Precious Nickel Recovery from Palm Oil Mill Fuel Ash Waste (Ni-POMFAW) Using Acidic Leaching Extraction (ALE)

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Abstract. This paper demonstrates precious recovery of nickel from physical pre-treated raw palm oil mill fuel ash waste (POMFAW). The acidic leaching extraction (ALE) using sulphuric and hydrochloric acids agents were carried out in a bath stirrer flask. Process parameter effects of acid concentration, solution pH and treatment time were investigated in the nickel recuperation. The highest nickel recovery (96.83%) was found by treatment time of 1 h, pH of 2.5 and hydrochloric acid concentration of 2.0 M. At the acids leaching higher than 2 M, the nickel recovery decreased. Results from acids leaching imply that nickel complex can be formed at substantial percentages within the acid concentration higher than 1 M. The hydrochloric acid provides impressive nickel compared sulphuric acid, and the POMFAW can be proposed as a substitute of non-renewable sources derived nickel for a promising material and the used ALE can be considered as a beneficial technique.

Introduction

Malaysia is one of the major crude palm oil suppliers in the world, and the palm oil is the leading agricultural industry in the country. Nowadays, Malaysia has around 4 million hectares of palm oil domain, where Sabah state possesses the biggest palm oil plantation region with 1.2 million hectares (30% of the total planted area). It is evaluated that 10.31 million tons of palm oil waste (8.25 and 2.06 million tons of palm oil husk and shell, respectively) generated about 516 thousand tons of boiler ash or POMFAW. Given the constrained use of POMFAW, this material has been being disposing as landfill material without any commercial returns [1]. The POMFAW is by-product from burning process in palm oil plantation, which palm nut and fibre of palm are burnt at temperature about 800-1000^{o}C. The characterized POMFAW reveals a spongy and porous structure in nature, which is main components are in the angular and irregular form, with a sizable fraction showing cellular textures. Meanwhile, raw palm ash was evidence consists of 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. Usually, the POMFAW would be disposed off for landfills due to limitation of utilization. This situation could lead to pollution case and loss of resources in the future. Many researchers have been studying about the utilization of POMFAW in concrete admixtures, aqueous and gaseous pollutant-removing adsorbents, cement replacement material, concrete additive, catalysts, etc. [2,3,4]. The catalyst synthesis, like metal oxides have been being extensively exploring for numerous basic scientific and