2 The Clay Life Cycle - Production Process

The manufacture of clay building products is constantly improving. The clay brick and tile industry is continually monitoring its energy usage which forms a significant part of total production costs. Much work has already been done to decrease energy consumption and consequently CO_2 emissions in line with government guidelines. Firing gives our products their exceptional performance, long life and durability and is an indispensable part of the production process.

Some products are designed to be energy efficient in use and there has been a significant increase in thermal performance qualities of products over the past few years. Our objective is to continue this trend in order to deliver efficient products that are manufactured with careful energy usage, controlled emissions and minimal waste.

2.1 Short description of the Production Process

After extraction from quarries, the clay raw material is laid out in order to obtain a homogeneous mixture.

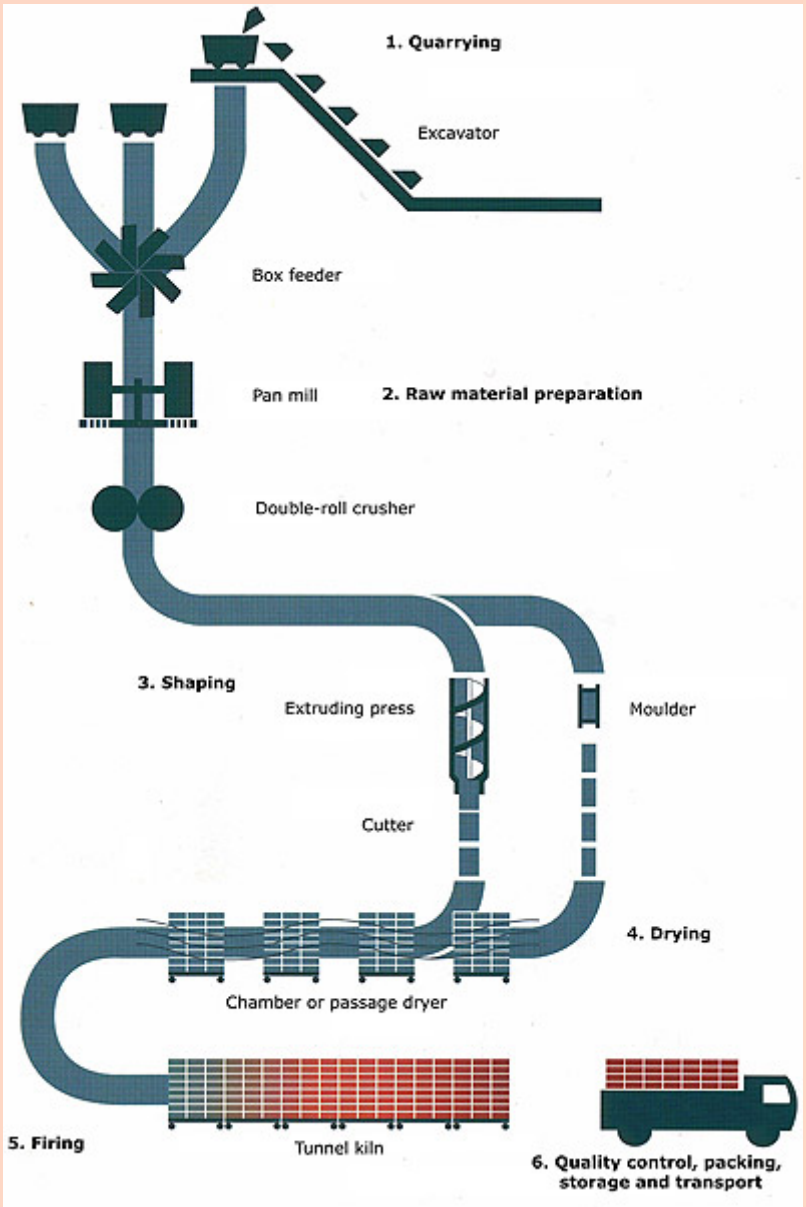
Several stages are involved in preparing the clay. It is stockpiled , then crushed to attain the required grain size and then stockpiled again for several days or even months.

Before processing, the moisture content is controlled and it may be necessary to add water to obtain the right consistency for forming. Materials such as sawdust or residue of paper industry can be added to increase the porosity of the final product.

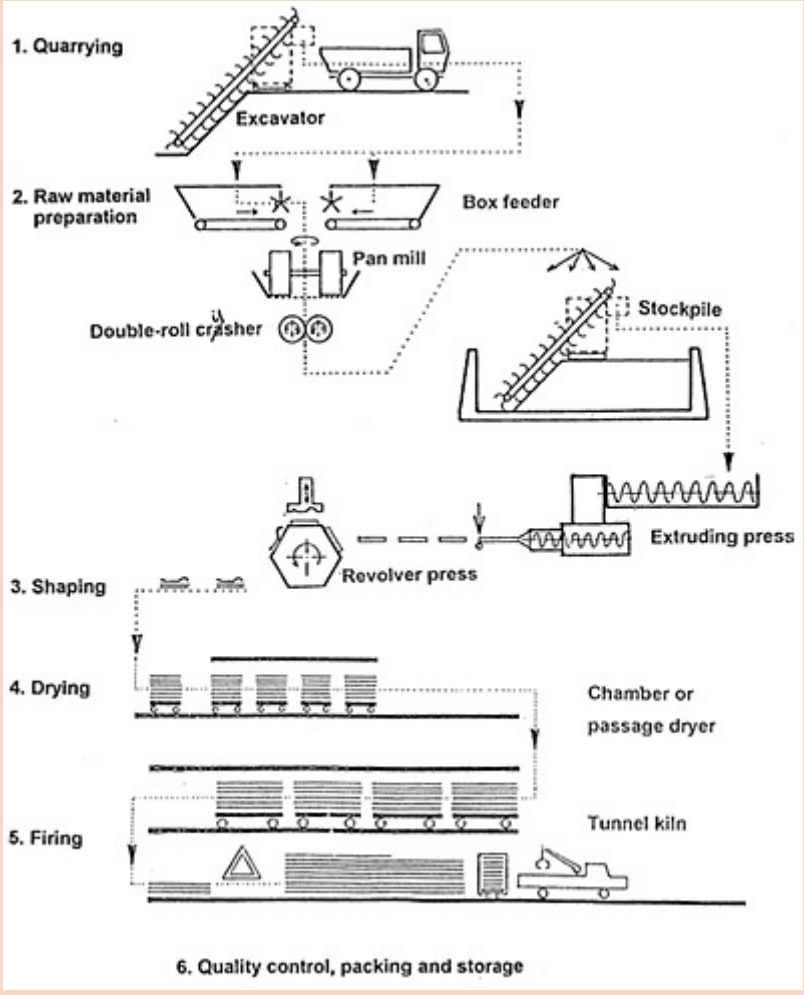
For bricks, the clay is extruded or moulded to obtain the shape required and then cut to size. In roof tilemaking, the clay can undergo a two-stage process, the second of which may occur after extrusion, depending on the roof tile being manufactured. For example, for interlocking tiles, the extruded clay is pressed between two moulds.

The formed clay is dried in order to reduce its moisture content and then loaded into kilns for firing. When this is completed and the products have cooled, they are packed ready for dispatch. Throughout all stages of production, the process is subject to rigourous quality control.

Example of Production of extruded bricks and handmade bricks



Example of production of pressed roofing tiles



2.2 Environmental Aspects

The clay building product industry has taken positive steps to deal with the inherent environmental aspects of the process. Constant improvement is made especially with regard to the following:

2.2.1 Energy consumption: close monitoring

The energy consumed during the manufacture of clay products is primarily that used in forming, drying and firing. Since energy costs are an important part of total production costs (up to 30%), the clay industry has always closely monitored its energy usage. Ecology and economy are often linked and the European brick and tile industry has not waited for statutory regulation before investing in better energy efficiency. Firing is responsible for the exceptionally long life of our products. Moreover, some products are designed to save energy when incorporated into

buildings and the thermal performance of such products has increased significantly over the last few years.

There are 3 ways of managing energy consumption:

Choice of energy
Reduction of energy consumption
Use of renewable energy

Choice of energy

Natural gas, LPG and fuel oil are used for most drying and firing operations, but solids fuels and electricity are also sometimes used, as is gas from landfills. Natural gas is increasingly used in factories. This fossil energy produces the least carbon dioxide- CO_2 (57 kg CO_2 / GJ as opposed to fuel oil which produces 75 kg CO_2 / GJ).

Development of the Percentage of Various Fuels Used (Thermal Energy)
Clay Brick & Roof-tile Industry

	COAL					OIL					NATURAL GAS				
	1960	1975	1990	1995	2001	1960	1975	1990	1995	2001	1960	1975	1990	1995	2001
AUT			2	0	0*			20	19	15*			78	81	85*
BEL	83	4	10	4	2**	17	40	7	6	2**	0	56	83	90	96**
GER	77	5	3	3		20	76	17	15		3	19	80	82	
DEN	68	11	5	4		32	89	9	9		0	0	86	87	
FRA		4	15	0			56	9	5			40	76	95	
ITA			0	2	0*			49	19	10*			51	79	90*
NED	49	2	2	1		51	1	1	0		0	97	97	99	
ESP	30	10	0	0		50	65	71	67		20	25	29	33	
UK		50	11	4	3		14	4	2	1		36	85	94	96
HUN	94	60	26	15		6	8	0	0		0	32	74	85	
CH			1	0	0			63	51	47			36	49	53

* 2000
** 2002
Data listed in this table are based on information provided by the National federations and associations. (source : TBE)

Reduction of energy consumption

Throughout the industry, the widespread change to gaseous fuels and improvements in drying, kiln technology and control have resulted in a progressive reduction in energy use and a marked reduction in emissions.

The primary process improvements are:

- improved design of dryers and kilns
- computer control of drying and firing regimes
- recovery of excess heat from kilns (mainly hot air from cooling zones of kilns ducted to dryers)

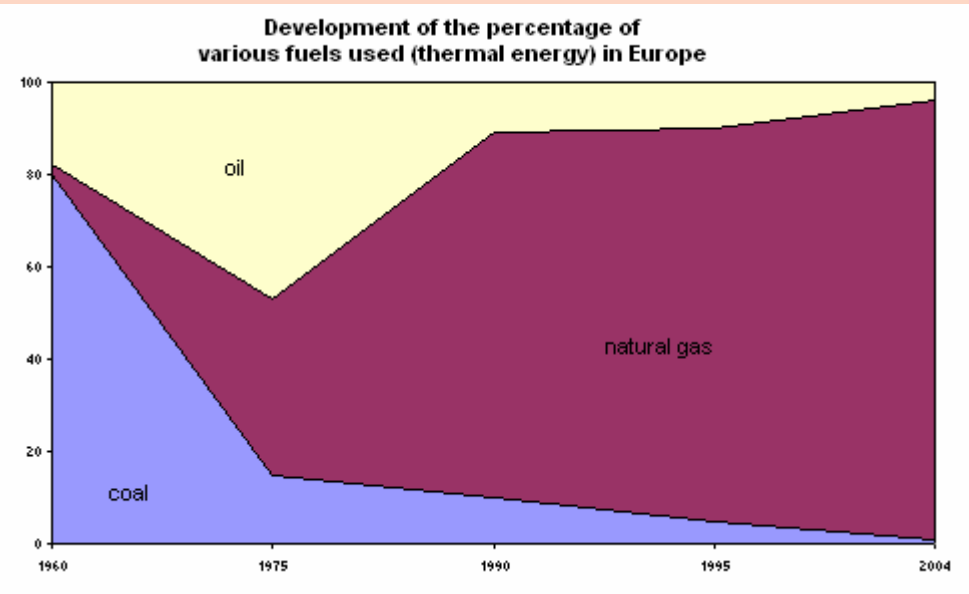
- product modifications

The EC/2003/87 Directive establishes a $C0_2$ emissions trading system. The European brick and tile industry is concerned by this Directive. Much effort has already been made to decrease its energy consumption (see table below) and levels of CO_2 emissions.

Specific Energy Consumption (GJ/tonne) – Brick & Roof-tile Industry

	1980	1985	1990	1995	2001	Reduction %[6]
AUSTRIA	2.38	2.09	1.71	1.72	1.65*	28
BELGIUM	3.30[2]	2.73[2]	2.16[2]	2.37[3]	2.23[3] **	32
GERMANY	2.43	2.31	1.93	1.63		33
DENMARK	2.73	- [1]	2.41	2.67		2
SPAIN	2.38	2.29	2.24	2.18		8
FRANCE	2.87	2.62	2.76	2.61		9
ITALY	2.8	2.6	2.1	1.9	1.9	32
THE NETHERLANDS	3.63	2.93	2.86	2.7		26
UNITED KINGDOM	1.1[4] 3.58[5]	1.01[4] 3.26[5]	0.84[4] 2.97[5]	0.83[4] 2.80[5]	2.42[4] 1.4[5]	25[4] 22[5]
SWITZERLAND	- [1]	2.55	2.62	2.53	2.32	1

* 2000
** 2002
[1] not available
[2] only bricks - data based on NIS
[3] clay bricks and roof tiles - based on data provided by the federation
[4] UK Fletton & [5] UK Non-Fletton / data for 1980 not available - data shown for 1984. The Fletton Industry cannot be compared to the previous figures. There have been large production changes to the output types at the 3 remaining fletton sites.
[6] 1995/1980 but 1995/1985 when the 1980 consumption data are not available - for Belgium ratio 1980/1990
Source : TBE



Use of renewable energy

The substitution of non-renewable energy by renewable energy is in constant progress. In many ceramic production processes, biogenic additives, such as sawdust can be added to the raw clay. The utilisation of such additives offers two advantages. The first one is an additional energy source and the second one is to lighten the products and increase their insulating performance.

This additional energy works by reducing the consumption of fossil fuels and therefore the emission of CO_2.

These additives are primarily selected on technical, environmental and health grounds. They must have a beneficial effect on the product's technical properties; they must not produce harmful emissions or if they do must be amenable to control. And they must not pose a health risk to factory and contruction workers.

Biogas reactors at brickwork Gasser/Italy

Tests determine whether the additives used fulfil these criteria.

2.2.2 Atmospheric emissions: Technical solutions to reduce emissions

Atmospheric emissions are associated with all phases of the manufacturing process.

- Three main kinds of gaseous emissions,
- technical solutions to reduce harmful emissions,
- main measures to minimize dust

Three main kinds of gaseous emission occur:

- Emissions coming from ceramic conversion of the raw material in the kiln. The emissions are HCl (hydrochloric acid), HF (hydrofluoric acid), SO_x (sulphuric acid) and $C0_2$.
- Exhaust gas emissions from combustion processes (from drying and firing plants). The emissions are CO (carbon monoxide), CO_2 (carbon dioxide), NO_x (nitrogen oxides) and particles.
- Emissions due to the use of organic substances (additives). The emissions are VOC's (volatile organic compounds).

Therefore technical solutions are used to reduce harmful emissions.

For gaseous compounds, the main measures are:

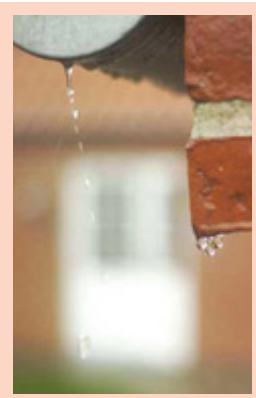
- use of raw materials that are low in sulphur, nitrogen, chloride and fluoride
- incorporation of inert additives in the clay body
- incorporation of fine limestone in the clay body to retain fluoride (and some sulphur)
- recirculation of low temperature carbonisation gases into firing zones of kilns (to combust CO and VOC's).
- thermal after burners
- exhaust gas treatment by purification (gravel or lime filter)

The extraction of clay usually occurs very close to the plant so emissions (CO_2 and NO_x) from transportation are minimised.

Main measures to minimize dust:

- enclosure of dust producing processes
- use of a covered conveyor belt
- use of moist raw materials where possible,
- maintain cleanliness of kilns and kiln cars.

2.2.3 Excess Water



Low rates of water consumption and water wastage are hallmarks of the brick and tile industry.

Water is used both as a raw material and a process fluid for cooling and washing. Some is given off as steam during production.

Some excess water is a by-product of washing operations and its recovery and re-use represents an important factor in the water balance of a clay brick or tile factory. Throughout the industry, the re-cycling of water is widely practised.

2.2.4 Waste materials: insignificant

The environmental impact of our industry's waste is insignificant.

There is no waste in the production process because it is possible to recycle clay at any stage.

The only waste that leaves the factory is from packaging. Paper cardboard and plastic is collected and sent for recycling.

2.3 Economic and Social Aspects

Factories are usually located in rural areas (close to raw material supplies). They generally employ local labour, often for generations, and in so doing help stabilise local communities.

The industry has gone to great lengths to improve its presence in these communities. For example, storage areas are tarred and regularly cleaned in a bid to reduce airborne dust, while fast growing hedges are often planted.

To improve the working environment, measures are taken to reduce dust emission from machinery.