UMSAEP UM-UWC Linkage Report
Visit to Cape Town May 24, 2018 to June22, 2018

An investigation into the influence placement technique has on the ability of mixed coal combustion byproducts to contain acid mine drainage

Submitted by John T. Kevern
Chair, Department of Civil and Mechanical Engineering and Associate Professor of Civil Engineering
University of Missouri-Kansas City (UMKC)

UWC Host: Dr. Leslie Petrik
Professor, Group leader Environmental and Nano Sciences
Department of Chemistry,
University of Western Cape (UWC)

1. Overview

I first participated in the UMSAEP during the summer of 2017 when I represented UMKC at the joint workshop on climate change at UWC. Besides falling in love with Cape Town, during that workshop I met Dr. Leslie Petrik. After listening to her students presentations and discussing research activities, we found a good deal of commonality between our research groups with work utilizing fly ash and with water treatment.

2. Description of Linkage Activities

When sulfur-bearing mine drainage comes in contact with air sulfuric acid forms and metals solubilize. Mixed coal-combustion byproducts (CCBs) has previously shown the ability to both neutralize but also block, over time, acid mine drainage migration from source locations. Placement can occur either hydraulically or mechanically at various moisture contents. Hydraulic

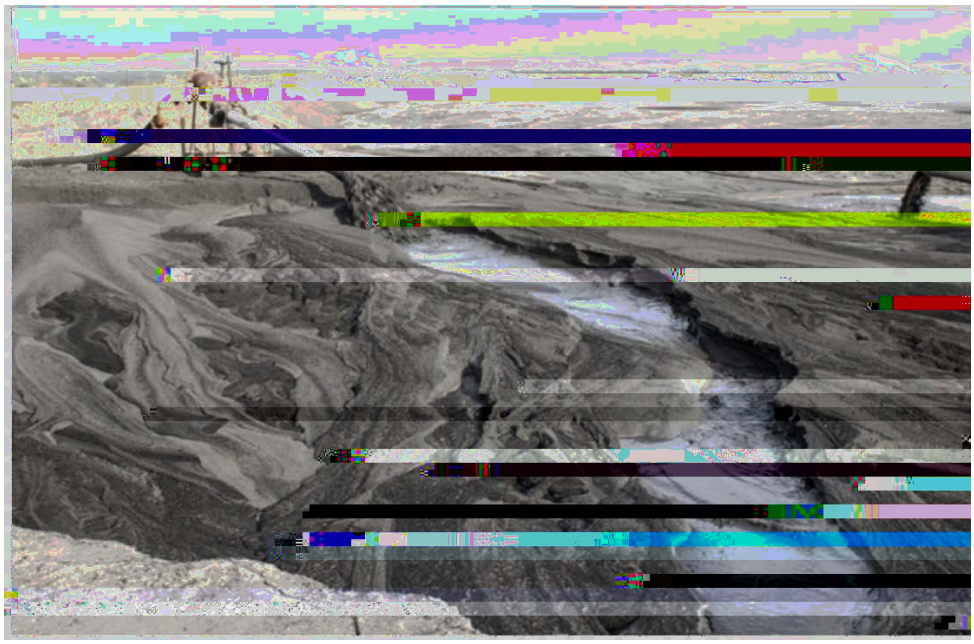


Figure 1. Dumping fly as in ponds

Figure 2. Environment and Nano Sciences Students at UWC

In order to obtain the fly ash and acid mine drainage needed for the research, I flew to Johannesburg with one of the graduate students, rented a truck, and drove the necessary materials back to Cape Town. I enjoy a good road trip and driving across South Africa was a fantastic experience (Figure 3). The student that accompanied me on the trip was Rosicky Kalombe (Figure 4). He is quite possibly the only student anywhere with specific experience of designing, construction, and overseeing a full-scale water treatment facility for a coal-fired power plant. I

have a current project doing just that for Kansas City Power and Light. His unique experience was so special that he started on his PhD at UMKC in January 2019.

Figure 3. Taking the N1 from Johannesburg to Cape Town

Figure 5. Acid mine drainage neutralization testing

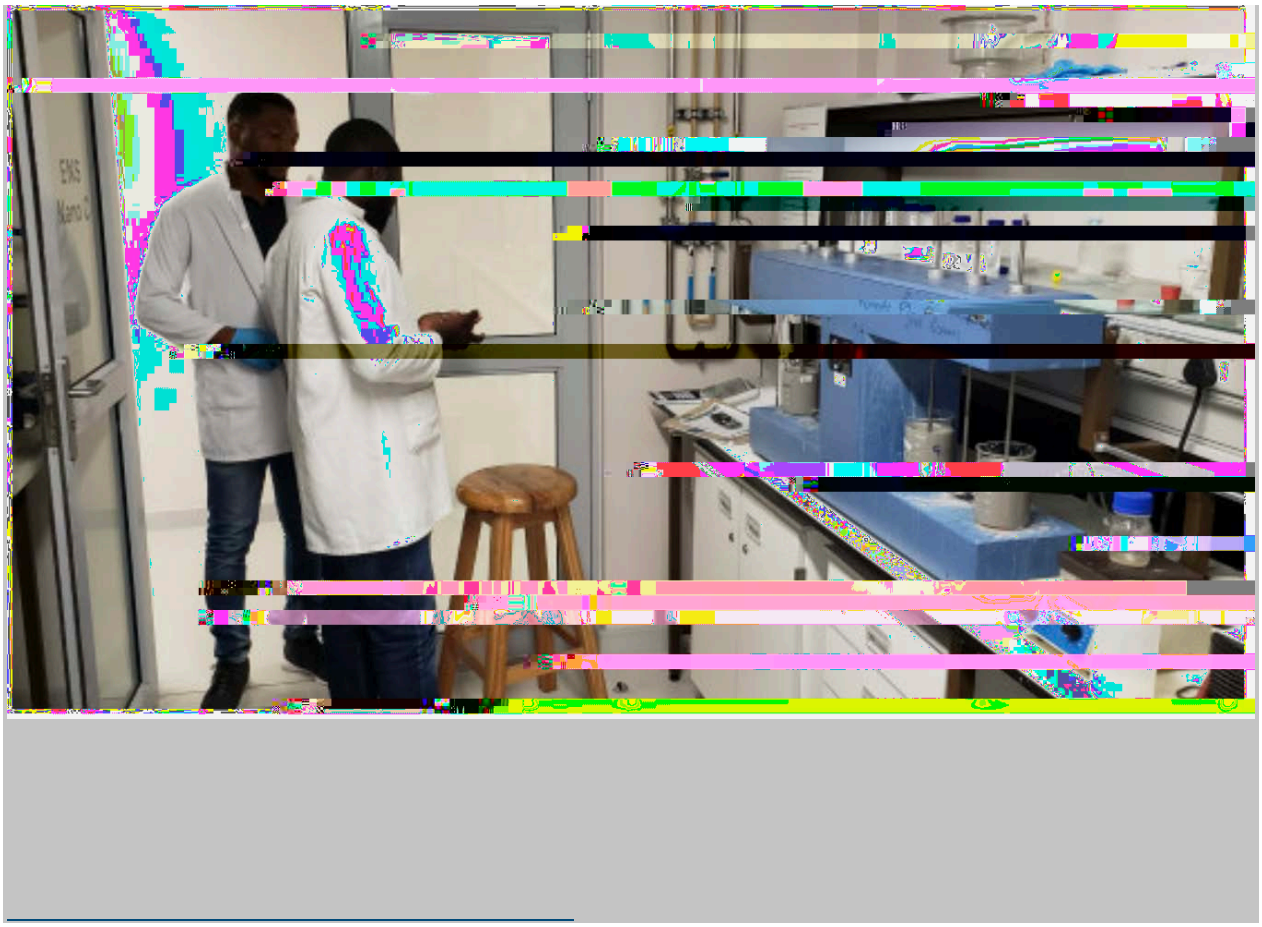
The aim of this study was to investigate the neutralization capacity of columns of Kendal and Lethabo fly ash for the treatment of Eyethu AMD. The experiment was successful as it was proven that Eyethu AMD can be treated by passively flow through coal fly ash. The pH was raised from 2 to over 12 by the dissolution of oxide component in the ash and hydrolysis of the major and trace elements in AMD once in touch with coal fly ash. There was a substantial removal of metals including Fe, Al, Mn and Mg and removal of some other elements during this study as the pH was increasing over contact time. This study highlights three major parameters to take in consideration if passively treating AMD in columns with FA (AMD: FA ratio, the contact time, and the chemistry of the acid mine drainage). The bedvolumes of acid mine drainage used before the fly ash was exhausted was approximately 44 and show that the Kendal fly ash has a significant durability to act as a passive barrier.

3. Products from Linkage Activities

- KCUR 89.3's Central Standard Radio Program, July 30, 2018 segment on Summer Vacation. https://www.kcur.org/post/summer-vacation#stream/0
- Clean water solutions-UMKC Today https://info.umkc.edu/news/clean-water-solutions/

C

2.5 ,



- Petrik, L. and Kevern, J.T. (Kevern as a no-load PI) “Treatment of storm water using waste concrete as permeable reactive barrier,” Proposal submitted to South African Water Resource Commission (WRC), 1005778, July 16, 2018.
- Katambwe, V.N., Kalombe, M.R., Nzadi, M., Bent, D., Nieuwouldt, G., Misheer, N., Reynolds-Clausen, K., Kevern, J., Ojumu, T.V., and Petrik, L.F. “Demonstration of 1000L jet loop pilot plant reactor in the treatment of acid mine water using South African coal fly ash,” Paper accepted to World of Coal Ash, St. Louis, MO, May 13-16, 2019.
- Nkongolo, E.T., Katambwe, V.N., Kalombe, M.R., Kevern, J.T., Ojumu, T.V., and Petrik, L.F. “Passive treatment of acid mine drainage using South African coal fly ash, column leaching study,” Paper accepted to World of Coal Ash, St. Louis, MO, May 13-16, 2019.
- Kalombe, M.R., Kevern, J.T., and Petrik, L.F. “Acid Mine Remediation using Hydrodynamic Fly Ash Cavitation,” Manuscript in preparation for Journal of Environmental Technology and Management, submission for April 2019.

4. Summary