

REMEDATION OF AGRICULTURAL WASTERWATER CONTAMINATED WITH FUNGICIDE/NEMATICIDE ADSORPTION ON DIFFERENT MATRICES

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Introduction

Fluopyram is a novel broad-spectrum fungicide from the pyridinyl-ethyl-benzamide class. It has been found effective against nematodes and was registered as nematicide, too. As an extensively used and persistent pesticide, could be easily distributed in environment causing toxicity in non-target organisms or contaminating drinking water (Table 1). The washing/loading sites of spraying equipment and pesticide packages discharge are potential point sources pollution by pesticides. Usually, the topsoil of these sites is removed and replaced by gravel and sand layers. Thus, the risk of leaching of pesticides to surface water and groundwater is increased because of poor biodegradation and sorption capacity. Zeolite, attapulgite, bentonite and biochar have been reported as an environmentally friendly, low cost and efficient adsorbents due to their high absorption capacity [1, 2, 3]. The aim of this study is to investigate adsorbents' ability to prevent the contamination of natural waters with fluopyram, originating from point sources pollution due to agricultural activity. The adsorption capacity was evaluated through batch equilibrium studies.



Table 1. Fluopyram physicochemical parameters.

Parameter	Value
Molecular Weight (g.mol ⁻¹)	396.76
Water Solubility (mg.L ⁻¹)	16.0
Adsorption coefficient K _{loc} (mL/g)	278.9
Log K _{ow}	3.3 (high bioaccumulation)
pKa	No dissociation
GUS index	3.23 (high mobility)
Soil degradation DT _{50field}	118.8



Materials & Methods

Adsorption experiments were conducted in a batch system. One gram adsorbent was added to 10 ml of pesticide solution in flasks. The aqueous solutions were shaken on an orbital shaker at 150 rpm at room temperature (22 °C). The aliquots were treated with liquid-liquid extraction and analyzed by a HPLC-DAD system. Four individual experiments were conducted for each adsorbent (natural materials zeolite, attapulgite, bentonite and commercial oak biochar). The particles size of adsorbents were 0.8-2.5 mm.

Firstly adsorption capacity and equilibrium time were determined. The initial concentration was 2 µg ml⁻¹ in flasks. The percentage of adsorbed pesticide concentration (1) was calculated as follows:

$$\text{Adsorption (\%)} = \frac{C_i - C_f}{C_i} \quad (1)$$

where C_i and C_f are the initial and final concentration, respectively

Further, adsorption isotherms (linear and Freundlich) were conducted at five different concentrations (1, 2, 4, 8 and 12 µg ml⁻¹). The linear (2) and Freundlich (in a linear mode) (3) isotherm equations are:

$$q_e = K_d \times C_e \quad (2)$$

$$\text{Log } q_e = \text{Log } K_f + (1/n) \text{Log } C_e \quad (3)$$

where q_e (µg gr⁻¹) is the concentration in solid phase, C_e (µg ml⁻¹) is the concentration in liquid phase, K_d is equilibrium distribution coefficient, K_f (µg gr⁻¹) is the Freundlich constant and n the Freundlich exponent.



Fig. 1. Adsorbents matrices: a) zeolite, b) attapulgite, c) bentonite, d) biochar

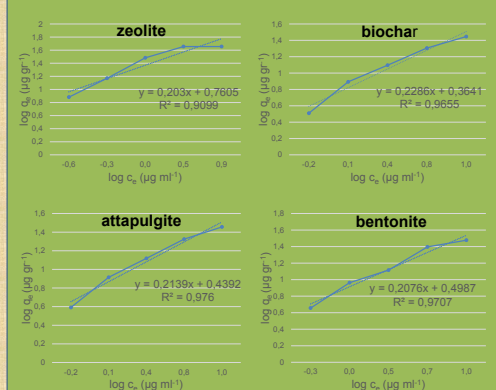


Fig. 2. Adsorption Freundlich isotherm.

Results

The efficacy of the adsorbents was estimated at the highest environmental relevant concentrations. The results showed that the adsorption capacity is higher in zeolite with removal efficiency of 64%. Bentonite, attapulgite and biochar reached 56%, 41% and 38%, respectively. Linear and Freundlich isotherms were obtained in all cases (Fig. 2 and 3). Experimental data were fitted better with linear isotherm. Zeolite, bentonite, attapulgite and biochar could be used in combination for the effective remediation of point-source pollution sites contaminated with pesticide mixtures.

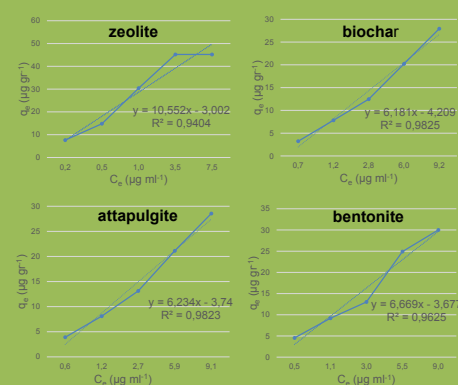


Fig. 3. Adsorption linear isotherm.

References

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