REUSING GLAZING WASTE IN RED STONEWARE BODIES

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At present, the environmental impact caused by uncontrolled glazing waste disposal by the ceramic industry is an issue of great concern.

The problem greatly affects the ceramic manufacturers in the Santa Gertrudes region in Brazil, one of the country's major tile producing areas. A way is therefore being sought to minimise this problem by reusing the waste.

One form of waste reuse is by incorporation into ceramic formulations that allow such recycling without causing product physical properties to undergo significant changes. Furthermore, on being liquid-phase formers, these materials could contribute positively to reducing firing temperatures and heat-treatment cycles of the bodies to which they are added.

Their use could thus be feasible for making bricks, as well as single-fire red stoneware prepared by dry milling.

The ceramic producers could thus collect the glazing waste and convey it to their milling facility to be milled together with the other raw materials.

Glazing waste is furthermore known to vary according to the glaze composition, while also differing from company to company. A study therefore needs to be performed

(a) (b) (c) (d) (e) (f)

Figure 1. *Photographs of glazing wastes E1 and E2. a) Waste fired 1020°C; b) Waste E1 fired at 1050°C; C) Waste E1 fired at 1080°C; d) Waste E2 fired at 1020°C; e) Waste E2 fired at 1050°C; f) Waste E2 fired at 1080°C*

on a laboratory scale with different wastes from various companies to characterise these and define their feasibility for use.

Characterisation tests were conducted, identifying the phases present by X-ray diffraction (XRD), phase-transition temperatures by differential thermal analysis (DTA) and thermogravimetry (TG). The texture of the material was also examined by scanning electron microscopy (SEM). Analysis revealed that the main clayey minerals were kaolinite and muscovite.

Two glazing wastes referenced E1 and E2 from two ceramic producers were added to the studied body, referenced M1. The formulations were homogenised.

The powders obtained from these formulations were used to form rectangular test specimens measuring 2x6cm at a pressing pressure of 250kgf/cm^2.

The test specimens were fired at three different temperatures (1020, 1050 and 1080°C).

After firing, tests were carried out to determine bulk density, linear shrinkage, water absorption and loss on ignition.

Figure 1 presents photographs of glazing waste specimens E1 and E2 fired at 1020, 1050 and 1080°C.

Specimen E1 fired at a 1020°C is fully densified, without yet exhibiting any trace of melting. At 1050°C it has already started deforming, indicating melting initiation. At 1080°C it has melted completely.

Specimen E2 fired at 1020°C, has already melted, i.e., it has already gone through the densification stage and started an expansion process with the formation of porosity. At 1050 and 1080°C pore number and size increase progressively. Sample E2 is therefore more fluxing.

The X-ray diffractograms of wastes E1 and E2 before and after firing at 1080°C indicate the presence of many phases in the samples, such as quartz, zircon silicate, albite, orthoclase, diopside, kaolinite, vermiculite, biotite, calcite, hematite, tridymite, and anorthite.

Figure 2 presents the data found in the ceramic tests for bulk density (Dap) in g/cm3, loss on ignition (L.O.I.%), linear shrinkage (LS%) and water absorption (WA%), for body M1 with waste E1.

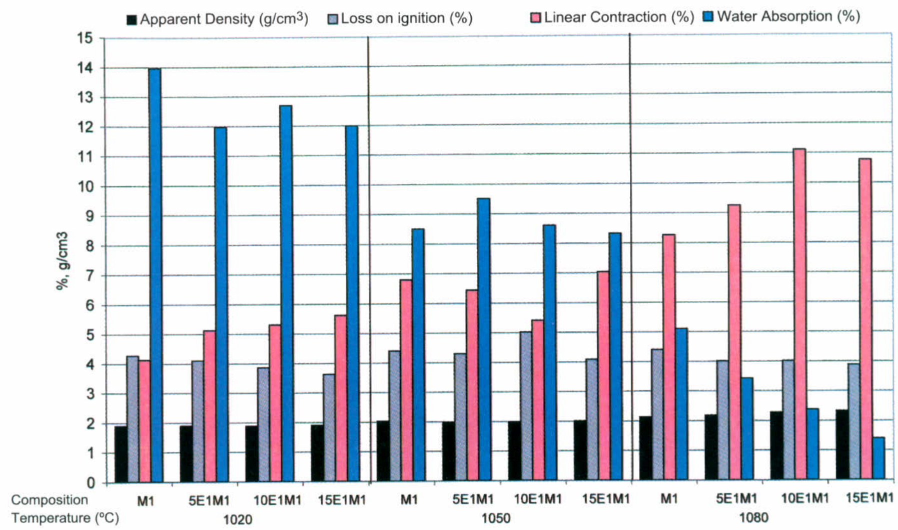

Figure 2. *Ceramic test data for studied body M1 containing additions of waste E1. With 5% E1: 5E1M1; with 10% E1: 10E1M1; with 15% E1: 15E1M1.*

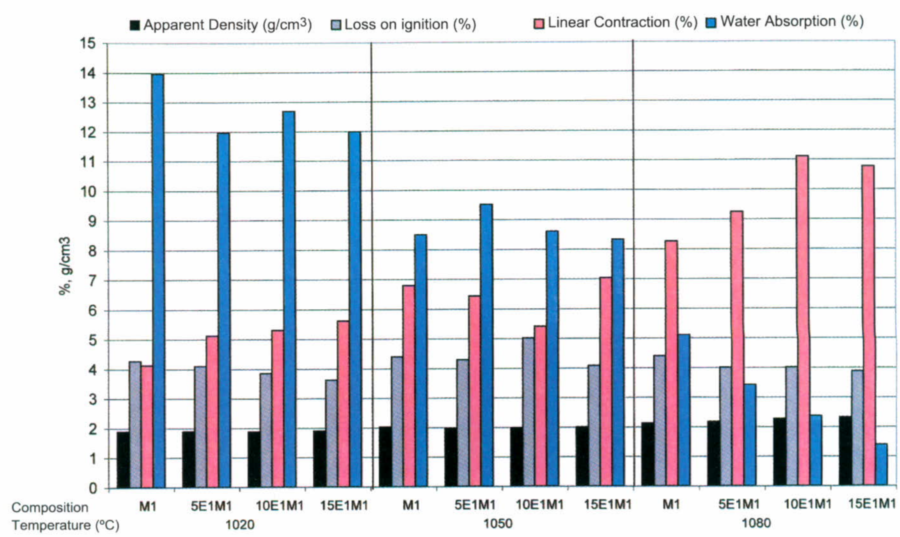

Figure 3. *Ceramic test data for studied body M1 containing additions of waste E2. With 5% E2: 5E2M1; with 10% E1: 10E2M1; with 15% E1: 15E2M1.*

Figure 3 presents the data found in the ceramic tests for bulk density (Dap) in g/cm^3, loss on ignition (L.O.I.%), linear shrinkage (LS%) and water absorption (WA%), for body M1 with waste E2.

It was found that adding glazing waste to body M1 raised linear shrinkage and lowered water absorption, indicating that the waste is a flux.

According to the findings, the wastes exhibited a melting point between 1050 and 1080°C.

Their use as a flux in ceramic bodies in the Santa Gertrudes region is therefore feasible, as these are the firing temperatures normally used by most companies in this area.

The next phase is a study of the proportioning and homogenisation of the different wastes to enable them to be used without producing significant changes in body characteristics

The last phase will be a study together with ceramic producers to adjust the production process to the new ceramic body properties, mainly with regard to temperature and firing cycle. It might be possible to reduce these last two variables, as well as improving product quality (obtaining products with lower water absorption, such as red stoneware).