Biochar for carbon sequestration and soil remediation

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Social and environmental aspect

Solid digestate is known as organic by-product sludge generated from urban wastewater treatment plant. It has been reported that Germany, UK, France and Italy are the main contributors for sludge generation, which accounts for 70% of total sludge production in EU (Smith, 2008). Regarding the overburden of the sludge generated at the municipalities or industrial sites, disposal of this organic biogas waste becomes problematic due to the costs for post-treatment, which account for 25-65 % of the total cost operation in wastewater treatment plants (Devi & Saroha, 2016). The organic waste sludge is considered as toxic due to the presence of pathogens (*i.e.* etiologic agents) that can possibly transfer infectious diseases to soil (Seadi & Lukehurst, 2012). Thus, several environmental friendly and cost effective approaches for digestate management are highly required. The conventional technologies for urban sludge disposal, *e.g.* landfills and application for agricultural purposes may be restricted, respectively due to limited landscape available and possible transportation of pollutants to the farmland (Devi & Saroha, 2016). Thus, valorization of the sludge through thermal decomposition process (*i.e.* pyrolysis) arises as one interesting technique for digestate management, which provides valuable-added product (*i.e.* biochar) and reduce total volume of the remained sludge for disposal.

Objectives and technological challenges

There are extensive studies on the use of biochar derived from agricultural residues (*e.g.* rice straw, pine chips, bamboo, etc.) and animal manures (*e.g.* swine solid, dairy manure, poultry litter, etc.) in soil and water. However, little literature on the potential use of biochar produced from urban organic waste digestate (*e.g.* sewage sludge, organic fraction of municipal solid waste digestate, food waste digestate, etc.) has been studied. Application of sludge-derived biochar as an adsorbent to soil and water is currently interesting due to the presence of undigested organic compounds and inorganic substances in the sludge. As a result, the sludge-based biochar can play a significant role of pollution sink in contaminated soils corresponding to available metal oxides and functional groups (*e.g.* carboxyl, hydroxyl) on biochar surface. Hence, complex bonding between the contaminant and biochar active pores can be formed. This research work aimed to produce biochar from urban organic waste digestate under a slow pyrolysis at lab scale and further use it as sorbing material in order to immobilize metals and pharmaceuticals in soil and water.

Name: Suchanya Wongrod
Promoter: Dr. Hab. Eric van Hullebusch (Université Paris-Est, France)
Co-promoters: Prof. Piet Lens (UNESCO-IHE, the Netherlands)
Prof. Gilles Guibaud (Université de Limoges, France)
Supervisors: Dr. Yoan Pechaud (Université Paris-Est, France)
Dr. David Huguenot (Université Paris-Est, France)
Graduated: MEng Environmental Management and Engineering (Asian Institute of Technology, Thailand)
Contact: suchanya.wongrod@gmail.com, suchanya.wongrod@u-pem.fr

References

Devi, P., & Saroha, A. K. (2016). Utilization of sludge based adsorbents for the removal of various pollutants: A review. *Science of The Total Environment*, *578*, 16–33. http://doi.org/10.1016/j.scitotenv.2016.10.220

Seadi, T. Al, & Lukehurst, C. T. (2012). Quality management of digestate from biogas plants used as fertiliser. *IEA Bioenergy*, 40.

Smith, S. R. (2008). Management, use, and disposal of sewage sludge. In *Encyclopedia of Life Support Systems*.