

MELIOR

De cinere surgo

ABSTRACT

«Aci is a maritime land of ancient civilization. [...] To the west of this country stands the mountain called Gabal 'an nar (the "mountain of fire", Mongibello)» (from Kitab Rugar – Book of Roger)

Etna has always been considered both as a generating and destructive force by those who live on its slopes. Eruptions, volcanic ash rains, earthquakes are phenomena which the inhabitants of the Etna countryside are accustomed to living with. "Il Mongibello" continues to influence the daily life, art and architecture of the villages on the slopes of Etna. The basalt extracted in abundance from the sides of Etna has always been used to build roads, buildings, churches and infrastructure. By contrast there is little evidence of the reuse of volcanic ash, that which there is mostly dates back to the ancient Greeks and Romans and the Maya civilization.

Pliny the Elder, in his *Naturalis Historia* (77 AD), describing the characteristics of the Roman "cement", writes:

"Impregnable to the sea waves and every day more resistant than the previous day".

The opus caementicium consisted of a mix of simple elements: volcanic ash (*pulvis puteolanus*), lime, sea water and volcanic rock sediments. Even today, the proportions of this design mix are unknown, making it impossible to replicate. Such an amalgam made the structures, especially those of the harbour, indestructible and even more resistant to the passage of time.

Roman ruins have survived centuries thanks to volcanic ash (R. Lorenzi, 2009)

THE PROJECT

In the summer of 2021, on my return to Acireale from Venice, I was able to observe how the large amount of volcanic ash had invaded the hinterland causing serious problems relating to disposal, roads, health and daily life. Several tons of ash covered the towns and cities on the slopes of Etna. The latest eruptions have led to volcanic ash emissions consisting of several kilograms per square meter. Furthermore, volcanic ash causes serious structural and infrastructural damage to buildings, due to the large accumulation of particles on roofs or the reduced traction on roads or airport runways.

What is volcanic ash?

When the magma rises through the volcanic conduit, powerful explosions, caused by the gases contained in it, fragment it into various dimensions, the tefra. Such explosions are also the cause of tefra expulsion, which is carried upwards by hot gases producing an eruptive column. The eruptive cloud is transported for thousands of miles dropping increasingly smaller pieces to the ground as it moves away from the eruptive crater. Depending on the particle size, we can distinguish the tefra into ash and lapilli. Volcanic ash is currently considered urban waste for landfill. The European Union classifies volcanic ash within the generic group of "municipal residues" (code 20) and more precisely as "road cleaning residues" (code 0303).

As a Sicilian and living in Acireale, a city on the slopes of Etna, I have had, several times, the opportunity of observing the phenomenon of the fall of volcanic ash, of seeing how it affects everyone and how it is experienced by the individual at the level of a personal problem and not just as a community concern.

We must do better! As indicated by the famous inscription: "Melior de cinere surgo", which is located in Catania on the Porta Ferdinanda, built in 1768.

Inspired by this, the Melior Project was conceived, with the aim of developing a new material, the MAGMA-lite, born from the reuse of volcanic ash, in an upcycling perspective that aims to use waste material, an unwieldy waste and turn it into a resource of greater value than that of the original. Thanks to production cycles that respect the environment, this process is part of the bio-economy, inspired by the so-called "12 ethical principles of Green Chemistry" and in particular from the following:

to use all products generated in a process, exploiting and exploiting any residual processing waste, especially if harmful to the environment.

synthesis methodologies that have the least impact on the environment using little or no polluting materials, and processes that use minimal amounts of energy.

The basis of the Project is sustainable design. The main element is tefra, used 100 percent, rather than as an additive to create other materials in ceramic production. In this way, we will be able to use large amounts of volcanic ash which will consequently be taken away from landfills. Ash and lapilli, in nature, do not dissolve in water and the low concentration of silica in the material gives it a low pozzolanic activity. It is for this reason that ash and lapilli have been discarded from traditional use in construction.

Recent studies have shown the possibility of achieving consolidation of inorganic alumina-silicate materials by chemical reaction in an alkaline environment.

The alkaline activator literally breaks down the chemicals in alumina-silicate powder and then rebuilds them into long polymer chains, in short giving rise to stone polymers.

The process of manufacturing MAGMA-lite, imitates the natural process of the outflow and consolidation of magma, i.e. a mass of silicate which in a molten state is introduced into the fractures generating intrusive rocks or which expands on the terrestrial surface assuming different shapes and configurations.

MAGMA-lite behaves in the same way which, depending on the design mix, determined by the different amount of silica, assumes different shapes and texture

MAGMA-lite is consolidated at low temperatures and in a short cooking process, thus ensuring the use of minimal amounts of energy compared to that of traditional ceramic materials.

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