Sorption and Desorption Mechanism of Phenanthrene and Nonylphenol on *Chlorella* Algae and Its Nonhydrolyzable Fractions Isolated with Different Methods

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The nonhydrolysable carbon (NHC) fractions were isolated from commercial *Chlorella* by using trifluoroacetic acid (TFA), sodium periodate (SP), ball mill (MES) and ball mill-sodium periodate (BSP), rspectively and were characterized by elemental analysis, CO_2 and N_2 adsorption techniques, Rock-Eval analysis, and advanced solid-state ^{13}C nuclear magnetic resonance spectroscopy. Then, the sorption and desorption mechanism of phenanthrene (Phen) and nonylphenol (NP) on the *Chlorella* and its NHC fractions were investigated by a batch technique. The TFA NHC fraction exhibited the highest polymethylene carbon content and the lowest polar carbon content, which was similar to algaenan structure. In addition, the TFA fraction showed the highest sorption capacity for Phen with the values of 200, 000 μg/g. The SP fraction exhibited the highest sorption capacity for NP amounting to 457,000 μg/g. A highly significant and positive correlations between the sorption capacity of Phen or NP and the aliphaticity among the NHC fractions suggested that their structure was critical to the Phen and NP sorption. Meanwhile, the (O+N)/C atomic ratios and polar groups were significantly and negatively correlated with the sorption capacity of Phen and NP, indicating that the accessibility also played a significant role in the sorption process. Moreover, hydrogen bonding played an important role to the sorption of NP on the investigated samples. Desorption hysteresis of Phen and NP was observed, and was related to entrapment, micropore deformation, and hydrogen bonding of the NHC fractions.