Corobrik and the Environment

July 2009

GREEN BUILDING COUNCIL SA
MEMBER ORGANISATION

CORОBRIK®

COROBRIK AND THE ENVIRONMENT

Preface

It is Corobrik's mission to embrace a holistic approach to environmental sustainability in the conduct of all aspects of its business.

With environmental sustainability being such a broad and complex subject Corobrik does not profess to have all the answers. This document therefore, and the information it contains, should be seen as part of an ongoing process by Corobrik in developing awareness and understanding of the influences of technology, processes and energy sources on its processes and product carbon footprint. It is an attempt to present to building professionals where Corobrik is at this point in time in the "greening" of its business and the scope of Corobrik products within the prevailing environmental debate.

It is a common cause that most of the debate on the environmental value of different products focuses on their embodied energy. While this document deals with comparative embodied energy values of Corobrik products at factory gate, Corobrik appreciates that the significance of embodied energy can really only be understood in the context of systems. This document therefore sets out to outline the relative life cycle value of Corobrik face bricks and plaster bricks as walling systems, this in the context of their holistic contribution to environmental sustainability.

With only limited credible comparative research having been undertaken in South Africa on product embodied energy values and embodied energy values of combinations of products in systems, it was necessary, in the compilation of this document to reference international research data. Consequent to this, not all the comparative values reflected in this document may necessarily be absolute. They are however valid in the context of the research used to compile this document.

CLIMATE CHANGE IN THE SOUTH AFRICAN CONTEXT

It is generally accepted that four interrelated factors are driving climate change. These are noted to be:
Societal changes
Economic development
Future energy demand
Global warming.

In the context of societal change and economic development, the world, as has South Africa, set itself various goals to eradicate poverty and raise living standards. These goals require energy, the driver to improved modern living standards. Increased access to modern energy services such as electricity are decisive factors for escaping the poverty trap vastly enhancing opportunities for industrial development, improved health and education.

In world terms non renewable fossil fuels such as oil and coal are the main fuels used for producing electricity. In South Africa, coal is the primary energy source for generating electricity and on the per capita bases CO_2 emissions are noted to be the highest in the world. With economic development so important to raise living standards in South Africa, and the reality that it will take generations to change power generation plants to more environmentally friendly facilities, Corobrik accepts the responsibility as a major player in the building materials industry, for taking all practical measures within its business to minimise energy usage and limit the negative impact of green house emissions on the sustainability of our environment.

REDUCING COROBRIK'S CARBON FOOTPRINT

Reducing Corobrik's carbon footprint is a key business objective. At brick manufacture level, different brick making methods and different fuel types have different impacts on the environment.

Kiln Technology:

Many years ago Corobrik exited from high carbon footprint processes such as more pollution intensive clamp and down draft kilns. Corobrik now only operates continuous fired kilns with new investment directed towards technology better able to drive efficiency in energy usage and accommodate clean burning fuels.

Cleaner Burning Fuels:

For each giga joule of energy, natural gas releases just 48kgs of CO_2 compared to 97kgs of CO_2 omitted from coal.

Consequent to that, Corobrik commenced a process in 1996 to convert, where possible, to natural gas for the firing of its kilns.

Presently Corobrik has six factories using natural gas as a primary fuel source for the firing of its kilns, bringing to the South African market clay bricks with the lowest possible embodied energy values. Further conversions to such cleaner burning fuels will depend on the availability of natural gas at the factory gate.

Corobrik's Certified Emissions Reductions:

In 2004 Corobrik was one of the first companies in South Africa to embrace the Kyoto Protocol. On the 13th June 2008, Corobrik following due process, became the first company in South Africa and Sub Saharan Africa to be awarded Certified Emissions Reductions (CER's) by the United Nations Clean Development Mechanism for its Lawley Factory Fuel Switch Project that has afforded annual CO_2 emissions reductions in the order of 17500 tons of CO_2 per annum.

In February 2008 Corobrik converted its Driefontein Factory from producer gas to natural gas designed to achieve similar green house gas emission reductions.

Interventions to achieve incremental reductions in energy usage:

In South Africa, the carbon footprint of the electrical power is quoted at 0.98kgs CO_2 per Kilowatt hour of energy consumed so reductions achieved by continuous improvement programmes translate into reductions in greenhouse gas emissions.
Interventions being pursued by Corobrik include:

Electrical Power Reduction Teams:

Corobrik has teams in place at all factories tasked with achieving ongoing reductions in power usage.
A reward system is in place to help drive the process.

Employment of Greener Technologies:

Corobrik is continually reviewing international best practice and looking at proven technological innovations able to enhance its products and afford incremental reduction in greenhouse gas emissions. A recent technological innovation has involved the progressive conversion of extrusion technology from the traditional three core brick to an internationally utilised ten core configuration.

This change has reduced the mass of Corobrik bricks, bringing productivity benefits to the building contactor; reduced diesel usage per thousand bricks delivered and at factory level, facilitated greater efficiencies yielding important incremental reductions and energy usage. Notably the ten core hole configuration reduces the mortar usage on site by some 8% thus reducing the carbon footprint associated with the cement component of mortar.

Worldwide, the cement industry quotes the carbon footprint of cement as ranging from 0.8kgs CO_2 to 0.95kgs CO_2 per kilogram of cement. In material terms, mortar makes up approximately 22% of a square metre of brickwork and hence this 8% reduction in mortar usage translates into an incremental reduction in the carbon footprint of brickwork when using Corobrik bricks.

Clay usage through the plant is also reduced thereby reducing the indirect carbon footprint of electrical power consumption used in brick manufacture and direct energy required for the drying and firing processes.

Corobrik embraces sustainable development at all its operations:

All Corobrik quarrying and manufacturing operations are strictly managed within a sustainable development framework.

- Quarrying and manufacturing operations are located in rural and semi-rural areas thus providing long term employment opportunities to neighbouring communities.
- Social and labour plans, within the framework for the new order mining rights, are in place for all such operations.
- Quarrying and manufacturing operations are undertaken within the parameters and requirements of an approved environmental management plan for each quarry and manufacturing process.
- Concurrent rehabilitation of all quarries during annual quarrying operations ensures that future rehabilitation liabilities are kept to a minimum.
- At the end of the lifetime of a quarry, the environment management plan provides for the final rehabilitation and reuse of the depleted quarry as a nature reserve surrounded by a pollution free dam, recreational area land for site or commercial/residential development site.
- Programmes are also in place to eradicate alien vegetation and plant indigenous trees to assist in offsetting Corobrik carbon footprint.

EMBODIED ENERGY OF COROBRIK MASONRY MATERIALS

Based on factory accounting records, the total energy utilized in the quarrying of raw materials, brick preparation, drying, firing and transport of the fired brick to the factory's finished goods storage area were provided to the CSIR Built Environment for typical Corobrik plants. These typical plants comprised concrete masonry and clay masonry operations that use Tunnel and Transverse Arch Kiln technology.

Direct energy inputs for diesel utilized for mining, in-works transport, energy usage for drying and firing derived from coal and natural gas were provided.

In addition the indirect carbon footprint derived from the electrical power usage and coal deliveries by cartage contractors of coal delivery trucks were also brought to account.

The carbon footprint results from this desk research are summarised as follows:

Corobrik Factory	Avoca Concrete (using 50% recycled aggregates)	Avoca 1 Transverse Arch Kiln	Lawley 2 Transverse Arch Kiln	Midrand Tunnel Kiln
Product Type in Imperial Format	Concrete Masonry Plaster Units	Clay Plaster	Clay Face Bricks	Clay Face Bricks
Kg CO_2 /1000 Bricks	206	563	651	446

Corobrik concrete masonry units had the lowest embodied energy value at factory gate.
Midrand Factory's relatively low carbon footprint [for clay bricks] results from this factory being a modern first world, natural gas fired Tunnel Kiln compared to the more traditional continuous fired Transverse Arch Kiln, using a combination of natural gas and coal (the latter as a body fuel additive) energy source for firing.

The Embodied Energy Values in Walling System terms:

The total Kilogram of CO_2 per m² of a single skin walling was calculated by bringing to account the carbon footprint of the mortar joint only in the face brick examples and that of the mortar joint, plaster and paint, in the painted and plastered brickwork examples.

Carbon Footprint Corobrik Masonry Walling

Factory Product Type	Avoca Concrete Concrete Plaster	Avoca 1 Clay Plaster	Lawley 2 Clay Face	Midrand Clay Face
Kg CO_2/1000 Bricks	206	563	651	446
Kg CO_2/m^2 single skin Brickwork	10.7	29.3	33.8	23.2
Kg CO_2/m^2 12mm Mortar Joint	8.1	8.1	8.1	8.1
Kg CO_2/m^2 12mm Plaster	3.7	3.7	-	-
Kg CO_2/m^2 Acrylic Paint (Primer, Under-coat, 2 Top Coats)	12.0	12.0	-	-
Kg CO_2/m^2 Single Skin Brickwork	34.5	53.1	41.9	31.3

In application, an external skin of brickwork built with clay face bricks from a tunnel kiln fired with natural gas yielded the lowest carbon footprint. Other face bricks with a higher carbon footprint would quickly offset any initial benefits concrete plaster and paint might offer at the time of first repainting involving 6kg CO_2/m^2 (2 coats of paint).

ENERGY USAGE OVER THE LIFE OF BUILDINGS

Embodied energy of building material at factory gate only explains part of the story. The carbon footprint of building materials in application over the life cycle of buildings is what is more important.

Notably over the life of buildings it is estimated that roughly 5% of the energy is taken up in the 'buildings manufacture'. The balance of the 95% of energy is used in the operation/use of the buildings that includes the heating and cooling of internal space and maintenance over the life of a building.

It is in this latter area that the thermal and durability properties clay face brickwork need to be considered for their ability to make a major contribution towards energy consumption reductions.

Thermal Efficiency of Clay Masonry Walling:

Double skin solid brick walls have U values below 2.20W/m²/°C. These U values typically provide for quality habitable space, supporting heating and cooling reductions and lower greenhouse gas emissions in climatic zones where there is a high diurnal temperature range. Double skin cavity walls are able to achieve U values below 1.60W/m²/°C.

The high thermal mass of clay bricks functions to moderate temperature changes through the building envelope. In practical terms clay bricks function as thermal batteries. Heat is slowly absorbed and stored during the day and then released at night when it is needed to offset heat loss from lower outdoor temperatures. It is recognised that the correct use of high thermal mass can delay heat flow through the building envelope by much as 8 to 10 hours naturally moderating internal temperatures and greatly reducing energy usage for the artificial heating and cooling over the life of buildings.

Energy Saved on Maintenance:

Repainting of masonry plaster products typically every five years with two coats of paint will add approximately 6kgs of CO_2/m^2 to the carbon footprint per event. In life cycle terms (say 100 years) this would involve twenty repaints accounting for an additional 120 kilograms of CO_2/m^2 emissions.

Other generic factors that make Corobrik clay face brick a seriously environmentally friendly walling material:

Contribution to the visual environment:

Clay face brick is an inorganic vitrified ceramic material typically recognised for its aesthetic contribution to the built environment. The enduring rich colours, hues and textures of fired clay face brick are the foundation of which the materials aesthetic appreciation is based. No other walling material has yet been able to demonstrate the same ability to add warmth, character and a human scale to an equally broad spectrum of architecture over an equal period of time as clay face brick has been able to do. For centuries now, clay face brickwork has demonstrated the propensity to massage the visual senses in an unobtrusive way, to mature in sympathy with the built environment as it were.

Contribution to Acoustic Comfort:

Clay face brick provides acoustic insulation to habitable space of 44dB for a single skin and 48dB for a double skin wall. Sound transmission between offices and the internal walls of houses are reduced to acceptable levels and ingress and noise from outside environments is kept to a minimum.

Contribution to Environmental Safety:

Fire Resistance:

The vitrification of clay raw materials at temperatures between a 1000°C and 1200°C provides clay face brick with class leading fire resistant characteristics. A normal (106mm) brick wall has a one hour fire rating. The exceptional performance attributes of clay brick masonry under fire were recognised back in 1666 after the great fire of London. Consequent to that, building regulations were drafted that use the performance attributes of clay brick masonry to provide the standards against which the fire resistance of all walling materials and systems were judged.

Resistance to Weather Events:

Clay face brick masonry has outstanding structural integrity providing exceptional protection against catastrophic weather events and man induced interventions.

Contribution to air quality and healthy environments:

The use of clay bricks does not reduce indoor air quality as do many paints and coatings.
No volatile organic compounds (VOCs) are emitted by clay face bricks.

Fired clay face brick is inert, providing for an inorganic wall that is not a food source for mould.

Clay face brick provides a non combustible vitrified ceramic material which does not emit toxic fumes in fire conditions.

Contribution to the builders work and the designer's environment:

Clay brick is widely recognised as being the most "forgiving" of the masonry materials. It is less harsh on the hands, less difficult to chase and plaster brick options are easier to plaster than concrete alternates.

Notwithstanding that all building materials move as a consequence of a thermal and moisture factors or both, clay face bricks have roughly half the coefficient of moisture and thermal expansion and contraction as applicable to concrete masonry units. The reduced movements associated with fired clay is thus more easily accommodated and issues associated with cracking and rain penetration, are reduced.

The human scale of brick and its flexibility in application enhances the designer's ability to create endless shapes and form.

Clay Face brick is fully recyclable:

Clay face brick masonry can be demolished with the minimum damage to bricks. Bricks cleaned of mortar can be reused as face bricks or pavers. In the UK and the USA the practice of recycling clay face bricks in new face brick and paver applications is a well entrenched practice this merely extending the life cycle value of the material. This "second" use of clay face brick is not recognised practice in the case of other walling materials.

Demolished brick and waste bricks are often crushed as an aggregate for concrete masonry and/or decorative landscape purposes.

COROBRIK CLAY FACE BRICK OFFERS A HOLISTIC ENVIRONMENTAL SOLUTION

Corobrik clay face brick maintains its initial structural and aesthetic integrity for generations this affording maximum opportunity for face bricks to add ongoing value to both built and natural environments.
The materials thermal mass and extreme durability properties effectively reduce the energy demand of buildings without adding any future carbon debt. From a holistic environmental perspective Corobrik clay face brick may be regarded as a seriously environmentally friendly walling material.

References:

The references considered in supporting the above include:

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