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FROM WASTE TO WEALTH: BOILER ASH GEOPOLYMER COMPOSITE

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PROBLEM STATEMENT

- Abundant of waste material from palm oil industry in Malaysia was produced - approximately 4 million tons/year from its waste was generated, which leads to extensive criticism and complaints, which are prompted mainly by its chronic, carcinogenic, and bio-accumulative effects.
- The waste such as palm fibers, nut shells, palm kernel and empty fruit bunches is the solid waste obtained from palm oil processing for oil extraction - incinerated in the boiler and the ash produced at the bottom of boiler known as boiler ash.
- Global warming - boiler ash geopolymer composite is more environmental friendly due to low CO₂ emission during manufacturing process.



PRODUCT DESCRIPTION

- Boiler Ash Geopolymer Composite** represent an innovative technology that is generating considerable interest in the construction industry, particularly in light of the ongoing emphasis on sustainability.
- The mechanical properties (i.e. strength and water absorption) are comparable to the existence product in market.
- This product lead to reduction of CO₂ emission by reducing the used of ordinary Portland cement (OPC). The production of OPC consumes high amount of energy and also high CO₂ emission. Thus, this product is more environmental friendly by using the abundant resources available around us.

MANUFACTURING PROCESS



PRODUCT PERFORMANCE

PROPERTIES	PERFORMANCE OF PRODUCT
Compressive Strength	12-30 MPa
Water Absorption	less than 5%
Chemical Resistance	acid resistant stabilized without further mass change
Carbon Dioxide Emission	Less compared with OPC Concrete (i.e., 90% CO ₂ emission reduction)

NOVELTIES

- Utilizing waste material (boiler ash is waste from palm oil industry)
- Alternative material to OPC as cementitious binder
- Low energy consumption
- Easy fabrication process, low processing temperature
- Environmental friendly - low CO₂ emission
- Wide range of applications of product

POTENTIAL APPLICATION

- Construction material - Concrete and Brick
- Coating
- Replacement for cement available in market
- Refractory items
- Decorative materials



PUBLICATIONS

a) Conference Proceedings and Journals

- Y. Zarina, A. M. Mustafa Al Bakri, H. Kamarudin and I. Khairul Nizar, "Review on the Utilization of Palm Ash for Geopolymer Composite", The 2nd International Malaysia-Ireland Joint Symposium on Engineering, Science and Business 2012 (IMieJS 2012), 18-19 June 2012, Putra World Trade Center (PWTC), Kuala Lumpur Malaysia.
- Y. Zarina, H. Kamarudin, A. M. Mustafa Al Bakri, I. Khairul Nizar and A. R. Rafiza, "Effect of Preliminary Calcinations on the Properties of Boiler Ash for Geopolymer Composite", The 3rd International Malaysia-Ireland Joint Symposium on Engineering, Science and Business 2013 (IMieJS 2013), 11-13 June 2013, Athlone, Ireland.
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- Zarina Yahya, Mohd Mustafa Al Bakri Abdullah, Kamarudin Hussin, Khairul Nizar Ismail, Andrei Victor Sandu, Petrica Vizureanu, Rafiza Abd Razak "Chemical and Physical Characterization of Boiler Ash from Palm Oil Industry Waste for Geopolymer Composite", Rev. Chim. (Bucharest), Vol. 64, December 2013, pp. 1408-1412 I.F. 0.538
- Y. Zarina, A. M. Mustafa Al Bakri, H. Kamarudin, I. Khairul Nizar and A. R. Rafiza, "Review on the Various Ash from Palm Oil Waste as Geopolymer Material", Review on Advanced Materials Science, Vol. 34, September 2013, pp. 37-43. I.F. 1.017
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- Y. Zarina, A. M. Mustafa Al Bakri, H. Kamarudin, I. Khairul Nizar and A. R. Rafiza, "Review on the Geopolymers Materials for Coating Application", Advanced Materials Research, Vol. 626, 2013, pp. 958-962. I.F. 0.144
- Y. Zarina, A. M. Mustafa Al Bakri, H. Kamarudin and I. Khairul Nizar, "Review of the Characterization and Processing of Palm Ash as a Geopolymer Composite", Advanced Science Letters, Vol. 19, No. 1, January 2013, pp. 306-308. I.F. 1.25

b) Books

- Mohd Mustafa Al Bakri Abdullah, Kamarudin Hussin, Rafiza Abd Razak, Zarina Yahya, Mohd Izzat Ahmad, Liew Yun Ming, Heah Cheng Yong, "Asas Geopolimer: Teori dan Amali", Published by Unit Penerbitan, Universiti Malaysia Perlis, 2013.