

Ancient bricks of Padova, Northern Italy: a knowledge base loaded with technological and heritage value

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Interdisciplinary and multianalytical studies on historical bricks provide information about the clayey materials provenance, the production technologies used or the skills developed. The production processes of bricks are also highly related both with the structural function they should performance and the context involved on their manufacturing. By means of Spectrophotometry, XRF, XRDP, POM and FESEM-EDS, bricks shaping the built heritage of Padua (Northern Italy) were studied. The city is located in the Eastern side of the so-called *Pianura Padana*, characterized by the abundance of clayey materials (mainly Quaternary alluvial deposits). Five historical and very representative constructions of the city were chosen: the Basilica of Santa Justina (areas built in 5-7th, 12-13th and 15-16th centuries), the Church of Santa Sofia (areas built in the 11th century), the Elderly Tower (13th century), the Ancient Castle of the Carraresi family (wall and entrance to the tower, 12-13th and 14th centuries respectively) and the Renaissance surrounding wall of the city (16th century).

Two main types of bricks were established. The type 1 shown a mineral assemblage constituted by the high temperature phases diopside, anorthite and gehlenite, and quartz, calcite and hematite. This pointed out the use of a mixes of illitic-kaolinitic and very calcareous clays, firing temperatures of 900-1000 °C and oxidizing conditions inside the kilns. These bricks displayed an important chromatic variability -clay matrix with yellowish, beige/orange or reddish hue- and textural heterogeneity. Hence, abundant inclusions -mainly rock fragments, clay pellets and clay temper- as well as many flux textures were observed. The lighter the hue of the clay matrix, the higher were the contents of the high temperature phases and the lesser of quartz and hematite. Besides, the lighter hue bricks shown a more uniform texture, very low porosity and a quite perfect conservation state. This revealed the achievement of important skills in order to attain the suitable mixtures and firing times to produce highly resistant bricks. The type 2 comprised bricks with a brownish hue, textural homogeneity and a mineral assemblage formed by quartz, illite, potassium feldspar, calcite and albite. Such bricks were made out from illitic-kaolinitic clays and were fired at temperatures of 800-900 °C. Bricks of type 1 were observed in the five constructions selected and those with a yellowish and a beige/orange hue were very used at Santa Justina, Santa Sofia and the entrance to the tower of the Ancient Castle. The type 2 was extensively used to build both the wall of the Ancient Castle and the Renaissance wall of the city.

The similar mineralogical composition of bricks belonging to type 1 could reveal that for many centuries specific outcrops supplied the clayey materials used to produce the building bricks for the constructions of the city. Their chromatism and texture so heterogeneous would correspond to very different manufacturing processes, where the mix of clays and the firing temperatures were quite diverse. Therefore, the existence of many local workshops and/or the production of bricks with very different qualities could be suggested. On the other hand, the extensive use of the yellowish and beige/orange hue bricks in Santa Justina, Santa Sofia and the entrance of the Ancient Castle could suggest the considerable funds and/or time available for such constructions, that allowed the use of high-quality bricks. The manufacturing of bricks of type 2 pointed out another production process, mostly conditioned by the need to build up defensive structures quite urgently.

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