NANYANG TECHNOLOGICAL UNIVERSITY SINGAPORE | Nanyang Environment and Water Research Institute

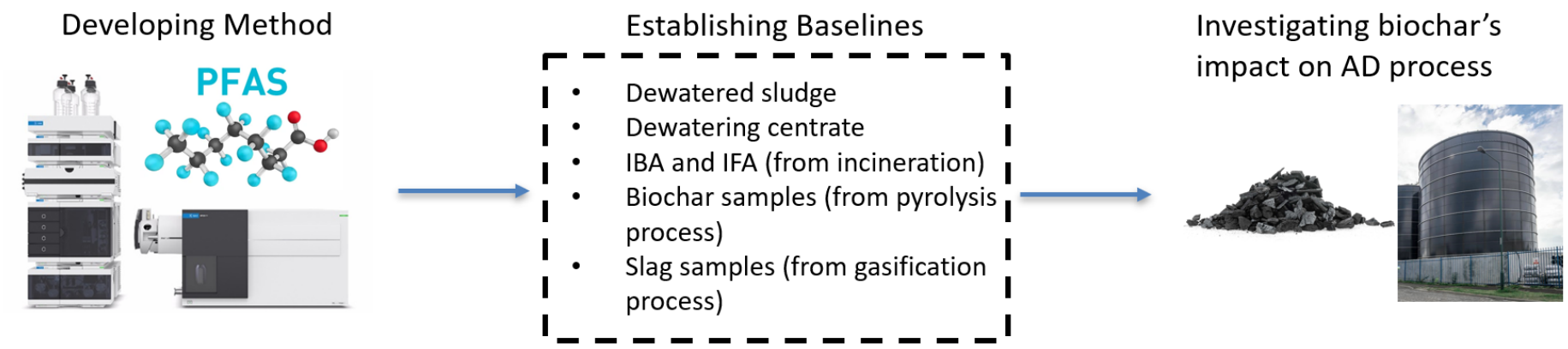
ESTABLISHING BASELINE AND EVALUATION OF PFAS IN SLUDGE MANAGEMENT PRACTICES

Abstract

Per- and polyfluoroalkyl substances (PFAS), a group of fluorinated chemicals used in a variety of applications, have been raising environmental and health concerns globally due to their persistence, bioaccumulation and toxicity. Wastewater Treatment Plant (WWTP) raw sewage often contains elevated levels of PFAS. Substantial attention has been paid to the monitoring of PFAS in the effluent of WWTP as it would discharge massive amount of PFAS into the environment. However, PFAS in biosolids are potential threats to the environment and human health due to the accumulation of more water insoluble or long-chain PFAS in the sludge, which is often being overlooked. There is a lack of information regarding PFAS presence in sludge from Water Reclamation Plants (WRPs) in Singapore.

Moreover, the thermal treatment of sludge (e.g. incineration, pyrolysis and gasification processes) would alter the quality and quantity of PFAS in the resulting products, such as in incinerated sewage sludge bottom ash (IBA) and fly ash (IFA), sludge biochar and slag. This alteration necessitates monitoring and evaluation of potential PFAS contamination in sludge and related solid products as it may be subsequently reused as part of PUB's circularity efforts. Additionally, the addition of biochar during sludge anaerobic digestion (AD) may reduce the PFAS in the digestate, increase methane production and improve sludge dewaterability, which has not been explored. Therefore, this project aims to 1) adapt USEPA method 1633 to establish methods to identify and quantify PFAS in sludge and the related byproducts, 2) establish the baseline of PFAS in dewatered sludge and centrate in our WRPs and the related by-products i.e., sewage sludge ash, slag and biochar, and 3) quantify the benefits of biochar addition to anaerobic digestion process on improvement of biogas yield and sludge dewaterability.

The project will analyze PFAS in AD centrate, and dewatered sludge from Changi WRP, Kranji WRP, Ulu Pandan WRP, and Jurong WRP, as well as IBA, pyrolytic sludge biochar, and slag samples after gasification. This study seeks to enhance understanding of PFAS in WWTPs and provide guidance on sludge management pathway forward.



Understanding PFAS in sludge management practices

With the increasing concern on potential health impacts posed by per- and polyfluoroalkyl substances (PFAS), more attentions are now given to biosolids management practice, where there has been a lack of accurate PFAS identification, especially in sludge and related by-products. Thus, this project aims to develop method for PFAS quantification and establish baseline measurement for PFAS in various samples, including sludge, liquid, in biochar and slags. Furthermore, being known as a good adsorbent, biochar's addition into anaerobic digestion (AD) will be assessed parameters, including methane production, sludge dewaterability as well as PFAS adsorption in the process.

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