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*Short Note*

# Preparation of Water Absorbing Pavement Material from Fly Ash

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**Abstract:** Fly ash generated from thermal power plants are considered to be a major environmental pollutant due to the toxic material. As per the recent development, fly ash presently is getting dumped as a waste. Being highly fine in nature, it has got high contribution in air pollution and water pollution. Many attempts have been made to utilize fly ash in various aspects such as mine filling, preparation of bricks, different concretes, textiles and many other applications. In concrete most of the research are concentrating on preparation of high tensile strength concrete which can't absorb water into it. In the present study, an attempt has been made to prepare a pavement composite which can absorb water. It has been found that utilization of such a composite material for the purpose of pavement preparation will help for groundwater recharging.

**Key words:** Fly-ash, pavement, absorption study, water pollution, concrete.

## Introduction

Fly ash is a finely divided waste by-product obtained from the combustion of pulverized coal in suspension fired furnaces of thermal power plants. It is generally finer than cement and consists of mostly spherical glassy particles of complex chemical as well as mineralogical composition. During the combustion of coal, the products formed are fly ash, bottom ash and gas or vapours. Fly ash is the finer part of the burnt mineral matter which is entrained part of flue gases and trapped by the electrostatic precipitator and bottom ash is the residue consisting of coarser discrete of fused particles heavy enough to settle down from the combustion zone of the furnace on to the bottom of the furnace (Clearfield et al., 1973; Clearfield and Stynes, 1964; Dwyer and Dyer, 1984; Gu et al., 2000; Srinivasan and Grutzeck, 1999). The properties of fly ash are extremely variable and depend upon several factors such as coal (type, nature and origin), degree of coal pulverization, flame temperature, oxidation conditions, nature of pretreatment of the coal, method of collection and storage of fly ash. Fly ash is an environmental pollutant and it is a great concern to find out ways and means to use this waste material (Varshney and Khan, 1999; Nabi et al., 1982; Nabi et al., 1985; Nabi and Siddiqi, 1985). Before finding out the suitability of this waste material, it is very important to know the mineralogy and chemical characteristics and other physical properties of the material. Fineness of the fly ash is a very important physical characteristic which influences the pozzoanic activity of fly ash more than any other physical factor. It is expressed by specific surface area. Specific surface is greatly influenced by un-burnt carbon content, particle shape and size and specific gravity of the fly ash.

The mineralogical composition of fly ash varies according to quality and fineness of the pulverized coal, type and amount of mineral matter associated into it, method of burning and control of the combustion system. The general utilization consists of preparation of adsorbing material, treatment of waste water, removal of dies from colour industry waste. The synthesis of

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zeolite, preparation of concrete, road sub-base material, mine back fill, preparation of geo-polymer etc. In concrete world the material which is prepared is non-porous with high tensile strength (Nabi and Siddiqi, 1986; Khanna et al., 1999, 2000; Snell and Snell, 1965). The material which is prepared for paving is high water resistant in nature. In the present work an attempt has been made to prepare a paving material with water soaking property.

## Materials and Method

In the present study the fly ash used is of Class F grade with the following compositions as represented in Table 1. For the preparation of pavement material an organic binder is used. The binder to fly ash is mixed at different ratio. The composite having the highest tensile strength is taken as the material under consideration.

**Table 1: Chemical composition of fly ash**

| *Constituents* | *Concentration %* |
|---|---|
| $SiO_2$ | 59.03 |
| $Al_2O_3$ | 25.86 |
| $Fe_2O_3$ | 5.81 |
| $TiO_2$ | 1.71 |
| CaO | 1.07 |
| MgO | 0.68 |
| $K_2O$ | 1.89 |
| $Na_2O$ | 0.07 |
| $P_2O_5$ | 0.72 |
| $SO_3$ | 0.14 |
| LOI (850°C) | 1.80 |
| Minor constituents | 0.34 |

## Result and Discussion

A semi-porous material has been prepared using class F-fly ash with a suitable percentage of binder. The fly ash and binder mixture is made uniform and kept overnight with continuous mechanical mixing process by which the binder gets through absorbed in the fly ash sample. The reaction mixture is then subjected to roasting in a temperature range 500-950°C with 50°C interval. The result obtained for tensile strength and relative density are represented in Table 2 and Table 3 respectively. Effect of time on the tensile strength of sinter material is represented in Table 4. The water absorption of sinter was determined with different water solid ratio. The water absorption can be used to represent and open porosity of the sinter material. The measurement was done by calculating two different specimen under over-dry and fully saturated solution. The percentage of water absorption for all samples varied in the range 2.5-16.7% which represented a sintered material of two days preparation age. The results obtained are represented in Table 5.

**Table 2: The increase in tensile strength along with the rise in temperature**

| *Temperature in °C* | *Tensile strength (MPa)* |
|---|---|
| 500 | 30 |
| 550 | 32 |
| 600 | 38 |
| 650 | 41 |
| 700 | 43 |
| 750 | 48 |
| 800 | 52 |
| 850 | 55 |
| 900 | 58 |
| 950 | 61 |

**Table 3: The relative density of the composite material**

| *Temperature in °C* | *Density* |
|---|---|
| 500 | 1.3 |
| 550 | 1.42 |
| 600 | 1.47 |
| 650 | 1.53 |
| 700 | 1.59 |
| 750 | 1.64 |
| 800 | 1.69 |
| 850 | 1.71 |
| 900 | 1.78 |
| 950 | 1.83 |

**Table 4: Effect of time on the tensile strength of the sintered material**

| *Time in mins* | *Tensile strength (MPa)* |
|---|---|
| 10 | 30 |
| 30 | 34 |
| 60 | 39 |
| 90 | 42 |
| 120 | 46 |
| 180 | 49 |
| 240 | 50 |
| 300 | 61 |

**Table 5: Absorption ratio variation with reference to water:sintered mass ratio**

| *Water/Sinter mass solid ratio* | *Absorption ratio (%)* |
|---|---|
| 2:1 | 2.5 |
| 3:1 | 3.7 |
| 4:1 | 5.6 |
| 5:1 | 7.2 |
| 6:1 | 9.8 |
| 7:1 | 11.2 |
| 8:1 | 13.6 |
| 9:1 | 15.0 |
| 10:1 | 16.7 |

## Conclusion

The above study revealed that by the use of suitable binder it is possible to develop a fly ash used as paving material which is highly efficient for water absorption. The optimum condition to obtain the above material are sintering temperature 950°C, sintering time two hours with addition of a binder in the ratio 20:1 for fly ash and binder. The result shows it is possible to produce water absorbing paving material with the tensile strength of 61% with density of 1.83. The water absorption capacity is found to be 16.7%. Thus it is possible to prepare a water soaking pavement material using a specific binder along with fly ash.

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# Calendar of Events

**2014 International Conference on Coastal and Ocean Engineering (ICCOE 2014)**
4th and 5th April 2014
Dubai, United Arab Emirates
Website: http://www.iccoe.net/
Contact person: Ms Mickie Gong
Organized by: CBEES

**4th International Conference on Environment Science and Engineering (ICESE 2014)**
24th and 25th April 2014
Erzurum, Turkey
Website: http://www.icese.org/
Contact person: Mr. Issac Lee
Organized by: CBEES

**Smart Water Systems 2014**
28th and 29th April 2014
Regents Park Hotel, 128 King Henry's Road, London, NW3 3ST, United Kingdom
Website: http://atnd.it/5324-0
Contact person: Andrew Gibbons
Organized by: SMI Group Ltd

**5th International Conference on Environmental Science and Technology (ICEST 2014)**
14th to 16th May 2014
Gdansk, Poland
Website: http://www.icest.org/
Contact person: Ms. Flora Feng
Organized by: CBEES

**2014 International Conference on Energy, Environment and Sustainable Economics**
26th May to 27th July 2014
Bangkok, Thailand
Website: http://www.iceese.org
Contact person: Dr Sebastian
Organized by: SCIE

**Water Pollution 2014**
26th to 28th May 2014
The Algarve, Portugal
Website: http://www.wessex.ac.uk/water2014
Contact person: Genna West
Organized by: Wessex Institute of Technology, UK

**Water Convention 2014 (an event of Singapore International Water Week)**
1st to 5th June 2014
Singapore
Website: http://www.siww.com.sg/water-convention
Contact person: Charmaine Tan
Organized by: Singapore International Water Week Pvt. Ltd

**ACSEE2014 - The Fourth Asian Conference on Sustainability, Energy and the Environment**
12th to 15th June 2014
Osaka, Japan
Website: http://acsee.iafor.org
Contact person: Kiyoshi Mana
Organized by: IAFOR - The International Academic Forum

**Storm Warning 2014**
14th to 17th June 2014
Beijing, China
Website: http://www.iseis.org/sw2014/
Contact person: Mr. Li Yanfeng
Organized by: North China Electric Power University

**Sixth International Conference on Climate Change**
27th and 28th June 2014
Reykjavik, Iceland
Website: http://on-climate.com/the-conference/call-for-papers
Contact person: Conference Director

# Correction

With reference to paper titled "Suitability of Groundwater for Irrigation in the Sheri Nala Basin, Sangli District, Maharashtra, India" published in *Asian Journal of Water, Environment and Pollution*, Vol. 9, No. 1(2012), pp. 91-103 by A.S. Yadav[1] and P.T. Sawant[2].

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On page 98 of paper, the correct formula of Kelley's ratio is

$$\text{Kelley's ratio} = \frac{\text{Na}}{\text{Ca} + \text{Mg}}$$

The error is regretted.