Supplementary Materials

Adsorption Kinetics of Imidacloprid, Acetamiprid and Methomyl Pesticides in Aqueous Solution onto Eucalyptus Woodchip Derived Biochar

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Adsorption Isotherms

Two-parameter adsorption isotherms models including Dubinin-Radushkevich and Temkin models were also applied to simulate the experimental data for the adsorption isotherm interpretation.

The Dubinin-Radushkevich adsorption isotherm is generally applied to express the adsorption mechanism with the distribution of Gaussian energy on the heterogeneous surface [1]. This model is commonly used to describe the adsorption of vapors and gases on microporous sorbents. The difference of the Dubinin-Radushkevich isotherm model from Langmuir and Freundlich isotherm models is that the Dubinin-Radushkevich model is a semiempirical equation where the adsorption of this model occurred through pore filling mechanism and multilayer characteristic. This isotherm is expressed as follow:

$$q_e = q_{m,DR} \exp[-K_{DR}\varepsilon_{DR}^2] \quad \text{(S1)}$$

where q_e is the equilibrium adsorption capacity (mg g^{-1}), $q_{m,DR}$ is the Dubinin-Radushkevich maximum adsorption capacity (mg g^{-1}), K_{DR} is a constant related to the adsorption energy (mol^2 J^{-2}) and ε is Polanyi potential (J mol^{-1}). The equation used for ε calculation is expressed as follow:

$$\varepsilon = RT \ln (1 + 1/Ce) \quad \text{(S2)}$$

where R, T and Ce are the gas constant (8.3145 J mol^{-1}), absolute temperature (K) and equilibrium concentration of adsorbate (mg L^{-1}), respectively.

The mean free energy of adsorption (E, J mol^{-1}) is can be calculated as shown in Equation (S3), which is defined as the change of free energy when one mole ion transfer to the surface of adsorbent from infinite distance in the solution.

$$E = 1/(2K_{DR})^{0.5} \quad \text{(S3)}$$

The Temkin adsorption isotherm model contains a factor that considers the effects of some adsorbent-adsorbate interactions [1]. Due to the interactions between adsorbate and adsorbent, the heat of adsorption of all molecules in the adsorption layer possibly decreases linearly with the coverage [2]. Temkin model is absolutely well for predicting the

gas phase equilibrium but this model is commonly appropriate to describe complex adsorption system including liquid-phase adsorption isotherms.

The non-linear expression of Temkin isotherm is given as follow:

$$qe = B \ln (K_T Ce)$$

$$B = RT/b_T$$

Where B, K_T and b_T are the Tenkin iostherm constant corresponeded to heat of adsorption, Temkin iostherm equilibrium binding constant (L mg^{-1}) and Temkin sorption heat constant (J mol^{-1}), respectively.

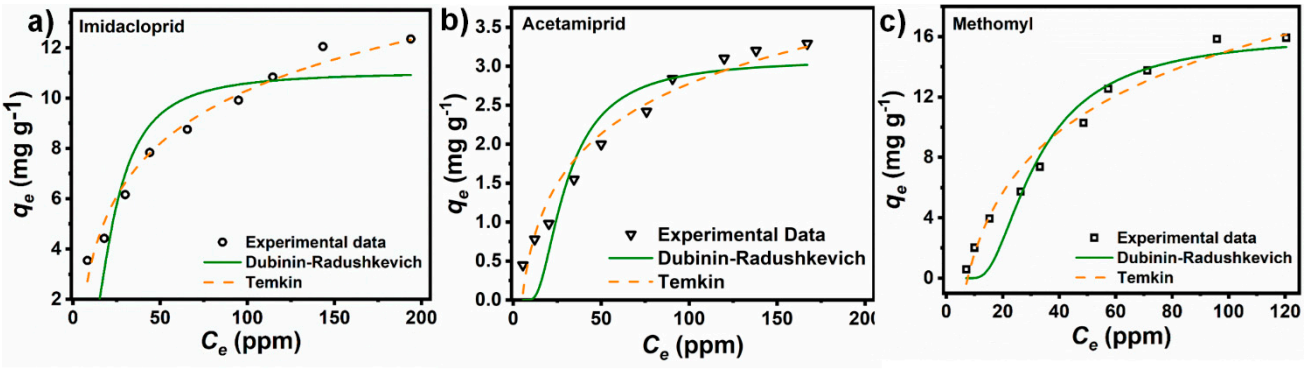

Figure S1. Dubini-Redushkevich adsorption isotherms for (**a**) imidacloprid, (**b**) actamiprid and (**c**) methomyl on BC, respectively.

Table S1. Dubinin-Radushkevich and Temkin isotherm parameters for imidacloprid, acetamiprid and methomyl on BC.

Models (Two-parameter)	Isotherm parameters	Pesticides		
		Imidacloprid	**Acetamiprid**	**Methomyl**
Dubinin–Radushkevich	q_{mDR} (mg g^{-1})	11.04	3.09	16.15
	K_{DR} (mol^2 J^{-2})	6.9×10^{-7}	1.1×10^{-6}	1.3×10^{-6}
	E (kJ mol^{-1})	0.8509	0.6273	0.6689
	R^2	0.7407	0.8735	0.9350
Temkin	K_T (L g^{-1})	0.2967	0.2005	0.1320
	B	3.0403	0.9260	5.840
	b_T (kJ mol^{-1})	0.8150	2.6757	0.4243
	R^2	0.9625	0.9770	0.9742

Supplementary Materials References

1. Foo, K. Y.; Hameed, B. H. Insights into the modeling of adsorption isotherm systems. *Chem. Eng. J.* **2010,** *156,* 2–10.
2. Mohammad, S. G.; Ahmed, S. M.; Badawi, A. F. M. A comparative adsorption study with different agricultural waste adsorbents for removal of oxamyl pesticide. *Desalin. Water Treat.* **2015,** *55,* 2109–2120.