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NIT Rourkela introduces bio-based system to combat pharmaceutical contaminants in water

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Two-stage process combines biochar adsorption and biodegradation to remove pharmaceutical pollutants from wastewater



Researchers at National Institute of Technology (NIT) Rourkela have developed a process to remove pharmaceutical pollutants from wastewater. The two-stage process combines adsorption and biodegradation to tackle a wide range of pharmaceutical compounds, including antibiotics, non-steroidal anti-inflammatory drugs (NSIDs), and synthetic dyes.

Pharmaceutically active compounds (PhACs) have become contaminants of emerging concern due to their bioaccumulation and biomagnification through the food chain, posing significant risks to humans and aquatic organisms even at trace concentrations.

As per the research at NIT, in the first stage, the antibiotics are captured using biochar adsorbents derived from roasted coco peat and rice straw. This step significantly reduces antibiotic contamination before the biological treatment phase. The second stage employs a specialised bacterial group, including Klebsiella and Pseudomonas strains, to break down residual pharmaceutical compounds such as diclofenac, paracetamol, and synthetic dyes.

When tested on synthetic wastewater containing a mix of NSAIDs, antibiotics, and pharmaceutical dyes, the system demonstrated excellent removal efficiencies. Biodegradation efficiency of pharmaceutical dyes and painkillers was more than 95 %. The biochar adsorption process also proved highly effective, removing over 99.5% of antibiotics from the water.

Speaking about the significance of the research, Prof. Angana Sarkar, Associate Professor, Department of Biotechnology & Medical Engineering, NIT Rourkela, said, “The process protects biodegrading bacteria, minimises toxic byproducts, and enhances the eco-friendly management of pharmaceutical contaminants. The treatment costs about Rs. 2.6 per liter and it can be further reduced by process optimisation and integrating this system as a tertiary step in existing treatments.”

The researchers suggest that this process is nontoxic, sustainable, and cost effective that can be scaled up in near future in collaboration with the pharmaceutical industries.

The system, demonstrated with model pharmaceutical compounds, can be applied to other molecules with similar structures. Further treatment through standard wastewater treatment eliminates the need for additional stages for bacteria and solid residue removal.

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