

Medieval and renaissance glass technology in Valdelsa (Florence). Part 3: vitreous finds and crucibles

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Abstract

Optical, SEM-EDS and TEM microscopy, Mössbauer and UV–Vis spectroscopy, SIMS spectrometry and ICP spectroscopy, were carried out on sixty vitreous finds, with particular attention to the trace elements, in order to correlate them to the raw materials, the working instruments and the technology employed. The colours of these vitreous finds have been studied in detail to establish the presence and kind of chromophores, the redox conditions used for obtaining of the vitreous mass during the fusion process, the role of the oxidation state and chemical environment of the different metal ions, etc. Eight crucibles and one refractory material were also investigated by XRD diffractometry and TG-DTA thermogravimetry. Their composition, morphology and thermal behaviour gave information on the working temperature inside the kilns. These studies offer a scientific contribution to the archaeological requests to characterise correctly the pre-industrial glass manufactures in Valdelsa. The obtained results allow us to gain a more exhaustive knowledge of the production technology at Germagnana (14th century) and Gambassi (16th century) and of the provenance of the employed raw materials and to register differences and analogies in their production process.

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1. Introduction and research aim

Recently an interdisciplinary project was undertaken in order to clarify archaeological questions about the pre-industrial glass technology in Italy [1,2]. The main purpose of this research is to reconstruct the history of pre-industrial glass making in its social and economical context, with particular regard to its technological evolution. Only an interdisciplinary approach, correctly balanced among archaeological, historical and scientific methodologies, can clarify these problematics.

Archaeological research on glass production sites identifies the so-called production indicators: crucibles, bricks, refractory materials, stones with glass dropping, glass scraps,

skims, moiles, cuttings, trails, etc. Scientific analyses on this kind of indicators supply information, not otherwise available, on the nature of the employed raw materials and their provenance, the fuel used, the environmental impact of the production and the possible relationships between resources of the territory and the development of glass manufactures. They also give useful information on technological aspects: the different steps of the production cycle, the raw materials used and their transformation into glass mass and finished objects, the different kilns employed, the working temperatures and the redox conditions inside these kilns.

Moreover a scientific approach is essential not only for an exhaustive and correct description of the conservation state of the archaeological finds, the decay mechanisms of the constituent materials and appropriate proposals for their safeguard, but also for their classification based on micrometric, nanometric or molecular properties and not only on macro-

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scopic ones, in order to insert them in the socio-economical context they were generated from.

In the previous papers [1,2] it was verified that the glass production in two sites of Valdelsa-Florence, Germagnana and Gambassi, although with some differences in the glass composition due to the employed raw materials, is comparable with that of coeval Italian and European sites, showing shared commercial routes for supplying fluxes. Indeed, archaeological and scientific researches, carried out on a relevant number of finds of several Italian and European sites in the last decades, prove that the medieval glass produced in Italy is mainly a sodic-lime silica glass (with a prevalence of the sodic component), while that produced in the northern Europe is potasso-calcic or potasso-sodic glass. However, in some production sites abroad, the influence of Italian technology is clearly detectable. For instance, the glass produced at Antwerp (Belgium) may be defined of a Venetian tradition more than of a German one [3].

Our attention was focused on the “production indicators” and in this paper we studied the physico-chemical properties of samples of glasses, crucibles and refractory materials in order to verify and further support the proposal archaeological classification of manufactures and glass wastes produced and used in these two factories, and to characterise their production cycles. In particular, thanks to a correct mixing of archaeological and scientific investigations, we were able to reconstruct almost completely the production technology of the pre-industrial manufactures at Gambassi and Germagnana in Valdelsa and the provenance of raw materials for the production of finished glasses, describing all the production steps and their evolution spanning three centuries [2].

2. The archaeological finds: macroscopical classification

The samples used for the scientific investigation was chosen and classified macroscopically by the archaeologists among the finds excavated in the two pre-industrial glass factories of Germagnana and Gambassi.

2.1. The vitreous finds

2.1.1. Working waste

Different kinds of working waste, belonging to the glass melting and refining phases of the production cycle (i.e. small glass masses, cuttings, drops, moiles, etc.), were considered. They were found in both factories in the working areas around the kilns (Figs. 1 and 2).

2.1.2. Finished glass objects

In the 14th century factory of Germagnana, green or colourless blown beakers, bottles and flasks were produced. Glass fragments were found in the working area in front of the kiln in a store (room A), but others came from the collapsed buildings containing the glass kiln or from the filled up water pits.

In the 16th century factory in Gambassi, variously coloured glass was produced: green bottles, beakers, flasks and lamps;

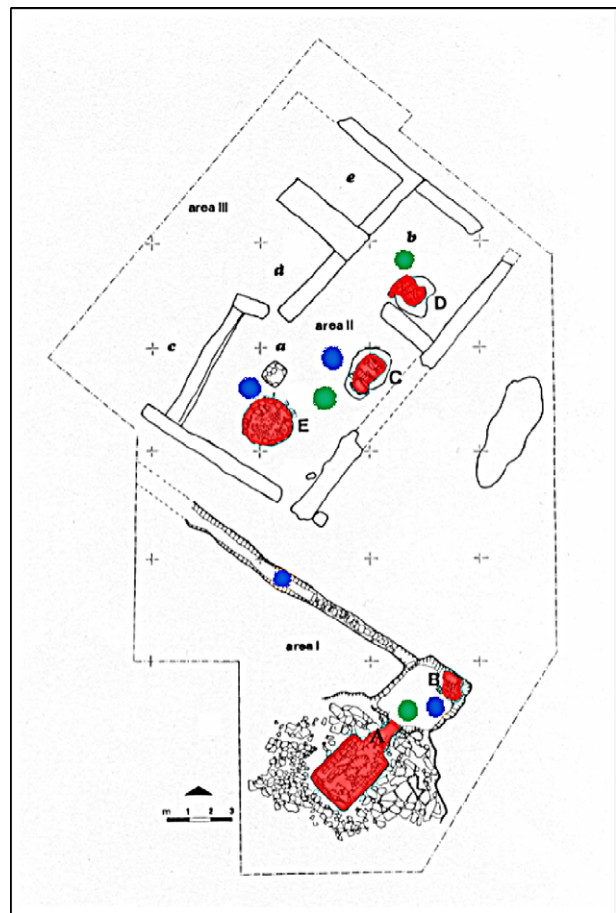


Fig. 1. Germagnana, plan of the excavated area (until 1990) with the position of the analysed samples. **Green** dots: glass wastes; **blue** dots: fragments of finished glass objects. In **red** the kilns.

colourless and smoked beakers, bottles and goblets; yellow beakers; yellow-amber bottles and blue cups. Furthermore, some fragments of red glasses were found.

2.2. Crucibles

Crucibles are truncated cone-shaped pots where frit was transformed into a homogeneous glass mass, suitable for shaping with appropriate tools (blowing pipe, pontello) into objects. Historical sources testify that crucibles were made by specialised craftsmen who used an “impasto” of refractory clay mixed with powder of broken crucibles (cleaned from the adherent glass). The crucibles were obtained by the “colombine” technique, finished by a wheel and dried for several months. Finally, they were baked into the frit furnace until red-hot [4].

In the Germagnana factory, a big quantity of crucibles was found; they have a truncated form with an inside bowed lip. Their upper diameter is between 25 and 30 cm [5]. In the Gambassi site, a smaller amount of crucibles, spread all over the excavated area, was found because they were dropped outside the town walls. These are also truncated but with a plain lip.

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