Large-scale SPE-filtration system based on a use of Bondesil-PPL bulk sorbent for isolation of gram quantities of DOM from marine water

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Dissolved organic matter (DOM) comprises large pool of organic carbon in the World Ocean. Its typical concentrations in the marine environments do not exceed 5 mgC/L. The most widespread approach to DOM isolation is solid phase extraction (SPE) using pre-packed cartridges, such as Bond Elut PPL. The closest bulk sorbent is Bondesil PPL, but it has the different basis (silicagel versus polymers in BondElut). Prior to its use for large-scale filtration, it was necessary to compare molecular composition of DOM extracted with a use of Bond Elute PPL cartridges and bulk sorbent Bondesil PPL.

The goal of this work was to estimate suitability of bulk sorbent - Bondesil PPL (Agilent) for preparative extraction of large quantities of DOM, which would be comparable in composition to DOM samples extracted by prepacked cartridges Bond Elut PPL.

Firstly, the model experiments were conducted on isolation of peat DOM (Fulvagara) using BondElut PPL cartridges, and self-packed columns of Bondesil PPL sorbent. Secondly, the large-scale filtration system was assembled using the self-packed columns with Bondesil PPL. It was used for isolation of marine DOM from 500-100 L. From the same station, marine DOM was isolated using the Bond Elut PPL cartridges to enable direct comparison of molecular composition of the DOM isolated by different sorbents.

The lab experiment was conducted using 3L of 70 mg/L Fulvagra solution, which was passed through the sorbents under study. Close similarity was revealed for sorption capacity of both sorbents: $60.1 \pm 2.1\%$ and $64.3 \pm 2.4\%$ respectively, for Bondesil PPL and Bond Elut PPL, and extraction efficiency: 42.5 ± 1.4 and $45.4 \pm 2.3\%$, respectively. The extracted materials were analyzed using optical spectroscopy and FT-ICR mass-spectrometry (15 T Solarix mass spectrometer located at the Zelinsky Institute of Organic Chemistry of RAS). The samples revealed close similarity in molecular composition with respect to the main peaks with the range of m/z 300-500 zone.

Large-scale SPE filtration set up was assembled aboard research vessel Ac. Keldysh during International Siberian Shelf Study (ISSS) Expedition in October 2020. Surface sea water was collected into 1000 L HDPE tank (about 500 L) after filtration through pre-combusted GF/F filters conducted by team of University of Stockholm led by O. Gustafsson. It was acidified until pH 2 and discharged through two sets of self-packed 60 mL cartridges filled with 15 g Bondesil-PPL sorbent each. The cartridges were unloaded in the lab using methanol elution. The extracts were also investigated using FT-ICR MS. The extracted fractions revealed an abundance of tannins and phenylisopropanoids. The similarity of fractions was proved by estimating of correlations between the fractions using mathematical models of comparison such as tanimoto, cosine and estimation of correlations.

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