CHAPTER 9

VALUABLES PRODUCTS AND ENERGY RESOURCE DERIVED FROM POME

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9.1 INTRODUCTION

Palm oil mill effluent (POME) is a serious environmental issue due to its harmful nature consisting of high biochemical oxygen demand (BOD) (25,000 to 50,000 mg/L), chemical oxygen demand (COD) (50,000 to 90,000 mg/L), total suspended solids (~30,000 mg/L), total dissolvable solids and volatile suspended solids (Ding et al., 2020; Nur & Buma, 2019). The POME production volume is very large considering that for every one ton of fresh palm fruit bunch generates about 0.5–0.75 tons of POME (Akhbari et al., 2020). Nonetheless, the valorisation of highly concerning POME either through nutrient recovery, utilization as growth medium or conversion into valuable products via the POME treatment system can create an economic opportunity, simultaneously, reducing the discarded by-products from POME treatment system. Various innovating treatment strategies have been proposed in the previous chapters of this book to achieve two main objectives which are (1) Meet the high standard of treated effluent by the government [Regulation 12 in the Environmental Quality (Prescribed Premises) (Crude Palm Oil) Regulations 1977 under the Environmental Quality Act 1974 (Act 127)

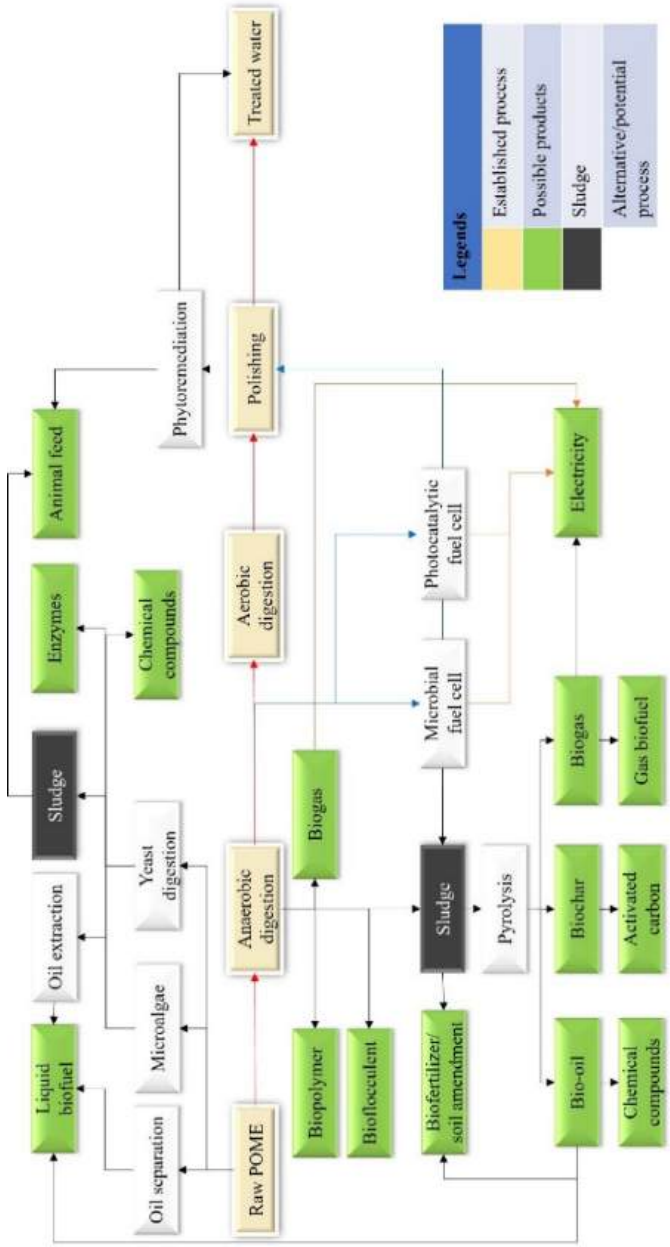

Figure 9.1 New circular economy from valorisation of discharge of POME treatment system

which have been detailed in Chapter 2], and (2) Create valuable products for new circular economy of palm oil industry. All these steps or strategies which have been discussed in this book have been summarized into a comprehensive flow chart in Figure 9.1 of potential new circular economy of POME.

Anaerobic and aerobic biodegradation in the obsolete pond system is the most established primary method of POME treatment with increasing novelty in utilizing its microbial products such as methane and hydrogen gas for biofuel and energy resources. The use of POME as growth medium for microalgae or phytoremediation plants is an innovative strategy which helps to lessen the generation of carbon footprint where microalgae and plants utilize the carbon dioxide for photosynthesis. Oleaginous yeast and microalgae are also a suitable host for lipid accumulation which can be turn into biofuel and producer of various high value-added products such as astaxanthin, b-carotene and vitamin E.

In terms of physicochemical treatment, the spent coagulants or flocculants, biochar and activated carbon can be further utilized as fertilizer. The forming sludge also has been converted into variable products via thermochemical treatment such as pyrolysis, liquefaction and gasification to produce a wide range of products including biochar, activated carbon, bio-oil and biogas.

In this chapter, the valuable products that can be obtained from the current treatment systems and various innovative strategies will be discussed in depth on how it can be obtained, its impacts on the industry and creation of circular economy of POME can be proposed.

9.2 ALTERNATIVE AND INEXPENSIVE GROWTH MEDIUMS

POME has been utilized as a growth medium/substrate for various microorganisms due to its organic carbon-rich and nitrogen-rich nature. The chemical composition of the POME has been discussed in Chapter 2. In the current POME treatment system, POME is utilized