder. The feeding rate is controlled by regulating the frequency of activation of the pneumatic valves of the feeders by electronic temperature controllers. The solid fuel from each feeder is then delivered pneumatically through a pipe to a high speed distributor, which distributes the fuel evenly to 6-8 nozzles through which the fuel is injected form the top into the kiln. There are a total of 12-14 units of such distributors for controlling the temperatures of different sections of the firing zone.

The kiln temperatures are detected by thermocouples as sensors for the temperature controllers. If the temperatures deviate from the preset values, the temperature controllers will vary their output signals proportionally and regulate the time of activation of the pneumatic vales so as to vary the feed rate of fuel and nullify the temperature deviation. The kiln temperatures can thus be maintained according to a pre-set firing curve within $\pm$0.2% continuously over a long period of operation.

Firing Systems for other type of Fuels

Light Fuel Oil Firing System

Natural Gas Firing system

3.10 Kiln Car

The kiln car is used to carry green bricks for drying and firing. It is heavily built with robust mild steel frame and moves on cast steel wheel with dust-proof and high temperature bearings. The car deck is covered with refractory bricks to protect against direct heating during the firing process. The deck is supported by perforated blocks filled with light weight insulation materials to prevent transmission of heat to the steel frame and wheel bearings. The kiln car is built light weight to save energy carried away from the kiln.

The kiln car can be built to a required dimensions and can carry a load up to 25 metric tons

3.11 Transfer Car

The transfer car is built with robust steel structure running on cast steel wheels. It is equipped with a hydraulic pusher powered by a power-pack unit mounted on car frame. It transfers kiln cars between the setting/storage lines, tunnel dryer and tunnel kiln. Movement of the car is driven by an electric motor or a hydraulic motor. It is capable of carrying kiln car with a load up to 25 metric tons

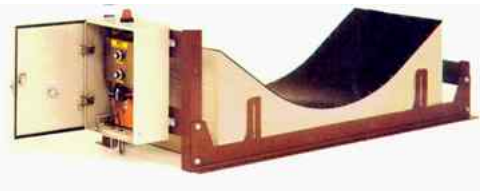
Operation of transfer car can either be manual or automated when link to the central control system.

3.12 Metal Detector

The metal detector is used to protect expensive clay preparation and brick making machines from damaged by metal scraps contained in the raw materials. It stops the belt conveyor and removes the clay from the conveyor automatically or manually. It can detect small pieces of metal of size down to +/- 5 mm. The sensitivity of the detector can be conveniently selected via a dial with readings.

Dual Detector Head

Model : IA-MTR750-S (Single detector head) IA-MTR750-D (Dual detector head)
Power Supply: 115/230 VAC 50/60Hz



Single Detector Head

3.13 Solid Fuel Processing Equipments

A solid fuel like sawdust normally contains high moisture and impurities such as stones, mud, bark, wood chips and scarps etc. It, therefore, requires processing system to get rid of the contaminations before using as fuel for firing. It is first filtered by a vibrating screen and the dried to the moisture content below 5% by an appropriate dryer. In case the solid fuel is too coarse to be used, it needs to be pulverized by a hammer mill to the required fineness. The dried solid fuel is then stored in a big storage silos.

The twin-paddle agitating dryer provides an ideal solution for drying powdered or granular materials such as sawdust, plant fibres or other agro wastes.

The wet feed at the entrance is heated directly by the input hot air. It is agitated vigorously and continuously by the paddles mounted on twin shafts rotating in opposite directions, resulting in excellent heat transfer efficiency. The totally closed process and the absence of large air flows virtually eliminate dust problems and give a minimum exhaust gas.

The dryer can deliver a drying capacity up to 20 metric ton per hour.

The advantages of twin-paddle agitating dryer :

- Suitable for processing entire range of feeds, except liquids
- Compact installation
- Very high evaporation capacity
- Very high thermal efficiency
- Totally enclosed
- Minimum exhaust gas

Vibrating Screen

Twin-paddle Agitating Dryer

Storage Silo

Sawdust Processing System

3.14 Unloading Machine

Semi-automatic Brick Unloading Machine

The Unloading machine is used to unload the finished products from kiln cars. It has hydraulic clamping arms for gripping and unloading blocks of brick directly from the kiln cars with minimum manpower. It greatly enhances the efficiency of unloading work as compared to that using manual unloading.

The machine is equipped with pairs of gripping arms (the number of pairs of gripping arms depending on the size of kiln car) powered by rugged hydraulic cylinders to clamp the finished products from the kiln cars. The gripper then lifts the products and travels on rails supported by robust steel frame. The traveling speed can be regulated by a variable speed electric motor monitored by PLC. The machine transfers the finished products in blocks and unloads onto a wooden pallet on a conveyor which will transport the bricks to a position to be carried away by forklift. The unloading machine can be operated semi- or fully automatically.

Specifications

	Motor Power, kW
Model	IA-BUL20K
Capacity, pcs/hour	20,000
Hydraulic lift for Gripper Arm	4.0
Traveling Gripper	1.1
Pellet conveyor	1.1
Electric Power Supply	380~430V 50/60 Hz

3.15 Brick Hacking Machine

The hacking machine is used for hacking one face of a brick by pairs of knives revolving in opposite directions to give a rock like texture. The degree of hack can be easily changed by two adjustable knobs. The machine is built for rugged use at long hours with minimum maintenance.

Specifications

Model	IA-BHM 700
Capacity, pcs/hour	720
Electric Motor Power, kW	4.0
Electric Power Supply	380~430V 50/60 Hz

3.16 Reconditioning Machines & Wear Parts

De-airing Extruder

Pug Sealer

Extruder Wearing Parts

High speed Roll Mill

We also supply completely re-conditioned branded extruder and other clay preparation machines from U.S.A. and Europe and their wearing parts. These machines are so robustly built that they can work almost like new machines after overhauled and re-conditioned.

3.17 Others Products

Large Air Volume Fan

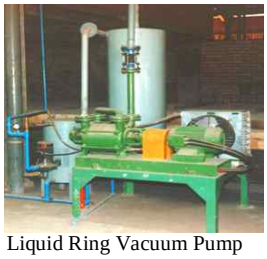
Centrifugal Blower

High Pressure Blower

Sand Rotary Screening Drum

Rotary Feeder

Paper Shredder

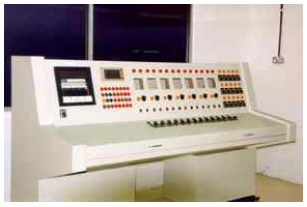


Liquid Ring Vacuum Pump

Vane Damper

Laboratory Oven

Water Chiller



PLC Control Panel

Kiln Car Hydraulic & Chain Pusher; Haulage System;
Cyclone Furnace;
Rotary Dryer;
Moisture Controller;
Dust collecting system
Hammer mill, Crusher, Double Shaft Mixer

And Many More¡- ..!!

4. Solid Fuel Firing Technology in Brick Making and Its Advantages

Energy is the major cost component of brick industry. The escalating prices of hydrocarbon fuels such as fuel oil and natural gas in the recent years have posed great threats to the survival of the industry.

So, how to achieve a low production cost while maintaining the product quality has become a matter of prime concern. In IA Engineering, we have developed a solid fuel firing technology which utilizes virtually any industrial/agro wastes such as saw dust, woodchip, palm fiber, coal powder etc. which contains sufficiently high thermal calorific value as low-cost substitutes for hydrocarbon fuels firing bricks. The table below gives a comparison of the estimated energy cost per brick for fuel oil, coal and sawdust.

Although solid fuels have such attractive cost benefits, they are generally more difficult to use than liquid and gaseous fuels for kiln firing in terms of processing, storing, delivering and controlling the firing temperature. Solid fuels require pre-processing before use. They must be screened to get rid of impurity contents and then dried to moisture content below 5% in a dryer. In case the solid particles are too coarse to be used, they need to be pulverized to appropriate sizes. The dried fuel is then kept in a large storage silos sufficient for at least 2 days consumption. The delivery and storage system of solid fuel must be dust-tight to prevent air contamination and fire hazard. The system must be trouble-free, durable and required minimum maintenance for a long period of continuous operation.

Relative comparison on energy cost per brick using oil, coal, and sawdust

Fuel Type	Relative Energy Cost (450Kcal/kg green brick)
Fuel Oil	100%
Coal	50-60%
Sawdust	10-15%

Fuel prices based on 2002-03 Malaysian market prices

During the firing process, solid fuel is injected by air through the burner nozzles directly into the firing zone of tunnel kiln where the temperature is sufficiently high for combustion. The feeding rate of solid fuel is controlled precisely by microprocessor based electronic temperature controllers which regulate the activated time of the pneumatic valves of the dosage controlling feeders. These feeders are specially designed and built to feed an accurate dosage of fuel every time when the pneumatic valves are opened. The solid fuel from each feeder is then delivered through a pipe to a high speed distributor, which delivers the fuel evenly through 6-8 nozzles and inject from the top into the kiln. Normally, there will be 12-14 units of such distributors installed for controlling the temperatures of the firing zone.

Through years of research and practice, we have perfected the technology for utilizing these cheap energy substitutes to produce a wide range of quality burnt clay products.

SOLID FUEL PROCESSING AND AUTOMATIC FIRING SYSTEM FOR TUNNEL KILN

Solid Fuels - Coal, Sawdust, Palm Fiber, etc

Box Feeder

Vibrating Screen

Solid Fuel Dryer

Solid Fuel Pulverizer

Central Firing Control Panel

High Speed Distributor and Burner Nozzles

Storage Silos

IA Engineering Sdn. Bhd.

No: 4 & 6, Jalan Arung 1,
Kawasan Perindustrian Taman Johor,
81200 Johor Bahru, Johor, Malaysia
Phone: +(607) 236-5536
Fax: +(607) 236-5531
Website : http://www.iaengineering.com
Email : info@iaengineering.com or iae@tm.net.my