Removal of single and mixtures CuO, TiO_2 and ZnO nanoparticle via anaerobic granules treatment

Valerio Cappadona [1,2] Charles Knapp[1] Rebecca Skuce[2], Vernon Phoenix [1]
[1] Department of Civil and Environmental Engineering, University of Strathclyde
[2] Scottish Water Horizons Ltd, Deerdykes Development Centre
valerio.cappadona@strath.ac.uk
www.hydronationscholars.scot

Scottish Government gov.scot
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Introduction

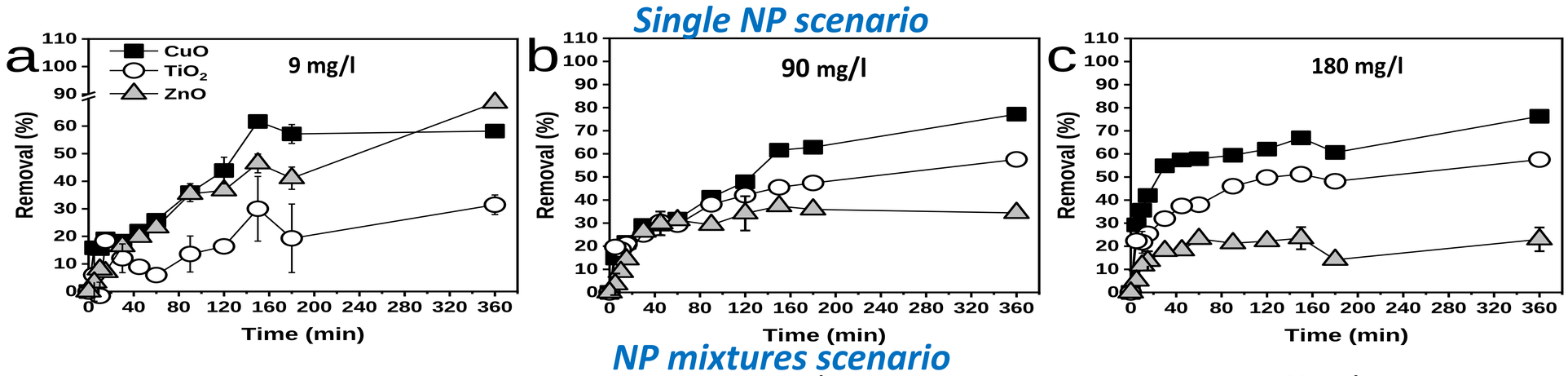
- Nanoparticle (NPs) release in sewer all along the material value chain: accidental spills, use and application of thousands of NP – containing products and waste processing at product end of life.
- Anaerobic wastewater treatment (AnWT) is one of the emerging processes used to treat sewage. It relies on Anaerobic Granular Sludge (AGS) and can remove the organic pollution load without needing oxygen and produces methane, used to produce energy.
- Highly likely that NPs will enter AnWT plants.
- Compelling need to investigate whether AGS based AnWT can cope with NP loads.

Methods

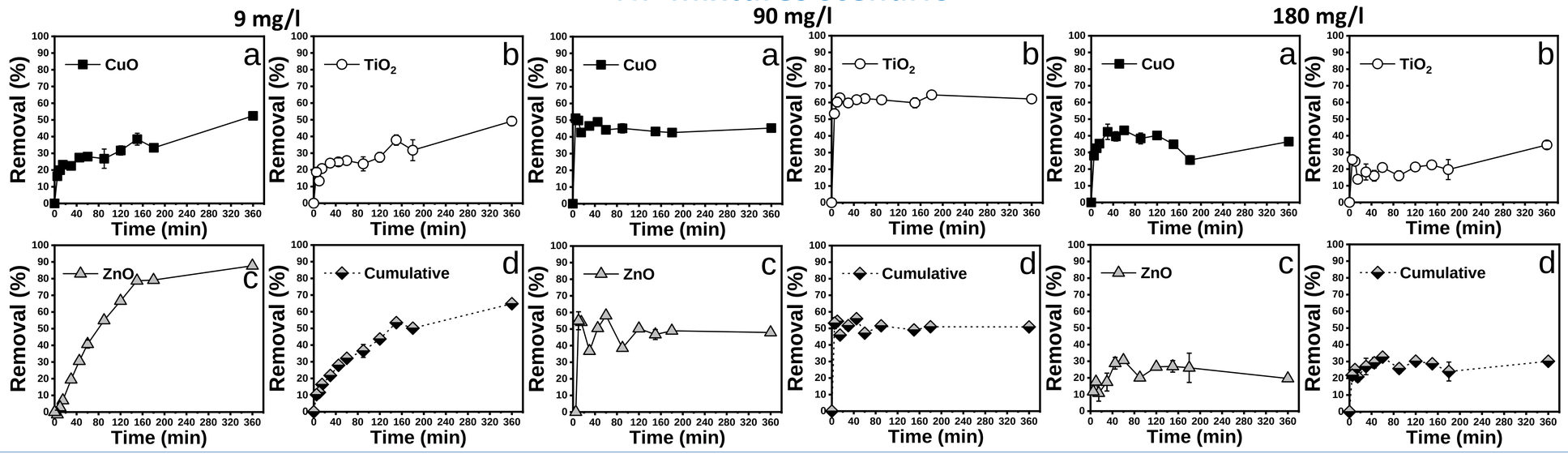
- Single analytical method to simultaneously quantify copper oxide (CuO), titanium dioxide (TiO_2) and zinc oxide (ZnO) NP mixtures based on microwave assisted sulphuric – nitric acids digestion paired with ICP-OES.
- Anaerobic granular sludge (AGS) obtained from a Scottish distillery.
- Lab tests run to investigate the AGS mediated test endpoints:
  - Overall removal efficiency of single and triple NP mixture
  - Time dependent removal profile over the course of 6 hours (hydraulic retention time)

Results

Single NP scenario



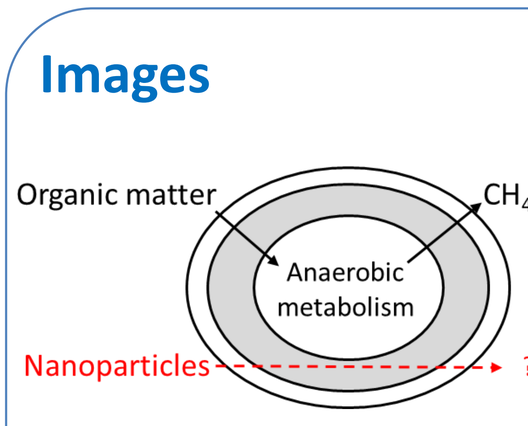
NP mixtures scenario

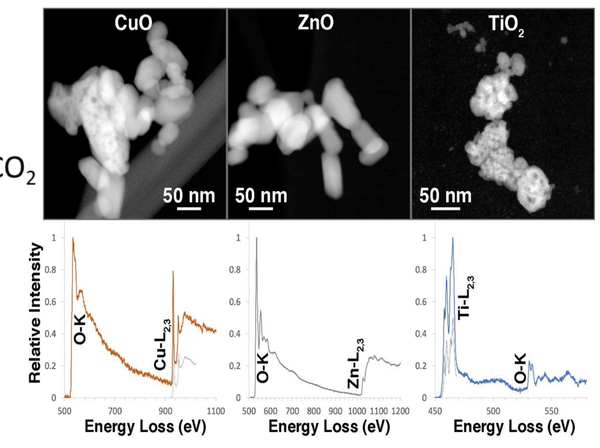


Conclusion

- Single NP removal varied from 20 to 90 %.
- Cumulative removal efficacy ranged from 30 to 70 % in NP mixture system.
- Anaerobic granules (AGS) have the potential to remove NPs from sewage.
- Less efficient in comparison to activated sludge (routine secondary biological wastewater treatment)

Images





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University of Strathclyde Glasgow

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