REDUCING THE YIELD STRESS OF GRANULES PREPARED BY THE DRY ROUTE FOR THE FABRICATION OF PORCELAIN TILES

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INTRODUCTION

Granules produced by spray drying are traditionally used in the fabrication of ceramic tiles1. The growing concern with energy and environmental issues in recent years has encouraged the search for alternative granulation processes that would require less energy and would be more environmentally friendly. In this context, studies evaluating alternative dry granulation processes were conducted and papers published2-4 in the last few years.

The main limitation of the dry granulation process is the relatively high yield strength of the granules that, at usual pressing pressures, results in higher water absorption and lower mechanical strength before and after firing, as compared to compacts produced with spray-dried powders.

In view of the scenario presented above, the objective of this study was to look for adjustments of the dry granulation process that would reduce the yield stress of the granules.

1. EXPERIMENTAL PROCEDURE

Two granulated powders with the same chemical and mineralogical compositions, typical of glazed porcelain tiles, were used. One of them was an industrial spray-dried powder and the other a dry-granulated powder. The size distribution, shape, flowability and mechanical behaviour during compaction were evaluated. After that, the effects of the size, moisture content and presence of additives in the granules prepared by dry granulation were studied in order to determine the effects of these variables on the yield stress.

2. RESULTS

The results showed that the granules prepared by the dry route in standard conditions presented a size distribution, shape and flowability similar to those of the spray-dried granules. However, as Figure 1 shows, during compaction granules prepared by dry granulation presented higher yield stress than those obtained by spray drying. The yield stress values presented in Table I express the hardness of the granules.

The effects of the size, moisture content and presence of additives in the granules prepared by the dry route on the yield stress are presented in Table I. The results indicate that the increase in the moisture content and the presence of small amounts of lubricants (stearic acid) contribute to reducing the yield stress of the dry granulated powders.

The higher deformability of the dry granulated powders leads to interesting increases of mechanical strength before and after firing. Figure 2 presents the effect of increasing the moisture content of the granules.

Similar results were achieved by the addition of small amounts of lubricant (stearic acid) in the dry granulated powder. The porcelain tiles obtained with these granules, using industrial pressing conditions, presented porosity and other technological properties, similar to those obtained with spray-dried powders.

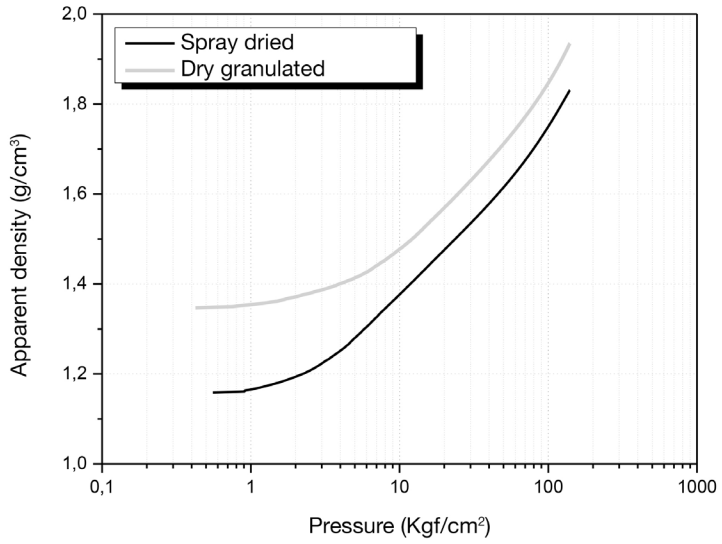

Figure 1. Compaction behaviour of spray-dried and dry-granulated powders.

Route	Granule Size	Moisture (%)	Yield stress (kgf/cm²)
Spray dried	Standard	6.0	2.2
Dry granulated	Standard	5.0	4.8
	Standard	7.5	4.0
	Standard	10.0	3.0
	> 0.71 mm	7.5	3.8
	0.25-0.71 mm	7.5	4.1
	< 0.25 mm	7.5	4.3

Table 1. Yield stress of granules prepared in different conditions.

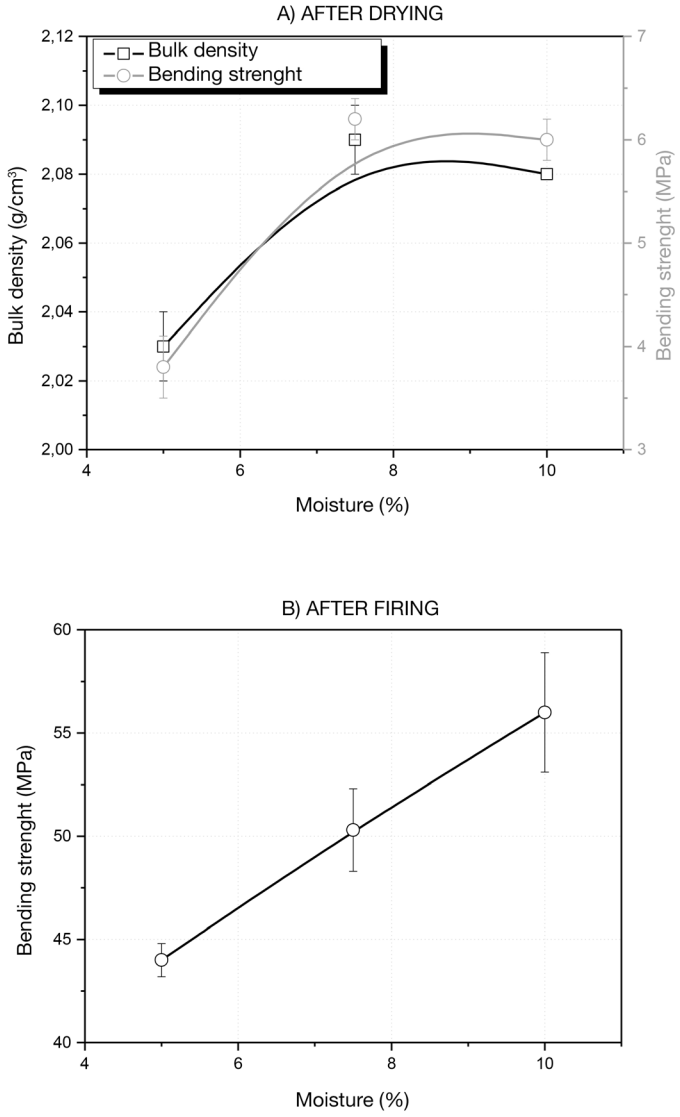

Figure 2. Effects of the moisture content in the dry granulated powder on the mechanical behaviour of the bodies.

CONCLUSIONS

- For the same compositions, the yield stress of dry granulated powders is higher than of spray-dried powders, tested in the same conditions;
- The increase of the moisture content and the presence of a small amount of additives contribute to reducing the yield stress of the dry granulated granules. The size of the granules does not affect the compaction behaviour in a significant way;
- Reducing the yield stress is a good alternative to increase the mechanical strength and decrease the water absorption of porcelain tiles produced by the dry route;
- These results bring original contributions to the feasibility of producing porcelain tiles by the dry route.

REFERENCES

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