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Arsenate Removal from North Dakota Well Water: Titanium with MOF (UiO-66) Impregnated Carbon Blocks

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Introduction

- Elevated exposure to arsenic disproportionately affects populations relying on private well water in North Dakota, USA, especially in American Indian communities.
- . They are at a higher risk of arsenic exposure due to their use of private well water. The arsenic levels exceed the EPA's safety threshold of 10 µg/L.
- Arsenic contamination is a global threat due to its toxicity and carcinogenicity and is a top-priority hazardous substance as it causes several health problems such as liver, lung, kidney, and skin cancers. Our study aims to address this issue by investigating the effectiveness of the Point-of-use (POU) carbon block filter treatment systems.
- Specifically, it will explore the potential of impregnating carbon blocks with amorphous titanium (hydr)oxide (THO) fabricated with MOF (UiO-66) (metal-organic framework) to enhance arsenic removal from private well water without introducing titanium (Ti) and MOF into the treated water.

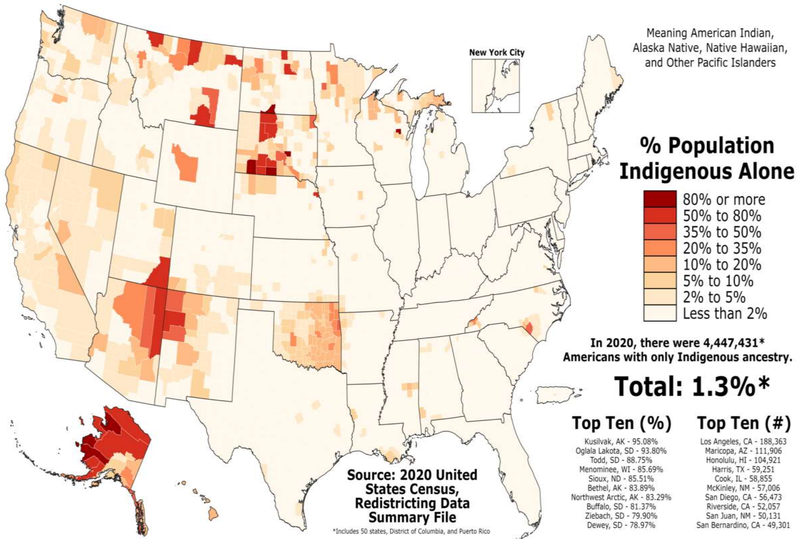

Fig1: The geographical locations of tribal nations across the United States, with a focus on North Dakota (ND).

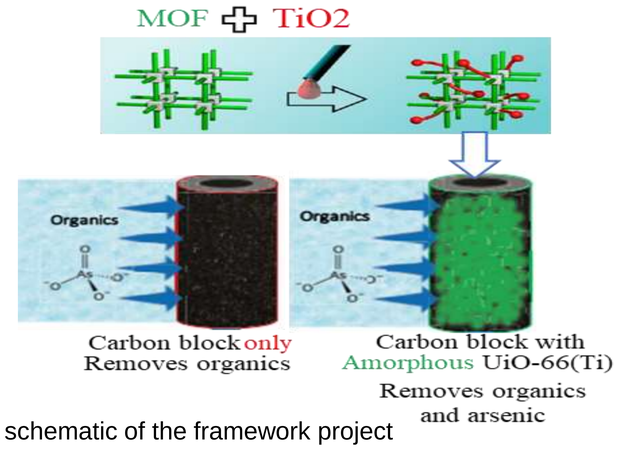

Fig 2: A schematic of the framework project

Materials and methods

- Synthesis of pristine MOFs with Ti precursor will be carried out using a modified solvothermal method
- MOF (UiO-66) with NH-2 amino and titanium precursor will be fabricated and synthesized with activated carbon in situ with heat treatment.
- The mixture will be heated at 120 °C for 24 h, washed with DMF and EtOH, and finally will be dried at 80 °C for 12 h to obtain the Zr-MOF-Ti/AC sample

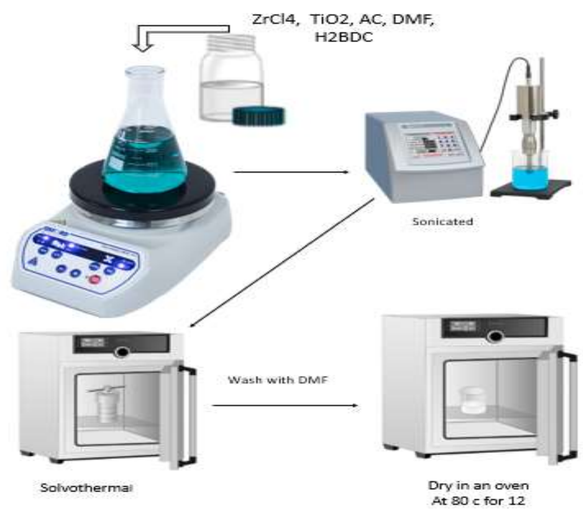

Fig3: In-situ synthesis of titanium with MOF accompanied by activated carbon impregnation

Fig 4: Point of Use (POU) treatment system

Conclusion

- Carbon block is the most widely used component in POU filters, but it cannot remove arsenic from water. Our objective is to enhance arsenic removal by impregnating these materials
- The porous structure of the AC provides a high surface area and facilitates the growth of well-defined MOF crystals, while the MOF coating on the AC particles enhances the adsorption capacity and selectivity of the composite material.
- This sustainable disposal of produced water may encourage the recycling and reuse practice, ultimately reducing the use of freshwater for hydraulic fracturing.
- The POU system provides a valuable solution for addressing water quality challenges at the household and community levels

Refernces

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3. Ajao, A. and Lim, Y.H., 2023. Sustainable Management of Dams and Reservoirs in North Dakota: Sediment Transport Characterization.