Utilization of Coal Ash From a Geo-environmental Point of View

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Introduction

As one of the largest industrial wastes in Japan, management of coal ash is considered one of the main issues from the point of view of environmental engineering due to the lack of disposal sites. In Japan about 20% of the electrical power is generated by coal thermal power plants. Furthermore , the number of these coal thermal power plants is expected to increase in the coming century yielding about 10,000 Gg/year of coal ash. Now, even though there is a big amount of coal ash used in cement manufacturing industry, there is a real need to find a way to utilize this huge amount of coal ash wastes. Geotechnical engineering has found its way to make this material applicable in some areas of earth works (Huang and Lovell, 1993 ; Tanabashi et al, 1996). In this research the authors have carried out a set of tests such as compaction test and permeability test. The coal ash used in this research was obtained from Kyushu Electric, Omura city, Nagasaki prefecture. It has a particle density of 2.05 g/cm^3, maximum grain size of about 2 mm, uniformity coefficient of 2. The gradation curve of coal and its water content-dry density curves are shown in Figs. 1 and 2 respectively. Based on this experimental study the physical characteristics of coal ash was evaluated together with its chemical ability if used as an adsorbent or a filter layer beneath all the structures where the chemical pollution is expected. Regarding the geotechnical aspect, hydraulic conductivity and compaction tests show that the coal ash is a very suitable material when used as fill material due to its low hydraulic conductivity and non existence of the optimum moisture point on the water content-dry density curve . Two major chemical analyses were carried out namely, pH test and Ultraviolet (UV) spectroscopy analysis. The two tests have indicated that coal ash is applicable as a filter material in reducing the effect of the harmful organic matters such as benzene.

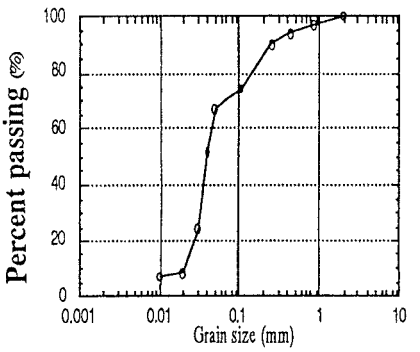

Fig. 1 Gradation curve of coal ash.

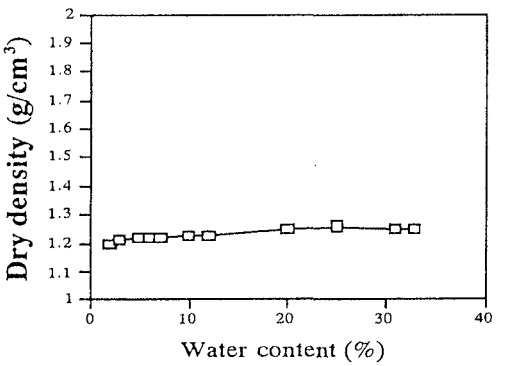

Fig. 2 Water content-dry density curve of coal ash

Methodology and Test Specimens

The ability of coal ash as an adsorbent of organic compounds was studied by Ultraviolet spectrophotometry using benzene as an organic compound.. About 200g of coal ash was washed with water in order to get rid of all the water soluble substances which may yield any positive errors. Samples for Ultraviolet spectroscopy were prepared by using three 15 cm in length and 1.5 cm in diameter glass test tubes with a hole punched at the bottom of each test tube. These tubes were packed with coal ash to a height of 3, 6, and 9cm at a density of 1.2g/cm^2. This was followed by washing the packed test tubes with a solution of water and methanol. The purpose of this washing was to use the outflow as the blank sample in the ultraviolet analysis. Finally a methanolic solution of benzene was allowed to pass through the three prepared test tubes for a period of 30 minutes and then the outflow was collected for chemical analysis.

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For pH value analysis the same procedure was also followed by passing of ordinary water, Nitric acid, and Sulfuric acid through the coal ash packed columns. The full experiment diagram is shown in Fig. 3.

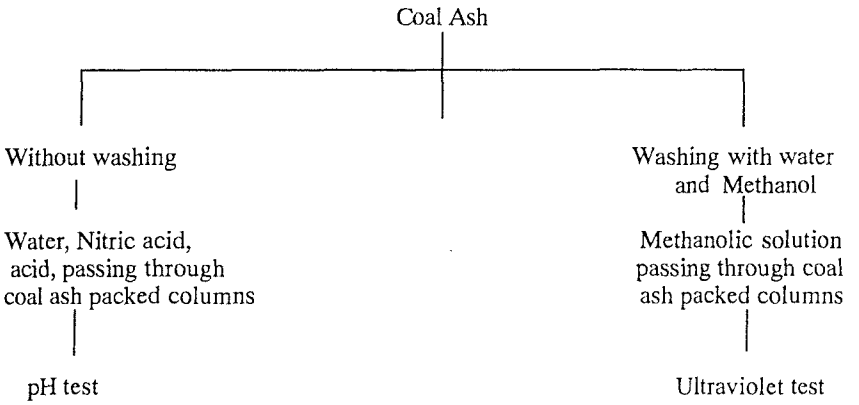

Fig. 3 Experiments schematic diagram

Discussion and Results

Ultraviolet analysis by using a Spectrograph machine was used in this research in order to check the concentration of benzene before and after passing through the coal ash columns. The change of absorbance of benzene at a wave length of 254 nm was monitored. Results indicate that the concentration of benzene as an organic material was reduced to about one-sixth . Figure 4 shows the complete results of Ultraviolet analysis on which the absorbance of benzene before entering the column ash was about 3.2 compared with 0.4 when passing through a 9 cm column of ash. Figure 5 shows the results of pH analysis on which the coal ash was proved to be an effective material in converting the acid materials to alkali materials.

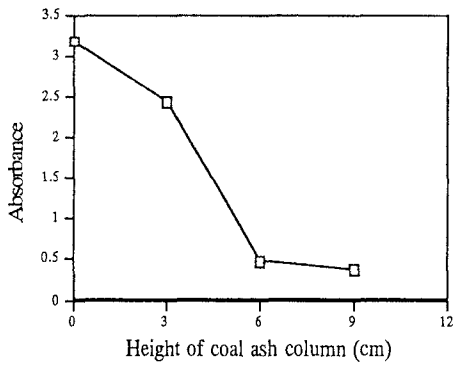

Fig. 4 Results of Ultraviolet test .

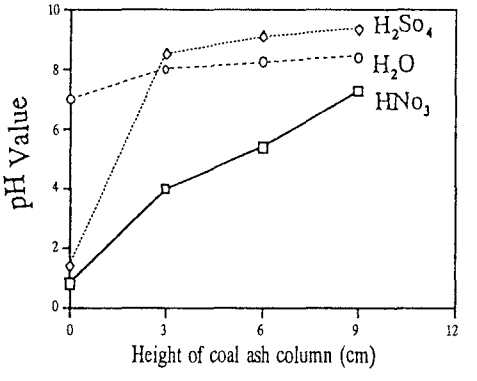

Fig. 5 pH test results of coal ash .

Conclusion

The main conclusion of this research is that coal ash could be used as a filter layer beneath structures that deals with harmful and organic materials.

References

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