Obtaining bactericide and viricide surfaces

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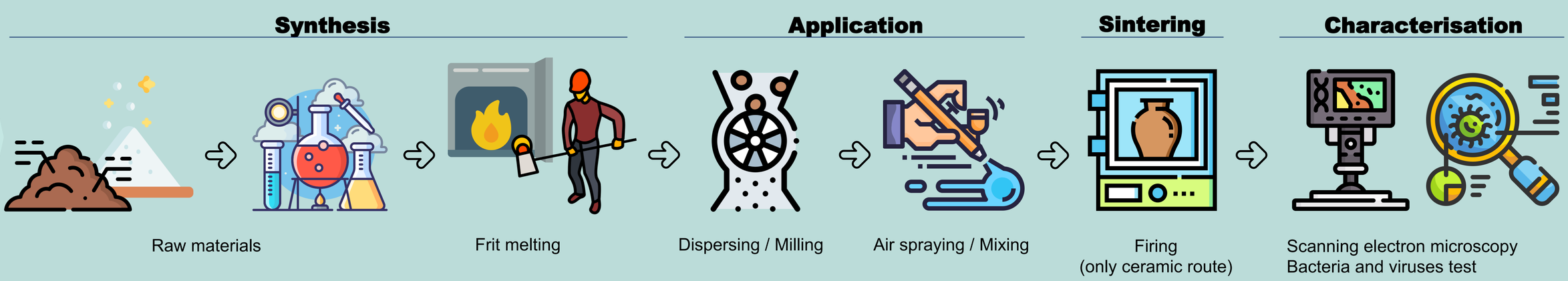
Since the COVID'19 pandemic, there has been a great interest in surfaces cleaning, especially in enclosed areas where many people gather, such as workplaces, shopping centres, restaurants, etc., because virus can be spread if someone touches an infected surface or object. Moreover, without cleaning and disinfection, the COVID'19 virus can remain on surface object from hours to days.

The main objective of this work was to obtain new antiseptic substances against bacteria and viruses, which are incorporated in different materials, such as ceramic tiles and coatings (varnishes or paints). For this purpose, some silicate glasses have been developed based on the system SiO_2-Al_2O_3-B_2O_3-RO_2-RO (R_2O corresponds to the combination of Na_2O, K_2O and Ag_2O, while RO corresponds to CaO, MgO, BaO and ZnO), which incorporate Ag_2O to partially replace Na_2O.

Experimental



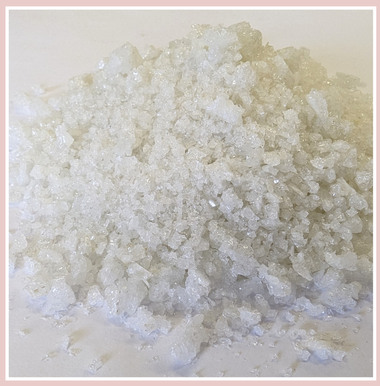
Ceramic route

Synthesis: F1 glass (frit) was obtained in a melting kiln at a maximum temperature of 1500°C for 20 minutes, followed by quenching in cold water.

Sintering: The glaze C1 was fired in laboratory (left) and industrial kilns (right), in order to compare the reproducibility and scalability of the process.

Application: The preparation of the C1 glaze was carried out by traditional ceramic milling. Glaze C1 was applied by air spraying on the surface of wall tiles at a density of 1.4 g/cm^3 until a weight of 160 g/m^2 was reached.

F1 Glass



Laboratory firing

Industrial firing

Composition	
(wt%)	**F1**
SiO_2	51.3
Al_2O_3	13.7
R_2O*	5.0
RO	30.0

** ≈ 5 wt% Ag_2O*

Glaze C1	
Oxides	(wt%)
F1	85.0
RO_2-R_2O_3	10.0
RO	5.0

Bacterial and viruses test	
Industrially fired glaze C1	
E. Coli	99.99
S. Aureus	99.81
TGEV*	99.30

**Transmissible gastroenteritis virus*

Bacterial and viruses test	
Industrially fired glaze C1	
E. Coli	99.99
S. Aureus	95.44
TGEV*	—

**Transmissible gastroenteritis virus*

Organic coating route

Synthesis: Frits (F2 and F3 glasses) were obtained in a melting kiln at a maximum temperature of 1450°C, followed by quenching in cold water.

Application: Frits were finely milled to increase the surface area of the particles. The preparation of the coating C2 was carried out by mixing of components and then applying them as a homogeneus layer onto a wood surface. The coating C3 was prepared by air spraying onto a 100% melamine paint layer over a wood surface.

Sintering: The coatings were left to air dry for a few hours.

F2 Glass

Coating C2

Coating C3

Composition		
(wt%)	**F2**	**F3**
SiO_2	59.2	46.7
R_2O_3	9.6	30.3
R_2O*	4.4	7.1
RO	27.2	15.9

** ≈ 4 wt% Ag_2O*

Coating		
(wt%)	**C2**	**C3**
F2	7	0
F3	0	10
Acrylic paint	93	0
Melamine paint	0	90

Bacterial and viruses test	
Coating C2	
E. Coli	99.95
S. Aureus	99.94
TGEV*	83.90

**Transmissible gastroenteritis virus*

Bacterial and viruses test	
Coating C3	
E. Coli	99.99
S. Aureus	99.95
TGEV*	96.70

**Transmissible gastroenteritis virus*

Conclusions

- New antiseptic substances based on silver-doped glasses were successfully developed.
- The incorporation of the silver-doped glasses was carried out in a glaze (ceramic route) and a varnish (organic coating route). In all conditions, silver was detected when EDX anális were carried out on the surface of the coatings. Moreover, coating C3 had a higher biocidal and viricidal capacity than coating C2.
- The bactericidal and virucidal effect was effectively developed in all samples. Futhermore, reproducibility at laboratory and industrial scale was quite acceptable.

Information

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