CHAPTER 1. INTRODUCTION

1.1 Background

Indonesia is one of the most productive producers of tofu at home industrial and on s large scale (Widayat *et al.,* 2019). In one year, Indonesia produces tofu reached up 1,200 kg to 1,500,000 kg of tofu and requires 2.56 million tons of soybeans for each tofu making process. Tofu wastewater is generated through the process of washing, clumping and soaking soybeans. The tofu wastewater generated can reach up to 2m^3 for every 1 quintal of soybean (Faisal *et al.*, 2014).

Tofu wastewater still contains high concentrations of organic substances such as proteins, carbohydrates, and fats that will accumulate into toxic compounds and cause the death of aquatic biota, so it dangerous for the environment if not managed properly (Luan *et al.,* 2017). Chemical Oxygen Demand (COD) contained in tofu wastewater ranges from 10,000 to 20,000 ppm, this is due to the protein content found in tofu wastewater. Wastewater with high COD concentrations can cause the death of aquatic biota if directly thrown away into water bodies (Singh *et al.*, 2019). Thus, the pollution load from the tofu industry is quite large, requiring further treatment to meet quality standards.

Aside from tofu wastewater, a wastewater that has a high organic content and quite widely produced is Palm Oil Mill Effluent (POME). POME is wastewater produced from palm oil processing. POME is acidic and contains residual oil that is not easily degraded using conventional systems (Suksaroj *et al.,* 2020). The Biological Oxygen Demand (BOD) content of POME is quite high, reaching up to

100 times higher than domestic sewage, even after treatment, a large amount of organic matter remains and will cause serious environmental impacts if directly thrown away into water bodies (Yahaya *et al.*, 2013).

The characteristics of POME are dark, high temperature and high solid compound, making effective treatment of this palm oil effluent still be a serious problem (Suksaroj *et al.,* 2020). POME treatment through effluent pond technology is the most widely used treatment, but this treatment method causes a lot of settling of solids or sediments at the bottom of the pond with a long hydraulic retention time (Albarracin-Arias, 2021).

A number of efforts have been made to reduce organic matter in general wastewater effluents. However, some common methods are still constrained, such as process complexity, high coagulant amounts, limited area for treatment, and high electricity costs for aeration. On the other hand, organic wastewater is abundant and can be a source of alternative renewable energy if utilized with good and appropriate technology (Permana, 2019).

One of the appropriate technologies to treat and utilize organic wastewater is Microbial Fuel Cell (MFC). This technology utilizes bacterial metabolism in degrading organic matter in waste to produce electrical energy. (Franks and Nevin, 2010). Parkash (2016) revealed that MFC technology can be a bio-electrochemical reactor, this is because of the role of bacteria in MFC that can oxidize organic and inorganic compounds in the anode chamber and release protons and electrons which will then be channeled to the cathode. Various types of substrates can be used in MFC which will be converted into electrical energy such as carbohydrates, proteins, cellulose and wastewater. Meanwhile, the addition of nutrients such as glucose to the substrate is also can produce better electricity in MFCs.

Tofu wastewater can be a substrate used in MFC because of the high organic compound in there. According to Permana's research (2019), tofu wastewater produces electricity of 9.216 x 10-5 kWh with a current of 5.49 mA and a voltage of 757 mV, and a decrease in wastewater load of up to 90% with the SCMFC method. The use of POME sediment as an MFC substrate in the research of Nor *et al.*, (2015) can produce electrical energy up to 91.12 mA/m^2 and reduce organic compounds by 60%. Febria *et al.*, (2020) also reported that estuarine sediments have the potential to produce electrical energy using SMFC of 432.69 mA/m^2. The addition of nutrients in the form of glucose to the substrate by Liu *et al.*, (2005) can increase electrical energy production than without the addition of glucose. So far, research on the combination of tofu wastewater and POME sediment in producing electrical energy using MFC has not been conducted. Therefore, this research is important to do as an effort to process tofu wastewater and *Palm Oil Mill Effluent* (POME) sediment that can produce electrical energy.

1.2 Problem Formulation

The problem formulations in this study are:

1. How is the production of electrical energy produced by Microbial Fuel Cell (MFC) using tofu wastewater and Palm Oil Mill Effluent (POME) sediment?
2. How is the production of electrical energy produced by Microbial Fuel Cell (MFC) using tofu wastewater and Palm Oil Mill Effluent (POME) sediment with the addition of glucose?
3. What are the characteristics of bacterial isolates on Microbial Fuel Cell (MFC) anodes?

1.3 Research Objectives

The objectives of this study are:

1. To find out the production of electrical energy produced by Microbial Fuel Cell (MFC) using tofu wastewater and Palm Oil Mill Effluent (POME) sediment.
2. To find out the production of electrical energy produced by Microbial Fuel Cell (MFC) using tofu wastewater and Palm Oil Mill Effluent (POME) sediment with the addition of glucose.
3. To characteristics of bacterial isolates on Microbial Fuel Cell (MFC) anodes.

1.4 Research Benefits

1. Provide scientific information about Microbial Fuel Cell (MFC) as a technology in wastewater treatment that can produce electrical energy.
2. Contribute to efforts to produce alternative electrical energy that is environmentally friendly.