# **Supplementary material for:**

**Processing of mullite-glass ceramics using simplex-centroid design: Densification process dominated by liquid-phase sintering**

**Procesamiento de materiales cerámicos de mullita-vidrio a través del diseño de mezclas simplex con centroide: Proceso de densificación dominado por la sinterización en fase líquida**

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**Table S1.** Factors levels used in the mixture design.

|  |  |  |
| --- | --- | --- |
| Raw materials | Low level (wt.%) | High level (wt.%) |
| Kaolinitic clay | 50.00 | 100.00 |
| Kaolin waste | 0.00 | 50.00 |
| Alumina | 0.00 | 50.00 |

**Table S2.** Chemical composition of starting materials.

|  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Raw materials | Oxides content (wt. %) | | | | | | | | | LoI (wt. %) |
| SiO2 | Al2O3 | K2O | CaO | MgO | Na2O | Fe2O3 | SO3 | Others |
| Kaolinitic clay | 46.64 | 33.21 | 0.55 | - | 0.06 | - | 0.41 | - | 0.13 | 19.0 |
| Kaolin waste | 51.96 | 35.67 | 4.82 | - | 1.61 | - | 0.23 | 0.11 | 0.10 | 5.5 |
| Alumina | 0.59 | 94.65 | 0.03 | 0.16 | 0.27 | 3.77 | 0.02 | 0.34 | 0.17 | - |

**Table S3.** Matrix of the augmented simplex-centroid design and values of linear firing shrinkage (∆L), water absorption (WA), apparent porosity (AP), and apparent density (AD).

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| Replicate | Design point | Observed responses | | | |
| ∆L (%) | WA (%) | AP (%) | AD (g/cm3) |
| 1 | 1 | 14.85 | 14.05 | 29.89 | 2.65 |
| 2 | 10.92 | 3.48 | 8.39 | 2.92 |
| 3 | 8.71 | 0.37 | 0.88 | 2.75 |
| 4 | 14.34 | 6.69 | 15.40 | 2.81 |
| 5 | 13.79 | 1.17 | 2.71 | 2.76 |
| 6 | 12.56 | 0.65 | 1.67 | 3.00 |
| 7 | 15.12 | 1.15 | 2.81 | 2.93 |
| 8 | 13.94 | 7.31 | 16.41 | 2.71 |
| 9 | 15.51 | 0.67 | 1.75 | 3.12 |
| 10 | 13.58 | 0.93 | 2.37 | 3.00 |
| 2 | 1 | 15.30 | 14.54 | 30.66 | 2.69 |
| 2 | 10.88 | 3.52 | 8.47 | 2.91 |
| 3 | 9.10 | 0.46 | 1.10 | 2.77 |
| 4 | 14.98 | 5.69 | 13.39 | 2.88 |
| 5 | 13.80 | 1.52 | 3.51 | 2.75 |
| 6 | 12.56 | 0.94 | 2.39 | 2.98 |
| 7 | 15.61 | 0.96 | 2.35 | 2.92 |
| 8 | 13.85 | 6.94 | 15.62 | 2.71 |
| 9 | 15.42 | 0.86 | 2.23 | 3.12 |
| 10 | 13.40 | 0.84 | 2.15 | 3.01 |
| 3 | 1 | 15.49 | 14.60 | 30.80 | 2.62 |
| 2 | 11.10 | 3.55 | 8.56 | 2.91 |
| 3 | 9.49 | 0.36 | 0.87 | 2.80 |
| 4 | 14.62 | 6.93 | 15.84 | 2.80 |
| 5 | 14.08 | 1.97 | 4.56 | 2.74 |
| 6 | 12.23 | 0.97 | 2.46 | 2.99 |
| 7 | 15.36 | 1.15 | 2.80 | 2.92 |
| 8 | 13.67 | 7.59 | 16.92 | 2.69 |
| 9 | 14.83 | 0.76 | 1.97 | 3.11 |
| 10 | 13.76 | 0.84 | 2.15 | 3.01 |
| 4 | 1 | 16.28 | 10.76 | 24.48 | 2.63 |
| 2 | 10.93 | 3.49 | 8.43 | 2.92 |
| 3 | 9.87 | 0.37 | 0.89 | 2.80 |
| 4 | 14.62 | 6.73 | 15.44 | 2.83 |
| 5 | 14.32 | 1.15 | 2.66 | 2.74 |
| 6 | 12.28 | 1.02 | 2.58 | 2.98 |
| 7 | 15.52 | 0.87 | 2.13 | 2.95 |
| 8 | 13.50 | 7.23 | 16.19 | 2.69 |
| 9 | 15.36 | 0.77 | 2.00 | 3.10 |
| 10 | 12.85 | 1.09 | 4.03 | 3.09 |



**Fig. S1.** XRD patterns of F2 (100 wt.% clay), F3 (50 wt.% clay and 50 wt.% waste) and F6 (75 wt.% clay and 25 wt.% waste) published in [1] for comparison.

**References**

[1] H.P.A. Alves, J.B. Silva, L.F.A. Campos, S.M. Torres, R.P.S. Dutra, D.A. Macedo, Preparation of mullite based ceramics from clay–kaolin waste mixtures, Ceram. Int. 42 (2016) 19086–19090. doi:10.1016/j.ceramint.2016.09.068.