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Ancient Monuments Lab Report No 4182

Analyses of Medieval enamelled glass found in London

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A quantity of enamelled glass was found during excavations conducted by the DUA in the City of London in 1982. It came from a chalk-lined cess-pit which was dated by the pottery it contained to the first half of the 14th century. Much of the glass has been re-constructed and a preliminary note on the vessels and their decoration has recently been published (Clark 1983).

Analyses of both the base glass and the applied enamels were considered desirable as part of the fuller study of this group of so-called 'Syro-Frankish' glass. Though the analytical facilities available in the AM Lab were not ideal for this type of work it was decided that some preliminary analyses should be done, if only to encourage another institution with more suitable equipment to confirm the results which are presented below. The fragments of glass which were made available for analysis were not the large reconstructed vessels but further pieces from them which did not join. These sherds included part of a base ring without enamel and body and rim sherds with various combinations of red, blue, green, yellow and white enamel. The machine used for the analyses was a Link Systems energy-dispersive x-ray fluorescence spectrometer. It is not set up as a quantitative analyses so the results obtained are qualitative or, at best, semi-quantitative. Its other drawback is that in its present configuration it analyses a relatively large area, about a centimeter across, and so was not always able to fully isolate the individual enamel colours.

The analyses showed that the bulk glass was an alkali silicate. Soda was not detectable under the analytical conditions used but the appearance of the glass

together with the other analytical results suggest it was a soda-lime-silica glass. Lead was just detectable but the amounts present, probably well under one percent, are not significant. The only 'colouring' elements detected were manganese, in some quantity, together with a lesser amount of iron. The relative amounts of these two elements, whether accidentally or deliberately added, and the redox state of the furnace in which the glass was founded were in perfect accord and have produced a clear, truely colourless metal.

The results of the enamel analyses are less clear cut for the reasons given above so what follows should be considered an interpretation rather than a straight presentation of the data. All the enamels (except possibly the red, see below) contained considerable quantities of lead. This is to be expected as lead glasses have lower melting points than alkali glasses and so will fuse to the base glass below the temperature at which it would soften and distort. All the colours are opaque and, unlike eg Roman enamels or Anglo-Saxon glass beads, very homogeneous; no distinct opaque particles were visible even at 30x magnification. The opacifying agent in the blue, green, yellow and white enamels appears to be tin, probably in the form of tin oxide ($Sn\ O_2$) which is white or lead tin oxide ('Pb Sn O_3') which is yellow. If the enamels were sampled and analysed by x-ray diffraction the presence of these crystalline components might be positively identified. It is reasonable to assume however that the tin in the white and blue enamels is in the form of tin oxide while the yellow enamel must be lead tin oxide. The green could contain either or both. It has been shown (Bayley 1982) that tin opacified yellow Saxon glass beads regularly contain far more lead than tin opacified white beads; this pattern may be repeated in these later enamels but the present results lack the necessary precision so no definate conclusions can be drawn. It should perhaps be noted in passing that none of the enamels contained any detectable amounts of antimony which was the other common glass opacifier used in antiquity (Biek and Bayley 1979 and Bayley forthcoming).

In the white and yellow enamels the colour is due purely to the presence of the opacifier. The blue colour is produced by cobalt and the green probably by copper though these two colours appear to contain more iron (relative to manganese) than the white and yellow do, which may also have some effect on the hue.

The red enamel is something of an enigma. The surfaces analysed were rather more weathered than were those of the other colours but this is unlikely to completely explain away the confusing results. The lead level detected was little higher than in the bulk glass and copper, the expected colourant, gave only weak signals. No tin or antimony was detected but this would not be a problem if there was a reasonable amount of copper present as cuprous oxide (Cu_2O) acts as both opacifier and colourant.

In addition to the glass described above a small piece of Islamic glass was also analysed (Ref SWA 81 <563>). It was far thicker walled than the rest of the glass and was gilded and carried blue and ?white enamel. The bulk glass appeared to be of similar composition to that of the other sherds though it was not quite so colourless and it contained no detectable lead. The enamels contained lower levels of lead than those described above; no colourants or opacifiers were positively identified in them.

References

Bayley J. (1982) Qualitative analyses of some Saxon glass beads from Dover, Kent. AM Lab Report No 3635

Bayley J. (forthcoming) Notes on the composition of coloured glass in The Archaeology of Canterbury, Vol III: Excavations in the Cathedral precincts, 1 by S. Campbell, P. Bennett et al

Biek L. and Bayley J. (1979) Glass and other vitreous materials World Arch 11 (1), 1-25

Clark J. (1983) Medieval enamelled glasses from London. Med Arch 27, 152-6