Some interim remarks on the scientific analysis of glass samples from Mittelfischbach*

von Julian Henderson

Introduction

The aims of carrying out these series of chemical analysis on the Mittelfischbach glass were (1) to establish the basic chemical composition of the glass being made there and (2) to attempt to relate the different byproducts of the industry to each other through their chemical analysis.
A sample of glass which had fallen onto a furnace block was removed for analysis, samples of glass were taken from both the inside and outside faces of a crucible fragment, and separate samples were removed from a lump of material resembling frit, from an opalescent slag and from an opalescent bluish vitreous slag. In all, six samples were analysed.

Technique

The technique used was electron-probe microanalysis. This technique involves the microanalysis of minute samples of glass. That is, an area of the sample of less than a tenth of a millimetre in diameter is analyzed each time. Each sample is mounted in epoxy resin and polished to produce a flat surface. The sample is then coated in a thin layer of carbon to prevent distortion or deflection of the electron beam during analysis. Glass is generally found to be homogeneous in composition; several analyses of the same sample are still cariied out. Each analysis involves the quantitative determination of 22 element oxides in the glass.

Results

Though the analyses produced low totals, many of the glass samples shared similar characteristics. The sample from the furnace block was basically of a potash-lime-silica glass with relatively high alumina, Al_20d23 (5.5 %) and phosphorus pentoxide P_2O_5 (1.2 %), consistent with the production of a potassium glass.

* Im Rahmen von Oberflächenbegehungen im Bereich des ehemaligen Standorts der Mittelfischbacher Glashütte konnten 1990 und 1991 zahlreiche Schmelztiegelfragmente, Glasscherben und Schlackenreste geborgen werden. Zu weitergehenden Analysen wurden einige dieser Funde an die Universität Oxford (England) gesandt, wo sie am Research Laboratory for Archaeology and the History of Art der Universität Oxford untersucht worden sind. Ein erster Vorbericht wird hier von Dr. Julian Henderson vorgelegt.

The glass samples taken from both surfaces of the crucible wall both contained very high alimina levels (22 % and 21.9 % respectively), indicating that alumina had migrated from the body of the crucible wall into the glass that was coating it during the process of glass production. This makes the glass more refractory (with higher alumina) at points close to the crucible wall, but does not indicate that the typical glass composition of the glass made at the site would contain these alumina levels: the level of 5.5 % alumina in the glass adhering to the furnace is probably more typical. Otherwise the crucible glass samples were high in potassium oxide and silica and contained a low impurity of iron.

The composition of the ›frit‹ sample, a mixture of vitreous and crystalline phases, showed that while the material contained potassium oxide (at 5.5 %) and alumina (at 6.6 %), the silica level 77.7 % and iron at 0.2 %, the calcium oxide level was very low at 0.1 % indicating that the fragment was a byproduct of glass production and did not have all the characteristics of the fully fused glass adhering to the furnace fragment for example.

The opalescent vitreous slag turned out to be essentially silica, though further work is necessary to be certain. The second slag lump had some of the chemical characteristics of the glass adhering to the furnace wall: high calcium oxide and about 6 % alumina and much higher iron at 2.4 % oxide (the furnace glass contained only 1 % iron oxide). Both samples contained trace levels of manganese oxide (0.6 % and 0.7 % respectively), magnesium oxide (3.3 % and 3.0 % respectively), phosphorus pentoxide (1.2 % and 1.3 % respectively) and barium oxide at 0.5 %. Both contained less than 5.9 % potassium oxide.

It seems clear then that the second lump of ›frit‹ analysed was a product of the glass-making procedures on the site, and that the high iron oxide may be the reason why the lump was discarded during the fritting process; the final colour would have been a very dark translucent colour.

Conclusions

The glass samples analysed do not appear to be particularly durable, resulting in what is probably a rather leached glass. High lime and potassium oxide glasses were being made. The phosphorus and magnesium levels probably indicate that an organic, rather than mineral, source of potassium was being used to make the glass: the obvious cAndidate is a plant ash (rather than the mineral, potassium carbonate). It is difficult to know the true aluminium levels would have been in the glass – in these analyses they may be somewhat high due to interaction of the glass with the crucible wall.

Due to weathering of the glass, some of the alkali has probably been leached out of the glass, and since only a maximum of 1.1 % soda (Na_2O) was detected, it is still possible that a mixed alkali glass was being made at Mittelfischbach. Only further technical analyses of complete vessel glass and other industrial debris will be able to answer this question.