



Industrie Service

Attestation for laboratory degradation of different chemicals in railway ballast by the innovative SOA-method, based on the following patent numbers: SOA: WO 2013 / 093903 and WO 2015 / 170317

The TÜV SÜD Industrie Service GmbH testifies hereby the proper execution of chemical degradation tests by the innovative SOA-method in the accredited laboratory of „görtler analytical services gmbh“ in Vaterstetten, Germany (see laboratory report from 27 th August 2019). The degradation tests, which have been executed under ideal conditions in laboratory scale, with different soil types and layers (track ballast, pure sand, agricultural soil/rich in humus) and testing of percolate water which had been contaminated prior with:

- Diesel fuel
- Used oil
- Glyphosate

The analytical laboratory tests have been carried out measuring the following parameters:

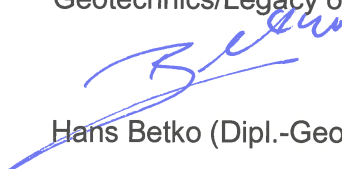
- HC-Index (C10 - C40)
- PAH
- Glyphosate/AMPA
- pH
- Electric conductivity
- DOC (Dissolved Organic Carbon)
- Dry residue

As a result, the technology showed high conversion rates for different treatment layers. Railway ballast (first layer): conversion up to 81% for oil and diesel leftovers and conversion of 93% for glyphosate decomposition. Railway sand (second layer): conversion up to 56% for oil and diesel leftovers and conversion rate of 94% for glyphosate decomposition. Railway groundwater (lowest layer): the conversion of oil and diesel leftovers was not measured. However, in this layer, the methodology reached a conversion of 99 % for glyphosate leftovers decomposition. These conversion rates were reached after single ballast treatment under normal temperature and pressure conditions with short treatment time. In summary it is hereby testified from an expertise-technical prospective, that the novel and forward-looking SOA-method is basically suitable for the fast and partly very effective decomposition of hydrocarbons and herbicide on track ballast and percolate water.

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Munich, 10 September 2019