

## TECHNICAL NOTE #32

### Energy Efficient Technologies - Dematerialisation

Dematerialisation is the reduction of total material and energy throughput of any product, thus limiting its environmental impact. One of the identified methods to implement dematerialisation in clay brick production is to change from solid to perforated bricks.

This case study focuses on the reduction of material required to produce a clay brick, and the subsequent reduction in energy required to fire the clay brick.

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## ENERGY EFFICIENCY TECHNOLOGY DEMONSTRATION

### DEMATERIALIZATION CLAY BRICK PRODUCTION AT PIKA BRICK

#### BACKGROUND

Pika Brick is a privately owned brick manufacturer in the Free State, operating in the vicinity of Bloemfontein producing clay plaster brick products. The company has traditionally fired their bricks utilising clamp kilns, but have recently converted to a zig-zag kiln firing technology.

This change to a more efficient firing technology has offered the opportunity to also implement a further measure leading to an even higher level of energy reduction and a further lowering of environmental impact.

#### ABOUT THIS ENERGY EFFICIENCY MEASURE

Funded by the Swiss Agency for Development and Cooperation (SDC) as part of their Global Climate Change Programme, the Swisscontact implemented EECB Project seeks to foster green and sustainable transformation in the Clay Brick sector through strategically targeted interventions that support improved energy efficiency and reduced emissions.

In May 2016 the EECB launched the South African Clay Brick Sector Energy Efficiency Guidelines. ([www.claybrick.org/energy-efficiency-guidelines](http://www.claybrick.org/energy-efficiency-guidelines)) These guidelines define South African benchmarks and investigate various opportunities for the implementation of energy efficiency measures. One of these identified measures is the change from solid brick production to a perforated product. As an energy efficiency measure, this change would be classified as Dematerialisation. Dematerialisation is defined by UNEP as:

*“reduction of total material and energy throughput of any product and service, and thus the limitation of its environmental impact. This includes reduction of raw materials at the production stage, of energy and material inputs at the use stage, and of waste at the disposal stage.”*

This case study therefore focuses on the reduction of material required to firstly produce a clay brick, and secondly on the subsequent reduction in energy required to fire the clay brick. Perforating a clay brick is the act of extruding the 3 dimensional clay body such that there are voided areas or holes within the clay body. Solid and perforated bricks are illustrated here.



## NATURE OF CHALLENGES

The traditional solid imperial clay “plaster” brick is deeply entrenched in the South African building sector, and is therefore still widely manufactured. Clay Brick manufacturers need to overcome this market related challenge.

Related to this is the fact that the predominant firing technology in South Africa, the clamp kiln, does not lend itself to the firing of perforated products. Facing products are usually produced in kilns and are mostly perforated, and in some cases where kilns are used, non-facing products are also perforated.

It is estimated that >30% of clay bricks manufactured in South Africa are perforated, meaning that there is much experience to draw from. The first step towards perforated extrusion is recognising the need for change, and although solid, stiff extrusion methodology may have been entrenched, rising energy costs, the threat of carbon tax and more demanding environmental related regulations are compelling arguments for a shift.

This shift, when applied to a change to perforated products, requires a step by step approach, preferably with the guidance and help of the local equipment suppliers that can bring the necessary expertise. An imbalanced die may lead to invisible drying cracking which would only become apparent after firing via an increase in fired waste. Clay preparation, green strength, green brick handling etc. are some of the issues that may also have to be addressed.

## NATURE OF BENEFITS

The shift to perforations provides a range of benefits, with the obvious one being a direct reduction in raw materials used, being either clay or a combination of clay and internal carbon. A total perforation ratio of 20% is an immediate 20% reduction in materials.

The drying of product is one of the foremost challenges faced by brick makers, and any introduction of perforations which means lower mass, less water and an increase in surface area, leads to a direct reduction in time and energy required for the drying of product.

The lower mass of product being fired requires a proportionate reduction in firing energy, and also usually has the added benefit of a more “even” burn due to each unit having a higher surface area and improved oxygen availability. Each individual unit also has a reduced “mass” that needs to be cored. Firing times are usually reduced as an added benefit.

A reduction in fired brick mass also allows for larger loads to be transported adding to the competitiveness of a cored product versus a solid product.

## IMPLEMENTATION

### EQUIPMENT AND MATERIALS

No changes were made at Pika Brick in terms of clay raw materials mining or preparation, nor in the green brick handling methodology, which is based on a pallet / forklift system.

Changes to the green brick or extrusion process were limited to adding a bridge piece, core rods, core bridge tips and die oil lubrication plates. A die lubrication system was already installed and no additional costs were incurred.

The fitted core bridge allows for 16% perforation in the traditional 3-hole configuration.

The quoted costs from a supplier for the oil bell modifications, oil plates, bridge bar assembly, bridge core and a shaper cap total R68 000.

### EXTRUSION

No significant changes challenges were faced during extrusion. Any changes in extrusion rate, extrusion Amps on the extruder motor and moisture content were not measured for this exercise as the variances were not significant enough to report on.

In theory the extrusion rate should increase as the same tonnage would be extruded as solid bricks, however higher core bridge induced resistance would could counter this increase. An increase in amps may be offset by an improved die lube system, something that would in any case be recommended as die balance becomes more of an issue with cored products.

## KEY RESULTS

	<b>SOLID</b>	<b>PERFORATED</b>	<b>CHANGE</b>
<b>Perforation % for 3-hole configuration</b>	0%	16%	16%
<b>Brick Weight (Wet)</b>	4.1 Kg	3.4 Kg	-16%
<b>Brick Weight (Fired)</b>	3.2 Kg	2.7 kg	-16%
<b>Firing Energy (% Carbon)</b>	6.2	6.2	0%
<b>Kg Coal / 1000 Units</b>	621Kg	521Kg	16%
<b>Drying Time</b>	21 Days	14 Days	33%

The coal used is calculated from an in-the-body Carbon content of 6.2% and a coal Carbon content of 45%.

## ANNUALISED SAVINGS

	SOLID	PERFORATED	CHANGE
<b>Annual Production Saleable</b>	8 500 500	8 500 500	0%
<b>Fired Waste</b>	3%	5%	+2%
<b>Annual Production Green</b>	8 762 887	8 947 368	+2%
<b>Total Mined Clay (m<sup>3</sup>)</b>	14 191	12 171	-2 019
<b>Cost of Mining (R28.00/m<sup>3</sup>)</b>	<b>R397 361</b>	<b>R340 810</b>	<b>-R56 551</b>
<b>Internal Fuel (Coal Fines)</b>	5 441 Tons	4 662 Tons	-780 Tons
<b>Fuel Cost Saving (R800/ton)</b>	<b>R4 353 402</b>	<b>R3 729 263</b>	<b>-R624 139</b>
<b>Drying Time</b>	21 Days	14 Days	-33%
<b>Total Savings (Annual)</b>	<b>R4 750 763</b>	<b>R4 070 073</b>	<b>R 680 690</b>
<b>Savings per 1000 bricks</b>			<b>R80</b>

The savings above are direct savings relating to the introduction of the perforations. Additional savings could be found in the transport, or delivery of bricks but these have not been calculated for this exercise.

## ANNUALISED COSTS

	SOLID	PERFORATED	CHANGE
<b>Oil Bell and shaper cap</b>	Same for both		
<b>Core Bridge and core tips (set)</b>	R 0	R 9 000	R9 000
<b>Sets / year</b>		1.5	
<b>Annual Cost</b>	R 0	R12 000	R12 000
<b>Cost per 1000 bricks</b>			R1.40

## FINDINGS SUMMARY

Pika Brick has successfully demonstrated that in spite of various market and process related challenges it is possible, and entirely feasible to convert from solid brick production to perforated bricks.

Annualised savings of R 680 000 are possible at an entry level perforation of 16% taking only clay material and internal fuel quantity savings into account. This against an initial investment of R68 000 and a maintenance cost of R 12 000 per annum. Put another way, the Rand saving is equivalent to R78.60 per thousand bricks produced. Some of the variable costs and savings, such as extruder amps and extrusion rates have not been considered but were thought to not impact in any significant way in this exercise.

Additional environmental benefits exist from a reduction in clay and coal mined and transported. The reduction of **1 794 tons CO<sub>2</sub>** emitted is an additional environmental benefit as well as a possible additional saving of R 215 000 per year carbon tax (R120 per ton).

## RECOMMENDATIONS

“No brick should be a solid unless it is going to be a paver” should be a quote that every brick maker adopts, taking into consideration that clamp firing may prove to be a challenge.

A change to perforations is not just about bolting on a shaper cap with a core bridge, and requires some thoughts on clay mining and preparation, as well as on being able to draw on the experience of the equipment suppliers.

It may also be discussed whether a change to perforations could on its own qualify for a 12L tax reduction application.

In closing, this case study should also trigger the thought amongst those producers already perforating to investigate whether they could perhaps further increase their percentage perforations.

### **For further information:**

Energy Efficient Clay Brick Project

The Clay Brick Association of South Africa

Website: [www.claybrick.org/eecb](http://www.claybrick.org/eecb)