Brick clay is the term used to describe ‘clay and shale’ used in the manufacture of structural clay products, such as facing and engineering bricks, pavers, clay tiles for roofing and cladding, and vitrified clay pipes. Brick manufacture is the largest tonnage use. Fireclay is also used in the manufacture of these products, particularly facing bricks, but because of its close association with opencast coal extraction it is dealt with separately (see Fireclay Factsheet). Some clay and shale is used for engineering purposes, such as lining and capping landfill sites, lining canals and ponds and for general construction purposes (fill).

Brick clays are essentially sedimentary mudstones of different geological ages and compositions. These range from relatively soft, plastic clays to hard mudstones. Their chemical properties, which are related to their mineralogical composition, and physical properties, particularly grain size, are critical to determining their suitability for the manufacture of structural clay products. These properties affect the forming behaviour of the clay (the process prior to firing in which the ware is shaped), its behaviour during drying and firing, and also the final properties of the fired product. These properties include strength, water absorption (porosity) and frost resistance, and thus durability and performance in service. Importantly, they also affect aesthetic appearance, such as colour and texture, providing greater choice and style for architects and developers. Clay bricks (and tiles) are versatile and durable construction materials and one of the most visible components of the built environment. In addition to their functional use, they make an important contribution to local architectural styles in our cities, towns and villages. The variety of clay used gives rise to the distinctive regional variations in the appearance of the built environment. Some brickworks specialise in hand-made products for the repair of historic buildings.

Most facing bricks, engineering bricks and related clay-based building products are manufactured in large automated factories. These represent a high capital investment in plant and are increasingly dependent, therefore, on raw materials with predictable and consistent firing characteristics in order to achieve high yields of saleable products. Blending different clays to achieve improved durability and to provide a range of fired colours and textures is an increasingly common feature of the brick industry. Continuity of supply of consistent raw materials is of paramount importance. Whilst in the past brick clay was usually consumed in brickworks adjacent to the quarry, today increasing tonnages are transported to other brickworks for blending purposes or to serve plants with no associated clay reserves.

Demand

Brick clays are used in the production of structural clay products, with the manufacture of ‘facing’ bricks being the most important use, accounting for over 90% of demand. The major use of facing bricks is in the domestic housing market. These are bricks produced to high technical standards, so that they are resistant to the weather, and also have an attractive external appearance. The introduction of new, and more demanding, EU standards for bricks in terms of durability is placing greater constraints on the types of clays that can be used. Most brick clays are red firing, but there is a demand for buff/cream coloured bricks for which fireclays are used. Developers, architects and planners are demanding that
new housing and other buildings have a ‘traditional’ appearance sympathetic to local vernacular styles. Great Britain is reported to be the largest market in Western Europe for facing bricks. Brick clays are also used to make ‘engineering’ bricks, which are high strength, low porosity bricks used in load-bearing structures and in other technically-demanding situations. ‘Paving’ bricks are of special composition and dimensions to serve as paving and are designed for hard wear, low porosity and resistance to frost. Brick clays are used to manufacture other types of structural clayware, such as pipes for drainage and sewerage, and roof tiles. Large tonnages of clay and shale are also used in the manufacture of cement (see Cement Factsheet). Small amounts are used in a process to make lightweight aggregate for block making.

Supply

Extractors’ sales of ‘clay and shale’ for the manufacture of bricks, pipes and tiles have been separately recorded by the Annual Minerals Raised Inquiry since 1974; production is shown in Figure 1. Brick manufacture is the largest tonnage use and accounts for perhaps 95% of the clay extracted in this sector. Only small quantities of clay and shale are used in pipe and tile manufacture. In addition to clay and shale, some 600 000 t/y of fireclay are also used in brick manufacture and minor quantities are also used in pipemaking. Approximately 3 tonnes of clay/shale are used in the manufacture of 1000 bricks. The decline in demand for ‘brick clay’ from over 16 million tonnes in 1974 to some 7.7 million tonnes in 2005 is broadly in line with the decline in the production of clay bricks (Figure 1). This was mainly due to the demise of ‘common’ bricks which have been replaced in the inner leaves of cavity walls in houses by concrete blocks and in internal walls by blocks and plasterboard. Brick production by type is shown in Figure 2. The output of facing and engineering bricks has remained fairly static in recent years. Over 94% of all bricks are clay-based, the remainder being principally concrete bricks. Production of clay bricks has been just less that 3000 million a year during the past decade. Clay tiles, which suffered severe competition from concrete roofing tiles, are becoming more popular and have increased market share to about 8–9%. However, the use of clay and shale in pipemaking has declined considerably due to competition from concrete and plastic pipes.
Brick clay extraction takes place mainly in England reflecting the location of brick manufacturing capacity (Figure 3), which has reduced significantly and is now based on fewer, but larger plants. The largest brickmaking regions are the West Midlands, the East Midlands, the East of England and the South East, which together accounting for some 65% of total GB production. In 2005, Scotland accounted for just less than 4% of UK production of clay bricks. The brick industry is currently operating at almost capacity (95%).

Trade

Brick clay is not separately recorded in overseas trade statistics but is not likely to be traded because of its low ex-quarry selling price.

The UK is, therefore, self-sufficient in brick clay. There is, however, international trade in manufactured clay-based building products and a summary of the main headings is shown in Table 1. The UK is a net importer of clay bricks and tiles and imports are on a rising trend. However, imports currently account for less than 5% of the brick market. The UK is a net exporter of clay pipes.

Significant quantities of bricks are transported from the main production centres in England to Scotland. Hanson Brick UK has no production units in Scotland but imports some 29 million bricks yearly from its plants in England. Although figures are unavailable, other companies with manufacturing units in England also import bricks into Scotland.

Consumption

Brick clay consumption declined significantly between the 1970s and the early 1990s, mainly reflecting the decline in brick production due to the demise of the ‘common’ brick. Output has since been more stable and in recent years has been around 7 million tonnes. In comparison consumption of natural aggregates was about 204 million tonnes in Great Britain in 2005. Brick clay consumption principally reflects clay brick deliveries, which have been between 2,600 to 2,900 million a year in the last decade. The principal markets for bricks are in:

- New housing 60%
- Commercial buildings 20%
- Repair and maintenance 20%

House building is the principle consumer of bricks (and therefore brick clay). Across the UK there is a reasonably close positive correlation between brick production and house building. However, this connection is becoming less well defined. In contrast to the downward trend in brick production, new dwelling starts have been on the increase (Figure 4). One of the primary reasons for this is the trend toward higher density housing. Smaller houses and flats consume fewer bricks per unit. In addition increased use of alternative building materials such as steel and glass has been an important factor (see ‘Alternatives and recycling’ section).

Figure 3  Great Britain: Production of clay bricks by region, 2005.
A review of housing supply (Delivering Stability: Securing our Future Housing Needs, 2004) concluded that the number of homes being built in the UK is not keeping pace with demand and is adversely affecting the local economy. The Government has, therefore, commenced a policy initiative to secure more affordable housing. However, despite a likely increase in the house building programme, it is debated whether this will translate into substantially greater brick clay consumption because the industry is already working close to capacity as a result of past brick plant closures. Increased requirements may lead to greater imports, unless additional plant capacity can be justified.

**Economic importance**

Clay and shale used in the manufacture of bricks, pipes and tiles are not generally sold on the open market but are consumed by the

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**Table 1  UK: Imports and exports of clay bricks, tiles and pipes, 2001–2005.**

Source: HM Customs and Revenue.

<table>
<thead>
<tr>
<th></th>
<th>Imports</th>
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<tr>
<td></td>
<td>Tonnes</td>
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<td>11 607</td>
</tr>
<tr>
<td>2002</td>
<td>220 552</td>
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<td>4 583</td>
</tr>
<tr>
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<td>21 804</td>
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<td>27 733</td>
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<td>767</td>
</tr>
<tr>
<td>2005</td>
<td>528</td>
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A review of housing supply (Delivering Stability: Securing our Future Housing Needs, 2004) concluded that the number of homes being built in the UK is not keeping pace with demand and is adversely affecting the local economy. The Government has, therefore, commenced a policy initiative to secure more affordable housing. However, despite a likely increase in the house building programme, it is debated whether this will translate into substantially greater brick clay consumption because the industry is already working close to capacity as a result of past brick plant closures. Increased requirements may lead to greater imports, unless additional plant capacity can be justified.

**Economic importance**

Clay and shale used in the manufacture of bricks, pipes and tiles are not generally sold on the open market but are consumed by the
brick/pipe manufacturers themselves. The principal exception to this is fireclay, although increasingly brick clays are also being sold on the open market. Brick clay has a very low unit value on an ex-quarry basis (about £2.3/t) and the total value of clay and shale production is placed at only £26 million in 2005. However, with the increasing trend towards blending, and the consequent movement of clay raw materials, the resulting delivered cost of clay to some brickworks is significantly greater. Nevertheless, while brick clay is a relatively low priced raw material, it supports a manufacturing industry of some considerable importance with a high value-added component. The total value of sales of clay-based construction products was £632 million in 2004. A breakdown of these sales by major product is shown in Table 2.

Bricks, pipes and tiles are themselves important building materials for the construction industry, which is a major sector of the economy. In 2005 the total value of the work done in the construction sector in Great Britain was £107 billion; £59.4 billion of new work and £47.6 billion repair and maintenance.

Structure of the industry

Brick clay (other than fireclay) is mainly produced by the brick manufacturers and the location of the industry thus mainly reflects the distribution of clay resources. The brick industry has undergone major rationalisation over the last two decades through mergers and acquisitions, and brick plant closures. There are around 100 brickworks in the country following recent mothballing of operations by Hanson Brick UK at Calder, Wainsgroves and Heather and the closure of Ibstock Brick Ltd Pinhoe site due to exhaustion of reserves. Five companies, who collectively have over 90% of the market, now dominate brick manufacture in the UK. These companies operate plants with capacities mainly in the range 30–55 million bricks a year, with a maximum capacity of 80 million bricks.

The two largest producers with a combined market share of over 60% are Hanson Brick UK, a subsidiary of Hanson PLC and Ibstock Brick Ltd (owned by the CRH Group based in the Irish Republic). Hanson and Ibstock each operate a relatively large number of manufacturing operations concentrated in England, although the latter operates a site in Scotland and the former in Wales. Wienerberger Ltd (owned by the Austrian-based Wienerberger AG, the world’s largest brick producer) is the third largest operator with a market share of about 17%. Other important brick producers are Baggeridge Brick PLC and Michelmersh Brick Holdings PLC. These companies also each operate at a number of sites in England. Remaining market share is taken by about 25–30 smaller companies. These are mostly single site operations scattered across England and the central valley of Scotland. In 2006 Wienerberger announced a proposed acquisition of Baggeridge Brick PLC. The Office of Fair Trading has since referred this takeover to the Competition Commission since the acquisition would bring together the third and fourth largest brick manufacturers in the UK. Four companies manufacture bricks in

<table>
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<td>58.7</td>
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<td>46.4</td>
<td>45.9</td>
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</tbody>
</table>

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Table 2 Value of sales of clay-based construction products, 2001–2004.
Source: Products Sales and Trade, Office for National Statistics.
Scotland. These companies operate five brickworks with a combined capacity to produce 120 million bricks per year.

Two companies account for almost all clay drainage pipe manufacture. The largest is Hepworth Building Products, with Naylor Clayware accounting for most of the remaining market. Both companies are based in the Penistone area of South Yorkshire.

Manufacture of clay roof tiles is dominated by four companies. Eternit Building Materials (based in Cheshire), Lafarge Roofing (Surrey), Sandtoft Roof Tiles (South Yorkshire) and Red Bank Manufacturing Co Ltd (Leicestershire).

The British Ceramic Confederation is the trade association for the ceramic manufacturing industry and deals with, amongst other topics, issues related to raw materials supply. The Brick Development Association is the trade association for the brick sector and deals primarily with technical standards, marketing and bricks in use. The interests of the clay pipes and roof tiles sectors are dealt with by the Clay Pipe Development Association and the Clay Roof Tile Council respectively.

**Resources**

A wide range of clays (including clay or shale waste from other mineral extraction operations notably coal) have been used in the past in the manufacture of structural clay products. Clays occur extensively in many parts of Britain and resources are, therefore, potentially very large. However, many clays are unsuitable for brickmaking. The extent of the principal brick clay resources is shown in Figure 5, although not all the areas shown will be suitable for the manufacture of structural clay products. The presence of other rock types, such as siltstone and sandstone, which may predominate in some areas, high overburden thicknesses and excessive amounts of impurities, such as carbon and gypsum, will also preclude working in some areas.

Sedimentary clays consist essentially of clay minerals and quartz, although many other minerals may occur in accessory amounts, which may considerably affect the suitability of the
clay for brick manufacture. In a brick clay there must be sufficient clay minerals present to make it plastic to mould and to retain its shape prior to firing. Sufficient fluxing materials must also be present for the clay to vitrify (partially fuse to form a glass to give the product strength) at temperatures between 900–1100°C. An adequate proportion of non-plastic constituents, usually quartz, is also required to prevent excessive shrinkage and deformation during drying and firing. In good quality brick clays, the predominate clay minerals are kaolinite and illite. These impart desirable properties which are important in forming and firing the brick. Carbon and sulphur can have a major influence on firing performance, and emissions, and low levels are preferred (< 1.5% and 0.1% respectively). The familiar red/brown colour of most bricks is due to the presence of iron minerals in almost all clays. However, the presence of carbonate minerals, such as calcite and dolomite, can produce paler-coloured bricks. Carbonate minerals must be in fine-grained form as coarse carbonate leads to a problem known as ‘lime-blowing’ (falling away of the surface of a brick due to expansion, following hydration of nodules of lime). Production of very pale buff/cream ‘through-colour’ bricks is presently only made possible by using fireclays with low iron contents. Fully-durable yellow bricks (such as London ‘stocks’) are made from a mixture of clay and calcium carbonate (chalk).

With the reduction in the number of brick and pipe works, clay production has become concentrated on a much more limited range of clay resources. Modern brickmaking technology requires a high capital investment and is increasingly dependent, therefore, on raw materials with predictable and consistent firing characteristics in order to achieve high yields of saleable products. This ensures that raw materials (both clay and energy) are used optimally, an important objective of sustainable development. Blending different clays to achieve improved durability and to provide a range of fired colours and aesthetic qualities is a common feature of the brick industry.

Bricks are produced in all the countries of the UK, but England accounts for more than 90% of production. Although other clays are used on a small scale, the location of the industry tends to reflect the distribution of the principal brick clay resources. In approximate order of tonnage used in brickmaking these are:

- Carboniferous mudstones in northern England and central Scotland: Variable in quality, with only a small proportion suitable for brick manufacture (most are too high in carbon and sulphur). Despite this, they are the most important resource, accounting...
for almost 30% of consumption in England and over 90% of consumption in Scotland. Almost all bricks made from Carboniferous mudstones are formed by extrusion (see Extraction and processing section). Most clay drainage pipes are made from these clays;

- **Etruria Formation or ‘Etruria Marl’** (Carboniferous age): High quality clay is close in composition to the ‘ideal’ brick clay. Extracted and used mainly within Staffordshire and other parts of the West Midlands. Bricks are made by both extrusion and soft-mud methods. Often used to ‘sweeten’ poorer-quality clays. Most clay roof tile makers use this material. Outcrop area is very restricted and parts have already been extensively sterilised by urban development;

- **Mercia Mudstone Group or ‘Keuper Marl’** (Triassic age) in the Midlands: Extraction and use of these clays is confined to the Midlands. The mineralogy of parts of the resource gives rise to distinctive pale-bodied bricks due to the presence of carbonate minerals. Extrusion is the commonest manufacturing method;

- **Peterborough Member or ‘Lower Oxford Clay’** (Jurassic age): Extraction of these clays is confined to Cambridgeshire and Bedfordshire, where they are used in the manufacture of ‘fletton’ bricks, so named because they were produced by the Fletton Process developed near the village of Fletton, Peterborough. Their high carbon content requires an unusual manufacturing process (semi-dry pressed bricks fired in chambered kilns). Fletton bricks dominated brick production in England for 100 years. There has been a reduction in usage of this clay over the last 30 years and manufacture of bricks is now restricted to three large production units;

- **Weald and Wadhurst clays** (Cretaceous age): Principal brick clay resource in South East England. Most production takes place to the south of London. Bricks are mostly manufactured using the ‘soft mud’ process;

- **Fireclays** (from Carboniferous coalfields in the Midlands and the North): Associated with coal seams and produced mainly as a by-product of opencast coal extraction. Although comprising less than 7% of total consumption, they are important clays used extensively in high-value extruded buff bricks which are manufactured at sites across the Midlands, the North and Scotland.

Minor brick clay resources are locally important and include brickearth in Kent and Essex; the Reading Formation in Hampshire and the Chilterns; the Gault clay in Kent, West Sussex and Hampshire; the Thanet Formation in Essex; Carboniferous and Devonian mudstones in South West England, the Skiddaw Group near Barrow-in-Furness and alluvial clays on Humberside.

**Reserves**

In mineral planning, the terms ‘reserves,’ ‘mineral reserves’ or ‘permitted reserves’ refer to the tonnage of mineral that has a valid planning permission for mineral extraction. Without a valid planning permission no mineral working can legally take place and the inherent value of a resource cannot be released. There has been no definitive survey of the size (tonnage) of permitted reserves of brick clay in Britain. However, in the course of preparing their development plans, Mineral Planning Authorities are required to undertake assessments of reserves in their areas. However, it may not be possible to publish such data due to commercial confidentiality concerns, although reserves may be otherwise identified in planning applications.

In the *Survey of land for mineral workings in England, 2000* for the former Department for Transport, Local Government and the Regions (DTLR), the area of surface planning permissions for clay/shale was 8,430 ha. Total permitted reserves of brick clay are, therefore, likely to be very large. However, as is the case with other minerals, gross figures for total reserves that derive in part from old permissions will include land that is non-mineral bearing or deposits that are no longer commercially viable. The reserve figure will also mask significant imbalances by clay quality leading to shortfalls of specific clay types.

In a study in 1999 on *Brick clay: Issues for planning* by BGS on behalf of the DTLR, spatial data were collected on valid planning permissions...
for brick clay covering some 7,300 ha. These were analysed by classifying the planning permissions by main brick clay resource. The results of this analysis are presented in Figure 6.

The Oxford Clay had the largest proportion of planning permissions, reflecting the large stock of historic permissions for fletton brick production. However, the manufacture of fletton bricks has declined. The Mercia Mudstone had a much lower proportion of permissions and notably in relation to its large outcrop area. This reflects the fact that it is only in the East Midlands that it is an important source of brick clay. The Etruria Formation had the largest proportion of planning permissions relative to its outcrop area, reflecting its importance as a premium source of brick clay. Brick clays based on the Etruria Formation and fireclays are nationally scarce.

Relationship to environmental designations

Some clay resources in Surrey, Kent and Sussex in South East England show a close relationship to environmental designations, notably the High Weald Area of Outstanding Natural Beauty, which affects, in particular the Wadhurst Clay. Elsewhere, clay resources are largely unaffected by national landscape designations, although some may be affected by national nature conservation designations.

Extraction and processing

In the manufacture of bricks and other structural clay products, the term ‘clay’ is used relatively loosely, since the clay mineral content of the raw materials may vary from 20% to 80%. Non-clay minerals, such as quartz, iron oxide and calcium carbonate, can profoundly affect the colour and properties of the fired bricks, and materials such as carbon, sulphur and gypsum are important impurities.

The brickmaking process consists of several different stages; clay extraction; clay preparation, in which the raw material is reduced to a workable consistency for forming or shaping; forming; drying to remove moisture and to give the brick strength to retain its shape, and finally firing.

Brick clays are worked entirely by open pit methods. A range of equipment and working methods have evolved to meet the very differing demands of deep or shallow quarries, uniform or heterogeneous deposits, soft clays or hard shales.

The impracticability and cost of removing impurities is such that brick clays undergo little processing other than grinding and screening to remove any hard or coarse components. It is, therefore, important to extract the clay selectively, avoiding any contaminating material and to ensure subsequent homogenisation of the clay raw material so that the feed to the plant has consistent and predictable firing characteristics. This is achieved by scraping the complete vertically exposed face of the deposit using a dragline or a shale-planer. More commonly, clays with different properties are laid down as superimposed layers in stockpiles, which are later removed vertically to ensure a consistent mix. Many stockpiles are allowed to ‘sour’, a process of weathering over several months to increase plasticity. This process is particularly common in works producing moulded (‘soft-mud’) products. Primary crushing and stone removal are sometimes necessary at the quarry site. Blending different clays to achieve improved durability and to provide a range of fired colours and textures is an increasingly common feature of the brick industry.

Figure 6  Great Britain: Brick clay planning permission areas by major brick clay resource, 1999. Source: BGS.
Most bricks are formed or shaped principally by extrusion or the ‘soft-mud’ process. Extrusion is by far the most important, accounting for about 65% of production with soft-mud somewhat in excess of 20%. The balance is mainly by a form of pressing. Extrusion involves forming a column of clay by pushing the material through a die at high pressure. The rectangular section column is then cut into bricks (known as ‘wirecut’). Most drainage pipes and clay roof tiles are also made by extrusion. In the soft-mud process, individual bricks are formed in a sand-lined mould from clay with a relatively high moisture content (known as ‘stock’ bricks). This process produces bricks with an irregular outline, often showing surface creases and sanded on all surfaces. The aesthetic properties of these bricks have resulted in a resurgence in their popularity. Although a very high proportion of soft-mud bricks are machine made, hand-making is still common, particularly in producing premium-quality facing bricks and complex shaped ‘specials’.

The bricks are then dried prior to firing. Most are fired using natural gas in a linear kiln known as a ‘tunnel kiln’, which allows the process to proceed continuously and in which a line of cars loaded with bricks is pushed through a stationary firing zone. However, intermittent (batch) kilns are also used. The important changes relating to the development of brick properties result from the breakdown of the original clay mineral and the formation of new crystalline material and glass phases. The temperature at which vitrification (glass formation) occurs depends on the mineralogy of the clay. Vitrification usually begins at 900°C and is complete by 1050°C (or up to 1100°C in the case of more refractory fireclays). Vitrification gives the brick the strength and durability it requires to perform in service, as well as an attractive appearance. ‘Facing’ bricks are used in external walls where architectural appearance is important – they can be wirecut or stock bricks. Wirecut ‘engineering’ bricks are made to meet strict technical specifications for use in demanding situations where strength and durability are critical.

Conventional tunnel kilns normally require a 2–3 day firing cycle. However, rapid firing using roller hearth kilns with firing cycles as low as 30 minutes are used for some products, including tiles and vitrified clay pipes. In this process the product is continuously fed through a small diameter tunnel kiln on rollers. Rapid firing reduces energy consumption and overall emissions. However, these techniques require careful control of the body composition. Many natural clays are unsuitable for rapid heating/cooling cycles. As a result, blending of clays and other minerals in order to avoid these problems is likely to increase with a consequent increase in demand for premium quality brick clays. Some clays used in pipemaking are subject to low temperature calcination prior to milling and extrusion.

The EU Integrated Pollution and Prevention Control Directive has been implemented in the UK by the Pollution Prevention Control Regulations. All facilities for the manufacture structural clay products require a permit from the Local Planning Authority or the Environment Agency as appropriate. Permits are site specific and take into account amongst other factors the raw materials used. Permits cover plant operating conditions and emissions such as fluorine and sulphur dioxide.

By-products

A small number of brick clay sites produce saleable aggregate from overburden and interburden, thus optimising the use of all mineral resources at a site. In particular, sites in Carboniferous mudstones also produce sandstone for use as a low quality aggregate (see Construction Aggregates Factsheet) and have the potential to produce building sandstone (see Building Stone Factsheet). Conversely some sandstone quarries may also sell associated mudstone to local brick manufacturers. Some sites working Coal Measures mudstones may also produce small amounts of coal as a by-product. Sand and gravel is also occasionally produced from the superficial deposits overlying brick clays, such as the Peterborough Member in Cambridgeshire. Fired brick waste is sometimes sold as low-grade aggregate, particularly in eastern England where sources of primary fill material are scarce.
Alternatives/recycling

Some secondary materials and waste types can, in some circumstances, be used as a partial substitute for primary clay in the manufacture of bricks.

Although extensively used in the past, the use of colliery waste in brick manufacture is now very limited. However, in Scotland colliery spoil, together with waste burnt oil shale continue to be an important secondary source of brick clay. Most colliery wastes are extremely variable, with carbon contents ranging from less than 5% to over 30%. This causes particular problems in mechanised brick manufacture, where consistency of the raw material is vital in maintaining product quality. These materials tend to show particularly high levels of emissions on firing.

Pulverised Fuel Ash (PFA) is a glassy, silt-grade material which is a by-product of coal incineration in thermal power stations. This material is finding increasing usage in the manufacture of both pressed and soft-mud bricks where it typically replaces between 10 and 20% of the clay. Other furnace ashes such as Municipal Incinerator Bottom Ash might also be used in a similar way by the brick industry.

Granular blast furnace slag can be used in extruded bricks. This material reduces emissions by dilution and by reaction with gases emitted by the clays. Trials on the use of finely ground recycled glass in brick manufacture are also being carried out. The glass acts as a flux reducing firing temperatures and, as a result, providing energy savings and reduced emissions.

Waste organic materials such as sawdust, chopped straw or foamed polystyrene can be used, along with paper mill waste (currently used by one brick production site in South East England and more widely in continental Europe) and, after incineration, water treatment sludge and sewage sludge.

Concrete blocks, bricks, pipes and tiles are the main alternatives to clay products. Concrete blocks have now almost entirely replaced ‘common’ bricks in building interior and rendered exterior walls. Plasterboard and stud walling is replacing both clay and concrete products in internal walls. Other building materials such as steel, timber, glass, and natural and reconstituted building stone compete directly with clay-based products. Block pavers and roof tiles made from concrete compete with those made from fired clay. Fired clay drainage pipes compete with those made from plastic (smaller diameters) and concrete (larger diameters).

Re-use of bricks for matching style in conservation and other building work is common practice. Recovery of bricks, for re-use as bricks, is generally limited to those buildings which are more than 60 years old where lime mortars were used. Bricks of that age and older can, subject to careful selection and cleaning, have an appreciable ‘new’ life in new construction projects. This is due to the lower strength of these mortars making them easier to separate from bricks. However, re-use may cause environmental and economic costs arising from the operation itself, as well as storage and transport. Problems may also arise due to the mismatch between imperial components in metric structures. Technical properties, such as frost resistance, may be uncertain.

Brick buildings less than 60 years of age were normally constructed using Portland cement based mortars. These mortars have superior setting and bonding strength. The removal of cement mortar to enable bricks to be reused is not practical. However, subject to the quality of the brick, the material can be recycled to produce low quality aggregate such as capping layers and sub-base in road construction, and drainage blankets in civil engineering.

Effect of economic instruments

‘Clay’ and ‘shale’ are exempt from the Aggregates Levy and these materials may be used as a source of bulk fill where they are unsuitable for brick manufacture. However, problems have arisen with the precise definition of these terms and the BGS has produced a report to describe them in more detail (see Further information). Sandstone occurs as
overburden at some sites and may be sold as a low quality aggregate. Increasing competition from alternative aggregates that are exempt for the Aggregate Levy may, however, locally have had an impact on sales of this material resulting in increased overburden removal costs.

The UK Government introduced the Climate Change Levy (CCL) on the 1st April 2001, which applies to some fuels used by energy intensive industries including the brick industry. In exchange for an 80% rebate on the Levy the brick industry has agreed challenging energy reduction targets through energy saving measures.

The EU Emissions Trading Scheme (EU ETS) came into effect in 2005 with the objective of reducing the EU’s carbon dioxide emissions. The brick industry is eligible for EU ETS and an allowance on carbon dioxide emissions has been allocated for almost all brickworks in Britain, although, in common with other energy intensive industry, as low CO₂ emitters most brickworks have been given a temporary exclusion from the Scheme until 1st January 2008. Allowances can be traded if they are not reached or exceeded. In the brick industry carbon dioxide is derived from two sources; the fuel used to manufacture the product and from the body itself where this contains carbonate minerals. For some products with high carbonate contents, carbon dioxide emissions from the clay body may be as much as from the fuel used for firing.

The extent to which both CCL and ETS will have on raw materials requirements is difficult to judge at this stage. For example, increasing the volume of perforations in a brick will reduce the amount of clay used and consequently save fuel when firing. However, a change to using lower carbonate bodies would have major implications for the colour and appearance of the product and thus on the very properties for which it is marketed. Rising fuel prices are of concern to all manufacturers in energy-intensive sectors and brick industry is no exception. The price of natural gas, the primary fuel of the brick sector has escalated in recent years and the market remains volatile.

Transport issues

Where brick clays are worked close to brickworks, covered conveyor belts and, rarely, aerial ropeways are used to transport the clay. There is, however, an increasing trend towards the import of clays and other raw materials from off-site into brickworks which, in the past, would have relied entirely on raw material from a ‘captive’, on-site pit. This trend is generally driven by the need to improve locally sourced clays to allow manufacture of bricks which both meet the highest technical specifications, and give the consumer maximum choice of colours and textures. This tendency is likely to increase, as product specifications become tighter. It is highly unlikely that this movement of clay will be by any other method than road. However, compared to movements of some other minerals (particularly aggregates), the volumes involved are small and haulage distances are generally short. The manufactured products are almost always transported to the market, i.e. building sites, by road.

Planning issues

Planning issues centre on the environmental acceptability of the quarry and the manufacturing plant in any proposed location. However, a number of other issues are relevant.

The important role that bricks and related products play in determining the appearance and quality of our built environment is widely recognised. The variety of brick products contributes significantly to the rich regional and local architectural heritage of mainland Britain as well as the repair of traditional brick built structures.

Clays used in the manufacture of bricks have a major influence on their technical performance and appearance, and consumers are likely to continue to demand a wide choice of high quality, affordable bricks. In order to satisfy this demand, remain competitive and meet increasingly stringent environmental controls, industry requires continued access to a range of clay resources, including premium quality clays, such as from the Etruria Formation and Carboniferous age fireclays.
The levels of capital investment required to build and maintain automated manufacturing plant, with associated environmental engineering, are large and require security of supply for brick clay to allow operators to secure and justify that investment. This could, in some cases, be as much as 20 or more years.

Technical innovation in brick, tile and pipe products, together with the implementation of more stringent European technical standards, increasing use of automated manufacturing and tighter controls on kiln emissions has led to more blending of clays, and therefore a trend away from using clay from a captive pit toward increased transport of material from other sites. The supply of brick clays to individual brickworks is increasingly from more than one source.

In England recent guidance in Mineral Policy Statement 1 (MPS1) and Annex 2: Brick clay provision in England draws attention to the need to safeguard the diversity of clay resources and particularly important and scarce resources. It also identifies the need to maintain and enhance the diversity of brick clay products and to ensure consistency of supply with reserves sufficient for 25 years of production. MPS1 also identifies the need for planning to take account of the supply of bricks in maintaining our architectural heritage and the relationship between brickworks and brick clay supply sources, which may be varied and in different MPA areas. Finally MPS1 notes that brick clay may also be extracted for use as an engineering material, in cement and as a lightweight aggregate. Relevant guidance in SPP4 for Scotland notes that MPAs should identify, safeguard and provide for working of clay for brick manufacture subject to general policies, although where brick clay is worked from coal bearing strata, not just where it is worked in conjunction with coal, SPP16 is relevant. In Wales guidance in MPPW refers to the need to safeguard resources and to maintain supply to meet needs, to protect amenity and habitats from impacts and to ensure efficiency in use. Reference is made to the potential use of fire-clay arising from opencast coal operations as a source of brick clay. Neither Scottish or Welsh guidance specifies the reserves required.

Further information


Definition and characteristics of very-fine grained sedimentary rocks: clay, mudstone, shale and slate. R J Merriman, D E Highley and D G Cameron. British Geological Survey Commissioned Report, CR/03/281N.

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