

Variation law of ecological properties of soil improved by high-performance ester materials under freeze-thaw cycle conditions

Qingxiu Zhang^{1,2}, Zhen Liu^{1,2}, Cuiying Zhou^{1,2}

¹ Guangdong Engineering Research Centre for Major Infrastructures Safety, School of Civil Engineering, Sun Yat-sen University, No.135 XinGangXiLu, Guangzhou 510275, China

² Guangzhou Engineering Research Centre for Major Infrastructures and Safety in Transportation, School of Civil Engineering, Sun Yat-sen University, Guangzhou 510275, China

Abstract: High-performance ester materials are soil improvement materials typically used for the ecological remediation of slope soils. Currently, the mechanism pertaining to the long-term performance of high-performance ester materials is yet to be elucidated, particularly under the conditions of freeze-thaw cycles. Consequently, a scientific basis is yet to be established for the assessment of the geographical application scope, climatic conditions, and long-term evolution of high-performance ester materials. Therefore, freeze-thaw cycle and plant growth experiments are conducted in this study to investigate the effects of freeze-thaw cycles on the ecological properties of high-performance ester-amended soils. The results show that freeze-thaw cycles reduce the viscosity of high-performance ester adhesive materials and the water-absorption capacity of water-retaining materials. Furthermore, they reduce the field water-retention capacity and conductivity of the improved soil, increase the soil pH, and reduce the effectiveness and longevity of high-performance ester materials in the soil. Freeze-thaw cycles benefit plant germination while slightly increasing the plant height. Based on experimental results, the variation law of soil ecological properties improved by high-performance ester materials under freeze-thaw cycles is obtained. This study provides a theoretical basis for subsequent investigations into the service life of high-performance ester materials and is important for reducing the cost of ecological restoration.

Keywords: high-performance ester materials; freeze-thaw cycle; ecological property; soil improvement; long-lasting effect