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SUSTAINABILITY FACTSHEET #01

Incorporating waste materials into clay brick production

Recycling waste products by incorporating them into clay brick during production is a practical and environmentally- friendly solution - curbing the costs and negative environmental impact associated with waste disposal.

Depending on the type of waste, the observed benefits include improvements in brick porosity, thermal conductivity, water absorption properties and reduced energy use during firing.

Technical Contributors

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EXECUTIVE SUMMARY

A variety of different wastes have been investigated by researchers and clay brick manufacturers for their potential as additives into the production of clay bricks. The most common waste types which have been investigated are fly ash produced in coal-fired power stations, sludge derived from municipal waste water treatment plants, waste paper and recycled glass. Other materials which have been investigated include, pulp residues, polystyrene, tobacco and grass.

However, while research and test has been carried on the suitability of most of the above wastes for their ability to be recycled and potentially be incorporated into the production of clay bricks, not all of these are suitable additives into clay bricks as the composition and chemical properties of the waste and the resulting manufactured brick, need to meet specific quality requirements and comply with relevant clay brick standards and regulations.

FLY ASH

A lot of research has been conducted into the potential for incorporating fly ash into clay bricks. Most studies indicate that adding fly ash into clay bricks can improve the density of the final brick by between 4-28%. It also also improves plasticity and drying properties and decreases shrinkage and crack formation during firing. The extent of these benefits depends on the clay to fly ash ratio and the particle size of the fly ash, with most researchers finding that fine fly ash is a better additive than coarse fly ash (Abbas et al, 2017).

The calorific value of fly ash typically ranges from 1,470 to 11,760 kJ/kg and depending of the quantity of ash added during brick production, the amount of energy used in the firing process can be reduced considerably (Abbas et al, 2017). Aside from contributing to energy savings in the firing process, researchers have also found that adding fly ash to clay also produces bricks with high resistance to efflorescence and frost melting.

The main producers of fly ash are coal power plants who store and sell it to companies, including some brick manufacturers. From the coal consumed in South Africa during the 2014/2015 financial year, about 34 million tonnes of fly ash was produced from Eskom's 13 coal-fired power plants, and less than 10% of this ash was sold.

Low sales partly due to restrictive legislation with regard to the use and commercial application of fly ash in South Africa as it contains some minerals that are harmful to human health. Hower there is also a lack of knowledge on the consumer side about the useful properties of fly ash and potential applications.

Figure 1: Fly Ash Bricks. Engineers Daily 2018

SLUDGE FROM MUNICIPAL SEWERAGE TREATMENT PLANTS

Locally, the incorporation of sludge into clay bricks began in Port Elizabeth in 1979. Since then, millions of "sludge bricks" have been produced and used in the construction industry in South Africa (Slim and Wakefield, 1991).

Sludge can be incorporated into the brick making process both in watered and de-watered form. During brick production, up to 30 % (by volume) of sludge can be added to clay in the production of stock bricks, and between 5 and 8% for face bricks. Some researchers have also found that these percentages can be considerably increased without affecting final brick quality (Slim and Wakefield, 1991).

The use of sludge provides a number of advantages in clay brick making, including:

- Saving on water and fuel requirements
- Reduced brick weight and transport costs as more bricks can be carried per load
- Provision of heat for drying; sludge burned in the afterburner provides a very cheap source of heat for the drying chambers.

PAPER WASTE

Research scientists from Spain's University of Jaen gathered cellulose waste from a paper mill, along with sludge left over from the purification process of that plant's waste water. Those substances were then mixed with clay used in building construction, pressurized, and then extruded in one long sausage-like length (Coxworth, 2012). The bricks were subsequently sliced from that material and fired in a kiln.

*Figure 2: **Paper waste used to make "green" bricks** Source: Coxworth, 2012*

According to the researchers, the bricks didn't need to be fired for as long as their conventional counterparts, due to their paper content.

The addition of the paper also caused the bricks to exhibit low thermal conductivity, meaning that they would have good insulating properties if used in the built environment. However, their mechanical resistance is lower than that of conventional clay bricks (Coxworth, 2012).

Conclusion

The incorporation of waste generated from everyday activities into clay brick production has been demonstrated to be viable for certain types of wastes. While this is still an area of ongoing research, the benefits from a resource efficiency, material cost, improved product characteristics and waste minimization point of view, can be significant.

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For further information:
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