Geophysical Research Abstracts
Vol. 17, EGU2015-12227-1, 2015
EGU General Assembly 2015


# An experimental approach to manufacturing technology of historical glass (XIII-XV centuries). Comparison with current glassmaking technology.

Mariona Tarrago (1), Domingo Gimeno (2), Flavia Bazzocchi (2), Maite Garcia-Valles (1), and Salvador Martinez (1)

(1) Dept. Cristal·lografia, Mineralogia i Dipòsits Minerals, Facultat de Geologia, Universitat de Barcelona, Spain (mtarrago@ub.edu), (2) Dept. Geoquímica, Petrologia i Prospecció Geològica, Facultat de Geologia, Universitat de Barcelona, Spain

One of the major and less explored issues in the characterization of historical glasses is the determination of their viscosity as a function of temperature in order to constrain technological aspects of glass production. Until now, assumptions on temperatures have been based on mathematical models based on chemical compositions. Hence, the topic of this work is to explore the technology of stained glass production related to the workability and melting process of the glass by experimental laboratory measurements.

This work presents the analysis of viscosity of glasses from different historical sites and chemical compositions: four from Santes Creus (Tarragona, XIII century), two of classical medieval stained glass window from Santa Maria de Pedralbes (Barcelona, mid XIV century), and three of evolved late-medieval type from Santa Maria del Mar (Barcelona first half of XV century), and one sample of soda-lime industrial glass by means of Hot-Stage Microscopy and glass transformation temperature Tg by dilatometry. These data are then compared to the predictions on theoretical viscosity obtained from mathematical models based on chemical composition.

These samples are classified according to their major modifier in: Na-rich (12-17% of $Na_2O$, between 65-77% of $SiO_2$ and less than 3 % of $K_2O$); Ca-rich (29% of CaO, 54% of $SiO_2$, 4% of $K_2O$, and 4% of $Na_2O$); K-Ca-rich (17 to 21% of $K_2O$, more than 14% of CaO, 49-55% of $SiO_2$and less than 2% of $Na_2O$); Na-Ca-rich (12-14% of $Na_2O$, 9-15% of CaO, 57-71% of $SiO_2$ and $< 6\%$ of $K_2O$).

Glass transition temperature (Tg) is correlated to chemical composition: 464-492 ºC for Na-rich, 645 ºC for Ca-rich, 582-586 ºC for K-Ca-rich and 497-542 ºC for Na-Ca-rich glasses.

Experimental viscosity-temperature curves are traced using Tg and fixed viscosity points measured by Hot-Stage microscopy (according to German standard 51730) in order to provide more accurate insight into the phases of glass production process (melting, working, conditioning and annealing ranges). These results are also compared to mathematical models of glass viscosity based on chemical composition.

The annealing range (viscosity between $10^{13.5}$ and $10^{12}$ Pa·s) is reached at temperatures between 484-633ºC (strain point) and 509-664ºC (upper limit). The working point (viscosity of $10^3$ Pa·s) has temperature values in the range between 958 and 1097ºC.