**Supplementary material - development of the *n* order model**

The proposed *n* order model is represented by Equation 01.

(01)

Equation 01 can be rewritten as in Equation 02.

(02)

Applying the following integration limits, Equation 02 becomes:

(03)

Assuming that is constant, the right side of Equation 03 is integrated directly. On the right side, it is necessary to use the following relation,

which is valid only for values . Thus Equation 03 becomes:

(04)

Isolating the adsorbate concentration in the solid phase at time *t*, the analytical expression of the *n* order desorption kinetic model can be obtained(Equation 05).

(05)

As e , the Equation 05 becomes:

(06)

Rearranging,

(07)

Applying the exponent rule,

(08)

Which is reduced as shown in Equation 09, the *n* order kinetic desorption model.

(09)

where is the initial concentration of adsorbate in the solid phase (mg g-1), is the constant rate (gn-1 mg1-n min-1) and (*n* > 1) is the desorption reaction order (dimensionless).