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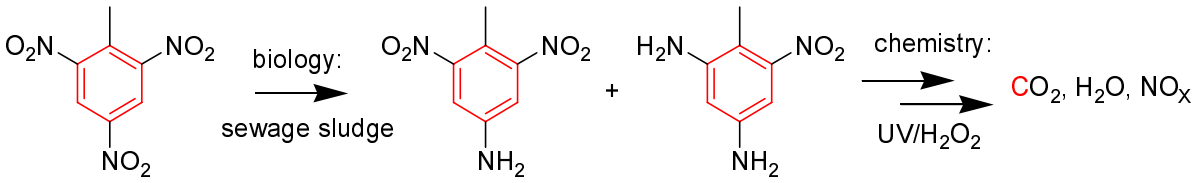
Balance of a Combined Biological-Chemical Degradation of ^{14}C-2,4,6-Trinitrotoluene (TNT)

In this dissertation the efficiency of a combined biological/chemical procedure for the clean up of waste waters containing TNT was shown and optimized. Aim of the clean up was the complete mineralization of the contaminant TNT into harmless substances like carbon dioxide, water and inorganic nitrogen compounds. Mineralization was shown by ^{14}C-ring-labelled TNT. The resulting $^{14}CO_2$ was adsorbed so that a balance of the whole process could be made up.

Since photochemical mineralization of TNT itself is very hard and energy consuming, we evaluated the strategy to reduce TNT in a first step, followed by photochemical treatment of the resulting aminonitrotoluenes, which are much easier to oxidize, in a second step.



mineralization of TNT via biological reduction and chemical oxidation

(red = ^{14}C-labelled atoms)

First a new one step synthesis for the four ^{14}C-ringlabelled TNT-metabolites 4-amino-dinitrotoluene (4-ADNT), 2-aminodinitrotoluene (2-ADNT), 2,4-diaminonitrotoluene (2,4-DANT) and 2,6-diaminonitrotoluene (2,6-DANT), based on the reduction of [U-ring-^{14}C]-TNT by baker's yeast (*Saccharomyces cervisiae*), was developed.

Oxidative treatment with hydrogen peroxide and UV-radiation yielded much higher rates of mineralization for ADNTs and DANTs compared to TNT. Addition of Fe^{2+} (Fenton-oxidation) further increased the speed of degradation.

In the combined procedure TNT was reduced by sewage sludge with sugar as cosubstrate. Anaerobic treatment proved to be more efficient than aerobic treatment. The outcoming compounds, with 4-ADNT being the main transformation product, were oxidized by UV/H_2O_2 in the following step. By the combined procedure we finally obtained a higher rate of mineralization compared to photochemical treatment of TNT.