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Property-Microstructure Relationship in Aluminous Porcelain Incorporated with Ornamental Rock Waste

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Abstract – In this work the property-microstructure relationship of aluminous electrical porcelains incorporated with ornamental rock waste have been investigated. Batches of aluminous porcelain with up to 35 wt.% waste were prepared. The porcelain pieces were pressed at 50 MPa end fired between 1300 – 1400 °C. The following properties were determined: linear shrinkage, water absorption, apparent density, compressive strength, and electrical resistivity. The development of the microstructure was evaluated by SEM and XRD. The results showed that the physical-mechanical properties of aluminous porcelain were influenced by the waste addition. The correlation between properties and microstructure of the aluminous electrical porcelains is well established.

Porcelains are vitrified ceramic materials. They are widely used for technical purposes. The electrical porcelains are used as insulators in electrical power transmission systems [1]. Porcelains are primarily composed of clay, feldspar, and quartz. The clay gives plasticity to ceramic formulation, quartz maintains the shape of the porcelain piece during firing, and feldspar acts as flux. In aluminous porcelain, however, the quartz is substituted by alumina. On the other hand, the ornamental rock industry generates huge amounts of wastes that have be discarded. These wastes are rich in flux materials. Thus, the ornamental rock wastes are attractive to be incorporated into electrical porcelain wares.

Batches of aluminous porcelain containing 0, 10, 20, 30, and 35 wt.% waste were prepared (Table 1). The ceramic pastes prepared by dry process were pressed at 50 MPa, and then sintered in air between 1300 – 1400 ºC during 1 h. The resulting pieces were characterized in terms of linear shrinkage, water absorption, apparent density, compressive strength, electrical resistivity, SEM, and XRD.

The linear shrinkage and apparent density of the pieces are shown in Figs. 1 and 2, respectively. It can be found that the porcelain pieces exhibited highest densification at 1350 ºC. Sintering beyond this temperature results in progressive deterioration of the technological properties of the aluminous porcelain pieces. This is due the high porosity developed in the pieces. It can also found that the addition of up to 10 wt.% waste results in aluminous porcelains with good technical properties.

Table 1: The proportions of the blends for the formulations (wt.%).

Formulation	Kaolin	Clay	Alumina	Sodic Feldspar	Waste
ST0	20	25	20	35	0
ST10	20	25	20	25	10
ST20	20	25	20	15	20
ST30	20	25	20	5	30
ST35	20	25	20	0	35

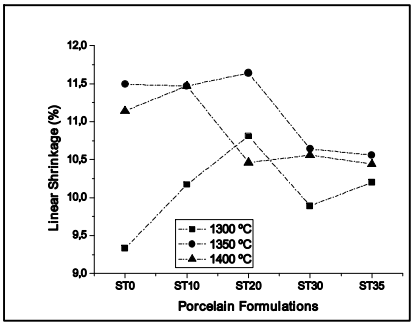

Figure 1: Linear shrinkage of the pieces.

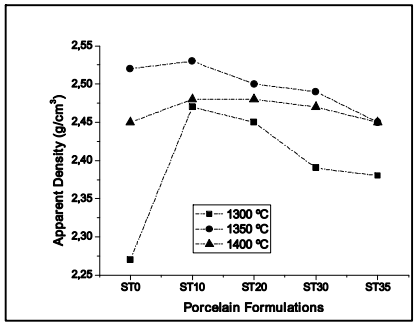

Figure 2: Apparent density of the pieces.

References

[1] A.L. Chinelato, D.P.F. Souza, Cerâmica 50 (2004) 62 – 68.