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ANALYSIS OF GLASS FROM TILBURY FORT, ESSEX

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Summary

Soda glass and high-lime, low-alkali glass compositions from 17th century contexts at Tilbury Fort are similar to those seen in other post-medieval collections in the City of London. A posset cup was shown to be made of soda glass, not leaded glass, as originally thought.

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Analysis of glass from Tilbury Fort, Essex

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Introduction

During consolidation work in 1990, excavation in the west curtain wall area revealed domestic ash midden deposits. Ceramic finds in midden layer 4242 suggests that most of the material comes from the mid- to late-17th century, sealed by the date the fort was rebuilt (1683), although there is likely to be some residual material from the Henrican blockhouse (c.1540).

Fragments from various types of glass vessel were found in the midden, including wine bottles, jars, beakers and cups. The glass fabrics represented are also very varied; the wine bottles are made of thick-walled dark green glass which is now nearly opaque, but the beakers and cups are of pale green/blue, slightly purple or near-colourless glass.

Eleven pieces of glass were selected for analysis (Table 1). Their compositions will be compared with contemporary glass from the City of London.

Analysis

Sixteen oxides and elements were analysed for routinely, in the manner established previously (Mortimer 1991, 2, 21-22). Small samples were detached and mounted in a resin block. The blocks were polished and carbon-coated. Analysis was performed using the AML Cambridge Stereoscan 200 scanning electron microscope and the LINK AN10000 X-ray analyser. Each sample was analysed in three areas and an average value is given in Table 2.

Results

Eight of the samples are soda glass, with compositions similar to those discovered amongst post-medieval soda glasses in London (Mortimer 1991, Table 5). In particular, the soda, magnesia and potash contents are comparable; the average lime content of the Tilbury examples is slightly higher than the average for the London group (10.0% $\pm$1.8 compared with 7.4% $\pm$2.3). The number of samples is too small to allow a comment on whether this compositional difference is significant (eg allowing comments on the source of particular groups of artefacts).

The Tilbury samples comprise four vessel fragments, two pieces from bottles and fragments from a beaker and a cup. Their pale green or blue-ish colour reflects the relative concentrations of ferrous (FeO) and ferric (Fe_2O_3) oxides present in the glass; however, all the iron oxide is routinely calculated as ferric oxide in the analytical programme used.

Two examples (a beaker base SF70 and a knob from a cup SF176) are nearly colourless when examined in section. Although their

chemical compositions are not unusual, the iron oxide levels in these two vessels are at the lower end of the range and the manganese oxide levels at the high end, when compared with the other soda glasses. Causes of colouring in glass are now reasonably well understood, but early glass producers used empirical means to achieve completely transparent colourless glass. In these cases, it appears that the purple colouration that manganese oxide contributes just balances out the green or blue (sometimes perceived as yellow) from the iron oxide. Both pieces have purple- and silver-coloured irridescence (corrosion products).

The soda glass compositions determined are comparable with the glass produced at Mansell's Broad Street, London glasshouse (Mortimer forthcoming) and could have been produced there, or at other contemporary glasshouses.

The small find SF149 is thought to be fragments from a posset cup, in a style similar to one known to have been produced by Ravenscroft, in his revolutionary lead-rich 'flint glass' (eg Vose 1980, plate 29). In this case, however, the glass used was a standard soda glass composition. The light weight, thin walls, mossy green colour and typical soda glass irridescent corrosion are in accordance with this identification; even after burial, glass with a significant proportion of lead oxide in its composition is noticeably heavier than soda glass and is frequently still glossy and almost colourless.

It is clear that SF149 cannot be associated with Ravenscroft's 'flint glass' production, either of the experimental period 1673-1676, when high-purity potash glass was produced (with severe crizzling problems; Vose 1980, 118) or of his successful production subsequently, since it does not contain more than a trace of lead oxide.

The composition of soda glass used for vessel manufacture has been shown to vary over time, with increasing levels of soda and decreasing levels of magnesia and lime amongst the crystal glass of the post-medieval period (Mortimer 1991). Despite this patterning, a glass fragment with a particular composition cannot be assigned to a particular period since there were broad compositional ranges. It may be significant, however, that the lime and magnesia levels are lower in SF149 than in other soda glass from this site.

During preliminary non-destructive surface X-ray fluorescence analysis, some of the corrosion products on SF149 were found to have low levels of lead and copper in them, presumably as a result of being buried close to metal artefacts. These elements were not detected in significant quantities during quantitative analysis of polished sections.

If, on reconstruction of the Tilbury fragments, the typological similarities outlined above are confirmed, this suggests that SF149 is a contemporary soda-glass example of the posset cup form produced by Ravenscroft. During the period 1667-1672, orders from the London Company of Glass Sellers for Venetian *cristallo* mention spouted posset-pots (Charleston 1984, 105). Furthermore, forms which are typologically similar to examples with the raven's head seal (the device that Ravenscroft adopted for his lead glassware) are known to be made in non-lead glass (*op cit*, 126).

Three samples from Tilbury are of the high-lime, low alkali glass type, in this case used for thick-walled, dark green wine bottles and for a paler green window pane. The opacity, caused by the strength of the colouring and the thickness of the walls, would effectively have kept the wine in the dark. A small number of other vessels have been shown previously to have similar compositions (Kenyon 1967, 39; Vose 1980, 203; Mortimer 1991, 13). This glass type became common in the second half of the seventeenth century and the Tilbury fragments of this type of glass are likely to have been the product of British glasshouses.

Conclusions

Soda glass and high-lime, low-alkali glass compositions from 17th century contexts at Tilbury Fort are similar to those seen in other post-medieval collections in the City of London. A posset cup was shown to be made of soda glass, not leaded glass, as originally thought.

Acknowledgements

Peter Moore (Passmore Edwards Museum) excavated the site and provided samples and information.

References

Charleston R 1984 'English glass and the glass used in England, c400-1940' (George Allen and Unwin, London)

Kenyon G H 1967 'The glass industry of the Weald' (Leicester University Press).

Mortimer C 1991 'Analysis of medieval and post-medieval glass from the City of London' AML report no 135/91.

Mortimer C forthcoming 'Analysis of post-medieval glass and glassworking debris from Broad Street, City of London' AML report.

Vose R H 1980 'Glass' (Collins, London)

Table 1: List of samples submitted for analysis

SF	Object	Type of glass
61	Base, bottle?	Pale green/blue, fine
62	Base, bottle	Pale green/blue, fine
63	Neck, bottle	Pale green, fine
70	Base, beaker? with raspberry punts	Pale, slightly purple
149	Frag from posset?	Pale green?, very fine
176	Knop of cup?	Pale slightly purple, fine
177	Frag, window	Very badly weathered
187	Neck, jar	Pale green, fine
399	Neck, bottle	Pale green, fine
470	Base, bottle	Dark green, thick-walled
471	Neck, bottle	Dark green, thick-walled

All samples from context 4242.

Table 2: Glass compositions

Type	SF	Col	Na_2O	MgO	Al_2O_3	SiO_2	P_2O_5	S	Cl	CaO	K_2O	TiO_2	Cr_2O_3	MnO	Fe_2O_3	CuO	SnO_2	PbO	Total
win	177	pale gr	1.1	1.8	2.4	59.7	2.1	0.2	nd	23.9	5.5	nd	nd	nd	1.1	nd	nd	nd	98.1
bot	471	dk gr	1.3	3.2	3.3	54.7	2.9	0.2	nd	20.2	7.3	0.3	nd	0.7	1.8	0.3	0.6	nd	97
bot	470	dk gr	1.1	2.5	2.5	55	3.2	nd	nd	23.5	6.4	0.3	nd	0.3	1.5	nd	nd	nd	96.6
v	187	pale gr	13.3	5.1	1.6	58.7	0.6	nd	0.3	11.3	4	nd	nd	1.1	0.9	nd	0.3	0.3	97.6
v	149	pale gr	13.6	2.1	1.2	65.2	0.4	nd	0.4	7.1	3.9	nd	nd	1.3	0.6	nd	nd	nd	96.3
v	61	pale bl	12.3	4.1	1.4	63.9	1	nd	0.3	11.1	3.9	nd	nd	0.2	1	nd	0.5	nd	99.8
v	62	pale bl/gr	11.2	4.8	1.9	61.3	1	nd	0.3	10.9	3.7	nd	nd	0.2	0.9	nd	nd	nd	96.4
b	70	clear	14.8	2.4	0.9	63.7	0.5	nd	0.4	8	3.8	nd	nd	1.1	0.4	nd	nd	1.6	97.8
c	176	clear	11.5	3	1	65.6	0.6	nd	0.3	11.9	4.7	nd	nd	0.9	0.6	nd	nd	nd	100.2
bot	63	pale bl/gr	11.7	4.9	1.4	60.1	0.5	nd	0.3	8.8	4.2	0.2	nd	0.7	0.7	nd	1.7	0.4	95.7
bot	399	pale gr	12.4	4.7	2	65.1	1.1	nd	0.4	11.3	3.8	nd	nd	nd	0.7	nd	nd	nd	101.7

win = window
bot = bottle
v = vessel
b = beaker
c = cup

gr = green
bl = blue