International Research Journal of Engineering and Technology (IRJET) e-ISSN: 2395-0056
Volume: 08 Issue: 03 | Mar 2021 www.irjet.net p-ISSN: 2395-0072

FLY ASH STIMULATION USING POTASSIUM HYDROXIDE (KOH)

Manuraj Singh Aharwal, Abhishek Tiwari

Department of Civil Engineering, Jabalpur Engineering College, Jabalpur-482011, India

---

Abstract: *In India, coal based thermal power plants generates majority of power. In the year 2020, 53.3% of total power generated in India was from coal. In India bituminous coal is used whose coal ash ranges from 30% to 50%. The fly ash generation in India was 226 million tonnes in 2019-20 which has increased from 145 million tonnes in 2011-12. Disposal of such immense quantity of fly ash causes challenging problems, in the form of land usage, health and environmental hazards. Fly ash particle ranges from 0.5 µm to 300 µm. As the fly ash particles are smaller in size, there are several problems associated with its disposal such as it affects the air quality, makes land unsuitable for agricultural practices, adverse effects on aquatic life, makes water unsuitable for domestic purposes. It also acts as slow poison for humans as it enters the pulmonary region of lungs of humans and also causes suffocation. Therefore disposal of fly ash should be done deliberately. Although its utilization has increases from 67.13% in 2017-18 to 83.05% in 2019-20, but still its disposal should be done in a vigilant manner as the quantity is still huge. Therefore by enhancing the properties not only its disposal can be reduced, its utilization can be augmented.*

1. INTRODUCTION

Fly ash a finely divided residue is formed due to combustion of pulverized coal and is transported by exhaust gases from the combustion chamber and is separated by electrostatic precipitator[6]. Coal-fired electric and steam generating plants are main source of fly ash generation[6]. There are two ways in which fly ash can be disposed off- the dry form or in wet form in which it can also be mixed with water and disposed as slurry in ash ponds. Disposal of fly ash is one of the extreme challenges faced by the thermal power plants in India.

The most common fuel that is used in Thermal power plants is still coal. Fly ash is the by-product obtained on burning coal. Fly ash production has increased by approximately 50% in the last decade[1]. Though the utilization of fly ash is also increasing every year, but still a large quantity of the fly ash is still disposed in India. In year 2019-20 83.05% of fly ash was utilized still the remaining amount of fly ash disposed off weighs 38.32 million tonnes[2]. Fly ash contains toxic elements and compounds. Fly ash discharged in the environment cause water, land and air pollution.

Therefore properties of fly ash need to be stimulated so its utilization can be increased.

This paper shows the comparative study of variation in properties of fly ash on being activated by KOH at different proportions (0%, 2%, 4%, 6%). The variation in OMC, MDD, permeability, pH and UCS is studied.

2. Materials and Methodology

Fly ash for the study was taken from Birsinghpur Thermal Power Plant, Satna. Foreign matters were removed and the fly ash was sieved through 1 mm sieve. The fly ash was then oven dried at the temperature of 105-110 °C and then sieved through 425 µm sieve. After that the samples were kept in air tight container for subsequent use. Specific gravity as determined by IS 2720: Part 3 was found to be 1.74. KOH was purchased from local market and was of reasonable purity. Fly ash was activated by adding 2%, 4% and 6% of alkali by weight to the fly ash. The samples of fly ash mixed with different alkali (0%, 2%, 4% and 6%) were cured for 0 days for OMC, MDD determination. Permeability was determined after 0, 7, 14 days curing (at 0% and 6% alkali concentration). pH was determined after 0, 7, 14 days curing (at 0% and 6% alkali concentration) and UCS was determined after 0, 7, 14 and 28days curing (for 0%, 2%, 4% and 6% alkali concentration). The subsequent tests were carried out by confirming to IS codes, strictly.

3. RESULTS AND DISCUSSION

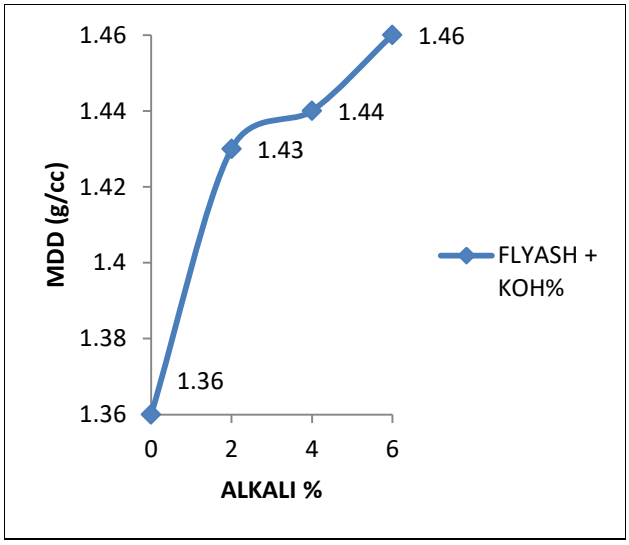

Fig. 1: Variation of MDD (g/cc) with KOH alkali content

Fig.1.shows Maximum dry density (MDD) of fly ash increases on increasing alkali concentration

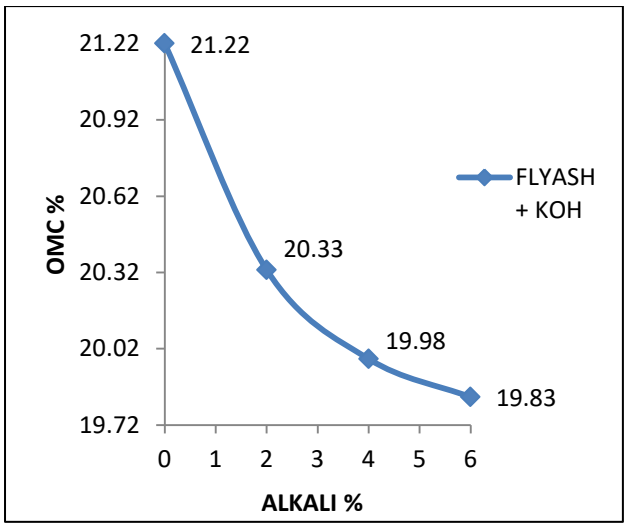

Fig. 2: Variation of OMC (in %) with KOH alkali content

Fig.2 shows that the optimum moisture content (OMC) decreases on increasing alkali concentration.

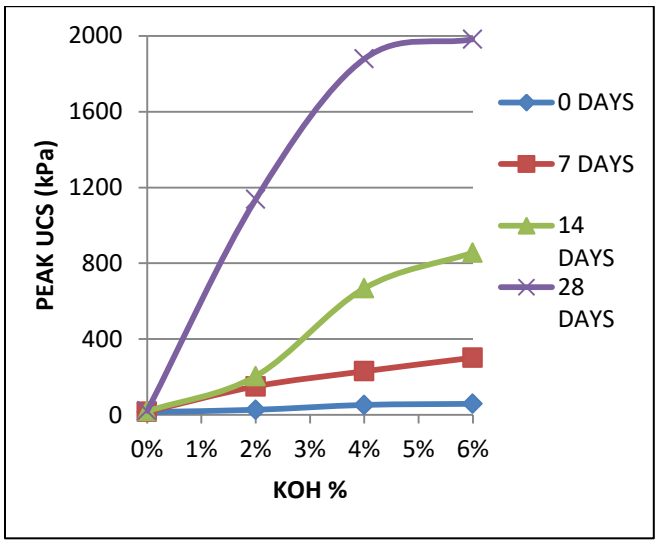

Fig. 3: Variation of Peak UCS values with KOH alkali content

Fig. 3 show the trend for peak unconfined strength of KOH respectively. The graphs show that strength of alkali activated fly ash increases on increasing the curing period. The maximum value for KOH activated fly ash is 1981.924 kPa achieved at 28 days curing and at 6% alkali concentration. The peak value for KOH alkali activated fly ash is almost 90 times more than that of pure fly ash at 28 days curing.

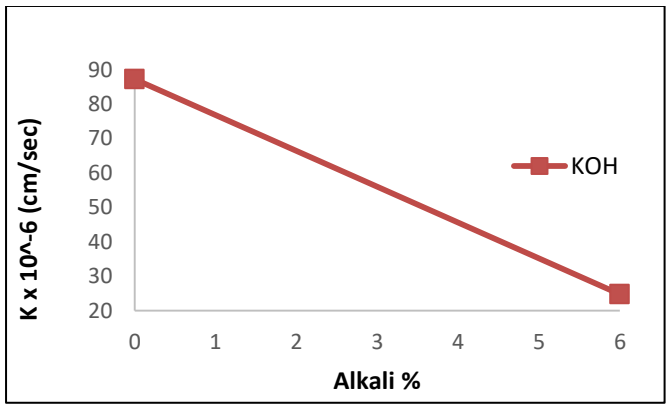

Fig. 4: Co-efficient of permeability variation

Fig. 4 shows the change in permeability values for pure fly ash and alkali activated fly ash. The result shows that the k value for pure fly ash is 87.2 x 10^{-6} cm/sec. The value of coefficient of permeability for alkali activated with 6% KOH is 24.2 x 10^{-6} cm/sec for 0 days curing.

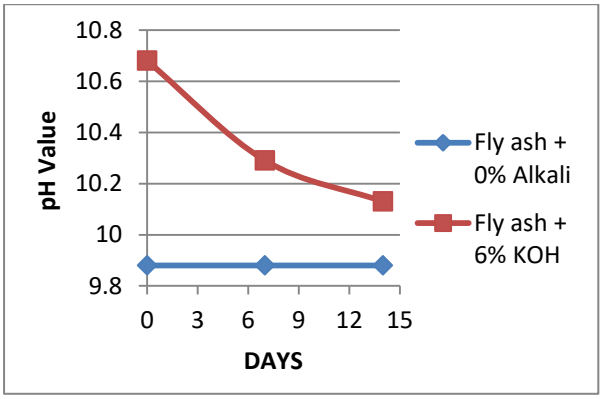

Fig. 5: Variation of pH values with KOH alkali content at Different Curing Period

Fig. 5 shows pH value of activated alkali at 0% and 6% concentration, cured at 0, 7 and 14 days. KOH being a stronger alkali has higher pH. The pH values decreases as curing days increases.

4. CONCLUSION:

Addition of alkali to pure fly ash stimulates the properties of pure fly ash. Maximum Dry Density (MDD) and Unconfined Compressive Strength (UCS) of fly ash are increased whereas Optimum Moisture Content (OMC) and permeability decreases on addition of alkali to fly ash. Unconfined Compressive Strength (UCS) of alkalized fly ash increases with increase in alkali content and curing period. Thus, it can be concluded that on addition of alkali to fly ash, its properties are stimulated and therefore its utilization can be increased in various works.

REFERENCES

1. Report on power generation in India in 2020 by Ministry of Power, Government of India.
2. Report on fly ash generation in India in 2019-20 by Central Electricity Authority.
3. Report on fly ash generation in India in 2017-18 by Central Electricity Authority.
4. Singh (2017): "Quantification of desiccation cracks using image analysis technique" International Journal of Geotechnical Engineering, DOI: 10.1080/19386362.2017.1282400.
5. Chowdhury (2015) "An Experimental Investigation on Strength Characteristics of Alkali Activated Fly Ash". Procedia Earth and Planetary Science 11 (2015) pp. 402 – 409.
6. Chowdhury (2015) "Alkali Activated Fly Ash: A New Generation Geo-material" 5th Young Indian Geotechnical Engineer Conference Mar 14-15, 2015, India.
7. S.P. Singh, A. Pani (2014) "Evaluation of Lime Stabilized Fly Ash as A Highway Material". International Journal of Environmental Research and Development. ISSN 2249-3131 Volume 4, Number 4 (2014), pp. 281-286.
8. Report on fly ash generation in India in 2012-13 by Central Electricity Authority.
9. Report on fly ash generation in India in 2011-12 by Central Electricity Authority.
10. U. S. Energy Information Administration, India's Central Electricity Authority.