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Subject Area	Water treatment
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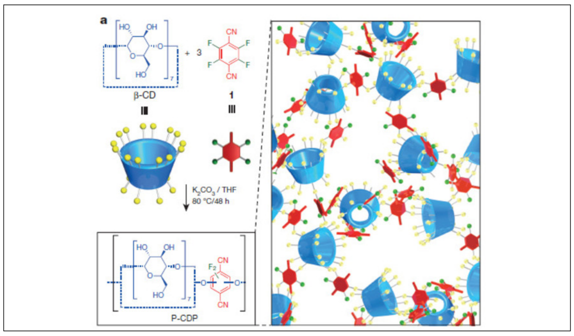
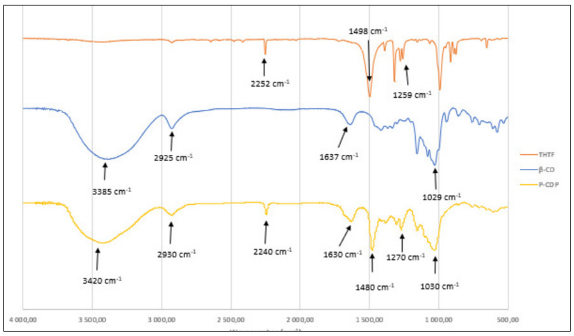
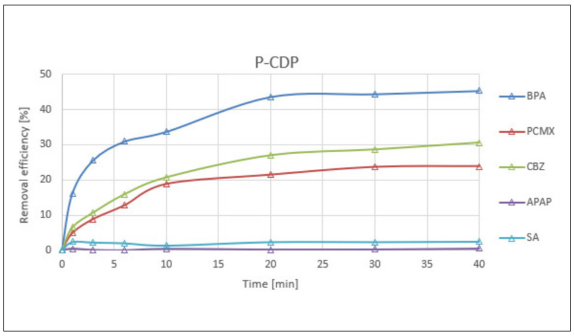
Removal of Micropollutants from Aqueous Solutions with P-CDP



Sythesis of porous beta-CD polymer. Beta-CD and THTF is polymerized in a suspension of potassium carbonate in THF + DMF.



FT-IR spectra showes similar stretches which indicate preservation of an intact beta-CD structure in the P-CDP polymer.



Removal efficiency of P-CDP. Co for each pollutant was 50 mg/L. Adsorbent concentration was 0,5 g/L.

Introduction: The input of organic substances into waters is a huge challenge for the water conservation. For example, in Switzerland, there are over 30'000 synthetic organic substances being used in countless products on a daily basis. These include pharmaceuticals, pesticides, hygiene- and cleaning products, and many more. Today's waste water treatment plants are designed to eliminate nutrients like organic carbon, phosphor and nitrogen. Many micropollutants are not at all, or just partially removed. Therefore, waste water treatment plants are the main input source into the waters. Oxidation with ozone or adsorption through adsorbents, like activated carbon, have been applied in pilot or full scale. The oxidation with ozone is indeed effective, but one disadvantage of this method is the formation of harmful by-products. Adsorption with activated carbon could be a convenient solution due to its relatively simple application, but it has a low selectivity for the target-pollutants and its regeneration requires excessive amounts of energy.

Objective: In this thesis, porous beta-CD polymer (P-CDP), a water insoluble beta-CD based polymer, has been investigated with respect to the adsorbption of selected micropollutants and compared with two other adsorbents, namely activated carbon and citric acid crosslinked beta-CD (CA-CD).

Result: Adsorption experiments have shown that P-CDP can effectively adsorb hydrophobic pollutants by forming host-guest complexes within the cavities of beta-CD. The hydrophobic pollutants BPA, PCMX, and CBZ were adsorbed while the hydrophilic pollutants APAP and SA were not. Further experiments with the addition of matrix constituents like natural organic matter and different ion-strengths as well as the variation of the pH value have shown a robust adsorption performance of P-CDP. While activated carbon will adsorb almost all kinds of dissolved organic substances, P-CDP has a high selectivity for certain molecules which fit into the cavity of beta-CD. Its adsorption performance was not affected by big molecules like humic acid or fluvic acid which are commonly natural organic matters in natural waters.
Kinetic and isotherm studies were conducted respectively to determine the pollutant uptake rate and the adsorption mechanisms of P-CDP. McKay's and Ho's pseudo-second-order model was applied to the kinetic data and it showed a good fit for the adsorption process of P-CDP. Freundlich and Langmuir isotherms were applied to the isotherm data. The monolayer model of Langmuir described the experimental resultes very well. The good fit of the Langmuir model suggests a homogeneous adsorption mechanism, which was consistent with the inclusion of organic pollutants by beta-CD cavities. One important feature of an industrially usable product is its cost. If the loaded adsorbents could be stripped of the pollutants and then be used again, the cost would drop significantly. Regeneration experiments for P-CDP have shown a good reusability over 5 cycles. The desorption with methanol proved successful and did not decrease the performance of the adsorbent.