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Effects of Raw Material Contents on Technological Properties of Multicomponent Ceramic Bodies

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Abstract – In the present study, statistical combinations of a five-component mixture were designed to obtain synergetic values of technological properties of multicomponent ceramic bodies. Twenty and one formulations constituted by two clays A and B, kaolin C, filites D and E were selected and used in the experiments design. Those formulations were wet processed and characterized. Results were then used to calculate statistically significant and valid regression equation, relating the property with the proportions of raw materials. The results shown that the use of the mixture design can be an important tool to understand the behaviour of these ceramic products.

Final quality of industrial ceramic products, such as floor and wall tiles, requires the technological properties control of the manufactured pieces. The properties of unfired and fired ceramic bodies depend on the raw materials and the processing conditions. If processing conditions are kept constant, such properties will only depend on the raw materials.

When a given property of a material or product is affected solely by its components, a methodology for the design and analysis of mixture experiments can be used [1]. The design of mixture experiments is a special case of response surface methodologies, which assume that a given mixture property depends only on the component fractions (x_i, summing up to unity), and not on the overall amount of the mixture. The response function *f* can be expressed in its canonical form as a low degree polynomial [2].

The effect of each raw material on the fired bending strength can be best visualized when response trace plots are constructed, as shown in Figure 1 [2]. In this case, the reference composition used was the corresponding to 14.28 wt.% clay A, 25.71 wt.% clay B, 25.71 wt.% kaolin C, 20.00 wt.% filite D and 14.28 wt.% filite E. Figure 1 shows that the FBS varies linearly with the filite D and E contents in the composition, increasing with it. A smooth decline of FBS can be observed when the clay B content increases. However, the decline is very accentuated for clay A and kaolin C contents.

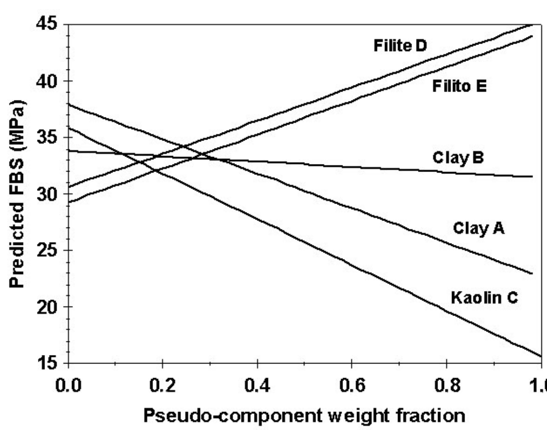

Fig. 1 Response trace plots of predicted bending strength as the composition.

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