THE INFLUENCE OF WATER AND SALT CRYSTALS CONTENT ON THERMAL CONDUCTIVITY COEFFICIENT OF RED CLAY BRICK

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ABSTRACT

This paper presents results of experiments aimed at studying hygro-thermal properties of red clay brick. The main objective of research was to investigate the relation between thermal conductivity coefficient of dry, filled with water and salt crystals brick. The research was conducted using stationary technique for the totally dried specimens, as well as the ones 25%, 50%, 75% and 100% filled with water or sodium sulfate solution and its crystals. The experimental results confirm negative influence of water or sodium sulfate on thermal properties of material. The value of thermal conductivity coefficient increases along with growth of water or Na\textsubscript{2}SO\textsubscript{4} solution content.

Keywords: building materials, thermal conductivity coefficient, sodium sulfate, brick.

INTRODUCTION

Water and salt are frequent problems faced in building materials. It causes deterioration of thermal and mechanical properties. Several scientists work on the dependence between moisture and heat conductivity, but with regard to, for instance, insulation materials (Jiřičkova, Pavlík, Fiala, Černý, 2006) or cement mortars (Siwińska, Garbalińska, 2011). Similar research has not been conducted for red clay bricks yet and furthermore the influence of water on heat conductivity has not been compared to the influence of salt solution on that parameter.

At the beginning, a sorption isotherm test was conducted for seven relative humidity levels. The next subject of research was to investigate the relation between thermal conductivity coefficient of brick and its water or Na\textsubscript{2}SO\textsubscript{4} solution content. In order to predict the quantities of mirabilite (Na\textsubscript{2}SO\textsubscript{4}·10H\textsubscript{2}O) and saturated solution of Na\textsubscript{2}SO\textsubscript{4}, an appropriate algorithm in the python programming language was developed. Six red clay bricks were used for the experiment. The research was conducted in the Taurus TLP 300 Apparatus, at the average temperature of 10\textdegree{}C assuming the temperature difference 10\textdegree{}C. The TLP 300 is a two-plate device, which uses stationary technique. The test was conducted for dried specimens, as well as the ones 25%, 50%, 75% and 100% filled with water and sodium sulfate solution. Furthermore the change of red clay brick pore structure before and after imbuing with water and salt solution was investigated by multi-cycle mercury intrusion test. Additionally the thermal conductivity coefficient of mirabilite (Na\textsubscript{2}SO\textsubscript{4}·10H\textsubscript{2}O) was studied.

RESULTS AND CONCLUSIONS

The initial results concerning the influence of water and salt crystals content on thermal conductivity coefficient are shown figure 1. They confirm negative influence of these factors
on heat conductivity of material. The value of thermal conductivity coefficient increases along with moisture level growth. The figure can be divided on two sections - for sample imbued in the range from 0% to 50%, when the thermal conductivity coefficient increases sharply, and for samples imbued in the range from 50% to 100%, when the thermal conductivity coefficient increases equably. The moisture content is expressed in grams of absorbed water or salt solution per grams of dry material. The study shows that the presence of Na₂SO₄ solution has less negative influence on brick’s thermal conductivity coefficient than water.

![Graph showing the relation between thermal conductivity coefficient and level of samples saturation](image)

**Fig. 1 - The relation between thermal conductivity coefficient and level of samples saturation**

**REFERENCES**
