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GLASS LINEN SMOOTHERS FROM 16-22 COPPERGATE, YORK

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Summary

Using non-destructive X-ray fluorescence analysis, five out of 41 linen smoothers were found to be made of high-lead glass. They date from the tenth to thirteenth century AD and could have been made in York. The others were thought to be potash-lime-silica glass. All of the artefacts would have appeared black originally, due to their thickness and their strong green colouration.

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Some of the glass linen smoothers from these sites had been noted to have a fine glossy appearance which contrasted strongly with very corroded appearance of the others. Some of these well-preserved smoothers felt appreciably denser and it was suggested that these might be made of high-lead glasses. However, because of the variety in fragment size it was difficult to judge densities by hand alone and a swift surface X-ray fluorescence (XRF) survey was carried out. Where lead was detected in an artefact, a vacuum was applied and a spectrum recorded over 50 seconds. The results of these analyses are presented in the table, together a sample of the unleaded artefacts analysed in the same fashion for the purposes of comparison.

The results show that five artefacts (sfs 1487, 6360, 13121, 3356 and 6757) have significant amounts of lead present and three others (sfs 12937, 1537 and 5703) have much smaller amounts of lead present. The high-lead artefacts come from contexts belonging to Periods 4B, 5A and 6 (dated from *c.*930/*c.*975 to the 12th/13th century).

The colours of the glossy smoothers have previously been recorded as black but, in each case, when a strong light is shone through a broken edge, it can be seen that the objects are really various shades of green. Glass artefacts are often said to be black when colouration is intense and corrosion products obscure the surface. This is especially the case when artefacts are very thick, so it is likely these smoothers would have been thought of as 'black' when originally produced. The high lead content would certainly have imparted a high gloss, as would the process of fire-polishing.

The high lead contents of these artefacts are likely to have been deliberate additions to the melt. High-lead glassworking evidence dating to the 10th century has been discovered at other sites in York (*eg* Henderson and Warren 1986) as well as at Coppergate itself (Mainman 1990, 471). Green high-lead beads from 34 Shambles were said to be coloured by the presence of copper (at 0.35%-0.98%; Henderson and Warren *op cit*) but the high-lead linen smoothers analysed here did not have detectable amounts of copper present, despite their green colouration. It is difficult to say what are the lowest levels detectable by qualitative XRF, but it seems likely that 0.35% Pb should be detectable in a glass matrix. It is likely that the green colouration in the linen smoothers is due to the presence of iron oxides (iron was detected in all the high-lead glass smoothers), but only fully-quantitative analysis can confirm the absence of significant amounts of copper in the glasses. From the evidence available, the high-lead glass linen smoothers could have been made in York; crucibles with dark green ('black') glass have been found at 34 Shambles (Bayley 1986), 16-22 Coppergate (Mainman 1990, 471) and 22 Piccadilly (*ibid*, 475). Although the colourants used in the Coppergate artefacts discussed here may differ from those in some other glass artefacts thought to have been made in York, this may not be significant as there is only a small amount of comparative data. Using qualitative analysis, it is difficult to determine whether the bulk composition is simply lead oxide and silica (as in the majority of high-lead glass of this period *cf* Henderson and Warren *op cit*; Ullrich 1989) or whether the other elements detected consistantly (potassium, calcium, iron and manganese) are also important components. Quantitative analysis would be necessary to determine this.

It is difficult to estimate the original colours of the poorly-preserved glass linen smoothers because the corrosion is so severe. Most medieval glasses, whether soda- or potash-based, would be at least lightly-tinted with 'natural' colours (*ie* colours which are present because of impurities in the melt, *eg* green, blue or brown). These colours would have been clearly visible in thin-walled artefacts such as windows or vessels, where light could pass through. As linen smoothers are thick artefacts, light would not be able to pass through them, and it is likely that the poorly-preserved linen smoothers would also have appeared 'black' when originally made. The poor preservation state of these artefacts make it most likely that they are made of potash-based glass, as potash glass frequently corrodes more extensively than soda glass.

References

Bayley J 1986 in Tweddle D (ed) 1986; 226-7

Henderson J and Warren S E 1986 'Analysis of the glass and glassy waste' in Tweddle D (ed) 1986; 224-5

Mainman A J 1990 *Anglo-Saxon pottery from Coppergate* Archaeology of York 16/5: The Pottery

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Ullrich R G 1989 'Halbedelsteine und Glasfunde' in von Müller A and von Müller-Muci K (eds) *Ausbgrabungen, Funde un Naturwissenschaftliche untersuchungen auf dem Burgwall in Berlin-Spandau* (Berliner Beiträge zur Vor- und Frühgeschichte, Neue Folge 6); 57-99; 253-56, Tafn. 25-28.

Table: Areas under peaks on XRF spectra

Site	Context	SF	Si	K	Ca (2)	Mn	Fe (2)	Pb
1977.7 IV	5238	1487	21396	5384	2592	1827	5103	204298
1979.7 I	14925	6360	14135	4530	2524	2106	6279	180015
1978.7 V	12577	3356	3867	1484	830	759	2099	159136
1979.7 I	14787	6757	6300	2660	1108	1004	2967	146924
1981.7 II	34663	13121	3713	1371	684	743	2484	116306
1976.7	22789	7990	52191	8340	1832	2454	4400	0
1977.7 I	7500	1537	17114	2433	567	2567	7060	4773
1977.7 V	17890	5703	45443	6798	801	1100	3790	1711
1981.7 IV	29844	12937	49844	5623	338	0	10858	1300
1977.7 IV	5484	2061	29880	2278	593	1529	2415	786
1977.7	9404	2071	41100	3401	609	936	4465	497
1977.7 IV	5395	1890	31721	3525	434	1199	6399	133
1980.7 I	30273	11035	32418	5355	435	462	3564	112
1977.7 III	3235	2078	35991	4040	637	1517	7258	0

Si = silicon (Kα+β peaks)
K = potassium (Kα peak)
Ca(2) = calcium (Kβ peak)
Mn= manganese (Kα peak)
Fe(2) = iron (Kβ peak)
Pb= lead (Lα peak)

Analysis under vacuum, at 35kV, 100mA, with 4mm collimator. Element windows recorded as 'pbglass' windows. Areas under peaks are not directly related to the concentration of an element. Where the Kβ peak alone is recorded, this is because the Kα peak overlaps with another important peak and cannot therefore be used. The values for Kβ peaks are typically 10% of the intensity of Kα peaks. The results are from single analyses, of the uncleaned surfaces of the artefacts.