

## **USE OF ZEOLITE-RICH MATERIALS IN THE BUILDING INDUSTRY**

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The use of zeolite-rich tuffs as building materials is witnessed by the several Italian historic sites for human settlements. This old practice was mainly due to the softness of this rock as well as many other technical properties which made easy to these ancient populations to excavate caves for catacombs, cellars, and to obtain raw materials for building purposes.

The historical use of zeolite-rich tuff in Italy dates back to 7<sup>th</sup> century B.C. Several remains of the Greek age can be found, for example in Naples, although most constructions were obliterated by the more recent Roman cities built over the Greek ruins.

The possibility to obtain hydraulic mortars, namely materials able to produce a cementing action also underwater, was already known by the Romans that used *pozzolana*, a natural material intimately linked to the zeolitized tuff, mixed with lime and water as described by M. Vitruvio Pollione (15 a.C) in *De Architectura*. Romans mainly used these mortars for harbors with a mix design which also accounted for tuff fragments and tuff powder. It was possible to manufacture the so-called “roman concrete”. The reason of the strength of this concrete was a consequence of the extraordinary adherence at the tuff/lime interface due to the great reactivity of lime towards the zeolites widely occurring in the matrix and representing the groundmass of almost all the volcanic tuffs. Firmly convinced of the excellent results obtained with the local tuffs (Neapolitan Yellow Tuff and Campania Ignimbrite) they used these mixtures also for far away harbors in Israel, Egypt, Crete and Turkey.

From that time on, the building techniques were widely improved and allowed impressive constructions that still survive throughout the centuries.

As far as Naples is considered, tuffs were formerly mined in underground excavations directly under the sites where buildings were erected. Only at the end of the 19<sup>th</sup> century the mining activity moved towards the periphery of the town in open-pit quarries.

Even though the exploitation of zeolitized tuffs for the production of dimension stones still continues in some Countries, nowadays these materials, or the production wastes, are used for some industrial applications which provide them an added value. However, the expectations from natural zeolites have likely been too high if compared to their “real” prospects. For example, since quite a long time an attempt to use natural zeolites for wastewater treatment was carried out but, at least for the Italian zeolites, the results were inconsistent. Did we ask too much?

Actually the research goes on and in the last years the use of this raw material found new perspectives in different sectors: agronomic, oenotechnic and as constituent of building materials. The use of natural zeolites as soil amendants and in zootechny as binders and agglomerants in animal feeding is quite consolidated. Recent studies proved the good performance of the natural zeolites as natural counterpart of *pozzolana* in the cement sector and in lime base binders. It is not excluded finally an important role in the traditional ceramic processes as partial replacement of the more expensive feldspathic melting agents or also in the preparation of expanded aggregates to be used in the production of structural or lightweight concretes.