

# **Eco-sustainability and technological innovation in the Venetian mosaic tradition: standardization and reformulation of recipes for glass mosaics**

*(Proposer: Prof. Alberta Silvestri)*

The Venetian sector of artistic glass and glass mosaic tesserae represents a prominent technological and cultural heritage where the technical control of mineral raw materials and thermal processes has evolved for centuries. Within the framework of Applied Mineralogy and Materials Geoscience, these "anthropogenic geomaterials" offer a unique opportunity to study the complex interactions between batch components, melting kinetics, and the resulting microstructural and optical properties. In this context, *Orsoni Venezia 1888* stands as a world-renowned excellence in the Venetian mosaic tradition. As one of the historic furnaces in Venice still producing thousands of chromatic varieties and precious gold-leaf tesserae using centuries-old techniques, it represents a unique living archive of glass-making knowledge.

Despite the historical significance of the *Orsoni Venezia 1888* heritage, there is a pressing need for systematic research that integrates traditional craftsmanship with modern scientific rigour, new raw materials, and current regulatory frameworks. The project proposes an exploration of the transition from traditional raw materials and formulations toward more sustainable alternatives, acknowledging the technical complexity of maintaining aesthetic and mechanical excellence.

This research aims to improve historical melting recipes towards modern industrial and regulatory requirements. Key objectives include:

- **Experimental Reformulation, Standardisation & Feasibility Study:** Exploring the potential transition from traditional components to sustainable mineral substitutes. This phase begins with a comprehensive characterisation of current products based on historical recipes, which is essential to experimentally verify the state of the art and establish a solid baseline for developing new formulations. The study also involves a preliminary rigorous analysis of Italian and European regulations (such as UNI, EN, and REACH) to adapt production to modern standards, while evaluating the scientific and technical feasibility of new recipes. A key focus will be the research and testing of intermediates already available on the market, such as glass cullet and/or pigments from the ceramic sector. The project may also experiment with these materials to adapt them to mosaic glass production. A core objective is to investigate the possibility of achieving high colour stability and reproducibility, which are currently challenging to guarantee traditional artisanal recipes. The research aims to ensure that new formulations preserve the brilliance and colour intensity of the traditional glass, while meeting specific mechanical requirements, such as brittle fracture behaviour, to maintain the traditional "ease of cutting" for master mosaicists.
- **Experimental Melting & Laboratory Scale-Up:** Implementing a workflow based on experimental melts and the establishment of a dedicated experimental laboratory to test the new formulations. This phase focuses on testing new materials and intermediates, standardisation of the melting process and the gradual transfer of know-how from laboratory-scale trials to industrial production, testing the consistency of results during the scaling-up process.
- **Energy and Economic Efficiency Research:** Exploring potential strategies that might lead to a reduction in production and energy costs. The research will evaluate the possibility of optimising thermal treatments and melting cycles, also considering the use of intermediates. The aim is to assess the feasibility of achieving economic savings in compliance with environmental regulations to ensure lower pollution levels, as a potential secondary benefit of technical process enhancement while maintaining the uncompromising high quality, brilliance, and durability of the glass mosaic tesserae.

The project will be developed in close synergy with *Orsoni Venezia 1888*, providing access to historical archives and industrial furnace facilities. Scientific support will involve the staff and the analytical facilities of the Department of Geosciences (University of Padua) for the diagnostic characterisation of traditional glass samples and new formulations, and potentially the *Stazione Sperimentale del Vetro* (Murano) and other national and international facilities for advanced rheological testing, mechanical analysis, and any other specialised investigations that may prove necessary during the research.

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