

HOW GREEN ARE ceramic tiles?

AN OVERVIEW OF CERAMIC TILES AND THE ENVIRONMENT

By Peter Halliday

Environmentally friendly buildings are the newest trend in architecture. Interest in lowering energy consumption, using sustainable materials and creating healthy environments for people to live and work in has spawned a worldwide interest in 'green' building. The United States Energy Information Agency reported in 1998 that buildings consume approximately 36 per cent of total primary energy use in the United States. Realising that energy consumption is a major concern, renowned architect Norman Foster said, "Buildings should be answerable. Everything should be there for a reason." In selecting concepts to develop further, his question is, "Which one has the lowest energy footprint?" The benefits of resource efficient buildings has resulted in governments mandating that new structures must incorporate so called "green building" characteristics to reduce energy and resource use. Government legislation will increasingly force all people to consider the environmental credentials of the design and materials they choose. Within the US and other countries, structures are being rated according to a variety of environmental factors by standards such as the Leadership in Energy and Environmental Design developed by the US Green Building Council. Interior finishing materials are at the same time being assessed for their contribution to indoor air quality (IAQ). Products that do not pollute their environment are being sought by an increasingly aware architectural community and consumer groups. Newly coined phrases such as Eco Boomers and LOHAS (Lifestyles of Health and Sustainability) describe the growing group of purchasers who are environmentally aware.

When the question was recently posted on a ceramic tile web site, "What environmental impact does ceramic tile have?" the person answering pointed out the obvious breadth of the question: did the enquirer mean the impact of manufacturing on the natural environment, the use of tiles within the interior environment or the disposal of tile at the end of its serviceable life? The answer, in short, was that tiles are one of the most environmentally friendly of all building products in each of the areas mentioned.

Ceramic tiles are made from naturally occurring clays and minerals and heated to create an inert, stable product that is robust enough for some manufacturers to offer a guarantee of up to 100 years. Ceramic tiles have a lower impact on the environment than most other finishing materials, in terms of both the manufacturing process and the built environment after they are installed. Tiles form a completely inert flooring system. Ceramic tile will not act as a "sink" to absorb volatile organic compounds (VOCs) or other chemicals from surrounding materials. They are not an original source of contaminants nor will they absorb or release other contaminants. They do not support bacterial or fungal growth. Ceramic tile also offers ease of maintenance with simple, water-based cleaning materials. They do not require solvent-based cleaners or sealers. Thus, they offer significant advantages for indoor air quality during installation, and for the lifetime of the tile's use in a building. The Centre for Sustainable Research at the University of Minnesota said durable finishes such as tiles, which require



The Abisko collection by Rex Ceramiche, a stunning timber look ceramic tile, produced by 'simply pressing the earth, rather than cutting down trees. (Courtesy Di Lorenzo Ceramics)

less chemical application for cleaning or maintaining surface finish, produces the least amount of indoor environmental impacts when compared to other flooring materials.

Improvements in Manufacturing

Over the last 10 years the focus of the ceramic tile industry, particularly within Europe, has been on adopting an integrated approach towards sustainability, to avoid pollution and limit the consumption of resources. The most progressive producers of tiles are joining the various environmental certification schemes such as Eco-label, ISO1400 and EMAS in Italy. These operate largely out of sight to the end consumer but the introduction of the European Communities 'Eco-Label' for hard-floor coverings encapsulates a set of technical standards that certify a tile's environmental impact throughout its entire life cycle (LCA).

According to a European Union study, the most significant lifecycle steps for ceramic tile manufacturing are:

- The quarry recovery and good management of raw material extraction
- The manufacturing process with regards to air emissions, water emissions and energy efficiency
- Specific raw material control, such as some metals are not to be added
- Packaging (80 per cent recycled)

While high quarry recovery and good management of raw material extraction are in the financial interest of the operators, other areas are being addressed by legislation and the various environmental quality schemes.

Energy Reduction

Ceramic tiles are described as having high embodied energy. The CSIRO defines embodied energy as "The energy consumed

HOW GREEN ARE ceramic tiles?

ISO 1400 Environmental Standards

As a continuation of the now familiar ISO 9000 series of international quality management standards, the ISO 1400 series has been developed for environmental management. The standard specifies requirements for establishing an environmental policy, determining aspects and impacts of products/activities/services, planning environmental objectives and measurable targets, implementation of programs to meet objectives, checking and corrective action and management review. Many European producers have introduced the environmental quality standard and they are not the only ones.

A number of leading producers from the world's largest producing nation, China has also signed up to the ISO 1400 standard. In addition, the China Environmental Label was established in 1993 by the State Environmental Protection Agency (SEPA). It is the only national label that identifies environmentally friendly products.

Assopiastrelle initiative – S_Tiles

"S_Tiles – Italian tiles towards sustainability" is an integrated environmental and social communication strategy initiated by Assopiastrelle. The dedicated website and seminar series conducted in the US have focussed on the sustainability of ceramic tiles for modern architectural solutions, in view of their energy saving characteristics, sustainable production and life cycle.

Environmental Awareness

Green building guides are being published by various organisations. The Centre for Sustainable Research, University of Minnesota has published the *Green Affordable Housing Guide*. The Centre considered differing impacts on the economy, energy consumption and environment over seven categories of flooring being: wood, laminate, vinyl, linoleum, ceramic tile, cork and carpet. Based on economic and environmental impacts they recommend ceramic tile and linoleum and found that vinyl, carpet and tiles used the most energy during extraction, manufacturing, transportation and use/disposal.

Due to the growing awareness of consumers regarding environmental issues, manufacturers are responding in a variety of ways. One response has been marketing initiatives that focus on the environment. Rex Ceramiche part of the Florim Group, launched its Abisko range at Cersaie in October 2004. The timber look, glazed porcelain products are named after the Abisko National Park, one of the most famous parks in Sweden. The Abisko wooden slats are a ceramic interpretation of the natural material. Without cutting down trees, but by simply pressing the earth, a product has been obtained which is resistant to pedestrian pressure for residential and light commercial uses, is not sensitive to light or atmospheric agents, needs minimal maintenance, and lasts forever. To emphasise the benefits of the product, Rex launched the "one metre for one tree" programme which formally undertook reforestation areas selected by the WWF Italy.

In response to growing market interest in the environment, a number of companies have developed environmentally friendly properties that can be incorporated into tile products. Japanese manufacturer, Inax has developed a series of air-purifying and dehumidifying tiles called Ecocar. Fired at low temperatures, the tiles remove all formaldehyde from the air; a chemical used in glues and adhesives, particularly in pressed wood products. Italian manufacturer Gambarelli exhibited oxygen enriching glazed tile in 2003 that could

enhance indoor air quality. Other manufacturers have developed graffiti resistant glazes, which require less cleaning chemicals.

Environment for the installer and end user

While almost all floor coverings have significant VOCs emissions at the time of installation and commissioning, low emission adhesive, grout, additives and (if required) sealers, can reduce VOCs when installing ceramic tiles. Special precautions at this stage will minimise potential longer-term adverse health impacts on installers.

Measuring Environmental Impact

The world is still defining environmental terms and methods to assess environmental impact. The development of Life Cycle Assessment (LCA) attempts to define the total impact of a product from 'cradle to cradle'. LCA recognises that the disposal of a product at the end of its useable service also has an environmental impact and any assessment must include the potential for reuse or recycling. While ceramic production produces greenhouse gas emissions, it must be looked at both historically and in comparison to alternative materials. To be truly useful, any measurement of environmental impact should be calculated over the material's entire lifecycle. It is pointless to say something has low impact during the manufacturing process if it cannot be safely reused or incorporated back into the environment without impact.

Life Cycle Assessment/Analysis

If trying to determine which material to choose to achieve the most environmentally sustainable outcome, LCA is providing a scientific basis rather than subjective opinions. LCA assesses the impact of both the manufacturing process and the finished product on the environment by examining factors, such as energy consumed and wastes generated during production, as well as the use and recycling capability of the product. It evaluates the product, process or activity using an approach defined as 'from the cradle to the grave'. The accompanying article entitled 'Ceramic Wall and Floor Tile: An Ecological Building Material' prepared by Messers Timellini, Palmonari and Fregni from Centro Ceramico deals with this in more detail.

Conclusion

Manufacturers of building products, including tiles, are now examining the impact of their products and activities from a broad environmental perspective. With more than 40 per cent of all materials moved globally ending up in, or associated with the built environment, energy savings, even in areas such as transport have significance at global level. Governments, specifiers and an increasingly educated public expect products to be sustainable in their manufacturing processes and not to adversely affect the built environment. The ceramic tile industries in Italy and Spain have both demonstrated a responsible approach to tile manufacturing, as they have increased overall production from 440 million square metres in 1990, to 1227 million square metres in 2003 while reducing emissions and energy consumption during the same period. Tiles are made from naturally occurring materials, have a low impact in terms of waste in the manufacturing process, have reduced energy consumption levels and provide a long lasting, inert surface that requires little ongoing maintenance. □

HOW GREEN ARE ceramic tiles?

by all the processes associated with the production, from the acquisition of natural resources to product delivery, including mining, manufacturing of materials and equipment, transport and administrative functions". Energy consumption within the tile manufacturing sector halved in Italy from 12GJ to 6GJ between 1980 and 1997 although production has more than doubled over the same period. Savings from more efficient firing are now being further enhanced by reusing waste heat from kilns to generate electricity that can be used to power other equipment in the most advanced and environmentally aware plants. In a recent interview, Len Pereira of National Ceramic Industries Australia said the company planned to install a cogeneration plant when they install their second kiln. The cogeneration plant would provide enough energy to power the spray drier. At the same time he also pointed out that water used to wash down machinery including glaze lines is reused in the grinding process of the modern manufacturing facility. Like most modern tile factories, there is no waste water discharge.

Kyoto Protocol

After years of debate, the Kyoto Protocol officially comes into force on February 16, 2005. It commits 34 industrialised countries to make significant cuts to six global warming, greenhouse emission gases, especially carbon dioxide between 2008 and 2012. Developing countries are not included in the first phase. Australia has refused to ratify the treaty although the Australian government has said it would aim to meet the commitment it accepted during the original negotiations of an eight per cent increase above 1990 levels. The only other major developed country not to sign the treaty is the USA as they fear it will stifle economic growth. Europe has been one of the biggest supporters of the treaty and has agreed to cut total emissions to 8 per cent below 1990 levels, a reduction of 74 million tonnes in total, but current figures indicate that progress seems to be behind schedule. The European Union is responsible for 23 per cent of global tile production. Ceramic tiles are fired in a combustion process that produces CO₂ – a greenhouse gas. In Italy these emissions have been stabilised at 1980 levels while tile production has doubled. The ceramic sector in Spain represents 0.9 per cent of total national greenhouse gas emissions.

It may be coincidental that following the announcement of the Kyoto Protocol, there was a significant surge in investment in ceramic tile manufacturing capacity in countries that were not listed in the treaty. Whether this is due to the lower costs of labour or proximity to rapidly growing markets or the ability to produce without the imposition of emission quotas to meet national targets will undoubtedly make countries such as Vietnam or Morocco more competitive. The global decentralisation of ceramic tile production will also reduce energy consumption in the form of fuel used in road and sea transport.

EU Directive Proposal on Emission Trading

The European Commission has proposed a framework for greenhouse gas emissions trading to be established within the European Community. The proposed mandatory emissions trading scheme is supposed to start with a preliminary phase between 2005 and the end of 2007 followed by a second phase between 2008 and 2012 (corresponding the Kyoto Protocol's first commitment period). The proposal is based on a cap and trade

approach with absolute targets for participants. In this first phase (2005 to 2007) only CO₂ emissions will be included which are produced by activities including the production of ceramic products. The mandatory inclusion of these "core activities" such as iron and steel, non-ferrous metals, cement, glass and pulp will result in coverage of about 46 per cent of estimated CO₂ emissions in 2010 (38 per cent of total greenhouse gas emissions). To participate in emissions trading the companies concerned are required to hold a greenhouse gas emissions permit as a condition for emitting CO₂, which defines monitoring, reporting and verification requirements for the direct emissions related to their activities. From 1 January 2005, all businesses affected by the regulations will need a permit to generate greenhouse gas emissions. The objective is to establish a market for emissions quotas. In order to promote cleaner production systems, industries exceeding their previously assigned quotas must purchase emission quotas from other industries which are not using up all their quotas.

Ascer comment on Emission Trading

During Cevisama 2004 the president of Ascer, Mr Fernando Diago, spoke of the threats and challenges to ceramic tile manufacturing in Spain. He outlined details of the consequences of the proposed European Commerce Directive on Emission Quotas coming into effect from a study commissioned from PricewaterhouseCoopers (PwC). In the report, PwC concludes that the cost of purchasing emission quotas in order to comply with Kyoto regulations (72 million euro for the ceramic sector in Spain) would result in the closure of 20 per cent of tile factories and the loss of 6000 directly connected jobs. Production would fall by an estimated 25 per cent. The report stated that the ceramics sector represents 0.9 per cent of total national emissions and less than 2 per cent of industries affected. Mr Diago pointed out that the industry had already cut emissions by half. Spain is committed to limiting emissions to 15 per cent above 1990 levels.

Other Environmental Initiatives

Despite the concentration on greenhouse gas emissions, there is a much broader focus on sustainability in ceramic tile manufacturing. While all unfired scrap material is recycled back into production in modern tile factories, scrap fired tiles are more difficult to reuse. In the past, broken traditional twice fired tile products were ground with other raw materials and incorporated into new products. Today, tiles are fired much higher, and are consequently more difficult to grind. Studies have been conducted in Brazil comparing the cost of disposing in landfill versus reprocessing. It was estimated that 3 per cent of the national production of Brazil was discarded. If this was sent to landfill, it would represent 200 000 tonnes per annum. Thankfully much of this material is being reused and at a cheaper cost than landfill. In Bulgaria up to 10 per cent of fired sanitaryware waste is also being incorporated back into ceramic tiles. Research is continuing on recycling various industrial waste products into ceramic tiles.

Eco-Labeling

In 2002 the European Union adopted a series of criteria for the award of an Eco-label to the hard floor covering category which includes ceramic tile. Through the application of life cycle assessment, the Eco-label permits the identification of environmental efficiency of certified products.