Supporting Information

Exploitation of seafood waste byssus as water remediation material

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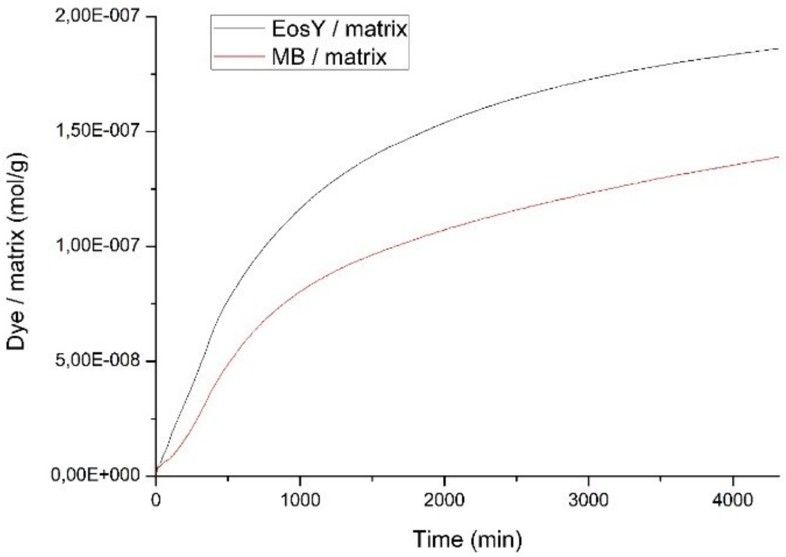

Figure SI1. Adsorption kinetic of the de-metaled byssus in a 0.01 mM solution of dye.

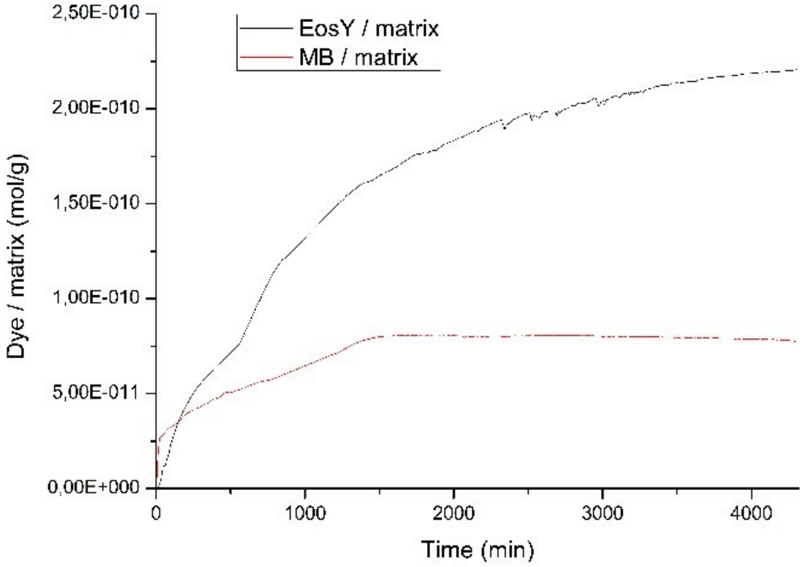

Figure SI2. Adsorption kinetic of the pristine byssus in a 0.01 mM solution of dye.

Adsorption Isotherms

The experimental data were fitted using three adsorption isotherm models.

Langmuir adsorption isotherm: This describes quantitatively the formation of a monolayer adsorbate on the outer surface of the adsorbent, and after that no further adsorption takes place. Thereby, the Langmuir represents the equilibrium distribution of metal ions between the solid and liquid phases.[i] The Langmuir isotherm is valid for monolayer adsorption onto a surface containing a finite number of identical sites. The model assumes uniform energies of adsorption onto the surface and no transmigration of adsorbate in the plane of the surface.

$$q_e = \frac{q_m \, b \, C_e}{1 + \, b \, C_e}$$

$$\frac{1}{q_e} = \frac{1}{q_m} + \frac{1}{q_m \, b \, C_e}$$

where C_e is the equilibrium concentration of adsorbate (mg L^{-1}); q_e is the amount of dye adsorbed per gram of the adsorbent at equilibrium (mg g^{-1}); q_m is maximum monolayer coverage capacity (mg g^{-1}); *b* is Langmuir isotherm constant (L mg^{-1}).

K_L is an important tool in the calculation of the dimensionless equilibrium parameters (R_L) that explains the favorability of adsorption process; R_L is calculated using

$$R_L = \frac{1}{1 + \, b \, C_o}$$

where C_0 is the highest initial dye concentration (mg L^{-1})

There are four possibilities for the R_L value: for favourable sorption $0 < R_L < 1$; for unfavourable sorption $R_L > 1$; for linear sorption $R_L = 1$; for irreversible sorption $R_L = 0$

Freundlich adsorption isotherm: This is commonly used to describe the adsorption characteristics for the heterogeneous surface sites.[ii]

$$q_e = K_F \, C_e^{1/n}$$

$$\ln q_e = \ln K_F + \frac{1}{n} \, lnC_e$$

where C_e is the equilibrium concentration of adsorbate (mg L^{-1}); q_e is the amount of dye adsorbed per gram of the adsorbent at equilibrium (mg g^{-1}); *n* is adsorption intensity; K_F is Freundlich isotherm constant (mg g^{-1}).

The value of 1/n indicates the type of isotherm. If the value of 1/n lies in between ($0 < 1/n < 1$) it showed that isotherm is favorable, if $1/n = 0$, it indicates isotherm is irreversible and if $1/n > 1$, it is unfavorable.

Dubinin–Radushkevich isotherm: Dubinin-Radushkevich (D-R) isotherm is generally applied to express the adsorption mechanism with a Gaussian energy distribution on a heterogenous surface. This model is successfully fitted high solute activities at different concentration ranges. This approach was implied to distinguish the chemical and physical adsorption. This isotherm is temperature dependent and assumes that there is no homogenous surface on the adsorbent and the equation is expressed as follows.[iii]

$$q_e = q_D\, e^{-K_D \varepsilon^2}$$

$$\ln q_e = \ln q_D - K_D\, \varepsilon^2$$

$$\varepsilon = RT \ln\,(1 + 1/C_e)$$

where K_D and ε are D-R constant ($mol^2\ kJ^{-2}$) and D-R isotherm constant, respectively; R and T are the gas (8.314×10^{-3} kJ mol^{-1} K^{-1}) and temperature (K) constant, respectively and q_D is the saturation capacity (mg g^{-1}). The parameters are obtained by the linear plot of ln q_e vs. ε^2.

K_D is the activity coefficient useful in obtaining the mean sorption energy E (kJ mol^{-1})

$$E = \sqrt{\frac{1}{2\,K_D}}$$

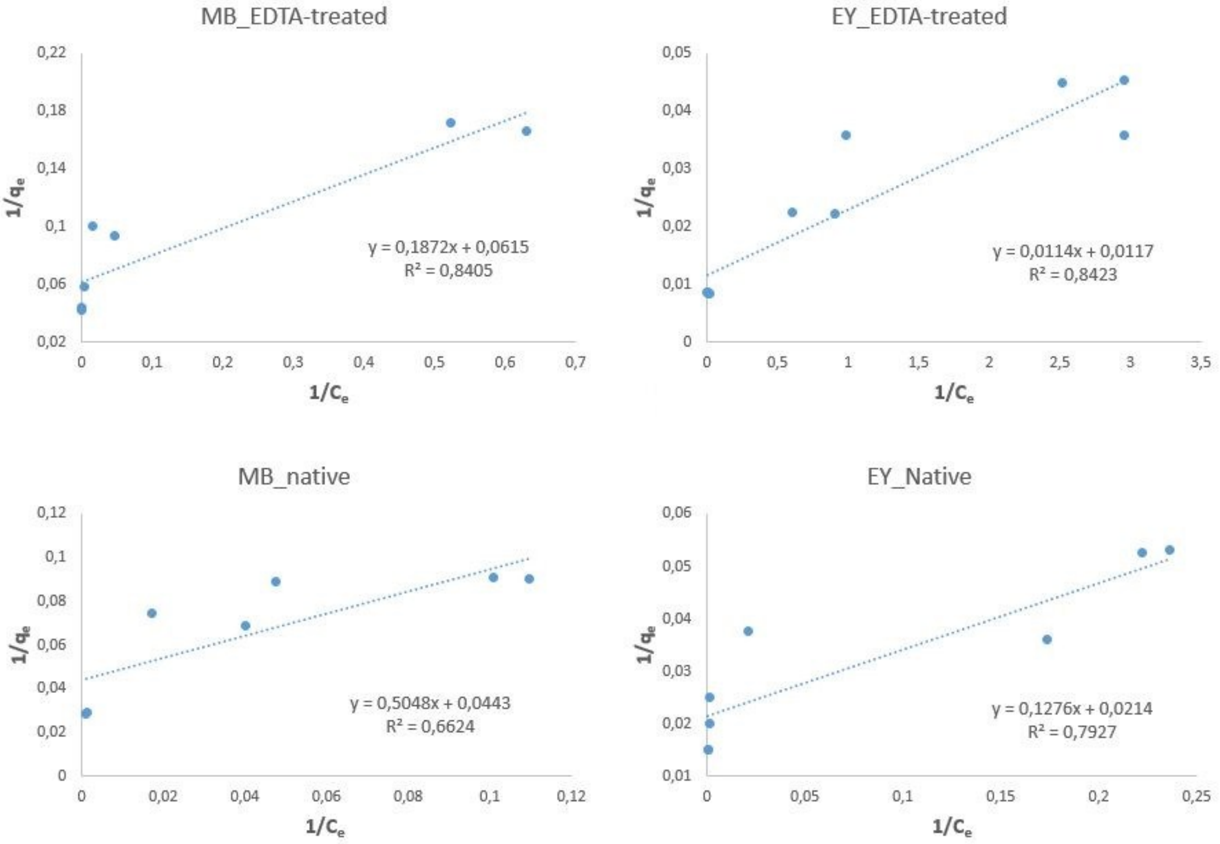

Figure SI3. Langmuir adsorption isotherms.

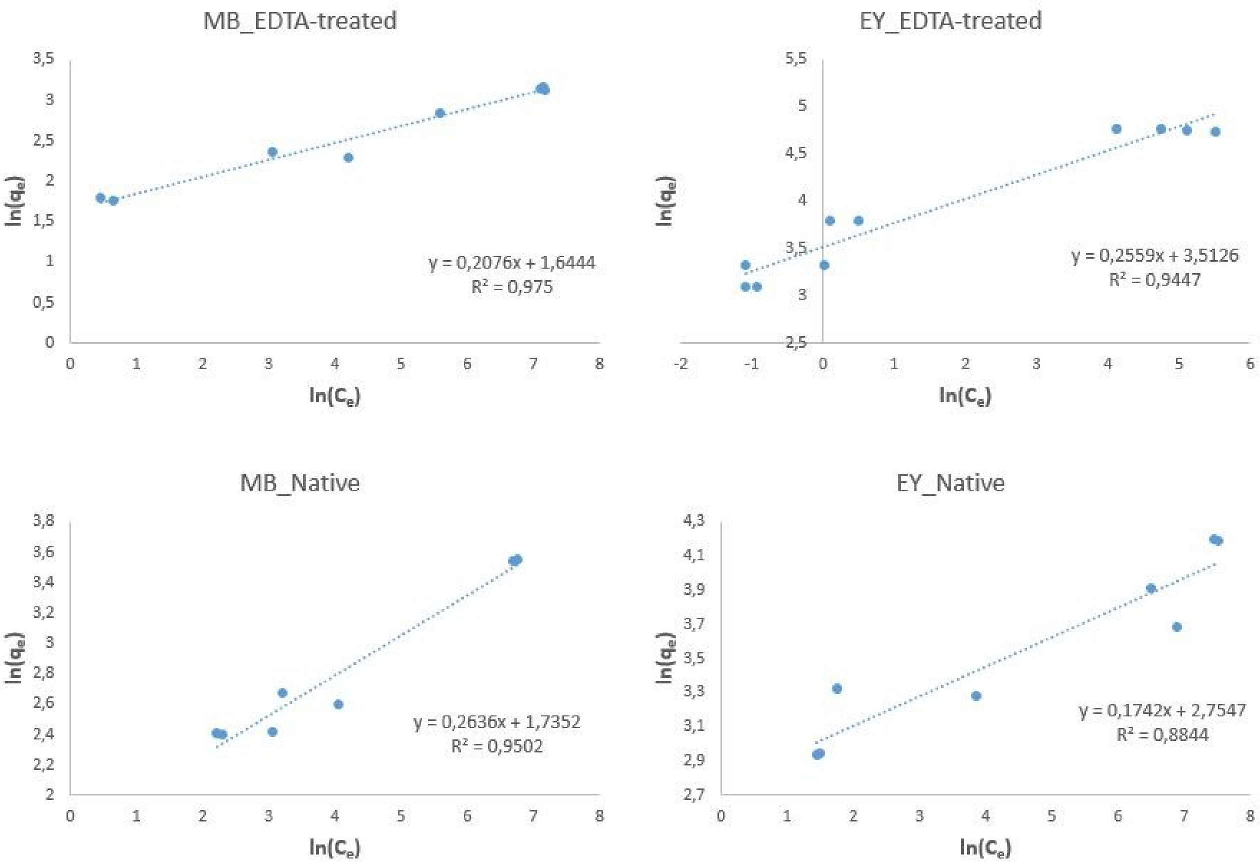

Figure 4SI. Freundlich adsorption isotherms.

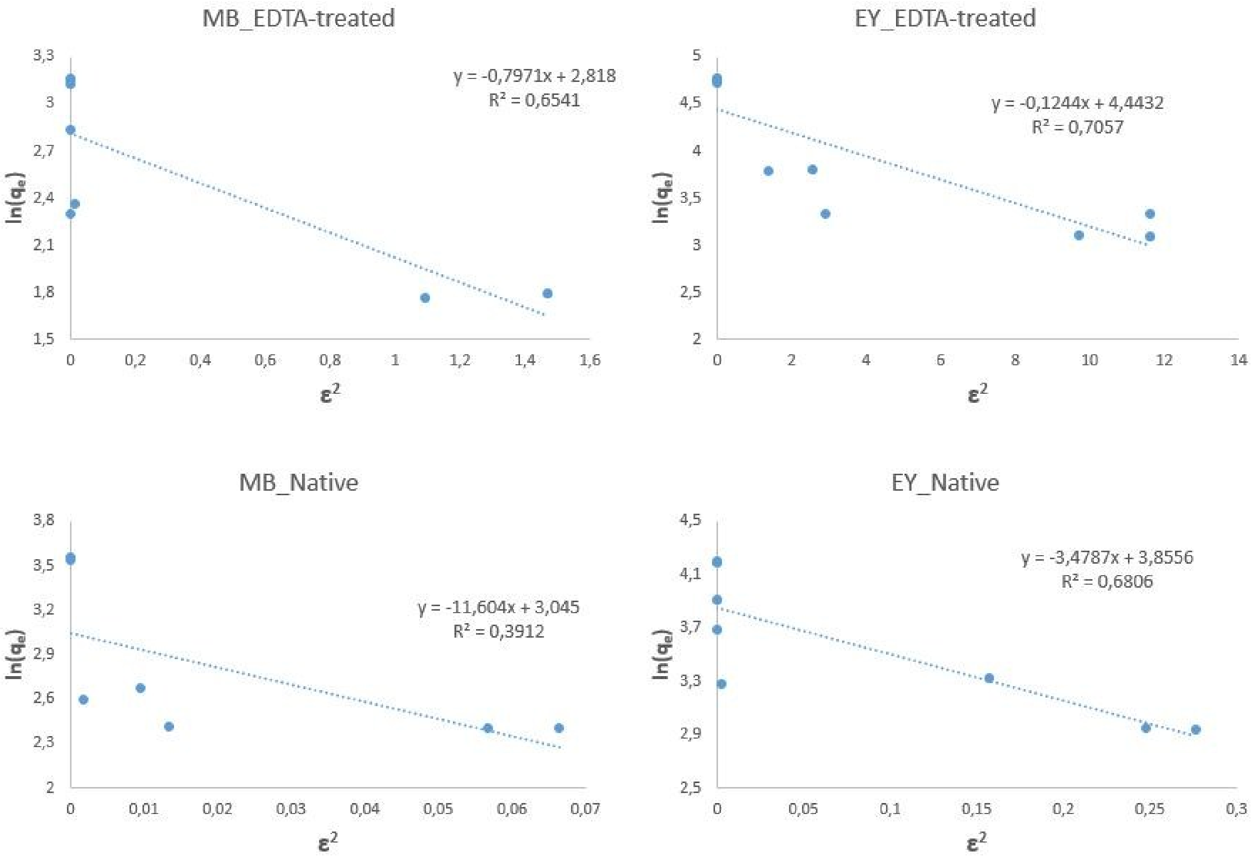

Figure SI5. Dubinin Radushkevich adsorption isotherms

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[i] Langmuir, I. The adsorption of gases on plane surfaces of glass, mica and platinum. J. Am. Chem. Soc. 1918, 40, 1361–1403.

[ii] Freundlich, H. M. F.Uber die adsorption in losungen. Z. Phys. Chem. 1906, 57, 385–470.

[iii] Dubinin, M. M.; Radushkevich, L. V. Equation of the characteristics curve of activated charcoal. Chem. Zent. 1947, 1, 875.