MODELS TO PREDICTING CERAMIC TILES PROPERTIES USING FACTORIAL DESIGN

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ABSTRACT

This work aimed at the development of mathematical models for predicting the properties of water absorption, linear shrinkage and flexural strength of the ceramic tiles using samples of two clay deposits used by one ceramic tiles industry of state of Sergipe, Brazil. Were planned sequentially two factorials designs of the type \(2^3\) to know how the major variables of ceramic processing (formulation, particle size, pressing, firing temperature, heating rate and time of firing level) influence the properties studied and, from this information mathematical models were built to prediction of these properties. The models obtained for absorption and shrinkage were satisfactory considered, allowing obtain in the laboratory, an experimental condition to improvement of the technical classification according to ISO 13006 with a smaller number of experiments and consequently with less time and lower cost of experimentation.

Keywords: ceramic tiles, design of experiments, empirical models.

INTRODUCTION

Experimental design techniques have been increasingly used to model and simulate the effect of operating conditions of production for the advanced ceramics (Mitic, et al., 2011, Ekberg et al., 2014) as well as for the ceramic tiles (Menezes et al, 2009; and Silveira Leite, 2010). However, most of the works of statistical design of experiments related to the production of ceramic tiles uses only the mixture design technique, and often they do not study the influence of other variables that influence the final characteristics of the product, nor their interactions.

After the experiments, we used mathematical models to represent the experimental data. The parameters of the models and parametric uncertainties were obtained by Statistica 8 software, and statistical analyzes were performed based on the evaluation of parametric uncertainties and Fisher’s test. Was used the Pareto diagram to assess what and how, the input variables influence the output variables.

RESULTS AND CONCLUSIONS

Figure 1 shows the Pareto diagram for water absorption models obtained for each experimental design, showing how the variables influencing the water absorption, for the processing conditions adopted and to level of trust of 95%.

After simulations of the water absorption and linear shrinkage models, has been found and validated, one experimental condition (Table 1), whose results showed the best relation absorption/shrinkage for improvement of the technical classification according ISO 13006.
The mathematical models obtained for the prediction of absorption and shrinkage were satisfactory considered, for they were able to describe the experimental data adequately in the evaluated range and to the desired level of trust. However, the same has not happened to the model for the flexural strength that must be associated to peculiar characteristic of mechanical behavior of ceramic materials.

The models obtained for absorption and shrinkage were satisfactory considered.

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REFERENCES


