

## Green Palm Oil Mill Fuel Ash Zeolites (G-POMFAZ) Using Hydrothermal-Alkaline-Ultrasound Technique (HAUT)

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### Abstract

*The tremendous fuel ashes are deserted by palm oil industries into environment, like CH Biotech Sdn Bhd, etc. without processing for commercializable products such as zeolites, etc. There are a few methods for zeolites synthesis, such as molten-salt, sol-gel, etc., but it takes considerable time, extensive set up and needs to high cost, thus this work aims to solve this issues by knowledge transfer of hydrothermal-alkaline-ultrasound technique (HAUT) for palm oil mill fuel ash (POMFA) based zeolites synthesis as sustainability and green material processing technology initiatives. The knowledge transfer methods of the POMFA characterization and analysis procedure completed via talks, workshop, practical, sample and data analysis. The analysis of POMFA using Scanning Electron Microscopy (SEM), X-Ray Diffraction (XRD), Brunauer-Emmett-Teller (BET), Fourier Transformed Infra Red (FTIR), and X-Ray Fluorescent (XRF) for composition approval has been conducted. The XRF result reveals 37.92 % silicon dioxide and 3.42% aluminium oxide etc. as major components typically used in the manufactures of zeolites. Next, the green technology transfer for zeolites synthesis from POMFA via HAUT utilization, process parameter effect, analysis equipments and operational procedure has been achieved. The highest resulted G-POMFAZ using HAUT was found at the operation condition of POMFA-alkaline ratio of 1:2, ultrasonic exposure time of 2.5 h, medium temperature of 80°C, irradiation power of 800 W and frequency of 45 kHz. The synthesized G-POMFAZ can be considered as an alternative material for industrial application, like construction, petrochemical, etc. The knowledge transfer program via training and dissemination of morphology analysis of G-POMFAZ has been being directing to the company staff. The staff knowledge is drastically increasing on the POMFA characterization and zeolites synthesis. The project contributes also to the reduction of the CH Biotech-wastes and contaminated particulate matter gradually.*

**Keywords:** G-POMFAZ, characterization, HAUT, morphology analysis, technology transfer

### 1. Introduction

Malaysia is currently one of the world leading producers and exporters of palm oil such as CH Biotech Sdn Bhd, etc. In year 2007 up to 2011, production of crude palm oil increased from 15.8 to 19.8 million tonnes, and the palm oil export of 36.75 % in year 2011. The export earnings of oil palm products were RM 45.1 billion that approximately USD 13.1 billion (Ismail, et al., 2013; Awal, et al., 2015). Commonly, for each bunch of the fresh palm fruit, approximately of value is consist of 21% of palm oil, 6–7% of palm kernels, 14–15% of palm fibers, 6–7% of palm shells and 23% of empty fruit bunches can be produced. Besides the production of crude palm oil, a large amount of solid waste such as palm fiber, shells, and empty fruit bunches is also produced as a residue output from the palm oil industry. Typically, solid wastes from palm oil residue are used as a fuel to produce steam for electricity generation in order to generated energy. After combustion, an ash is estimated about 5% by weight of solid waste (Foo and Hameed, 2009). The solid waste in the form of Palm Oil Mill Fuel Ash (POMFA) is by-product from burning process in palm oil plantation, like CH Biotech Sdn Bhd, which palm nut and fiber of palm are burnt at temperature about 800-1000°C. The POMFA is characterized by a spongy and porous structure in nature, of which is main components are in the angular and irregular form, with a sizable fraction showing cellular textures. Meanwhile, raw palm ash was evidence consist a rather spherical particle with a median size of 183.0 µm and small particles ground palm ash were individually noted containing crashed shape structures with a median of 15.9 µm and 7.4 µm. The approximation value of oil palm ash production in Malaysia is predicted at 4 million tons per year. Usually, the POMFA would be disposed off