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Investigating the effect of mullite on the permeability of distilled water through geopolymeric membrane based on blast furnace slag

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geopolymerization technique has been used for membrane synthesis to replace conventional ceramic membrane synthesis. For the past decade, researchers have been working on geopolymerization reactions by mixing fly ash and minerals as raw materials to replace expensive raw materials and high-temperature sintering steps to make mineral membranes[1][2].In this research, 3 types of geopolymeric membranes (Z_1, Z_2, Z_3) have been used to check the permeability of distilled water at 3 different pressures of 1 , 2 and 3 bar that in Z_1 and Z_2 membrane, with constant mullite percentage (4% W.t) with different ratio of Sodium silicate to Sodium hydroxide (1 and 2) at 3 bar pressure, the permeability of distilled water through membrane Z_1 with ratio (W.G)/NaOH=1 is equal to 9.4× $10^{-7}\, m^3/m^2 s$ and membrane Z_2 with ratio (W.G)/NaOH=2 is equal to 4.5× $10^{-7}\, m^3/m^2 s$. In the comparison of Z_1 and Z_3 membranes, this time by keeping the ratio (W.G)/NaOH = 1 and increasing the amount of mullite by (12% W.t) at a pressure of 3 bar, the permeability increased to 42× $10^{-7}\, m^3/m^2 s$. In the manufacturing of the mentioned membranes, the amount of micro silica in all membranes was determined to be (3% W.t) . Alkaline activators were used in the construction of Z_3 membrane to activate furnace slag, with 5.84 (g) of sodium hydroxide, 5.86 (g) of Sodium silicate (W.G) and 28.50 (g) of distilled water. The duration of the experiments for each pressure was 30 minutes, and for testing each membrane, the synthesized membrane was compacted for 25 minutes with pure water under a pressure of 4 bar. The results of FT-IR analysis show a broad main absorption band and strong in the range of 1024.13 cm^{-1}, which is the main band related to the asymmetric stretching vibrations of Si-O(Al) in the SiO4 tetrahedron and the asymmetric stretching of Al also in the peaks around 457.10 cm^{-1},[3]

Keywords: Membrane, blast furnace slag, mullite, geopolymerization

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