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SUSTAINABILITY FACTSHEET #02

Monitoring and Reducing Air Pollution from Clay Brick Production Facilities

The Department of Environmental Affairs has set limits for the air pollutants that may be released from clamp kilns.

As the oldest and (still) most utilized firing technology in the country's formal and informal brick making sector, local and international researchers have looked for ways of optimizing the design of clamp kilns in order to reduce emissions of sulphur dioxides (SOx), nitrogen oxides (NOx) and particulate matter released during the firing of clay bricks.

Technical Contributors

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THE CHALLENGE

The emission of toxic air pollutants such as, sulphur dioxide, nitrogen oxides and particulate matter (dust and smoke) presents a risk to human health and has a negative environmental impact. Inhalation of these air pollutants can result in respiratory problems and heart disease and also the acidification of rain due which can damage crops, forests and soil. Moreover, acid rain entering water bodies rivers, can also lead to the largescale death of aquatic animals. The main sources of air pollution in clay brick production are quarrying and brick making activities, such as raw material preparation and brick firing. Brick firing, particularly those using low-grade coal, can be a source of sulphur dioxide and nitrogen oxide emissions.



Figure 1: Open air clamp kiln. Source: Worcester Brick

From a regulatory point of view, the Department of Environmental Affairs has set limits on the air pollutants that may be released from clamp kilns, as set out in the National Ambient Air Quality Standards which are premised on the National Environmental Management: Air Quality Act (NEM: AQA) (No. 39 of 2004) (Kornelius, 2015). As an activity which is considered to produce atmospheric emissions which have a detrimental effect on the environment, clamp kiln operators are required under the NEM: AQA to apply for an Atmospheric Emissions License (AEL). Compliance to an AEL requires a clamp kiln operator to compile comprehensive emission inventories for the entire site where a clamp kiln is used for clay brick production.

However, given the open-air configuration of clamp kilns, the accurate measurement of air pollutant emissions is undoubtedly challenging, as the emissions are not released through a stack but from all over the surface of the clamp (Kornelius, 2015). Work carried out over the 2012 – 2013 period by the Environmental Engineering Research Group of the Department of Chemical Engineering of the University of Pretoria, has shown that mass balance calculations were in most cases adequate for calculating SO₂ emissions from the clamp kilns. However, other sources at brickyards also emitted particulate matter and nitrogen oxides, which made assigning these emissions to a particular source difficult. This inevitably makes it challenging to formulate measurement-based air pollution mitigation measures for the sources of air pollution at brickmaking facilities (Kornelius, 2015).

INNOVATIVE KILN DESIGN FOR EFFECTIVE EMISSIONS MONITORING

In collaboration with the South African Clay Brick Association (CBA), a study was initiated to design and test a small-scale model kiln that could adequately fire bricks and effectively monitor gaseous pollutants and particulate matter.

The effective monitoring of kiln emissions facilitated the calculation of pollutant emission factors for the kiln and other operations in a typical brickyard. Hence, it also facilitates the redesign of air pollution mitigation measures at these facilities. The objective of the study was to build and test a small-scale, model clamp kiln model that could fire bricks while accurately monitoring gaseous pollutant (nitrogen oxides and sulphur dioxides) and particulate matter emissions.

The model kiln was placed in an isolated location on the site of an existing brickyard and was designed to simulate the transverse slice of a full-scale clamp kiln used for brick firing in South Africa, but with a limited number of bricks per firing cycle (25,000 - 32,000 bricks).

This design allows for the emissions to be routed through a duct so that the released pollutants can be measured and also for the efficient capture and channeling of flue gas through the stack. The partially closed sides limit gas losses (Akinshipe and Kornelius, 2007).



Figure 2: Model Kiln with horizontal stack and mesh windscreen Source: Akinshipe and Kornelius (2007)

Input data for different brick factories across South Africa was collected, including data about methods of raw brick processing and packing, the intrinsic properties of the “green” bricks (such as moisture content and clay type) and the type of fuel used. Thirteen successful firings were completed, each lasting for 8-14 days. To ensure a realistic range of variables, the raw bricks, packing pattern and the firing technique were provided by eleven separate CBA Members (Akinshipe and Kornelius, 2007).



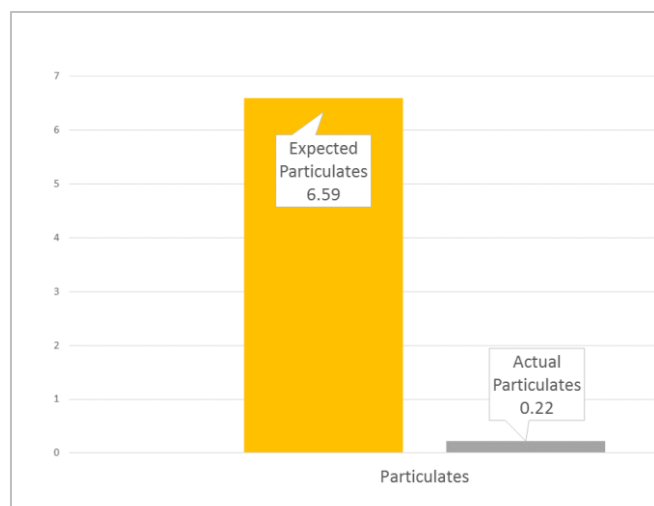
Figure 3: University of Pretoria students take readings at the model kiln

- [Watch the video](#)

RESULTS

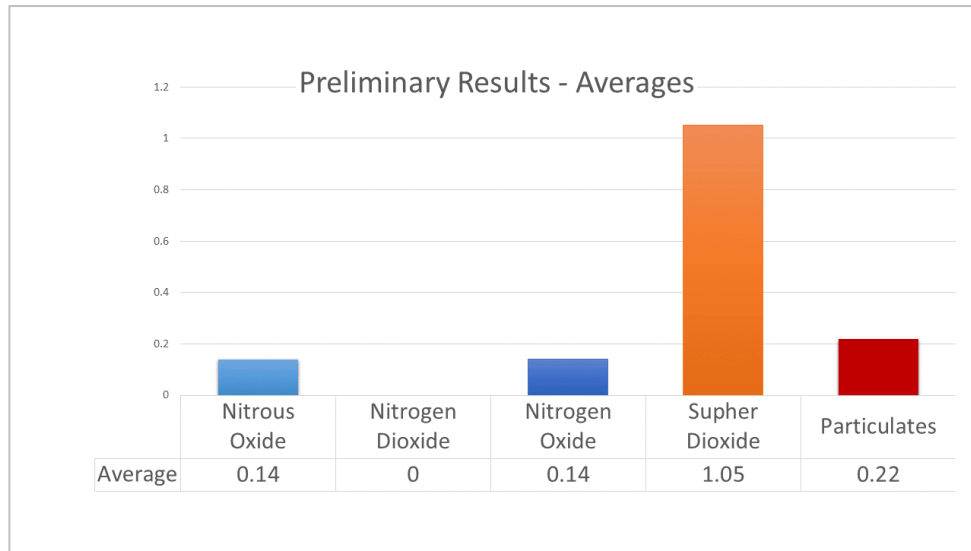
The primary findings from the study showed that particulate matter emissions from clamp kilns are much lower (by a factor of 5 or more) than the values observed from literature.

This result has implications for dust management around brickyards – especially with regard to emissions from road traffic, which may have a much larger impact on particulate matter emissions than the kiln itself (Kornelius, 2015).





In addition, due to the kiln design which enabled for effective stack monitoring, Sulphur Dioxides accounted for the majority of the gaseous pollutants arising brick firing. This extent of Sulphur dioxide emissions was found to be directly related to the quality of the fuel used, thus inferring that lower emissions could be achieved through using low Sulphur Dioxide fuels. A simple mass balance method is sufficient to account for SO₂ emissions from clamp kilns (Kornelius, 2015).



REFERENCES

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For further information:

The Clay Brick Association of South Africa
 Website: www.claybrick.org