Title: Targeted degradation of polycyclic aromatic hydrocarbons as potential strategy in coal tar remediation

ABSTRACT:

Cleaning of coal tar contaminated sites is receiving considerable attention and has become a priority, because coal tar contains multifold of polycyclic aromatic hydrocarbons (PAHs), of which some PAHs such as benzo[a]pyrene are very toxic and classified as carcinogenic. For instance, coal tar from the Sydney Tar Ponds is one of the pollutants that mainly consists of PAHs. Due to different physico-chemical properties of the PAHs in coal tar, it is generally a challenge task to clean through degradation or transformation. In this study, three approaches were investigated for targeted degradation of specific PAH constituents in Sydney Tar Ponds, namely, i) chemical reduction using acidified Mg/EtOH, ii) chemical oxidation using Fenton’s reagent and peroxy acetic acid, and iii) catalytic degradation using microwave-assisted heating. An open microwave system was developed for degradation of PAHs in coal tar with and without catalyst/microwave absorber (e.g., biochar, activated carbon, and TiO2). In addition, TGA analysis of coal tar was conducted to determine the influence of the temperature on efficiency of the catalysts. Due to the large number of parameters considered in the study, the statistical method of experimental design was employed to optimize the PAH oxidation and reduction conditions. The results indicate that chemical reduction and oxidation are the most effective way of removing some PAHs from coal tar. For example, anthracene can be removed with >90% efficiency within 0.5 h of reaction time. With the aid of microwave absorbers (biochar and activated carbon), even high molecular weight PAHs can be degraded in the coal tar at relatively low energy cost.