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Micro-fractures produced in the Cadalso de los Vidrios granite (Madrid) subjected to Freeze-Thaw Durability Testing

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A specific leucogranite (fine to medium grain sized) from Cadalso de los Vidrios, Madrid, Spain, from where it takes the name of the stone variety, which is a traditional heritage building material used in Central Spain, was subjected to freezing-thaw durability tests or accelerated artificial ageing tests (according to Spanish standard EN 12371:2001) to assess its durability by means of ultrasonic velocity measurements (a non-destructive technique), and optical and fluorescence petrography using a polarized optical microscope (destructive technique), both techniques used before, during and after laboratory ageing tests, or in other words, what is determined is the improvement or deterioration in some properties.

The measurement of the ultrasonic velocity in the leucogranite cubic test specimens along the freezing-thaw cycles shown that the velocity diminishes with the number of cycles, in relation to the decay that the stones were experiencing. This deterioration can be observed by the loss of crystalline minerals in the surface of the analyzed samples and by the micro-fractures appearance up to one centimeter deep, which have been detected by the petrographic techniques previously mentioned.
The images taken by means of the fluorescence microscope clearly show the micro-fractures generated during the durability test. These images have been processed and analyzed by the UTHSCSA Image Tool program with the purpose of being able to quantify the degree of decay that this type of crystalline materials undergone, when subjected to a number of freezing-thaw test cycles. It is therefore an effective, reliable and complementary technique to that of the petrography analysis, both optical and fluorescence ones.
In the first cycles of the ageing test, the micro-fractures propagate along crystals edges and during the last cycles of the test, intracrystalline micro-fractures are generated, which are developed in different ways depending on the mineralogy of the crystals. Thus, the quartz crystals are those that undergo more intracrystalline micro-fractures, whereas the biotites, behave in a more ductile form and they are not micro-fractured.
Both analytical techniques give information of this granite deterioration, showing a relation between the number of freezing-thaw cycles, the superficial micro-fractures proliferation and the decrease of ultrasonic waves propagation velocity produced by the ageing cycles.