Assessment of mechanical, thermal, mineral and physical properties of fired clay brick made by mixing kaolinitic red clay and paper pulp residues

Muñoz, P.
Letelier, V.
Bustamante, M.A.
Marcos-Ortega, J.
Sepúlveda, J.G.

Abstract
Among the largest producers of waste, the paper industry stands out due to its impact on human health and ecological balance. However, these residues may also contribute to a more environmental friendly brick industry, since the incorporation of fluxing agents may improve the firing process and the induced porosity reduces thermal conductivity of fired bricks. Therefore, this study aims to assess the feasibility of replacing clay with solid paper residue (PPR) from 2.5 to 17.5% in order to reduce resources depletion and improve brick performance. The original clay was characterized as a non-calcareous red clay with high contents of kaolinite. Several samples were made by extrusion and fired at 900 °C in accordance with industrial procedures. The addition of PPR led to increase shrinkage from 5 to 10% due to the effect of fluxing oxides which reduced pores volume and enlarged pores size. In addition, the impervious fraction was slightly reduced while the apparent porosity certainly increased (i.e. approx. 17%) due to the macroscopic pores developed by PPR combustion. This porosity produces lighter bricks (i.e. density decays from 1.76 to 1.39 g dm^{-3}) with lower thermal conductivity (i.e. from 5.53 to 0.41 W m^{-1} K^{-1}) but also reduces compressive strength (i.e. from 11 to 3 MPa) and increases water absorption (i.e. up to 24%). Nevertheless, toxicity is below the regulatory limits in all cases and fired bricks are easily adaptable to industrial procedures.

Author keywords
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