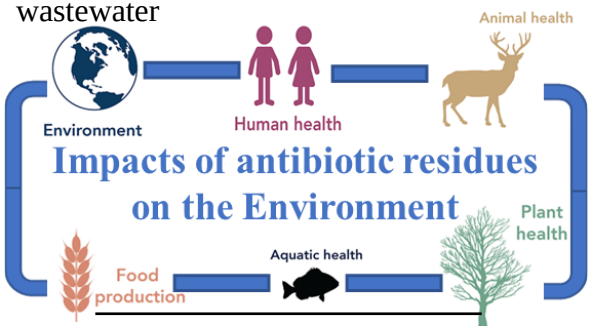
Nonthermal atmospheric pressure plasma jet: An energy-efficient route for mineralizing ciprofloxacin in water

UNESCO-IWRA ONLINE CONFERENCE 17-19 JANUARY 2023 3rd IN THE IWRA ONLINE CONFERENCE SERIES

Sub-theme: Emerging pollutants and managing wastewater and waste

1. Introduction

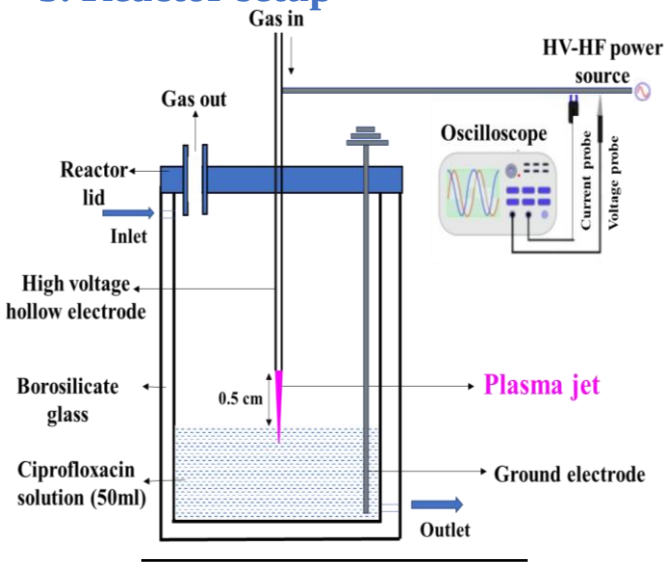
Pharmaceutically active compounds (PACs), commonly referred as emerging contaminants (ECs), are detected in surface water because of untreated or partially treated domestic and industrial wastewater discharge. Ciprofloxacin (CP) is a commonly used PAC. Conventional treatment methods are generally ineffective in removing CP. So, there is a need for developing sustainable and efficient treatment technology for effectively removing such pollutants from water and wastewater



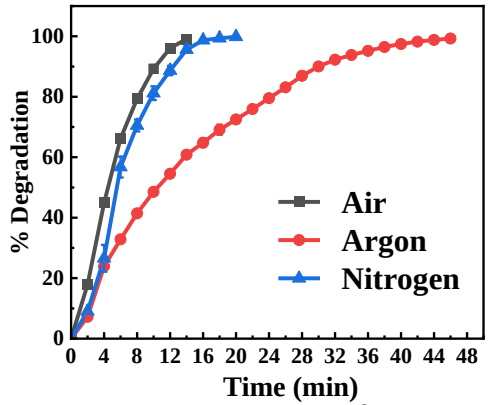
2. Objectives

- Development of an energy-efficient plasma jet reactor for the treatment of antibiotics in water
- Optimization of operating parameters such as input voltage, plasma gas media, and gas flowrate for maximizing energy yield

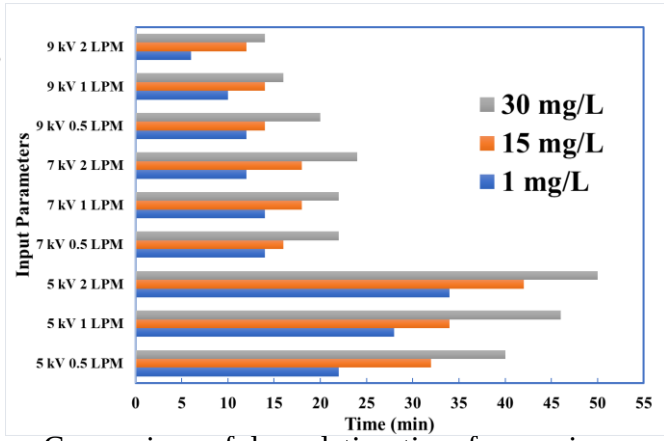
3. Reactor setup



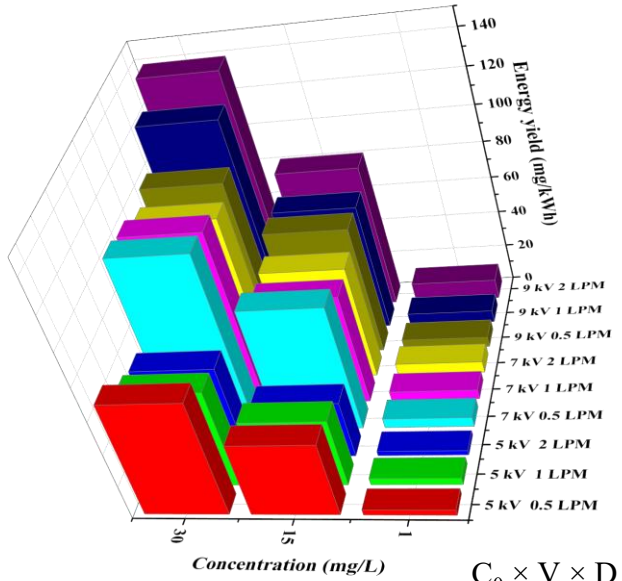
4. Results



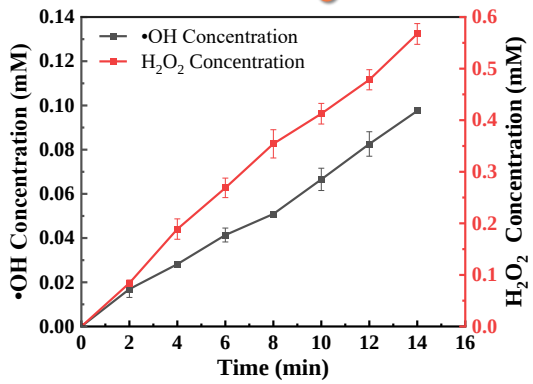
Degradation kinetics of CP in various plasma gas media



Comparison of degradation time for varying voltage & flow rate at different concentrations



Energy yield, Y (mg/kWh) = $\frac{C_0 \times V \times D}{P \times t}$



Quantification on reactive chemical species (RCS)

5. Conclusion

- Plasma jet reactor is developed for efficient removal of antibiotics from water and wastewater
- Air is a superior plasma gas medium in terms of performance and cost
- For lower voltage, low airflow rate performs better, and vice-versa for higher voltage
- The highest energy yield for the optimum configuration (9 kV; 2 LPM) is calculated as 138.5 mg/kWh

6. References

- S.M. Allabakshi, P.S.N.S.R. Srikar, R.K. Gangwar, S.M. Maliyekkal, Feasibility of surface dielectric barrier discharge in wastewater treatment: Spectroscopic modeling, diagnostic, and dye mineralization, Sep. Purif. Technol. 296 (2022) 121344.
- S.M. Allabakshi, P.S.N.S.R. Srikar, R.K. Gangwar, S.M. Maliyekkal, UV-C photon integrated surface dielectric barrier discharge hybrid reactor: A novel and energy-efficient route for rapid mineralisation of aqueous azo dyes, Journal of Hazardous Materials, 446, (2023) 130639.

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