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Dr. Martin Jekel is a professor in the Department of Water Quality Control at TU Berlin. His undergraduate degree was in Chemistry from the University of Karlsruhe, Germany (1970 - 1975), and his doctorate degree was in Chemical Engineering also from the University of Karlsruhe, Germany (1976 – 1978). He was a Post-Doctoral Researcher at Stanford University (Environmental Engineering) from 1978 to 1979. Between 1976 and 1986, Dr. Jekel was a researcher at the Engler-Bunte Institute, Department of Water Chemistry, University of Karlsruhe, Germany. Between 1986 and 1988, he was an associate professor at the University of Paderborn, Germany. Since 1988, he has been a full professor at TU Berlin. His research focuses on water quality control.

ABSTRACT

"Removal of Bulk and Trace Organics in Underground Treatment Systems"

Underground treatment systems are applied in drinking water preparation in Central Europe and some parts of the world for more than a century. They include systems with bank filtration out of rivers (RBF) and lakes (LBF), artificial groundwater recharge (AGR) , soil-aquifer-treatment (SAT) or aquifer storage and recovery (ASR). A common term is now Managed Aquifer Recharge (MAR) for all subsystems. The conditions of underground treatment vary from site to site in view of raw water qualities (surface water of different quality, secondary or tertiary effluents, storm water etc..), infiltration rates, residence times, travel distances and redox conditions established along the flow path.

Caused by the detection of numerous trace organic compounds in the last decades, studies were initiated to follow the fate of these compounds together with inorganic parameters and the bulk organics (DOC). The overall results indicate a high potential to remove a great part of the substances, depending on the subsurface conditions, but some persistent substances are not removed even during long passages. They are present in the recovered groundwater and may impart the use for drinking and other purposes or additional specific treatment is needed. The knowledge about the removal efficiencies of the underground systems is rising in the last years significantly, allowing a careful evaluation of the existing examples of underground treatment and a more reliable prediction of new applications in given cases.

The presentation will include the results of trace and bulk organics removal in the case of Berlin, where 70 % of the drinking water is produced via lake bank filtration and artificial groundwater recharge out of eutrophic surface waters with significant portions of treated domestic wastewater (up to 40 %). Thus the Berlin case can be considered as an indirect potable reuse system and is comparable to water reclamation systems employing SAT or ASR. The retention times in Berlin are in general above 2 months, which allow the recovery of groundwater without any microbiological problems and distribution without disinfection.

The results on bulk organics show a very significant effect of redox conditions on the rate and extent of DOC removal. The fraction of biopolymers in the DOC is removed aerobically within days, while anoxic conditions seem to require up to 4 and more months. The trace organics detected in the surface waters behave quite differently. Some are fast and completely removed, like most antibiotics, except of Sulfamethoxazole. Others show a slow removal, depending on the redox conditions along the flow path. And a few compounds are not removed at all and can be qualified as conservative tracers. However, as seen in the Berlin Tegel case, the antiepileptic Carbamazepin, may be degraded to some extent if iron release is occurring, while higher redox potentials are not suitable for removal.

The presentation will also include recent studies in laboratory columns on the interacting influences of DOC-degradation and metabolism of Sulfamethoxazole, an antibiotic compound with rather unusual behavior.