Article
“Porcelain stoneware panels: the behaviour of powders”

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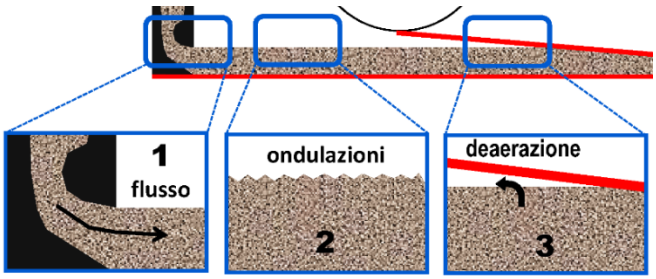


Figure 1. The most critical points in terms of spray-dried powder behaviour prior to pressing. 1) Powder flow through the hopper orifice; 2) formation of undulations on the top of the bed of powder; 3) de-aeration of the soft layer.

Table 1. Effect of the intrinsic characteristics of spray-dried powders on their behaviour during deposition

Process phase [REFERENCE PARAMETER]	Finer particle size	Less fine particle size	Irregularly shaped aggregates (>10% vol.)	Moisture content
Powder flow from the hopper [MASS FLOW]	**higher flow rate** [>14.5 g·cm^{-2}·s^{-1}]	**lower flow rate** [<14.5 g·cm^{-2}·s^{-1}]	**lower flow rate** [<14.5 g·cm^{-2}·s^{-1}]	irrelevant
Powder deposition [ANGLE OF REST]	not critical	**arrangement with larger angle** [>30°]	**arrangement with larger angle** [>30°]	
Apparent density of soft powder [POURED DENSITY]	not critical	**less dense soft powder** [<0.97 g·cm^{-3}]	**less dense soft powder** [<0.97 g·cm^{-3}]	
De-aeration of soft powder [HAUSNER RATIO]	not critical	**less mobilisable soft powder** [>1.12]	**less mobilisable soft powder** [>1.12]	

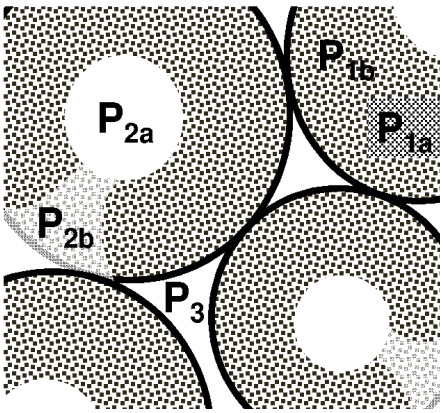


Figure 2. Porosity of the soft powder. Intragranular microporosity: P_{1a}, “incompressible” fraction and P_{1b}, “compressible” fraction. Intragranular macroporosity: P_{2a}, “central cavity” and P_{2b}, “funnel”. Intergranular macroporosity: P_3, empty spaces between the granules.

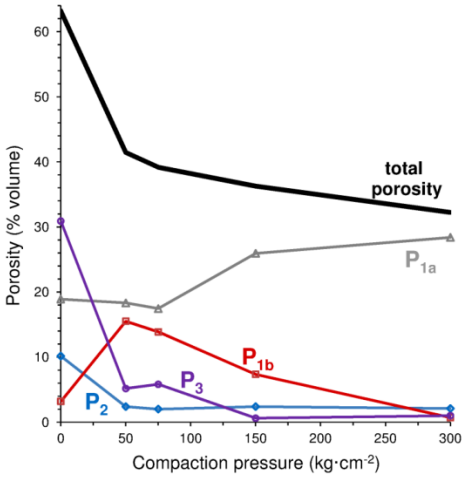


Figure 3. Variations in the various types of porosity as the specific pressure increases.

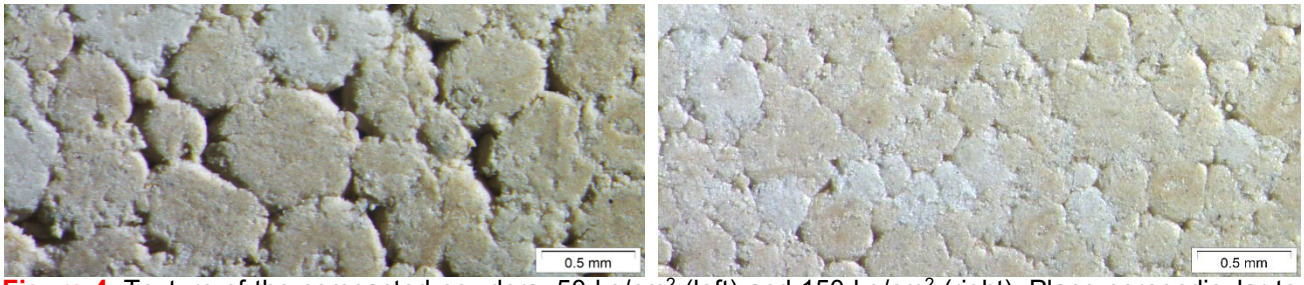
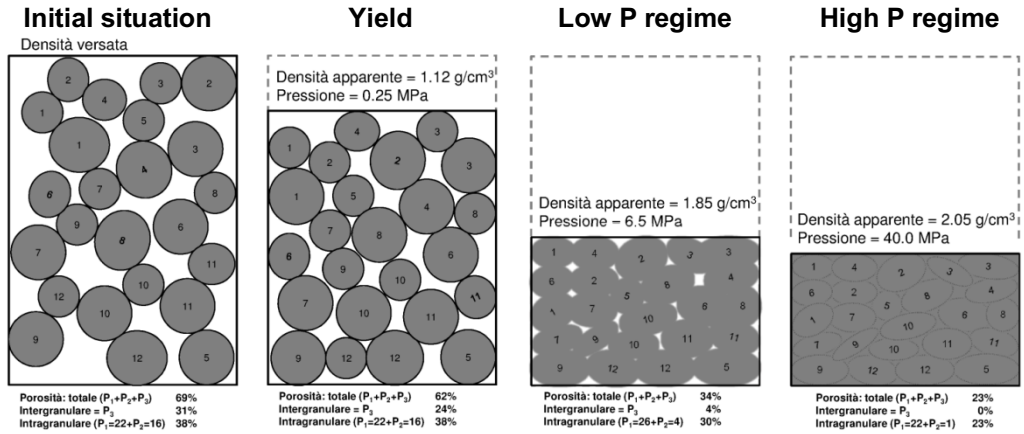


Figure 4. Texture of the compacted powders, 50 kg/cm^2 (left) and 150 kg/cm^2 (right). Plane perpendicular to the load application direction.



Flowability of powders
Friction between granules

Mechanical yield of granule
Flowability of powders

Closure of P_3
Collapse of P_{2a}
Partial collapse of P_{2b}
Increase in P_{1b}
Compression of granules

Closure of P_{1b}
Increase in P_{1a}
Partial residue of P_{2b}
Creation of triple point junctions

Figure 5. Diagram showing the compaction of spray-dried powders in the four key stages of the process and the main phenomena that occur in each stage.