

Introductory notes on the study of archaeological glass

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What is glass

Despite appearances, glass is not a solid. Solids are composed of crystals which reflect the arrangement of the constituent atoms. Glasses, by contrast, have never crystallized and have stiffened whilst retaining their liquid structure. They are super-cooled liquids, and it is because of this that glass is transparent. In an ordinary solid, a little light is reflected each time it passes a crystalline boundary, and so solids are opaque. In glass there are no crystalline boundaries to reflect the light, and so it is transparent.

Chemical Composition

Naturally occurring glasses are rare, and virtually all glass that an archaeologist has to deal with is man-made. There is a direct causal relationship between the ingredients used to make it, and whether or not it survives. It is therefore important to understand the chemistry.

The three main ingredients of glass are sand, an alkali to bring the melting temperature down and lime to improve its chemical stability.

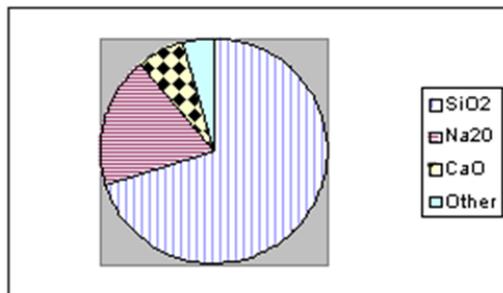


Fig. 1: typical composition of a soda lime silicate

The typical composition of antiquity was a soda lime silicate (Fig. 1). The alkali was an inorganic soda called natron. This results in glass that is chemically very stable in the north of Europe. I have noticed that in the south (Pompeii, Beirut, the Sudan), it appears less stable. Devitrification – where glass starts to form a crystal structure, is more noticeable.

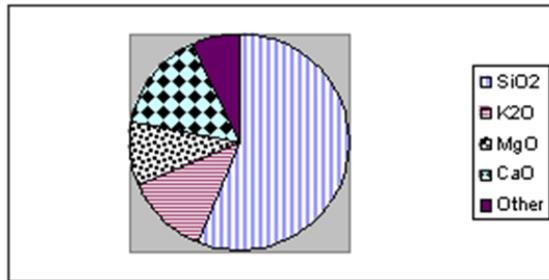


Fig. 2: typical composition of a potash glass

Natron is found in Egypt and Greece but not in the north of Europe. Sometime towards the end of the first millennium AD; supplies of either natron, or the raw glass made using it, stopped reaching the north. The glass workers had to find another alkali. They started to use wood ash and the result is a potash or forest glass. This is much less chemically stable, and tends to disappear (Fig. 2).

Soda glass continues to be made in the Mediterranean area, and soda glass vessels are found in medieval period in the north but are generally the preserve of the aristocracy.

Glass can also be made using lead as the main ingredient. Lead crystal was developed in the late 17th century, but lead glasses are also found in early medieval contexts being used for small jewellery items and linen smoothers.

The process of making glass from raw ingredients involves heating them together over several hours at a low temperature to burn off some impurities and start the process of melting. This results in a granular crystalline material called frit. The frit is then ground and melted at a much higher temperature (c. 1400-1500°C for a soda lime silicate glass).

Factors affecting the colour of glass

- **Raw materials.** The natural colour of glass is blue/green because of the iron compounds in the sand. Decolourisation results from the addition of manganese or antimony. Strong colours such as deep blue, red, emerald green can be produced by the addition of such compounds as cobalt or copper. Opaque glasses can be produced by incorporating additions to the glass that do form crystals within it. Lead is often used for this.
- **Furnace conditions.** Reducing or oxidising conditions will alter the effect of certain elements. For example, copper will produce deep blue in oxidising conditions and opaque red in reducing ones.
- **Time.** the length of time in the furnace will result in changes of shade; e.g. blue/green to light green and back to blue/green.

Methods of manufacture of vessels

- Core forming. Used for small unguent bottles and perfume containers from the 16th to 1st century BC.
- Casting and slumping. This basically involves manipulating sheets of hot glass over formers. The resulting vessels are then ground and polished on a wheel. This technique died out in the 1st century AD, though a few types were still in use in the early to mid 2nd century. The technique favours the manufacture of open vessels such as dishes and bowls.
- Blowing. This technique was discovered during the 1st century BC and revolutionised the industry. For the first time it was possible to quickly make both closed and open forms, and to exploit the plasticity of the medium. The technique spread across the Roman world very rapidly and displaced the casting and slumping techniques during the 1st century AD. The technique remained dominant until the late 18th / early 19th century with the development of the mould pressed industrial techniques.

Types of articles made of glass

- Small items of jewellery and objects such as gaming counters – generally made by casting and manipulation.
- Vessels – made by all the methods noted above.
- Windows – made by casting in the 1st to 3rd centuries AD, and by blowing from the late Roman period onwards. During the Roman period, the cylinder method of blowing window panes (elongate, straight bubbles) was definitely used, the crown method (elongate curved bubbles) may also have been introduced.

Factors affecting the recovery of glass

- Composition
- Recycling. The collection of broken glass (cullet) has a long established history, as the combination of cullet with frit when making glass reduces the temperature to which the frit has to be raised before it melts. Some industries appear to have relied entirely on cullet.

Questions to ask when faced with a piece of vessel glass

In order of importance

What is it made of? i.e. is a soda or a potash glass.

How was it made? - blown, cast, machine made.

What colour is it? NB do not agonise over precise shades of pale /light green. Perception of these varies from person to person and depending on the lighting conditions.

What diagnostic features does it have? Rim, base, folds, pontil scar, decoration.

Useful starting points for reading

Allan, D., 1998. *Roman Glass in Britain* (Princes Risborough).

Cool, H.E.M. and Baxter, M.J., 1999. 'Peeling the onion; an approach to comparing vessel glass assemblages', *Journal of Roman Archaeology* 12, 72-100.

Cool, H. E. M. and Price, J., 1995. *Roman Vessel Glass from Excavations in Colchester 1971-85*, Colchester Archaeol. Rep. 8, (Colchester).

Foy, D. and Nenna M-D. (eds.) 2003. *Échanges et Commerce du Verre dans le Monde Antique Monographies Instrumentum 24* (Montagnac).

Frank, S., 1982. *Glass and Archaeology* (London).

Grose, D. F., 1989. *The Toledo Museum of Art: Early Ancient Glass*, (New York).

Hume, I.N., 1961. 'The glass wine bottle in colonial Virginia', *Journal of Glass Studies* 3, 91-117.

Price, J. and Cottam, S. 1998. *Romano-British Glass Vessels: a Handbook CBA Practical Handbook in Archaeology 14* (York).

Tait, H. (ed.), 1991. *Five Thousand Years of Glass* (London).

Talbot, O., 1974. 'The evolution of glass bottles for carbonated drinks' *Post Medieval Archaeology* 8, 29-62.

Tyson, R., 2000. *Medieval Glass Vessels found in England c. 1200-1500 CBA Research Report 121* (York).

Wilmott, H., 2002. *Early Post-medieval Vessel Glass in England c. 1500-1670 CBA Research Report 132* (York).

Journals

The two major international periodicals on glass which regularly have articles dealing with archaeological glass are the *Journal of Glass Studies* published annually by Corning Museum of Glass, New York, and the *Annales du ... Congrès de l'Association*

Internationale pour l'Histoire du Verre (AIHV). These are the proceedings of the congress held by the Association every three years. The [website](#) for the AIHV provides details of the Annales

Day Schools and local associations

The Association for the History of Glass Ltd originated as the British section of the AIHV. It publishes a newsletter Glass News twice a year, and runs dayschools once or twice a year that often feature the most recent research on archaeological glass. Details can be found on the [website](#).

Web sites

The following may be of interest

The Roman Glassmakers produce reproduction Roman glass. Their [website](#) carries reports on their researches into how the vessels might have been made.

This [website](#) from the British museum shows how colour was manipulated to form the effects seen in the Lycurgus cup, a very rare type of 4th century vessel

Another [British Museum report](#) shows how composition can be used to date vessels. In this case proving that the Portland vase is indeed a Roman piece, and not the Renaissance production one art historian wanted it to be.