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Mechanical properties of tanolite subjected to combined effects of chemical corrosion and freeze-thaw cycles

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This paper presents an investigation into the coupled effects of chemical corrosion (by Nitric acid solution) and freeze-thaw cycles on the physical and mechanical properties and damage deterioration of tanolite specimens. The experiments included the uniaxial compression test, the Young's modulus test, the X-ray diffraction test and the scanning electron microscope test. The damage condition of tanolite specimens was analysed using scanning electron microscope (SEM). The experimental results reveal that chemical erosion has a significant influence on the propagation of micro cracks and accelerates the development of damage in the tanolite samples under monotonic loading. Due to cementation, no obvious difference in uniaxial compressive strength was observed between the specimens subjected to combined effects of chemical corrosion and freeze-thaw cycles and those subjected to freeze-thaw cycles only. The amount of cementing materials in the chemically treated specimens was found using SEM. The results of XRD and SEM can prove that the SiO_2 particles are absorbed into cracks and voids. Meanwhile, based on the result of Young's modulus, the chemical corrosion makes further damage to specimens with freeze-thaw cycles can be proved. As more cracks and pores are generated in the specimens due to freeze-thaw cycles, SiO_2 colloidal particles can move into specimens with the acid solution. In addition, the result of peak strain shows that SiO_2 colloidal particles can increase the peak strain of tanolite specimens subjected to freeze-thaw cycles.

Key words: Tanolite; chemical corrosion; freeze-thaw; combined effect; mechanical properties