GEOPOLYMER CONCRETE – POTENTIAL APPLICATIONS IN CHEMICALLY AGGRESSIVE SANITATION AND WASTE INFRASTRUCTURE

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The degradation of concrete infrastructure due to the interaction with chemically aggressive gases and solutions from e.g. waste deposits and sewage transport facilities is a globally unresolved economic issue. The vast majority of the damages are caused by biotic metabolic reactions occurring during fermentation processes. This results in the production of various acids, such as sulfuric acid, lactic acid or formic acid, and subsequent interaction with the concrete. Conventional Portland cement based construction materials, mainly composed of Ca-hydrates and Ca-silicate-hydrates, cannot guarantee expected service life in such acidic environments, which raise the demand for alternative materials. In this perspective, distinct types of geopolymer concrete (GPC) might be chemically more resistant in the latter environments. Geopolymers are formed via polycondensation of alumosilicates to form a highly stable polymer network of Si – Al – tetrahedrons with O, thereby avoiding the formation of acid dissolvable hydrates. Additionally, their nano-structural similarity with zeolites enables GPC to have analogous applications, such as the long lasting carrier of antimicrobial cations.

This study presents the critical assessment of GPC performances exposed to a biogenic acid corrosion environment and to a corroding biowaste facility within two long-term field exposure campaigns of up to 24 months. Material performances were characterized using a holistic approach including advanced mineralogical, microbiological and hydro(geo)chemical analytical tools. Additionally, exposure sites specific environmental conditions, such as H_2S and CO_2 concentrations, temperature and relative humidity were monitored. GPC performances were compared to standard Portland cement (PC) concrete, as well as to calcium aluminate concrete, simultaneously exposed. Up to 8 times lower corrosion rates could be observed on distinct GPC mixtures compared to the standard PC concrete exposed to the biogenic acid corrosion environment, while no signs of corrosion could be detected on the GPC exposed to the biowaste facility.