I. INTRODUCTION

1.1 Background

Plastics are synthetic organic polymers that are generally obtained from fossil fuels-derivatives and different hydrocarbons (Elahi et al., 2021; Tuladhar & Yin, 2019). It is durable, versatile, light-weighted, pliable, and also inexpensive (Elahi et al., 2021; Thompson et al., 2009; Tuladhar & Yin, 2019). Owing to these benefits, plastics are widely used in various life sectors and industries such as automotive, electronics, healthcare, transportation, construction, consumer products, and packaging (Cui et al., 2019; Tuladhar & Yin, 2019). However, most plastics are disposed of after single use (Tuladhar & Yin, 2019). The stable nature of plastic polymers makes them hard to degrade naturally, resulting in their accumulation over time (Basak & Meena, 2022; Cui et al., 2019).

Petro-polymers such as polyethylene terephthalate (PET) and polyurethane (PU) have been widely used in various applications. Among 367 million metric tons (MMT) of plastics that were produced globally, approximately 56 million tons are PET and 24 million tons are PU (Bala et al., 2022; Danso, Chow, & Streit, 2019; Suryawanshi, Sanap, & Wani, 2019; Zhang et al., 2022). PET is used in many single-use products like plastic bottles, while PU is used in products that need to be replaced over time, like clothes, cars, and furniture (Kemona & Piotrowska, 2020). Along with its recalcitrant nature towards natural degradation, there has been an accumulation of post-consumer waste in land and oceans, causing major environmental pollution with adverse effects on both nature and human health (Cui et al., 2019; Elahi et al., 2021; Mohanan et al., 2020). Previous attempts of degradation by physical, mechanical, and chemical methods have been employed to address PET and PU pollution issues. However, these methods are deemed inefficient and have negatively affected the environment, either due to their land-consuming nature or the involvement of harmful substances (Basak & Meena, 2022; Kemona & Piotrowska, 2020).

Recently, microbial degradation has been gaining interest as a promising strategy for plastic degradation due to its wide range of possibilities (Anani & Adetunji, 2021; Basak & Meena, 2022). It requires moderate temperature, does not involve harmful reagents, and has a possibility for alterations (Kemona & Piotrowska, 2020; Wei and Zimmermann, 2017; Zimmermann and Billig, 2011). Both PET and PU are semi-crystalline plastic, and have an amorphous section that is more susceptible to microbial degradation (Khan et al., 2017; Wei et al., 2020). Several microorganisms, including bacteria and fungi, have been found to degrade PU and PET plastics through their enzymatic activity (Basak & Meena, 2022; Mohanan et al., 2020; Tan et al., 2022; Yoshida et al., 2016). The release of extracellular enzymes hydrolyse the polymer bonding in plastic, resulting in a shorter polymer that can be used by the cells as a carbon source, or be used in the recycling process (Mohanan et al., 2020).

Some of these plastic-degrading microbes were discovered and isolated from plastic-heavy environments, such as landfills and dumpsites (Basak & Meena, 2022). Indonesia with diverse microbial communities, including in landfills, has a very high potential for the exploration and characterization of plastic degradation (Gultom, Nasution, & Ayu, 2017). However, there has not been much research in relation to the topic. A previous study done by Pikoli et al. (2020) in Cipayung landfill reported the presence of bacteria and fungi with microplastic degradation ability. However, the microbial identification was based only on its morphological features and the plastic degradation ability is yet to be quantified (Pikoli et al., 2020). Further confirmation of its plastic degradation ability is much needed. Therefore, this research aims to characterize the microorganisms isolated from landfills in Jakarta, specifically in Cipayung landfill, and evaluate their ability to degrade plastic waste of PET and PU. Different types of samples from landfill, such as soil, leachate, and plastic waste will be taken to increase the diversity of isolates as well as the chance of finding the plastic-degrading microorganisms. The isolates' ability to degrade PET and PU plastic will be investigated by plastic weight loss measurement and Fourier transform infrared spectroscopy (FTIR) analysis.

1.2 Research Scope

The scope of this study are:

1. Sample collection (soil, leachate, and plastic waste) in Cipayung landfill, Depok
2. Cultivation of microorganisms isolated from Cipayung landfill using selective media
3. Isolation of the microorganisms into single colony strain
4. Characterization of the microbial isolates using morphological observation, gram-staining, and biochemical analysis
5. Plastic degradation potency test towards PET and PU plastic types by plastic weight loss measurement and FTIR analysis

1.3 Research Question

From the background and objective mentioned above, several research questions are made:

1. Do microorganisms isolated from the Cipayung landfill have the ability to degrade plastic waste made from PET?
2. Do microorganisms isolated from the Cipayung landfill have the ability to degrade plastic waste made from PU?

1.4 Hypothesis

From the research questions, some hypotheses are formulated:

1. H_0: Microorganisms isolated from Cipayung landfill have the ability to degrade plastic waste made from PET

   H_1: Microorganisms isolated from Cipayung landfill did not have the ability to degrade plastic waste made from PET
2. H_0: Microorganisms isolated from Cipayung landfill have the ability to degrade plastic waste made from PU

   H_1: Microorganisms isolated from Cipayung landfill did not have the ability to degrade plastic waste made from PU