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EXTENDED ABSTRACT

Impact of pH Variations of Kaolinite upon Some of its Geotechnical and Geo- Environmental Properties

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1. Introduction

The use of clayey soils as clay barrier in landfills is very common. This is due to the suitable adsorption, buffering capacity and water retention of clays (Yong et al., 1992). However, changes in geotechnical and microstructural properties of clayey soils in acidic and alkaline conditions have caused many challenges in the application of clayey soils in these projects (Cherian, 2018). In industrial regions, soils are subjected to the acidic rains; therefore they usually encounter acidic conditions. On the other hand, in humidity condition areas, due to the evaporation of soil pore fluid, soils usually run into the alkaline conditions. These environmental conditions have caused the soils to have different initial pH backgrounds (Chemeda, 2015). These changes in the pH of clayey soils may cause some changes in geotechnical and geo-environmental properties of soil. Such a change can affect the long durability of barrier properties. In spite of several researches which have been performed on the geo-environmental properties of clayey soil, the review of the previous researches shows that there is a lack of extensive research on the subject of pH effect of clay on its properties and behaviour (Ouhadi and Yong, 2003). In addition, in the recent years the use of kaolinite as a lowest barrier clay layer in landfills has increased. Therefore, the main objective of this paper is to investigate on the impact of pH variations of kaolinite upon some of its geotechnical and geo-environmental properties.

To achieve this objective in this research with addition of acid and alkaline to kaolinite, several soil samples with different initial pH were prepared. Then, with the application of a series of microstructural and macro-structural experiments such as Atterberg limits, grain size distribution, unconfined compression strength and XRD experiments on kaolinite samples having different initial pH (3, 5, 9, and 12), the variations of some of its geotechnical and geo-environmental properties are investigated.

2. Methodology

Kaolinite is known as a pH dependent mineral (Wang and Siu, 2006). The kaolinite sample of this research is called Super Zenous kaolinite which has been taken from North West of Iran. In this research HCl and NaOH has been used to adjust the pH of kaolinite samples in different acidic and alkaline levels. Atterberg limits, proctor tests, grain size distribution measurements, and unconfined compression experiments were performed to address the impact of initial pH of kaolinite on its mechanical properties. In addition, a series of XRD rests were implemented to investigate on the influence of pH variations upon microstructure of kaolinite.

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3. Results and discussion

The achieved results indicate that even though the change in initial pH of kaolinite makes more than 52% changes in its grain size distribution curve (Fig. 1), with the change of initial pH of kaolinite from acidic to alkaline conditions, the results of geotechnical experiments such as liquid limit, plasticity index, unconfined compression strength have shown only 3%, 4%, and 3%, increase, respectively. The maximum dry density of soil reduces only 3% by changing the initial pH of kaolinite. Furthermore, the results of XRD experiments on kaolinite samples with different initial pH show that the intensity of major reflection line of kaolinite in soil pH of 3, 5, and 12 in comparison to that of for natural kaolinite (pH=9), show only 3%, 7%, and 7% increase, respectively.

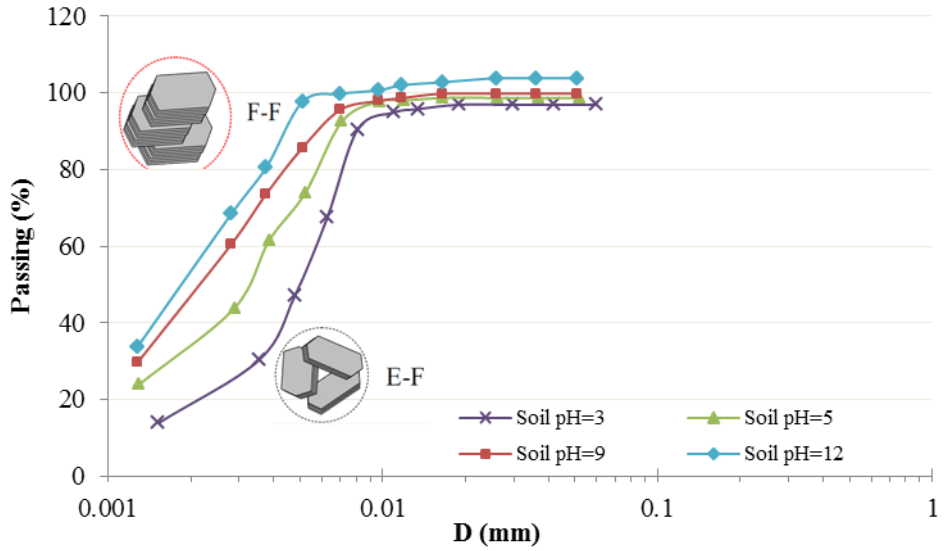

Fig. 1. Variations of grain size distribution of kaolinite at pH 3, 5, 9, and 12.

4. Conclusions

Based on the experimental results of this research it is concluded that in spite of some changes on the results of grain size distributions, the changes on the results of geotechnical and geo-environmental properties of kaolinite at different pH conditions are very low and negligible. Based on the results of this paper, it seems that due to the stability of the geotechnical and microstructural properties of kaolinite in acidic and alkaline conditions, the use of kaolinite as the lowest clay barrier of industrial and municipal landfills has a suitable justification specifically in the application of kaolinite with layers of bentonite.

5. References

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