ABSTRAK

Fatmah Aisyah Siregar (NIM. 5211250013) "*Perbandingan Pengaruh Volume Abu Terbang Dengan Molaritas Aktivator Alkali Terhadap Performa dari Beton Geopolimer Berbahan Limbah Pengerukan Pelabuhan*". Fakultas Teknik Universitas Negeri Medan. 2026

Penelitian ini menganalisis pemanfaatan sedimen Belawan sebagai substitusi agregat halus 10% dalam beton geopolimer, serta pengaruh variasi volume *fly ash* (20% dan 30%) dan molaritas NaOH (8M, 10M, 12M) terhadap kuat tekan beton dengan target mutu rencana *f'c* 20 MPa. Penelitian menggunakan metode eksperimental dengan *fly ash* tipe F dari PLTU Pangkalan Susu dan aktivator alkali natrium silikat (Na_2SiO_3) dan natrium hidroksida (NaOH) rasio 2:1. Benda uji silinder 15 x 30 cm diuji kuat tekannya pada umur 7, 14, 28, dan 56 hari sesuai SNI 1974:2011, serta diuji TCLP pada sedimen awal untuk mengetahui konsentrasi pelindian logam berat. Hasil menunjukkan molaritas alkali lebih dominan dibandingkan volume *fly ash* dalam memengaruhi kuat tekan. Peningkatan molaritas 8M ke 12M menaikkan kuat tekan umur 56 hari sebesar 92,6–131,4%. Variasi optimum C2 (*fly ash* 30%, NaOH 12M) menghasilkan kuat tekan tertinggi 33,74 MPa, melampaui mutu rencana. Pada molaritas rendah 8M, penambahan *fly ash* hingga 30% justru menurunkan kuat tekan 2,5% karena *fly ash* berperan sebagai filler inert akibat aktivasi belum optimal. Uji TCLP menegaskan sedimen mentah tergolong limbah B3, sehingga pemanfaatannya dalam beton geopolimer merupakan solusi potensial secara teknis dan ekologis untuk beton struktural bermutu tinggi.

Kata kunci: Beton Geopolimer, Abu Terbang, Molaritas Aktivator Alkali, Limbah Pengerukan Pelabuhan, Kekuatan Tekan.

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ABSTRACT

Fatmah Aisyah Siregar (NIM. 5211250013) "*Comparison of the Effect of Fly Ash Volume and Alkali Activator Molarity on thePerformance of Geopolymer Concrete Made from Port Dredging Waste*" *Thesis. Faculty of Engineering – State University of Medan. 2026*

This study analyzes the use of Belawan sediment as a 10% fine aggregate substitute in geopolymer concrete, as well as the effects of varying fly ash content (20% and 30%) and NaOH molarity (8M, 10M, 12M) on compressive strength, targeting a design strength of f'c 20 MPa. This study employed an experimental method using Type F fly ash from the Pangkalan Susu Power Plant as the primary material and an alkaline activator—a mixture of sodium silicate (Na2SiO3) and sodium hydroxide (NaOH) in a 2:1 ratio. Cylindrical specimens measuring 15 × 30 cm were cured at room temperature, and their compressive strength was tested at 7, 14, 28, and 56 days in accordance with SNI 1974:2011. Additionally, the Toxicity Characteristic Leaching Procedure (TCLP) was conducted on the initial sediment to determine heavy metal leaching concentrations prior to its use as a mixture component. Research results indicate that the molarity of the alkaline activator is a more dominant factor than fly ash volume in influencing the geopolymerization reaction and compressive strength development. Increasing the molarity from 8M to 12M boosted the 56-day compressive strength of the geopolymer concrete by 92.6% to 131.4%. The optimum result was achieved with mixture C2—combining 30% fly ash and 12M NaOH—which yielded the highest compressive strength of 33.74 MPa at 56 days, thereby exceeding the specified design strength. At the lower 8M molarity, however, increasing fly ash content to 30% actually reduced compressive strength by 2.5%, as the fly ash acted primarily as an inert filler due to suboptimal alkaline activation. TCLP test results also confirmed that raw sediment from Belawan Port is classified as hazardous and toxic waste (B3); thus, utilizing it as a fine aggregate substitute in geopolymer concrete offers a technically and ecologically viable solution for producing high-quality structural concrete.

Keywords: *Geopolymer Concrete, Fly Ash, Alkali Activator Molarity, Port Dredging Waste, Compressive Strength.*