study the physical and microstructure properties of a geopolymer, that was reinforced with carbon nanotubes (CNT)

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1.Introduction

Carbon nanotubes due to their specific atomic structure have interesting chemical and physical properties according to those of graphite and diamond [1]. Discovered in the last century and thoroughly characterised by a team headed by Ijiama, in 1991, carbon nanotubes (CNTS) arose a great interest in the application of nanometric structures in numerous branches of research and industry [2]. CNTSs belong to the group of so-called nanomaterials, which feature unique physical properties, resulting directly from their structure of nanometric dimensions [3]. Alkali-activated materials, so called geopolymers, Alkali activated materials can practically serve as an alternative to conventional building materials, especially cement based concrete, but thanks to its parameters can be applied in a number of other disciplines (eg. in the restoration of monuments, etc.). Despite the fact that studies of alkali-activated materials have been ongoing since the sixties of the last century, their potential is still exploited only in sporadic scale [4]. This review is to summarize the literature reporting work done on study the physical and microstructure properties of a geopolymer, that was reinforced with carbon nanotubes (CNT)

2. Literature Review

Carbon nanotubes may be classified as single-walled carbon nanotubes (SWNTs), double-walled carbon nanotubes (DWNTs) or multi-walled carbon nanotubes (MWNTs). SWNT and DWNT comprise cylinders of one or two (concentric), respectively, graphene sheets, whereas MWNT consists several concentric cylindrical shells of graphene sheets [5]. A further study on the effect of adding carbon nanotubes to fly-ash-based geopolymer has shown an increase in the mechanical and electrical properties of geopolymer nano-composites when compared to the control paste [6]. However, the higher mechanical properties of the MWCNTs alone do not ensure a mechanically superior nanocomposite geopolymer. Previous studies have shown that sodium hydroxide (NaOH) acts as a surfactant and removes oxidation debris from the surface of the MWCNTs, consequently allowing them to de-

bundle and form well-dispersed nanotubes within the geopolymetric matrix[7]. Recently, Khatera et al. [7] investigated the effect of MWCNTs on the properties of slag geopolymeric mortar and found that the enhancement in mechanical strength with MWCNTs. Morsy et al. [8] have investigated the effect of different concentrations of MWCNTs with nanoclay particles on the compressive strength of cement mortar and they noticed that the nano-clay particles improved the dispersion of CNTs within the mortar. Lio et al. [9] studied the influence of MWCNTs mixed with silica fume (SF) on the mechanical property of cement-based composites. Hunashyal et al.[10]fabricated hybrid composites of plain cement by integrating both carbon micro-fibers (CMFs) and MWCNTs.

Geopolymerization was conducted for MWCNTs and FA, when the nano were mixed with aqueous NaOH solutions of 5, 10, and 15 M concentrations. Sodium silicate solutions containing 10.15% Na2O, 31.38% SiO2, and 58.47% H2O were used as alkaline activators. For all mixtures, the weight of the sodium silicate to sodium hydroxide solution was fixed at 2 for fly ash based geopolymer [12]
different contents of the mixtures of FA and the MWCNTs were used for 0, 1, 2, 3, 4, and 5wt% for the MWCNTs at different NaOH concentrations. First, the sodium silicate (Na2SiO3) and NaOH solutions were premixed in each plastic container and were then left until the solutions reached room temperature. In the four mixed proportions of the MWCNTs described above, geopolymerization was conducted using 10 15 or 20 M NaOH solutions. [13]
The geopolymer samples were prepared from the mixed raw materials The FA and MWCNTs were mixed together and then mixed as a powder with alkaline solutions by shaking for 1 min to achieve good homogeneity. After mixing, the liquid pastes were poured into a plastic cubic container with 2×2×2 cm. Then these geopolymers were cured at room temperature for 24 h. For characterization of these specimens, X-ray diffraction (XRD) (D8 Advanced machine; Bruker Analytik GmbH), XRF (XRF-zsx-Primus), and The morphology of the surface was investigated under the secondary electron microscope SEM (SEM, JEOL-JSM-840A) were used. To analyze the geopolymer components and phases, X-ray diffractrometry was used with a scanning angle of 10–80 deg. In the SEM micrograph of the geopolymers, the fractured surfaces of geopolymer samples were fixed on aluminium stubs with carbon tabs. Then the

samples were coated with a thin layer of gold. Secondary electron detectors were used to investigate the geopolymer samples. All geopolymer nano-composites showed lower densities and higher porosities than the control paste. The addition of MWCNTs has increased the density and reduced the porosity of geopolymer nano- composites when compared to control geopolymer past [13]

Several kinds of raw materials were used to prepare the samples. The function of the binder takes alkali-activated form of finely ground granulated blast furnace slag. Activation was carried in waterglass solution, the silica modulus was treated with 50 % sodium hydroxide solution to Ms = 2,0. As filler was used norm-test sand and carbon nanotubes in different amounts for different sets , The presence of carbon nanotubes in the sample creates a conductive path, which corresponds to a reduction of electrical resistance for samples with higher concentration of MWCNTs, such phenomenon can be observed. [14]

3. Conclusion

Adding MWCNT to alkali activated geopolymer paste specimens increases and offers an extra nucleation sites for geopolymer formation and accumulation. [13]

The NaOH solution appears to has was positive effect on the dispersion quality of MWCNTs up to 1 wt.% Increaseing in concentration of NaOH solution shows the dense of microstructure of geopolymer paste due to it can be complete the reaction between fly ash and activator solution hence it causes a good compressive strength**.** [14]

4. References

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