DRY GLAZING OF CERAMIC TILES. CONDITIONING OF THE NECESSARY GLAZE POWDERS

Belda A.[(1)], Bautista Y.[(1)], Castellano J.[(1)], Gozalbo A.[(1)], Orts M.J.[(1)], Sanz V.[(1)]

[(1)] Instituto de Tecnología Cerámica (ITC). Asociación de Investigación de las Industrias Cerámicas (AICE)

Universitat Jaume I. Castellón. Spain.

1. INTRODUCTION

Dry glazing of ceramic tiles is a process that is acquiring particular relevance owing to the appearance of new digital dry decoration machines. In order to achieve satisfactory results by this process, it is necessary to determine optimum glaze properties and to evaluate the appropriateness of the different preparation techniques.

2. EXPERIMENTAL PROCEDURE

2.1. GLAZE PREPARATION

Glaze powders were prepared by two different methods (Figure 1): spray drying of a liquid suspension and granulation of a mixture of particulate material using a binder. Traditional glaze compositions formulated with frit and kaolin were used and replacing kaolin with clay to obtain more compact granules. A polyvinyl alcohol (PVA) solution was used as binder.

The resulting glaze powders were sieved to obtain a similar particle size distribution, regardless of the preparation method, which was narrower, between 200 and 400 μm.

Figure 1. *Equipment used for spray drying (left) and granulation (right).*

2.2. GLAZE CHARACTERISATION

The glaze powders were characterised by determining their flowability and the friability or consistency of the granules.

The flowability of the powders was analysed from the flow rate, by means of a flowmeter consisting of an inverted truncated cone of known dimensions, and using the powder flow analyser shown in Figure 2. This apparatus allows the flowability of a material to be analysed through the compaction and cohesion coefficients, obtained by a rotating screw that travelled through a column of sample.

To evaluate granule consistency, a new procedure was developed, which consisted of the determination of the sample fraction below 200 μm that had been milled in a planetary mill with a jar without grinding media, so that granule erosion or fracture took place by collision between the granules.

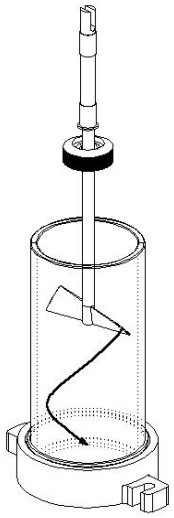

Figure 2. *Powder flow analyser.*

3. RESULTS AND DISCUSSION

3.1. INFLUENCE OF THE PREPARATION METHOD

The flowability and friability data obtained for the glazes, prepared with clay in their composition, are shown in Table 1, detailed in terms of a conventional spray-dried powder, a spray-dried powder prepared with a PVA solution, and a granulate also prepared with PVA.

The greatest flowability corresponded to the conventional spray-dried powder without binder but it also exhibited lower granule consistency. The granulate, with a less spherical shape, exhibited the lowest flowability, with the highest compaction and cohesion coefficients. The granulate displayed a lower percentage of fracture in the friability test.

Sample	Flowability			Friability
	V (g/s)	Comp. coeff. (g·mm)	Cohes. coeff. (g·mm)	< 200 µm (%)
Spray-dried powder	33.3	9191	995	77.6
Spray-dried powder PVA	26.6	11467	919	42.4
Granulate PVA	27.3	28664	1682	17.5

Table 1. *Flowability and friability of the samples prepared with clay.*

3.2. INFLUENCE OF THE GLAZE COMPOSITION

Table 2 details the flowability and friability data for the samples prepared with the PVA additive, classified according to the preparation method (spray drying or granulation) and to the glaze composition (kaolin or clay).

The glaze powders prepared by spray drying exhibited greater flowability but they were more brittle and broke more readily. When the kaolin in the composition was replaced with clay, granule strength increased substantially while granule flowability decreased.

Sample	Flowability			Friability
	V (g/s)	Comp. coeff. (g·mm)	Cohes. coeff. (g·mm)	< 200 µm (%)
Spray-dried powder kaolin	32.3	7004	902	76.1
Spray-dried powder clay	26.6	11467	919	42.4
Granulate kaolin	27.4	20131	1132	42.5
Granulate clay	27.3	28664	1682	17.5

Table 2. *Flowability and friability of the samples prepared with PVA.*

4. CONCLUSIONS

In this study glaze powders were prepared under different conditions and they were characterised by innovative procedures to evaluate their flowability and friability. Glazes with different properties were obtained, which provide a wide range of possibilities for application by digital dry decoration. The influence of the preparation method (spray drying or granulation) on granule properties and the influence of the clayey material (kaolin or clay) in their composition were analysed.

REFERENCES

[1] SIMONS, S. J. R., PEPIN, X., ROSSETTI, D. Predicting granule behaviour through micro-mechanistic investigations. *Powder Technology*, 72, 463–475, 2003.

[2] RAMAVATH, P., SWATHI, M., BUCHI SURESH, M., JOHNSON, R. Flow properties of spray dried alumina granules using powder flow analysis technique. *Advanced Powder Technology*, 24(3), 667–673, 2013.

[3] POWDER FLOW ANALYSER Getting Started Manual – v3.4.