Effects of biomass, COD and bicarbonate concentration on fermentation of hydrogen production from POME by granulated sludge in a batch culture

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ABSTRACT
Effects of three selected variables viz. biomass concentration, initial chemical oxygen demand (COD) concentration and initial bicarbonate alkalinity (BA) on biological hydrogen production from palm oil mill effluent (POME) using the granulated sludge in batch culture were investigated. The experimental results were analyzed and modeled using a central composite design (CCD) of response surface methodology (RSM). In order to carry out a comprehensive analysis of the biohydrogen production process, indicative parameters namely hydrogen yield (YH2), specific hydrogen production rate (SHP), and COD removal efficiency were studied as the process responses. Maximum hydrogen yield (124.5 mmol H2/g CODremoved) and specific hydrogen production rate (55.42 mmol H2/g VSS.d) were achieved at CODin 3000 and 6500 mg/l, MLVSS 4000 and 2000 mg/l, and initial BA 1100 mg CaCO3/l, respectively.

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1. Introduction
One of the most important contributors to Malaysia’s economy is palm oil industry. This industry generates large quantities of polluted wastewater commonly called as palm oil mill effluent (POME). It is estimated that 5–7.5 tonnes of water are required for each tonne of crude palm oil production; and more than 50% of the water ends up as POME [1,2]. Based on palm oil production industry in Malaysia, 15.2 million tonnes of POME were produced in 2005 alone [3]. The three main sources of POME are sterilization (36%), clarification (60%), and hydrocyclone (4%) units. Raw POME as a colloidal suspension contained 95–96% water, 0.6–0.7% oil and 4–5% total solids [2,4].

Nowadays, fossil fuels are the primary source of global energy requirements, with their foreseeable depletion due to limited fossil energy resource. With respect to global environmental impacts due to the usage of this energy resource, such as greenhouse effect, ozone layer depletion and resource recovery, intensive search is going on worldwide for renewable and non-polluting energy source [5–16]. Hydrogen is an effective fuel with high-energy yield (122 kJ/g) which is 2.4, 2.8 and 4 times higher than energy yields of methane, gasoline and coal, respectively [17–23].