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Adsorption/Desorption Of Organic Pollutants And Their Removal

AMAN D. SHARMA

School of Agriculture, Lovely Professional University, Phagwara, Punjab India

email-amandeep.24814@lpu.co.in

Abstract: Organic pollutants are finding their ways to human food chain via soil, water and environment. It is important to study their behavior. In this paper, different types of organic pollutants, their fate and remediation strategies have been discussed. The novel materials which can act as adsorbent of organic pollutants have been considered.

Antibiotics as organic pollutant

Tetracycline antibiotics (TC's) are mostly used in veterinary medicine (Conde-Cid et al., 2019a; Trukhanov et al., 2018). Due to low absorption, 90 % of these antibiotics are excreted. Soils with high organic matter were found to adsorb 100% however, thedesorption was always less than 3% (Conde-Cid et al., 2019a; Anand et al., 2017). The adsorption of both antibiotics sulphamethoxypyridazine (SMP) and enroflaxacin (ENR) was found to fit well for linear equation and freundlich model (Alvarez-Esmoris et al., 2020; Mahesh et al., 2014). Multiple regression indicated that in case of SMP, soil organic carbon (SOC) and exchangeable-Mg explained the variation in adsorption coefficient Kd while for ENR, no significant relationship was observed (Alvarez-Esmoris et al., 2020; Ansari et al., 2016).

In another study, adsorption parameters of suplhamethazine (SMT) and sulfachloropyridazine (SCP) were found to be low indicating high mobility of these compounds (Conde-Cid et al., 2019b; Gupta et al., 2014; Singh et al., 2015). Due to different degree of hydrophobicity, adsoption parameters were found to be low for SMT than SCP. For both sulfonamides, soil organic carbon showed the maximum influence (Tandon et al., 2018a; 2018b, 2019). Fitting these data into linear regression helped to develop models for the prediction of adsorption and desorption behavior of these compounds (Conde-Cid et al., 2019b; Bashary et al., 2010). These models can be used as a screening tool to find vulnerable soils having lowest value of adsorption parameters. Entry of pollutants can be minimized, and management decisions can be done for these vulnerable soils to reduce risks and impacts on human and environmental health (Conde-Cid et al., 2019b; Usman et al., 2019).

1.2 Herbicide and Fungicides as organic pollutants

The adsorption of fungicide (fenarimol) has been found to be controlled by organic carbon (OC) however, mineral fraction played a major role in the adsorption of herbicide dimethenamid (Rodriguez-Liebana and Pena, 2018; Singh et al., 2019; Sharma et al., 2019). In another study related to the effect of soil pH and organic matter on the adsorption and desorption of pentachlorophenol, acid soil was found to adsorb more pentachlorophenol in comparison to alkaline soil (Chien et al., 2018; Prabhakar and Sivakumar, 2019; Bawa et al., 2019).

1.3 Beads as smart nanofactories for the removal of organic and inorganic pollutants

pH responsive, porous and reusable hydrogel beads can be used for the removal of organic and inorganic pollutants (Fig.1) (Vyas, 2016; Upadhyay and Rao, 2019; Singh et al., 2019).

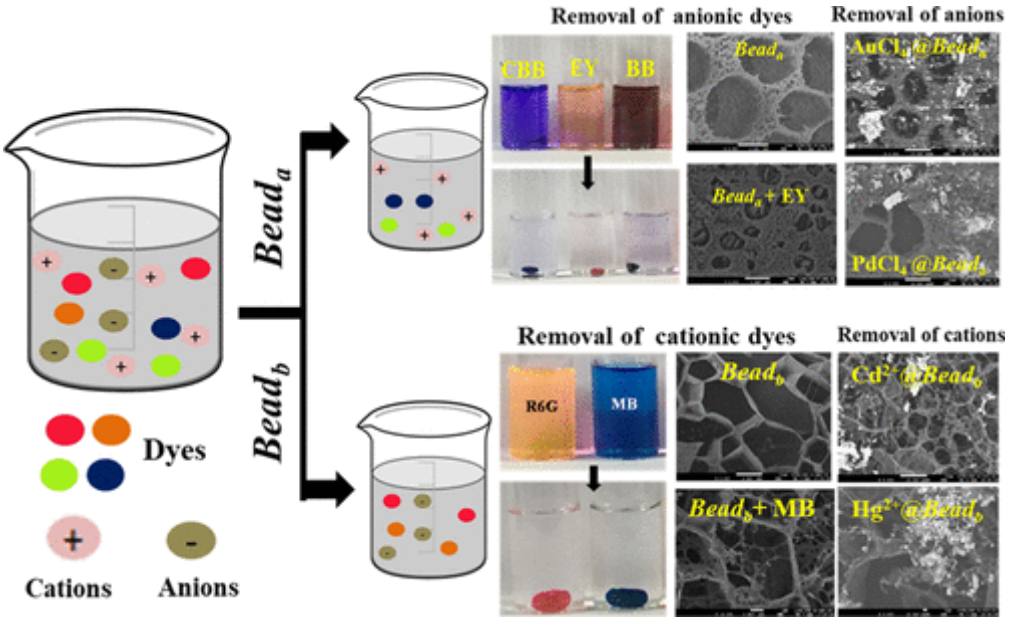

Fig.1 Beads as nanofactories for the removal of organic pollutants (Upadhyay and Rao, 2019)

Bovine serum albumin beads (Beads stored in acidic medium Ba; Beads stored in basic medium Bb) selectively adsorb organic dyes and inorganic species depending on pH. These beads have shown reusabilility and can be recycled by changing pH (Upadhyay and Rao, 2019; Prabhakar et al., 2020).

1.4 Biochars as adsorbent

Peanut hull biochars have been found to adsorb organic pollutants like phthalic acid esters (PAE's) in greater amounts than wheat biochars due to more O-bearing functional groups (Jing et al., 2018). In another study the order of removal efficiency of 2,4 dichlorophen by four different biochars was bush branch biochar > peanut hull biochar > spartina alterniflora biochar > rape straw biochar (Cui et al., 2017). Rice husk activated carbon has also been observed to effectively remove benzene, toluene, ethyl benzene and Xylene (Yakout and Daifullah, 2014).

New approaches like bioremediation, biostimulation and bioaugmentation should be considered while studying organic pollutants (Perelo, 2010).

Summary

Discussion on types, behavior and remediation strategies of organic pollutants will help in the removal of these pollutants to minimize the risk of human consumption and to safeguard environment.

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