THE ANALYSIS OF SINGLE WALLED NANOCABON CHLORINATION USING FT IR SPECTROPHOTOMETRY

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Abstract: There is a great concern regarding the potential toxicity of nanocarbon materials, because of their extensive industrial applications and possible discharge to environment. When found in water or wastewater that is treated using classical methods, there is a danger of interactions between standard pollutants, nanomaterials and chemicals used for treatment. We are presenting results of the study on interactions between chlorine (commonly used as disinfectant) and two types of single-walled nanocarbons: SWCNTs not functionalized, purity more than 90%; OD 1-2 nm, length, 5-30 µm; and SWCNTs with attached -COOH functional groups, 2.73 % and purity more than 90%; OD 1-2 nm, length, 5-30 µm. Chlorination of nanocarbons was tested in distilled water at pH = 7.0 and 6.0 ± 0.12 (solutions were buffered), for different mass ratios (5:5 - 20:20 mg/L) at ambient temperature, and with continuous mixing. Analysis of FT IR spectra for SWNCTs–COOH, identified absorptions peaks due to ν(C=O) at 1700.9 cm⁻¹, ν(C–O) at 1161 cm⁻¹, δ(OH) at 1303.7 cm⁻¹. Also, the absorptions corresponding to ν(C=C) from 1463.7, 1565.9, 1645 cm⁻¹ and for ν(C-C) from 1066.5 cm⁻¹ were determined. The intensities of these maxima were small; they ranged between 0.01-0.06 a.u. (arbitrary units). FT-IR spectra of chlorinated samples collected over reaction time were different when compared with SWCNTs and free chlorine. We observed new bands with higher absorptions at different wavelengths. These bands appeared 10-20 minutes after reagents mixing, and they were correlated with reaction conditions. Their maxima were at 524-544, 920-940, 1050-1100, 1230-1300, and 1645-1652 cm⁻¹. The intensities of their absorptions increased when reaction progressed, and those recorded after 3 hours were as follows: 0.187-0.37, 0.45-0.85, 0.15-0.43, 0.16-0.40 a.u. After separation of nanocarbon from water, we found that nanocarbon and water samples presented similar absorption bands; however spectra of samples containing dissolved by-products were more intense. The obtained results suggested that charge transfer complex was formed between nanocarbon and chlorine.

Key words: SWCNTs; functionalized nanomaterial, chlorine, disinfection, toxic by-products, FT IR spectrophotometry

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