ASEC 2024 Conference

The 5th International Electronic Conference on Applied Sciences

04–06 December 2024 | Online

MDPI

# Advances In Implementation of Metal Oxide Nanoparticles for Urban Water Pollution Treatment

**Md. Golam Sazid[1], Sk. Tanjim Jaman Supto[2]**

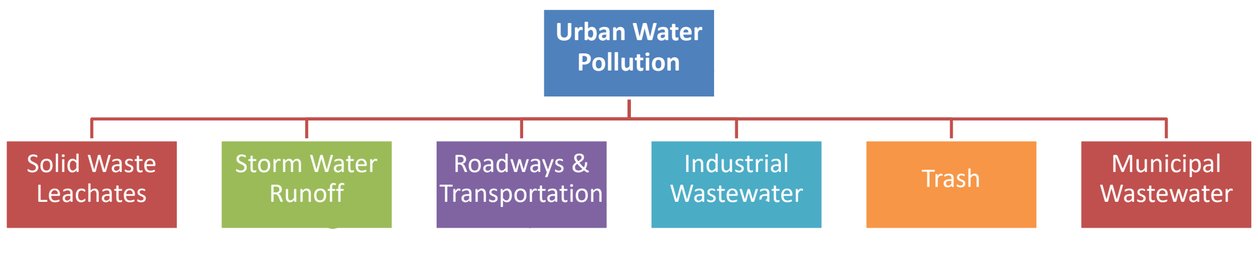
[1] Nano Research Centre, Bangladesh , [2] Department of Geography and Environment, Shahjalal University of Science and Technology, Sylhet-3114, Bangladesh

*Corresponding author email: mdgolamsazid@gmail.com

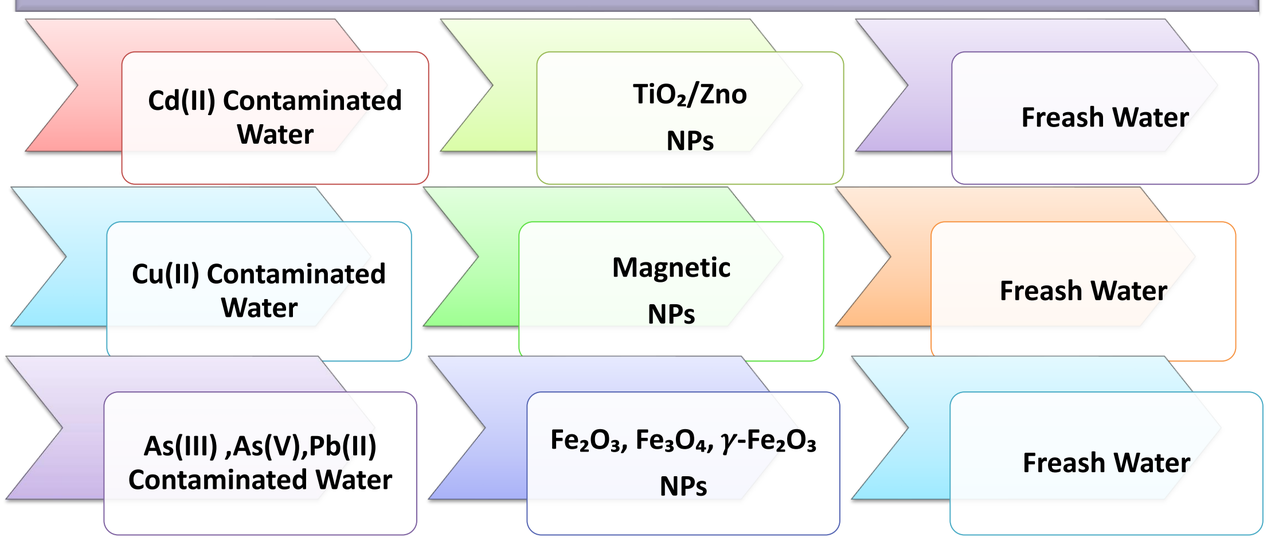
## ABSTRACT

Urban water bodies are facing a growing crisis due to contamination from a diverse array of pollutants, encompassing heavy metals, oil and grease, organic and inorganic chemicals, industrial effluents, and pathogenic microorganisms. This study focuses on the burgeoning field of utilizing metal oxide nanoparticles (MONs) as a potential solution to this pressing environmental challenge. The distinctive physicochemical properties of MONs, including their large surface area, catalytic activity, and photocatalytic ability, position them as promising candidates for water purification technologies. This study also comprehensively discusses the sources of urban water pollution and the specific challenges posed by different types of contaminants. A critical evaluation of MONs' efficacy in removing heavy metals, oil and grease, organic and inorganic chemicals, and industrial pollutants is presented, with a focus on the underlying mechanisms such as adsorption, photocatalysis, and redox reactions. Furthermore, the potential of MONs to neutralize pathogens and microbial contaminants is investigated. While MONs exhibit significant advantages, this study acknowledges the challenges associated with nanoparticle stability, recovery, and potential environmental repercussions. To fully realize the potential of MONs in water treatment, sustained research is imperative to refine treatment processes, develop economically viable strategies, and ensure the long-term sustainability of these technologies in addressing urban water pollution.

## SOURCES OF URBAN WATER POLLUTION




## TREATMENT OF HEAVY METAL CONTAMINATION IN WATER

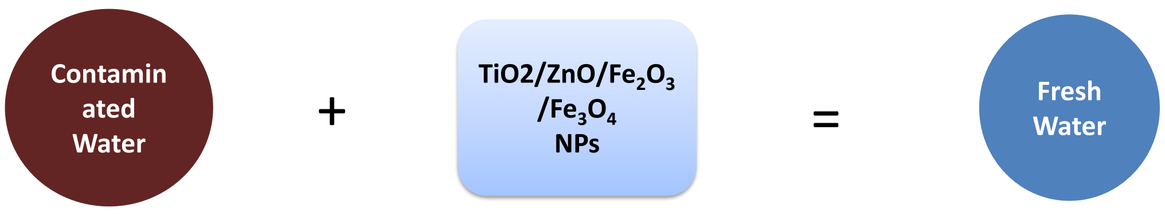



## TREATMENT OF OIL AND GREASE POLLUTION IN WATER

Iron Oxide Nanoparticles with CNTs:

- Separate Oil From Water Droplets
- $Fe_2O_3$ nanoparticles exhibit super-hydrophobicity and high adsorption capacity for oil removal.
- Oil-water separation and oil adsorption.

## CHEMICAL CONTAMINANT TREATMENT IN WATER




## TREATMENT OF PHARMACEUTICAL POLLUTANTS IN WATER

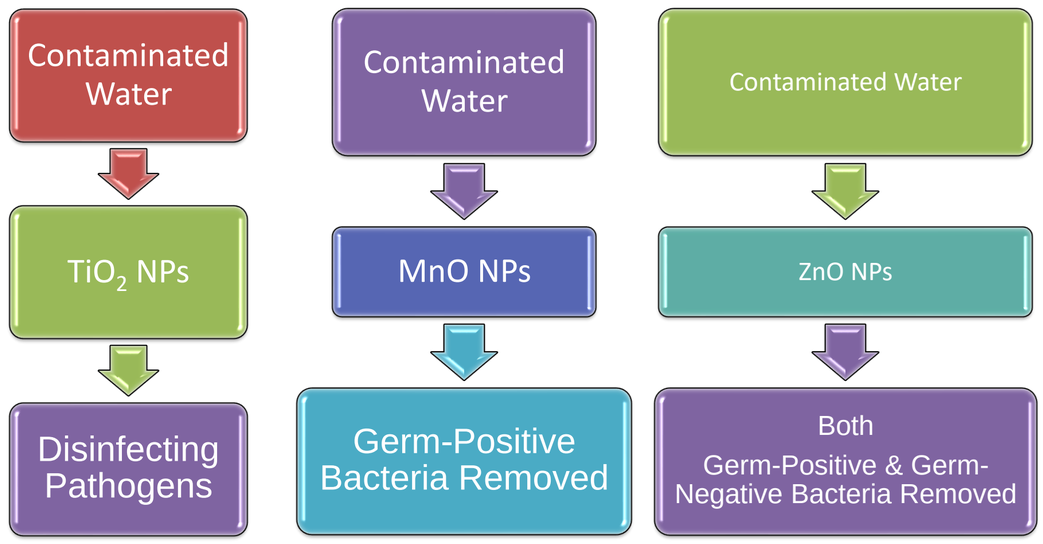
ZnO NP and GONS combined works efficiently removing pharmaceutical pollutants, particularly levofloxacin..

NiO, $Nb_2O_5$, $Ta_2O_5$, $ZrO_2$, and $Ga_2O_3$, have photocatalytic degradation ability of pharmaceutical pollutants.

pharmaceutical contaminants such as atenolol, ciprofloxacin, and gemfibrozil can be absorbed using Magnetic Nanoparticles (IONPs)

For the Treatment of pharmaceutical chemicals $SiO_2$ NPs are effective

## TREATMENT OF PATHOGENS AND MICROBIAL CONTAMINANTS IN WATER




## CHALLENGES AND POSSIBILITIES OF APPLYING NANOPARTICLES IN URBAN WATER TREATMENT.

**Challenges:**

- Cost
- Environmental Risk
- Health Risk
- Harm Living Organisms

**Possibilities:**

- Water Purification
- Reuseable
- Enhanced Water Treatment
- Multiuse

## CONCLUSION

Metal Oxide (NPs) can be the future of wastewater treatment. With physical and chemical properties such as adsorption, photocatalytic and antimicrobial activity. They have been shown to effectively eliminate heavy metals, organic contaminants, and pathogens etc. Nonetheless, issues such as the aggregation of nanoparticles, environmental and health risks, and the shortcomings of current water treatment technologies impede their widespread use. It is crucial to tackle these challenges through advancements in the synthesis of materials, enhanced separation methods, and thorough risk assessments. With ongoing research and innovation, metal oxide NPs have the potential to transform water treatment technologies, aiding in the development of more effective and sustainable environmental management systems.

## REFERENCES

- Sundaram, G. A., Muniyandi, G. R., Ethiraj, J., Parimelazhagan, V., & Kumar, A. S. K. (2024). Introduction and Advancements in Room-Temperature Ferromagnetic Metal Oxide Semiconductors for Enhanced Photocatalytic Performance. ChemEngineering, 8(2), 36.
- Dave, P. N., & Chopda, L. V. (2014). Application of iron oxide nanomaterials for the removal of heavy metals. Journal of Nanotechnology, 2014(1), 398569.
- Singh, S., Kumar, V., Romero, R., Sharma, K., & Singh, J. (2019). Applications of nanoparticles in wastewater treatment. Nanobiotechnology in bioformulations, 395-418.
- Singh, S., Barick, K. C., & Bahadur, D. (2011). Surface engineered magnetic nanoparticles for removal of toxic metal ions and bacterial pathogens. Journal of hazardous materials, 192(3), 1539-1547.
- Hahn, Y. B., Ahmad, R., & Tripathy, N. (2012). Chemical and biological sensors based on metal oxide nanostructures. *Chemical Communications*, *48*(84), 10369-10385.