METHANE PRODUCTION POTENTIAL OF POME: A REVIEW ON WASTE-TO-ENERGY [WTE] MODEL

Shahidul M. I, Malcolm M.L. and Eugene J.J.
Department of Mechanical and Manufacturing Engineering, Faculty of Engineering, Universiti Malaysia Sarawak, 94300 Kota Samarahan, Sarawak, Malaysia,
Corresponding author: Shahidul. M.I. (mislam@unimas.my)

ABSTRACT: *This review article presents the research outcomes published in various scientific journals on methane production from palm oil mill effluent (POME) in line with WtE aiming to contribute to achieving energy and environmental sustainability. The total number of articles reviewed for this study is 76 in order to addressee answers to questions arising related to methane production from POME through the aid of anaerobic reactors. This study rebuilds that methane yield depends on the density of organic elements, volatile suspended solids, pH, sludge age, Hydraulic retention time, temperature and C/N ratio of POME. It has been reported that the methane potential of POME is about* $15m^3CH_4(1.0m^3POME)^{-1}$*; which emits to air as the Greenhouse Gas and have been appearing as 25 times higher global warming potential than carbon dioxide. The review concludes that this article would be a potential reference in selecting the model to estimate methane potential and developing the anaerobic reactor for capturing methane from POME.*

Keywords: Methane Potential; Anaerobic Reactor; Energy Sustainability; Environmental Sustainability; Waste to Energy

1.0 INTRODUCTION AND BACKGROUND

Methane emission from POME has been identified as one of the vital source of Global Warming Potential [1, 2]. It has been also stated in various journals that the Global methane potential of POME is about 600 million m^3 per year; and this gas emits to air as the GHG which is 25 times higher Global Warming Potential (GWP) than carbon dioxide [3, 4] It has been also stated that methane is a heat and energy sources [5-8] which currently appearing as a GWP and contributing to increasing climate change. With this background, the review has structured to gather information on methane capturing process by aiming to contribute to achieve sustainable energy supply and to reduce carbon emission to the atmosphere.

This review article aims to identify the various options used for producing methane from POME. Special emphasis has given to collect several models used to estimate CH_4 potential in POME. The priority was given to gather information on methane production process and effectiveness of anaerobic reactors in optimizing methane (CH_4) capturing from POME. The optimal operating condition of the anaerobic reactor for maximum biogas production has also highlighted in this article.

This review article answers to question arising from the aspect of designing, anaerobic reactor building and operation related to optimize methane production from POME. However, this paper primarily focused on two areas that include methane potential in POME and the application of different types of anaerobic reactor used to methane capture. This review also gathered information on models associated with organic elements and volatile suspended solids (VSS) of POME that used to estimate methane potentials.

The total number of papers reviewed in this work is 76 and published within the years 2000-2018. More than 22 percent of the papers outlined in discussing the energy potentials of POME. The models to estimate the methane potentials due to COD and VSS loads in POME has discussed in 15 percent reviewed papers. About 44 percent of the reviewed papers discussed on various type of anaerobic reactors used to produce methane from POME. Rest of the papers reviewed demonstrated the effect of methane capturing from POME on environmental sustainability.

It has been reported that during POME treatment in open tank, COD and VSS of POME convert to methane gas and emits to the air as Greenhouse gas (GHG) [9, 10]. It has been demonstrated that methane must be captured from POME for using in energy purpose and to protect the environment as well [6, 11]. On this view, this review has organized to collect information on the ways of capturing CH_4 from POME efficiently.

Indeed, this review could be a potential information source for researchers involved in innovation activities of renewable energy harvesting from waste; and it would be also providing a guideline in selecting the model to capture methane to mitigate GHG emission. However, the novelty of this review is to unlock the methane production potential of hazardous POME in line with the waste to energy [WtE] management.

1.1 The Energy Potential of Hazardous POME

This section of review demonstrates the research findings on methane potentials of POME. Historically, POME has always been regarded as a highly polluting wastewater generated from palm oil mills [9, 10, 12] during CPO production [13]. POME is a brownish liquid composed of biomass, BOD and COD. POME is also recognized as a source of CO_2 and CH_4 emission responsible for GWP [14, 15]. However, various research findings demonstrated that methane potential of POME could be a dependable renewable energy source instead of carbon emission [16]. It has been reported that about 28 m^3 of biogas could be produced from 1.0 m^3 of POME [17], which has the methane potentials of about $15m^3$ [18]. However, the composition of biogas produced from POME is listed in Table 1.

The data listed in Table 1.0 demonstrated that the methane gas is the major component in biogas produced from POME [19]. The review of this section concludes that CH_4 gas potential in POME is significantly high, which shall capture to achieve sustainability in energy supply.