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PALMYRA

GLASS FROM PALMYRA IN LABORATORY STUDIES

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The goal of this report is to present the results of a chemical analysis and high-temperature microscope investigation of three glass fragments from Palmyra.[1] All the samples are from the Roman period and macroscopically they belong to the same group of slightly colored transparent glass. Typologically, they represent three different vessel types: the bottom and rim of two different vessels plus the foot of a goblet. The chemical composition of the glass samples was determined in the laboratory of the Arbeitsgruppe Archaometrie FU Berlin by WD-XRF (Dr. Gerwulf Schneider).

The characteristic temperatures, such as sintering range, softening point, melting point and flow temperature, were determined under a Leitz high-temperature microscope. In preparation for analysis, samples were ground to a fine powder, pressed into a cube and heated at a rate of 300°C/h in air.

All the samples under analysis represent soda glass melted with natural soda; they contain less than 1.3% potassium oxide and the ratio of sodium oxide to potassium oxide is higher than 13:1 (Tables 1 and 2). The formula is typical of that used in Roman glass workshops, which is recognized by the low concentration of magnesium oxide and the high proportion of calcium oxide to magnesium oxide. The last ratio is relatively low, indicating not very pure limestone as a source of lime. Also typical of Roman

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[1] The analyses were part of the project *Ceramics and glass from Polish excavations in the Near East in laboratory studies*, financed by the Committee of Scientific Research.

Samples for analysis come from the tower-tomb of Atenatan in Palmyra, excavated in the 1992 season.

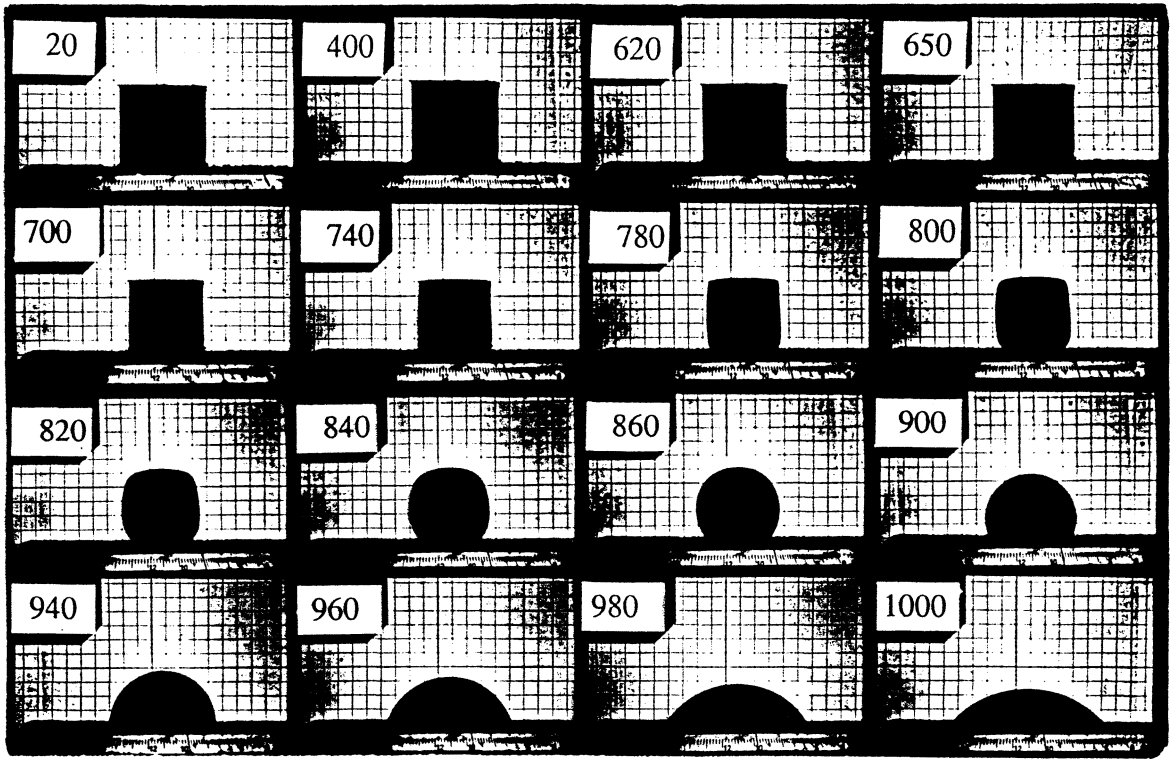

Fig. 1. Sample No. 3 during heating, observed under a high-temperature microscope.

Table 2. Chemical characteristics of glass from Palmyra.

Sample No. Color*	1 25A2	2 25A2	3 25B3
Na2O/K2O	23.80	30.50	32.30
Na2O+K2O	16.60	16.70	16.30
CaO/MgO	14.70	18.30	18.00
CaO+MgO	9.10	8.10	8.70
Na2O+K2O/CaO+MgO	1.80	2.10	1.90
SiO2/CaO+MgO	7.60	8.80	8.20
SiO2+Al2O3+Fe2O3+TiO2	73.05	74.49	74.47
Si02+Al2O3+Fe03+TiO2/Na2O+K2O	4.00	4.47	4.56

* Taschenlexikon der Farben, Muster-Schmidt Verlag, Zürich-Göttingen

25B3 – grayish green 25A2 – greenish white

Table 3. Characteristic temperatures for glass from Palmyra.

Sample No.	1	2	3
	Temperature [°C]		
Beginning of sintering*	620	650	620
End of sintering	700	700	700
Softening point	740	740	780
Melting point	940	900	940
Flow temperature	1000	1000	1000
Length of glass**	300	300	300

* Beginning of sintering corresponds with the so called softening point after Littleton, meaning viscosity of $10^{7.65}$ P

** Viscosity of $10^{2.7}$ P- 10^{6} P

formula is the relation of the sand contents to the sum of sodium and potassium oxide contents.

The results of the analysis under a high-temperature microscope indicate that all the samples are so called long glass in the hand-forming range. It means that they have a large range of forming temperatures: 300°C (Table 3, Fig. l).

All the glass samples are long sodium-calcium-aluminum-silica glass melted with natural soda. Trace elements, especially cyrconium and itrium, clearly indicate a very different source of sand used in the production of sample 1, as compared with the other two samples. This probably means that sample 1 is of a different provenience.

The samples are very long and also soft, meaning that they were practical in the making with relatively low temperatures and a broad temperature range for forming.

References

M. Daszkiewicz, J. Raabe (1996), Chemical composition and technological studies of Abbasid glasses from the Bijan Island in Iraq, in: K. Bartl (ed.) *Continuity and change in Northern Mesopotamia from the Hellenistic to the Early Islamic Period,* Berlin.