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A Sustainable and Low-Cost Filter to Treat Pesticides in Water

Authors : T. Abbas, J. McEvoy, E. Khan

Abstract : Pesticide contamination in water supply is a common environmental problem in rural agricultural communities. Advanced water treatment processes such as membrane filtration and adsorption on activated carbon only remove pesticides from water without degrading them into less toxic/easily degradable compounds leaving behind contaminated brine and activated carbon that need to be managed. Rural communities which normally cannot afford expensive water treatment technologies need an economical and sustainable filter which not only treats pesticides from water but also degrades them into benign products. In this study, iron turning waste experimented as potential point-of-use filtration media for the removal/degradation of a mixture of six chlorinated pesticides (lindane, heptachlor, endosulfan, dieldrin, endrin, and DDT) in water. As a common and traditional medium for water filtration, sand was also tested along with iron turning waste. Iron turning waste was characterized using scanning electron microscopy and energy dispersive X-Ray analyzer. Four glass columns with different filter media layer configurations were set up: (1) only sand, (2) only iron turning, (3) sand and iron turning (two separate layers), and (4) sand, iron turning and sand (three separate layers). The initial pesticide concentration and flow rate were 2 µg/L and 10 mL/min. Results indicate that sand filtration was effective only for the removal of DDT (100%) and endosulfan (94-96%). Iron turning filtration column effectively removed endosulfan, endrin, and dieldrin (85-95%) whereas the lindane and DDT removal were 79-85% and 39-56%, respectively. The removal efficiencies for heptachlor, endosulfan, endrin, dieldrin, and DDT were 90-100% when sand and iron turning waste (two separate layers) were used. However, better removal efficiencies (93-100%) for five out of six pesticides were achieved, when sand, iron turning and sand (three separate layers) were used as filtration media. Moreover, the effects of water pH, amounts of media, and minerals present in water such as magnesium, sodium, calcium, and nitrate on the removal of pesticides were examined. Results demonstrate that iron turning waste efficiently removed all the pesticides under studied parameters. Also, it completely de-chlorinated all the pesticides studied and based on the detection of by-products, the degradation mechanisms for all six pesticides were proposed.

Keywords : pesticide contamination, rural communities, iron turning waste, filtration
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