Biogeochemistry of landfill leachate plumes - DTU Orbit (11/11/2019)

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The literature has been critically reviewed in order to assess the attenuation processes governing contaminants in leachate affected aquifers. Attenuation here refers to dilution, sorption, ion exchange, precipitation, redox reactions and degradation processes. With respect to contaminants, focus is on dissolved organic matter, xenobiotic organic compounds, inorganic macrocomponents as anions and cations, and heavy metals. Laboratory as well as field investigations are included. This review is an update of an earlier comprehensive review. The review shows that most leachate contamination plumes are relatively narrow and do not in terms of width exceed the width of the landfill. The concept of redox zones being present in the plume has been confirmed by the reported composition of the leachate contaminated groundwater at several landfills and constitutes an important framework for understanding the behavior of the contaminants in the plume as the leachate migrates away from the landfill. Diverse microbial communities have been identified in leachate plumes and are believed to be responsible for the redox processes. Dissolved organic C in the leachate, although it appears to be only slowly degradable when the volatile organic acids are gone, apparently acts as substrate for the microbial redox processes. Several xenobiotic organic compounds have been found to be degradable in leachate contaminated groundwater, but degradation rates under anaerobic redox conditions have only been determined in a few cases. Apparently, observations in actual plumes indicate more extensive degradation than has been documented in the laboratory. The behavior of cations in leachate plumes is strongly influenced by exchange with the sediment, although the sediment is often very coarse and sandy. Ammonium seems to be subject to anaerobic oxidation, but the mechanisms are not yet understood. Heavy metals do not seem to constitute a significant pollution problem at landfills, partly because the heavy metal concentrations in the leachate are often low, and partly because of strong attenuation by sorption and precipitation. Although complexation of heavy metals with dissolved organic matter is significant, the heavy metals are in most cases still strongly attenuated in leachate-polluted aquifers. The information available on attenuation processes has increased dramatically during the last 15 years, but the number of well-documented full scale leachate plumes are still few and primarily from sandy aquifers. Thus, the diversity of attenuation processes in leachate plumes is probably not yet fully understood. Apparently, the attenuation processes in leachate plumes may for many contaminants provide significant natural remediation, limiting the effects of the leachate on the groundwater to an area usually not exceeding 1000 m from the landfill. (C) 2001 Elsevier Science Ltd. All rights reserved.

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