Venice Emergency Communicate: Chemical Relation

We send an appeal from the heart to all the Venetian Citizens; both resident and elective.

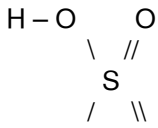
The historic stone and brickwork of Venice can no longer support the assault of the sulphur emitted by the engines that work on its waterways, an assault made worse by the almost non-existent and madly inefficient administration, combined with the concrete trafficking construction companies.

The sulphation of calcareous surfaces and above all the sulphation of the veins of calcite inclusions (crystalline calcium carbonate), which commonly intersect almost all the historic marble and Istrian stone in Venice, is due to an excess of sulphur dioxide (SO_2) in the atmosphere. The chemical reactions of the phenomenon may be schematised as follows:

$$SO_2 + {}^1/_2\ O_2 + H_2O = H_2SO_4$$

sulphur dioxide + Oxygen → sulphuric anhydride + water → sulphuric acid

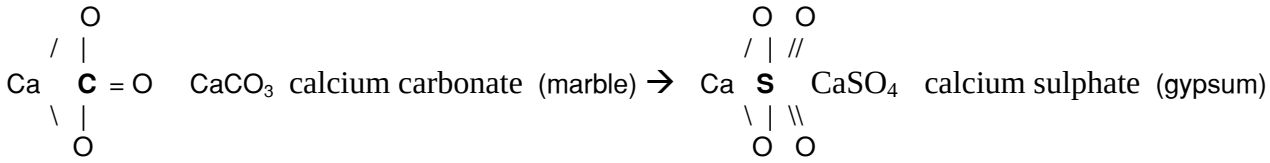
Sulphur dioxide (SO_2) emitted into the atmosphere binds with oxygen from the air (${}^1/_2\ O_2$) to become sulphuric anhydride (SO_4), which with the water from the humidity in the air and rain (H_2O), produces sulphuric acid (H_2SO_4)



H_2SO_4 sulphuric acid

Sulphuric acid (H_2SO_4) dissolved in the humidity and rain (H_2O), when in contact with the calcium carbonate ($CaCO_3$), gives it its sulphur component, "moving" carbon out of the compound, freeing it as carbon dioxide (CO_2). The calcium carbonate transforms into another salt, calcium sulphate, better known as gypsum or chalk.

$$H_2SO_4 + Ca\mathbf{C}O_3 + H_2O = Ca\mathbf{S}O_4 \times 2H_2O + CO_2$$



$CaCO_3$ calcium carbonate (marble) → $CaSO_4$ calcium sulphate (gypsum)

We can see the substitution in the centre of the salt structure of the carbon (the base of life), with one of the most aggressive agents of death and destruction: sulphur. This happens because of the stronger chemical reaction power of sulphur in respect of carbon.

So our historic stone and brickwork, which are in the large majority calcium carbonates, are being reduced to rubble - like blackboard chalks - working as catalytic sponges removing the sulphate from the acid rain.

One may observe the impressive rate of sulphation of calcite component of the historic stonework. Being the calcite a crystalline form, which is pure calcium carbonate, it is immediately decoded by sulphur. Apart from

surface damage (the calcium carbonate in the surface being reduced to a chalky powder) the acid rain slices along the veins of calcite inclusions, resulting in the physical cutting apart of the works-of-art.

Another phenomenon of particular gravity in the historic city of Venice is the crumbling of the brickwork. Bricks are made out of clay, and clay itself belongs to silicates. Silicates suffer from silicate hydrolysis. These compounds are particularly sensitive to hydrogen ions H^+ which are present in acid waters: the binding of these H^+ ions, means that the silicates endure an hydrolysis phenomenon. Hydrogen ions are able to break down silicate structures and free other ions like sodium Na^+, potassium K^+, calcium Ca^{++} and magnesium Mg^{++}. These ions are then removed by atmospheric and human agents, transforming bricks into dust and rubble, as we can see almost everywhere around Venice.

Both phenomena (calcium sulphation and silicate hydrolysis) are already seen to be in a very advanced state in Venice. They are at the point of not only of destroying the decorative heritage of its people, but are also threatening the static stability of its architectural heritage, as can be seen from the very recent (July 2003) photographs published on

http://savevenice.net/venezia/Venezia_gessificazione/index.html

The static stability of the buildings is not helped by the ludicrous casting of enormous mass concrete foundations along many of the fondamente, works implemented by incapable and/or corrupt business and public administrators.

The gravity of the situation has pushed myself, Umberto Sartory along with a group of citizens of Venice to form the 'Public Health Committee' and to file the following request with the Nucleo Carabinieri per la Tutela del Patrimonio Artistico:
http://savevenice.net/venezia/Venezia_gessificazione/docs/comando_carabinieri.pdf
Further documentation underlying the Public Health Committee's reasons and proposals for change, are available on
http://savevenice.net/venezia/Venezia_gessificazione/docs.html

Umberto Sartory, Venice Public Health Committee 31 July 2003
venetian@ombra.net