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Water Hyacinth (*Eichhornia crassipes*) As a Possible Alternative Energy Source: A Case Study for INSEE Cement Manufacturing Plant in Puttalam, Sri Lanka

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Abstract

Cement manufacturing is typically energy-intensive process and currently using alternative fuels partially or totally to replace fossil fuels to reduce the energy and environmental costs. Biomass is one of the main alternative fuel utilized by the cement industry with the potential to replace up to 20% of total energy demand. Water hyacinth (WH) is a problematic invasive alien species in aquatic ecosystems of all climatic zones in Sri Lanka. Because of it is non-edible, rapid growth, and freely available in larger quantities, WH has the potential to be used as biomass energy. Several countries have been studied for WH as feedstock for bioenergy production while physical and chemical composition of WH biomass has been tested by many researchers. However, biomass physiochemical properties may be varied by different place and conditions and there is no significant study for industrial application of WH biomass to burn in cement plant kiln as alternative energy source. Thus, this study aimed to elucidate the potential of WH biomass as an alternative energy source for the INSEE cement plant in Puttalam. The study was conducted in three selected reservoirs namely, Tabbowa reservoir (TR), Murukkuwatawana reservoir (MR), and Nawadankulama reservoir (NR) located in Puttalam district Northwestern province of Sri Lanka. The quantity of fresh and dry WH biomass was estimated with the WH covered area and fresh and dry weights of WH in unit area.WH covered area of in each reservoir during 2020 and 2021 was digitized directly in Google earth satellite images using Google Earth Pro software with help of visual interpretation techniques. WH biomass per unit area were measured by the subjective sampling method. WH samples from each reservoir were collected for analyzing biomass, and to determine the fuel characteristics such as net calorific value (NCV), Chlorine and Sulfur content, moisture, volatile matter, fixed carbon, and ash content. According to the results, the fresh WH biomass was recorded as 692.62, 389.85, 23.58 tons in 2020 and 3570.82, 584.53, 33.31 tons in 2021 in the TR, MR, and NR respectively, while the dry WH biomass was recorded as 41.65, 24.65, 1.31 tons in 2020 and 214.74, 36.96, 1.85 tons in 2021 in the TR, MR, and NR respectively. NCV of the WH composite sample was 12.02 MJ/kg. Moisture content, ash content, chlorine and sulfur content were recorded as 13.56%, 10.95%, 1.06%, and 0.14% respectively. Except for chlorine content, other parameters agreed with the acceptable limits for using WH as an alternative energy source for cement industry. To replace 1 ton of coal, 2.2 tons of dry WH were required from 35 tons of fresh WH biomass while to produce 1 ton of clinker, 0.32 tons of dry WH were required from 5.2 tons of fresh WH biomass. Since relatively large quantities are freely available and with high volatile content and calorific value, WH is suitable as an alternative energy source for cement industry. However, economic feasibility should be studied prior to the commercial application.

Keywords: Alternative fuel, Biomass, Water hyacinth, Calorific value