Design of metal-oxide nanoparticle reinforced Nano-fibrous biopolymer composites for water treatment

Prof Gitari WM/University of Venda, South Africa

Photo Title: a)Assessing fluoride rich borehole water quality, b) community elder exhibiting dental fluorosis, c) discussion of project with community leaders

People in photo: a) PI with research assistants, b) community elder suffering dental fluorosis, c) community elders, PI and research assistant

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Research Approach: Aim is to fabricate multifunctional biopolymer-metal oxide nanoparticle reinforced composites for fluoride and pathogen removal in groundwater. This biopolymer composite is envisaged to have high fluoride adsorption capacity and simultaneously remove pathogens resulting in powerful treatment system to deliver fluoride free and safe water for drinking.

Data to being collected include:

- Temporal water quality in two selected community boreholes with high fluoride content
- Operational parameters for the synthesis of the biopolymer composites
- Test fluoride and pathogen removal potential of the fabricated biopolymer composites (batch and gravity flow tests)
- Regeneration potential and chemical stability of biopolymer composites
- Field testing of the optimum adsorbent and social acceptability of the testing module

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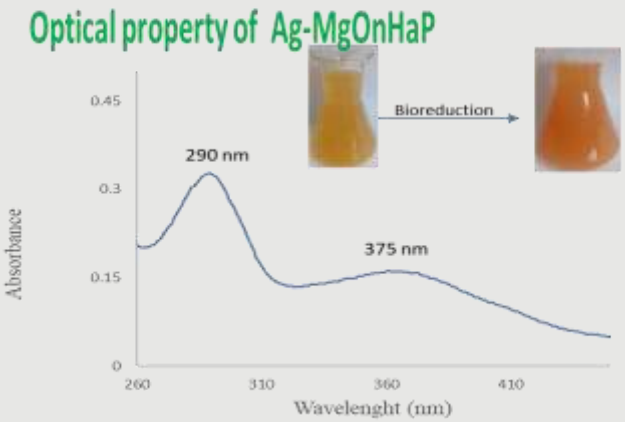
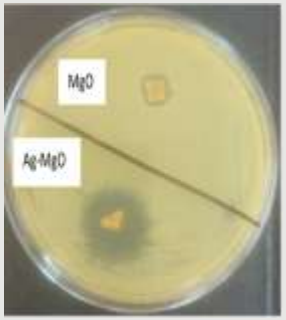
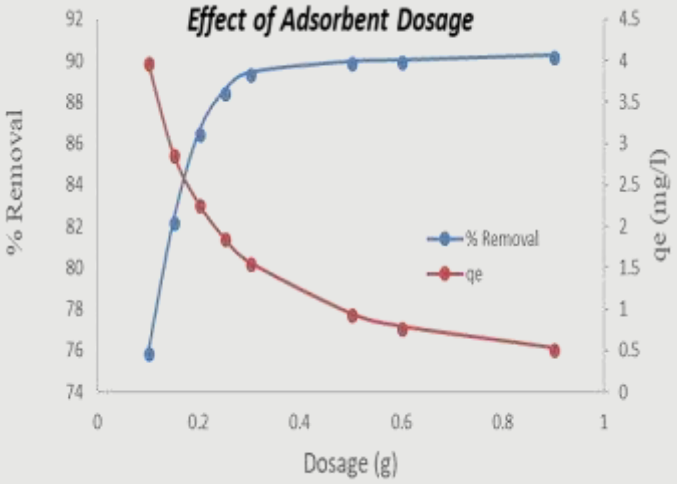
Key results of research/project so far:

- Successful integration of bio-mediated microwave and ultrasonic synthetic methods in the synthesis of a **bi-layered Ag-MgO core-shell** synergy using an aqueous peel extract of *Citrus paradisi* fruit as the reducing, capping and stabilizing agent towards antimicrobial activity.

- A multipurpose adsorbent was successfully synthesized using an aqueous peel extract of *C. paradisi* with **Ag-MgO anchoring on the nano-hydroxyapaptite layer** for simultaneous floride and pathogen removal in groundwater







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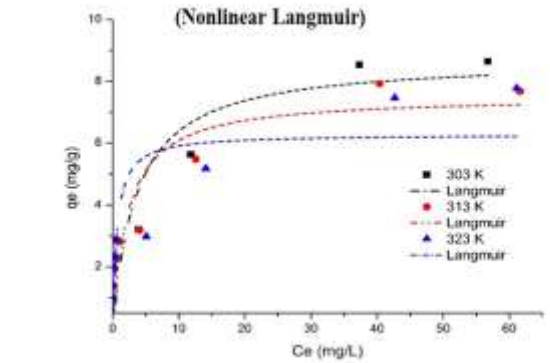
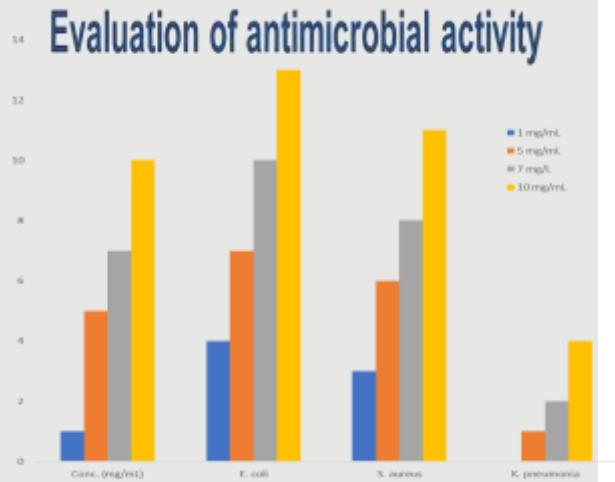
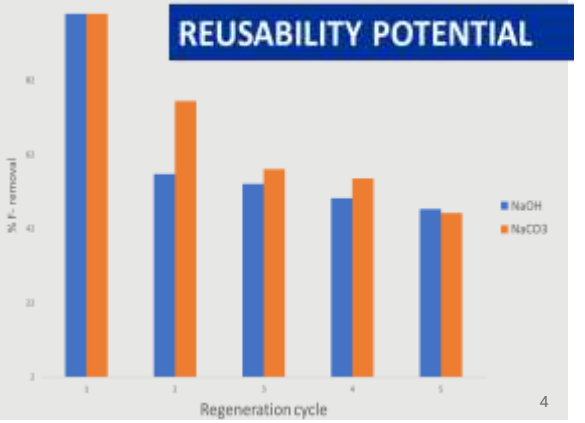
- Successful synthesis of a modified **Ag-MgO anchoring on the nanohydroxyapatite layer impregnated on a cellulose nanofiber (CNF-AgMgOnHap)**
- Composite possesses 3–4 times enhanced fluoride adsorption capacity than AgMgOnHAp.

- Adsorbent has high fluoride adsorption capacity and antibacterial properties toward ***E. coli, S. aureus and K. pneumonia*** with better reusability property







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Top next steps for your project:

- Testing of the adsorbents/composites in dynamic and gravity flow set-ups
- Conversion of the adsorbents/composites into sodium alginate beads composites
- Conversion of the adsorbents into electron spun nanofibres and testing their performance in fluoride and pathogen removal

How data and results from your project will impact stakeholder decisions and the development problem:

- High adsorption capacity of the adsorbents and their applicability in gravity flow systems will impact positively in terms of piloting the treatment systems and field testing

Challenges you have faced in collecting meaningful data: Very poor and slow support system at procurement level and lack of enough laboratory space and administration support in the host Institution

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