

Archaeometric investigation of pit-fire structures: a ceramic pyrotechnology experiment

Maria Pia Riccardi^{1,2,*}, Serena Chiara Tarantino³, Michele Zema¹

¹ DiSTA – Università degli Studi di Pavia, Italy

² Laboratorio Arvedi – sede di Pavia, Università degli Studi di Pavia, Italy

³ Dipartimento di Chimica, Università degli Studi di Pavia, Italy

* Corresponding author: mariapia.riccardi@unipv.it

Abstract

In the archaeological and archaeometric studies of ceramics, the definition of the thermal system of fire structures is a very important issue (Gosselain, 1992; McDonnell, 2001; Gibbs, 2015, Rice, 2015). Firing structures are associated with different thermal systems (Gosselain, 1992) that leave their traces both in the remains of kilns identified from archaeological excavations and in the fragments of ceramic objects.

The need of understanding the functioning of these types of kilns was the starting point for organizing a pyrotechnological experiment aimed at firing ceramic artifacts in a "pit" kiln, with a clay cover.

The created structure had dimensions of 1.0 m × 0.95 m and a depth of 0.5 m. The fire was lit using small pieces of dried wood, while charcoal was the fuel that sustained the firing phase, lasting about 2 days, until the fuel was completely exhausted, and the firing system cooled down. The use of thermocouples allowed the constant monitoring of the structure temperature on 5 different points for the duration of the experiment, until the temperature cooled down to about 150 °C.

The archaeometric investigation focused on the study of the fragments of the clay cover, on the walls of the firing pit (reddening rim) and on the fragments of ceramic artefacts. The analytical approach was based on the use of Optical and Scanning Electron Microscope, Electron Microprobe and X-ray powder diffraction.

The acquired data allow to evaluate the variation of the temperature inside the fire structure during the firing process. The comparison between thermal and mineralogical data represents the opportunity to verify the correlations between these two parameters.

Gosselain, O. P. (1992). Bonfire of the enquiries. Pottery firing temperatures in archaeology: what for? *Journal of Archaeological science*, 19(3), 243-259.

McDonnell, J.G. (2001). Pyrotechnology. In: Brothwell, D.R., Pollard, M. (Eds.), *Handbook of Archaeological Science*. Wiley, London, pp. 493–506.

Gibbs, K. (2015). Pottery invention and innovation in East Asia and the Near East. *Cambridge Archaeol. J.* 25 (1), 339–351.

Rice, P.M. (2015). *Pottery Analysis: A Sourcebook*. University of Chicago Press, Chicago (IL).

Keywords: ceramics, ancient pyrotechnology, experimental archaeology, pottery firing, firing temperature, XRPD, OM, SEM