

Competitive co-adsorption of bacteriophage MS2 and Natural Organic Matter onto Multiwalled Carbon Nanotubes

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Supplementary information

1. MWCNT purity

Since MWCNT contain metallic impurities, which proportions and composition vary from one supplier to another, we reported below the mass of impurities per mass of MWCNT of the MWCNT used in this study (*CheapTubes*, LOT number 180320; USA).

Table S1: ICP-MS measurements of MWCNT digestates to quantify the metallic impurities (i.e. manganese, iron, strontium, barium and nickel). Digestates resulted from the digestion of a fixed mass of MWCNT into Teflon vials containing 4 mL HNO₃ (65%) and 0.5 mL H₂O₂. Measurements were performed with samples (n=6) taken at different spots of the same MWCNT batch used in this study (LOT number 180320). The values reported in the table stand for the average values measured for the 6 samples and their corresponding standard deviations.

Mn	Fe	Sr	Ba	Ni
mg/kg	mg/kg	mg/kg	mg/kg	mg/kg

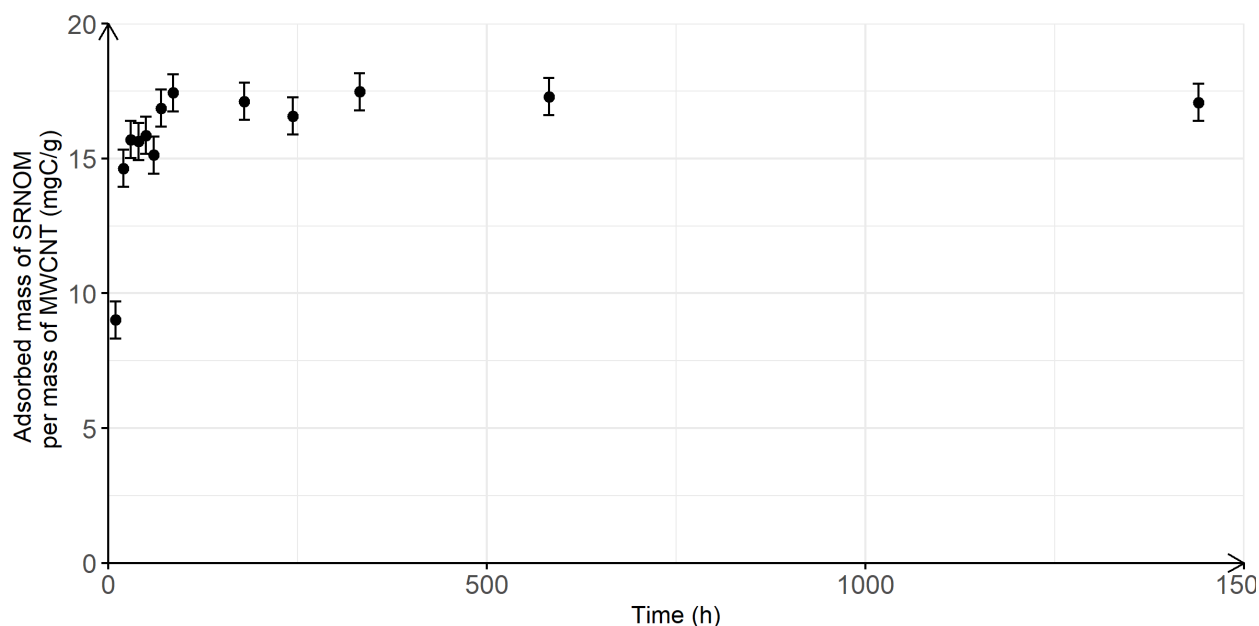
0.05 ±0.01	0.44 ±0.43	0.20 ±0.04	0.51 ±0.04	115.19 ± 8.14
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31 **2. Preliminary tests to evaluate the batch experiment time required to**
 32 **reach equilibrium**

33 Before starting the batch experiments, we first evaluated the time required to reach adsorption
 34 equilibrium of both SRNOM (Figure S1) and MS2 (Figure S2) onto the MWCNT used in this
 35 study.

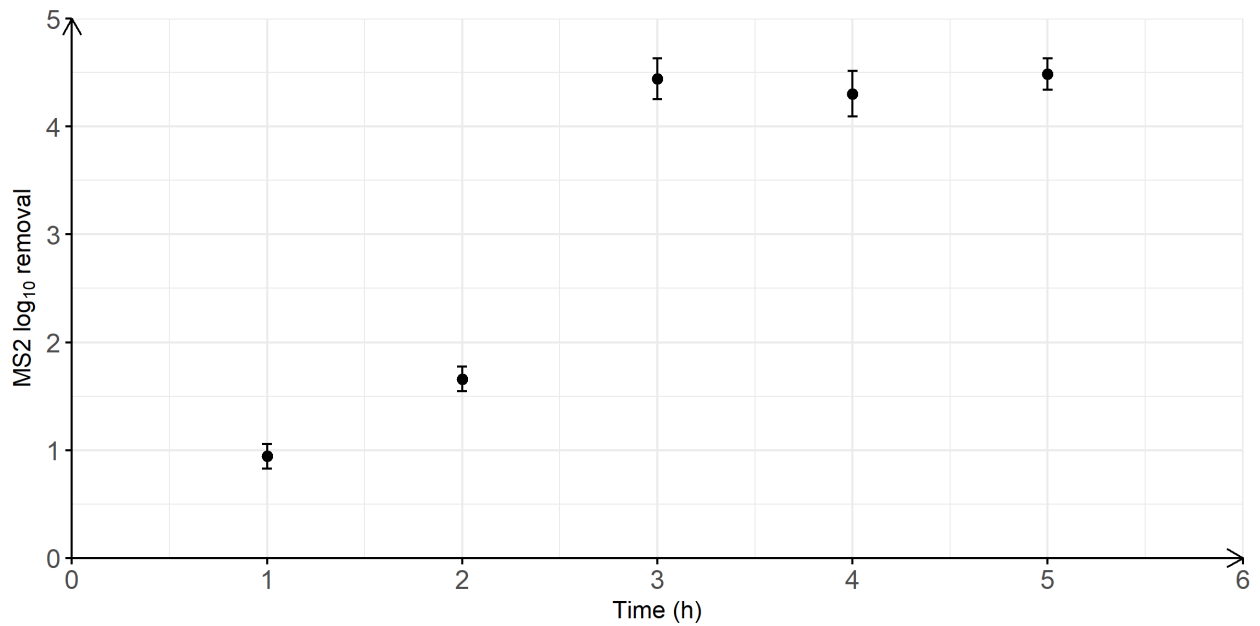
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38 *Figure S 1: SRNOM adsorbed mass per mass of MWCNT as a function of time. This batch*
 39 *experiment was performed at pH 7.7, with a mass of MWCNT of 15 mg and SRNOM solution*
 40 *at an initial concentration of 10 mgC/L. This experiment served to evaluate the time required*
 41 *for the batch experiments to attain apparent NOM adsorption equilibrium. One reactor was*
 42 *sampled in duplicate at different times. Error bars represent laboratory precision calculated*
 43 *using a pooled standard deviation, or weighted average of standard deviations calculated for*
 44 *all groups of samples, from the sets of duplicate samples.*

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47 *Figure S 2: MS2 log₁₀ removal as a function of time. This batch experiment was performed at*
 48 *pH 7.7, with a mass of MWCNT equal to 15 mg, MS2 concentration of 10⁶ PFU/mL, to*
 49 *evaluate the time of required to reach material saturation. One reactor was sampled at*
 50 *different times.*

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52 **3. Description of the statistical model used to evaluate the effect of pH** 53 **on MS2 adsorption on MWCNT**

54 To evaluate the effect of the pH on MS2 LRV as a function of MWCNT mass, we ran a
 55 statistical model with Rstudio.

56 The hypothesis of this model was: if the pH affects MS2 LRV as a function of MWCNT mass,
 57 it would affect the intersect of the linear regression, because a net surface change would occur
 58 either for MS2 or for MWCNT and consequently more or less MS2 could adsorb to the MWCNT
 59 for the same mass. However, the hypothesis further suggests that the change in LRV relative to
 60 the change in MWCNT concentration (slope) is unaffected at different pH, because the number
 61 of adsorption sites on MWCNT is proportional to MWCNT mass.

62 The model used was the following:

$$63 \text{ LRV} = \beta_0 + \beta_1 \text{MWCNT} + \beta_2 \text{I}(\text{pH}7.7) + \beta_2 \text{I}(\text{pH}8.7)$$

64 pH5.2 data was used to plot the linear regression and I(pH=7.7) and I(pH=8.7) are switch
 65 functions either equal to 1 or 0.

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