

Quantity and form of natural and engineered TiO₂ present in outdoor concrete weathering experiments

K.E. CHALLIS¹*, R.S. LANKONE², H. FAIRBROTHER²,
A. KENNEDY³ AND J. RANVILLE¹

¹ Department of Chemistry, Colorado School of Mines,
Golden, Colorado 80401 (*correspondence:
kchallis@mines.edu)

² Department of Chemistry, John Hopkins University,
Baltimore, Maryland 21218. (rlankon1@jhu.edu)

³ US Army Engineer Research & Development Center
Environmental Laboratory, Vicksburg, MS 39180
(Alan.J.Kennedy@usace.army.mil)

Titania (TiO₂) containing cement (TXactive™) is marketed as self-cleaning cement. The photocatalytic properties of TiO₂ promote degradation of adsorbed pollutants[1]. A 2-year study was performed to determine the magnitude of release of TiO₂ from TXactive™ concrete under a variety of natural weathering environments. Disks of TiO₂-containing concrete with a 5cm diameter were weathered at six outdoor locations: Tempe, AZ; Corvallis, OR; Golden, CO; Baltimore, MD; Vicksburg, MS; and Pittsburgh, PA. Triplicate samples were suspended in containers that passively collect precipitation over the course of each month. Containers without cement were used as controls. Ti content of the rainwater, and an acidic rinse of the containers, was measured using ICP-OES. The form of TiO₂ was examined by electron microscopy and single particle ICP-MS (spICP-MS), which detects individual Ti-containing particles as time-resolved pulses above background signal[2]. All control (background) and concrete samples contained detectable particulate titanium when analysed by spICP-MS. The background particulate titanium interferes with determining the amount of released engineered titania. Analysis of the background particles by electron microscopy/EDS showed that the Ti was primarily present as titania particles. A summary of titanium concentrations and their relationship to climate, as well as attempts to distinguish released TiO₂ from background TiO₂, will be presented.

[1] Lehigh Hanson Heidelberg Cement Group. (2018) [2]
Montano *et al.* (2016) *Anal Bioanal Chem* **408**, 5053-574.