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Journal of Cultural Heritage
Journal of Cultural Heritage 9 (2008) e27–e32

Original article

Technological study of enamelling on Roman glass: The nature of opacifying, decolourizing and fining agents used with the glass beakers from Lübsow (Lubieszewo, Poland)

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Received 30 March 2008; accepted 23 June 2008

Abstract

This paper reviews questions around the production of decorated Roman glass vessels with a focus on the enamelling techniques used. A detailed study of beaker fragments from the site of Lubieszewo (type locality for the so-called Lübsow-tombs in Poland) yielded a range of interesting information about glass quality and especially the use of opacifying pigments. It was found by Micro-Raman studies that yellow and white colours were the usual antimony bearing compounds, but red was produced with hematite pigments. Surprisingly, powdered lapis lazuli is responsible for the opaque blue colour. Investigation of the glass medium used for binding the enamel pigments by Micro-X-ray Fluorescence provided indications that beside the yellow lead antimonate, none of the enamel layers contained high lead contents. So the principle of enamelling upon Roman glass seems to be similar to the firing process of short duration observed on Islamic and Venetian enamelled glasses. Analytical results demonstrate that the vessel glass is effectively refined and decolourized by means of antimony. The observations made all testify to the high quality of raw materials used, to the skill of the glass maker(s) and the high rank of the grave owner.

Keywords: Enamelled glass; Roman; Opacifiers; Lapis lazuli; Lazurite; Ultramarine disease; Micro-XRF; Micro-Raman; Antimony; Refining

1. Introduction

1.1. Research aims

Enamelled glasses form a rare but fascinating group of exquisite Roman glassware. From the middle of the first century AD onwards, glass bowls decorated with vegetable motifs, animals and also gladiator combat scenes became very popular. Unfortunately, only few examples have survived. Whereas Islamic and Venetian enamelled glasses have been submitted to a range of technical studies [1,2], there are no detailed technological and chemical investigations on the material dating to the Roman period. We do not know about the nature of opacifiers the Romans used for decorating glass vessels, about the glass medium those pigments are bound into or constituents used for refining and decolourizing the glass batch. Are the enamels comparable to those used for metal substrates? Does the enamelling technique differ from the Islamic and Venetian traditions, which obviously share the application of high fusion temperature enamels? The present work reports on fragments belonging to a Roman enamelled glass vessel that have been investigated by Micro-Raman spectroscopy and Micro-X-ray fluorescence.

The origin of enamelling on glass is not quite clear and many regions have been suggested as birthplace of this technique. According to Axel von Saldern [3] the precursors of Roman polychrome decoration must be sought in Hellenistic glassware.

Two European regions excel by a large number of enamelled glass vessels: The Locarno-group dating to the 1st century AD

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doi:10.1016/j.culher.2008.06.006

with most of the vessels coming from Switzerland and Italy [4] and a second group found in Danish tombs of the 3rd century. A third group is defined not so much by a geographic distribution pattern, but the form of the vessel: The Begram-group, which is also represented by the glass vessels from Lübsow, is characterized by high beakers (Isings vessel type 21 [5], Eggers vessel type 185–186 [6]) decorated with gladiators and mythological scenes. Enamelled Roman glasses are usually free-blown [3].

1.2. Samples

Among Roman enamelled glass, the vessels known as the Lübsow beakers dating from the first half of the 2nd century have become famous, not only because of their stylistic proximity to the finds from Begram (Afghanistan), but also for the archaeological importance of the tomb. Lübsow has become the type locality for a group of Barbarian tombs with a huge proportion of high quality Roman imports among the grave goods [7]. Lübsow (Lubieszewo) is situated not far from the Polish coast of the Baltic sea in the district of Gryfice. Originating from one of the most prominent tombs situated on the north-eastern borders of the Roman Empire, they accompany other grave goods representing the high social status of the owner. After their detection in 1925 the beakers had been restored around 1939 in Trier (Fig. 1) and were housed in the Museum of Szczecin afterwards. During World War II the beakers were lost during rescue transports. Fortunately, four surviving fragments have recently been detected by one of the authors (J.S.) in the collections of Szczecin museum and were sent to Germany for technical studies. The work reported in the present paper was initiated by a new excavation campaign on the site of Lubieszewo under supervision of the University of Bonn, funded by the German Science Foundation DFG during which finds from the old collections as well as freshly excavated objects are investigated. In the course of the current field campaign one little enamelled glass fragment has recently been detected on the site and will be analyzed in the near future. The following results are attained from those fragments found in the museum collection.

Three of the four transparent fragments bear enamel decorations. The colourless vessel glass is very thin (around 1–2 mm) showing few bubbles and no visible tinge. The enamel colours range from dark red to a lighter red, yellow, white and blue (Fig. 2).

The four fragments have been submitted to the archaeometry lab at the Roemisch-Germanisches Zentralmuseum Mainz for analysis of the vessel glass composition, the identification of the opacifying pigments as well as traces of the manufacturing procedure.

2. Experimental

2.1. Methodological

Scientific studies of enamelled Roman glasses are scarce. Nothing precise is known about the type of mineral pigments used as opacifiers, the glass base used as a binder for the pigments or the type of vessel glass involved in the production of the enamels. So both phase identification and chemical methods have been applied for analyzing the Lübsow fragments.

This investigation by Micro-XRF, Micro-Raman, ICP-MS and optical microscopy adds substantial information to the still limited knowledge concerning Roman enamelled glass vessels and their production technology. Beyond that, a chemical study of main and trace elements of the vessel was carried out. This paper will focus on technical details of the production process that reflect the quality and value of the glass vessel such as the use of precious pigments, the skilled application of high fusion enamels on this thinly blown beaker, as well as the successful management of refining and decolourizing processes. Thus, ICP-MS results with all trace element data and the complete set of bulk glass analysis are omitted here as well as the results obtained from optical inspection of the

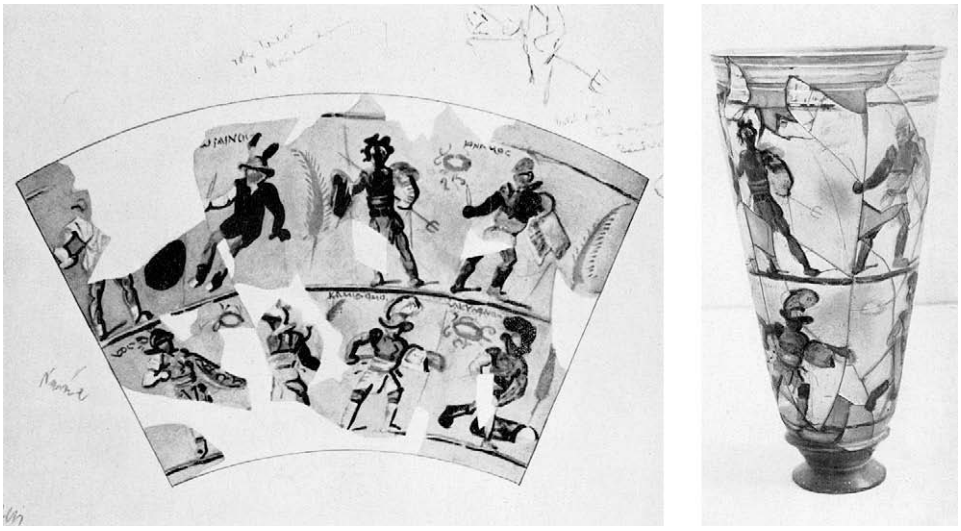

Fig. 1. A watercolour and a black and white print of the restored beaker before its destruction during World War II (taken from Ref. [7], height of the beaker: 16.5 cm).