INTISARI

Metode perbaikan tanah pada pasir lepas dapat dilakukan dengan berbagai metode, salah satunya metode *grouting*. Umumnya, grouting menggunakan bahan kimiawi seperti *portland cement* yang dapat berdampak buruk pada lingkungan, terutama emisi karbon yang dihasilkan selama proses produksinya. Konsep *biocementation*, satu diantaranya ialah metode *Enzyme-Induced Calcite Precipitation (EICP)*, dapat diaplikasikan sebagai bahan alami substitusi semen. Konsep ini memanfaatkan peran enzim urease dalam proses hidrolisis urea untuk mempresipitasikan kalsit dalam tanah. Enzim urease secara alamiah dapat diekstraksi dari tanaman, seperti kacang kedelai. EICP telah banyak dilakukan penelitian skala laboratorium namun masih menggunakan metode perkolasi. Penelitian ini bertujuan untuk membandingkan hasil sementasi tanah menggunakan metode perkolasi dan metode injeksi dengan pompa peristaltik dengan beberapa konfigurasi selang.

Perbandingan dilakukan dengan mempertimbangkan parameter visual, sebaran kalsit, dan nilai UCS prediksi. Terdapat lima konfigurasi metode biogrouting yang diteliti, yaitu perkolasi, *open-bottom tube*, dan *segmental-port tube* dengan peletakan sisi dan tengah. Sampel pengujian menggunakan pasir Keisha #6 pada cetakan silinder PVC (5×12 cm). Evaluasi keseragaman distribusi kalsit didapatkan dari deviasi standar hasil kuantifikasi persentase kalsit yang terbentuk pada tanah tersementasi dengan metode *CO_2 Volume Evaluation* (CVE). Selain itu, *pocket penetrometer* digunakan sebagai alat penentuan nilai UCS prediksi.

Keseragaman kalsit paling baik didapatkan dengan metode *side alignment segmental-port tube injection* dengan nilai deviasi standar sebesar 0.05. Selain itu, tanah dengan hasil visual fisik yang baik dan persentase kandungan kalsit tertinggi diperoleh oleh tanah dengan metode *center alignment segmental-port tube injection*, yaitu mencapai 3.33%. Akan tetapi, hasil tanah dari metode tersebut menghasilkan kuat tekan UCS prediksi terendah, sebesar 392.60 kPa. Sedangkan, nilai UCS tertinggi diperoleh oleh tanah tersementasi hasil metode perkolasi permukaan, sebesar 908.93 kPa. Hal ini menunjukkan jika hasil sementasi tidak menghasilkan distribusi kalsit yang preferensial dan kristalisasi *contact-cementing* pada antar partikel butiran tanah.

Kata kunci: *Enzyme-Induced Calcite Precipitation (EICP),* Perkolasi permukaan, Injeksi, Distribusi kalsit, *Pocket penetrometer*

ABSTRACT

Ground improvement methods in loose sandy soils can be implemented by various methods, including grouting. Generally, grouting uses chemical materials like portland cement which can have a negative impact on the surrounding environment, especially the carbon emissions produced during the production process. The idea of biocementation, particularly the Enzyme-Induced Calcite Precipitation (EICP) method, can be implemented as natural materials for the substitution of cement. This concept utilizes the presence of urease enzyme in the urea hydrolysis process to precipitate calcite in the soil. The urease enzyme can naturally be extracted from plants, such as soybeans. Numerous laboratory-scale studies have been conducted on EICP but still using the percolation method. This study aims to compare the results of soil cementation using percolation method and injection method with peristaltic pump in several tube configurations.

The comparison was carried out by considering visual parameters, calcite distribution, and predicted UCS values. Five configurations of the biogrouting method were investigated, namely percolation, open-bottom tube, and segmental-port tube with side and center alignment. The research was conducted with Keisha #6 sand in PVC cylindrical molds (5×12 cm). The evaluation of calcite distribution uniformity was obtained from the standard deviation of the results of quantifying the percentage of calcite formed in cemented soil using the CO_2 Volume Evaluation (CVE) method. Furthermore, the predicted UCS value was measured utilizing the pocket penetrometer.

The best calcite uniformity was obtained by using the side alignment segmental-port tube injection method with a standard deviation value of 0.05. In addition, the soil with good visual physical results and the highest percentage of calcite content was obtained by the center alignment segmental-port tube injection method, reaching 3.33%. However, the soil results from this method produced the lowest predicted UCS of 392.60 kPa. Meanwhile, the highest UCS value was obtained by the cemented soil from the surface percolation method, amounting to 908.93 kPa. This indicates that the cementation results did not result in preferential calcite distribution and contact-cementing crystallization between soil grain particles.

Keywords: Enzyme-Induced Calcite Precipitation (EICP), Surface percolation, Injection, Calcite distribution, Pocket penetrometer