Goldschmidt 2026 Abstract
https://doi.org/10.46427/gold2026.37563

International Biodeterioration & Biodegradation 198, 105995.
DOI: 10.1016/j.ibiod.2024.105995.

Rust tubercles on steel structures in German inland waterways: prevalence, core microbiomes and the influence of environmental factors

ANNIKA FISKAL[1], LIPI RAGHUNATHA REDDY[1], ILONA HERRIG[1], ANDREAS SCHÜTTLER[1], SVEN-ERIK WULF[2], MATTHIAS J. SCHMID[2], LISSA HELMHOLZ[1], ARNE WICK[1], HELMUT FISCHER[1] AND **JUTTA MEIER**[3]

[1]Federal Institute of Hydrology (BfG)
[2]Federal Waterways Engineering and Research Institute (BAW)
[3]University of Koblenz

Field investigations of microbially influenced corrosion (MIC) on steel infrastructure in freshwater sites still remain underrepresented compared to marine environments. However, the prevalence of MIC in German inland waterways became evident from a survey, in which the majority of the participating authorities confirmed the typical signs of MIC, such as mound-like accumulations of corrosion products (so-called 'rust tubercles') and the formation of blackish scales, within their area of jurisdiction. A detailed study on structure and composition of rust tubercles at selected sites had shown that these are hot spots of microbial activity, exhibiting steep chemical gradients and prokaryotic communities reflecting strong redox zonation [1]. Enrichment cultures from field samples demonstrated that steel could serve as sole electron donor under anoxic conditions with nitrate, carbon dioxide or sulfate [2] as electron acceptor. In order to get a broader perspective on the microbiome related to steel corrosion in freshwater and the environmental factors that may have an impact on shaping these communities, we collected tubercle material from sheet piles of construction harbors, embankments, weirs, and locks, along with water, sediment, and backfill samples from twelve different geographic sites. Prokaryotic community analysis was performed on a total of 76 samples by 16S-rRNA amplicon sequencing. Corrosion products were additionally analyzed for mineral phases by Attenuated Total Reflection (ATR) Fourier Transform Infrared (FTIR) spectroscopy and content of C and S. Results showed that prokaryotic communities depended more strongly on sample type than on geographic location. Specifically, the comparison of tubercle and water samples revealed that these habitats hosted distinctive core microbiomes. Furthermore, site-specific environmental factors correlated weakly with dominant taxa. All this clearly indicates that steel surfaces allow the creation of a specific habitat emerging from combined chemical and microbial processes. Rust tubercles harbor different prokaryotic groups with a broad range of metabolic traits which keep the corrosion going.

[1] Fiskal, Shuster, Fischer, Joshi, Raghunatha Reddy, Wulf, Kappler, Fischer, Herrig, Meier (2023) *Environmental Microbiology* 25, 1796-1815. DOI: 10.1111/1462-2920.16393.

[2] Raghunatha Reddy, Egerter, Jehmlich, Fiskal, Helmholz, Castronovo, Schweyen, Wulf, Ternes, Wick, Meier (2025)