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Acoustic and Electrical Signal Emission recordings when marble specimens are subjected to compressional mechanical stress

Dimos Triantis (1), Ilias Stavrakas (1), George Hloupis (1), Konstantinos Ninos (1), and Filippos Vallianatos (2)

(1) Laboratory of Electrical Characterization of Materials and Electronic Devices, Technological Educational Institute of Athens, 12210, Greece., (2) Technological Educational Institute of Crete, laboratory of Geophysics and Seismology, Greece.

The detection of Acoustic Emissions (AE) and Electrical Signals (ES) has been proved as a valuable experimental method to characterize the mechanical status of marble specimens when subjected to mechanical stress. In this work, marble specimens with dimensions 10cm x 4cm x 4cm where subjected to sequential loading cycles. The maximum stress of each loading was near the vicinity of fracture and was maintained for a relatively long time (th=200s). Concurrently to the mechanical tests, AE and ES were recorded. Specifically, two AE sensors and five ES sensors were installed on the surface of the specimens and the detected emissions were stored on a PC. The recordings show that AE and ES provide information regarding the damage spreading and location in the bulk of the specimen. Specifically, when the mechanical stress was maintained constant at the high stress value during each loading cycle the cumulative number of the AE hits become gradually less reaching a minimum after the first three loading cycles, indicating the existence of the Kaiser effect. During the eighth loading cycle the AE hits show a significant increase that became maximum at the ninth cycle before where failure occured. A similar behavior was observed for the cumulative energy. A b-value analysis was conducted following both Aki's and Gutenberg-Richter relations on the amplitudes of the AE hits. The b-values were found to increase during the three first loading cycles while consequently they were practically constant until reaching the two final loading cycles where they became gradually lower. The ES significantly increases during the stress increase of each cycle and gradually restores at a background level when the applied stress is maintained constant near the vicinity of fracture. It was observed that the background restoration level becomes gradually higher during the first four loading cycles. Consequently, during the next three loading cycles the background level is maintained practically constant. During the two final loading cycles the background restoration level significantly increases indicating the upcoming fracture.

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