

# ADVANCES IN MATERIALS ENGINEERING

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## Volume 1

Edited By:  
Zahurin Halim  
Iskandar Idris Yaacob  
Md Abdul Maleque



IIUM PRESS

INTERNATIONAL ISLAMIC UNIVERSITY MALAYSIA

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**IIUM Press**

Published by:  
IIUM Press  
International Islamic University Malaysia

First Edition, 2011  
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Perpustakaan Negara Malaysia

Cataloguing-in-Publication Data

ISBN: 978-967-418-167-3

Member of Majlis Penerbitan Ilmiah Malaysia – MAPIM  
(Malaysian Scholarly Publishing Council)

Printed by :  
**IIUM PRINTING SDN. BHD.**  
No. 1, Jalan Industri Batu Caves 1/3  
Taman Perindustrian Batu Caves  
Batu Caves Centre Point  
68100 Batu Caves  
Selangor Darul Ehsan

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## Characterization and Utilization of Fly Ash

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**Keywords:** Fly ash, Waste, Environment, Characterization

**Abstract.** As waste material from power plants, fly ash causes air pollution creating significant environment problems. In power plant the fly ash is collected using filter and other techniques. The ash is commonly used for landfill. However the ash may be used for other application which has higher economic value. Because of that, some research on the characterization of fly ash was carried out. Three types of ashes that are fly ash type 1 (FAB), fly ash type 2 (FAD) and bottom ash were studied. The composition, structure, morphology and particle size distribution have been investigated using scanning electron microscope with energy dispersive x-ray, particle size analyzer and x-ray diffractometer. The results show that all types of fly ash have  $\text{SiO}_2$ ,  $\text{Al}_2\text{O}_3$ , and  $\text{Fe}_2\text{O}_3$  as their major constituents. The constituent presents in both crystalline and amorphous phases. The chemical composition of the three types of ash does not differ much. The difference is in term of minor constituent such as  $\text{K}_2\text{O}$  and  $\text{P}_2\text{O}_5$ . The ranges of particle sizes are  $0.17 \mu\text{m}$  to  $275.19 \mu\text{m}$  for FAB,  $0.17 \mu\text{m}$  to  $84.99 \mu\text{m}$  for FAD, and  $0.16 \mu\text{m}$  to  $290.01 \mu\text{m}$  for BA. FAD has narrow particle size distribution compared to FAB and BA.

### Introduction

Environmental issue such as management of waste material and air pollution had raised much concern. Everybody has responsibility to protect the environment. One way to minimize the waste materials is to reuse them and create some valuable products. Here, solid waste material that is coal ash powders from power plants have been characterized in order to utilize them for something that has higher economic values such as for the development of light weight composite material for automotive application.

Large amounts of solid waste are produced during combustion of coal in thermal power plants. This residue is known as ash and can be classified according to the zone where it recovered from. There are two kinds of ash that are fly ash and bottom ash. About 80% of the ash is entrained in the gas flow and it is captured and recovered as fly ash. The remaining 20% of the ash is bottom ash which is collected in a water filled hopper at the bottom of the furnace. A huge amount of ash powders generated in thermal power plants causes disposal related problems. The total worldwide production of coal ash in 1992 was 459 million tones and only 153 million tones that are 33.3% are utilized. In 1992, Malaysia produced 227000 tones of ash and 45000 tones or 19.8% was used as blended cement [1].

Fly ash has three main elements, silicon, aluminum and iron, the oxides of which account for 75-85% of the material. Fly ash consists principally of glassy spheres together with some crystalline material and un-burn carbon. Silicon and aluminum are mainly present in the glassy phase, with small amounts of quartz. The iron appears partly as the oxides magnetite ( $\text{Fe}_3\text{O}_4$ ) and hematite