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Webinar Talk

Innovative 3D-Printed Adsorbent for Wastewater Treatment

Exploring Cutting-Edge 3D Printing Applications in Wastewater Treatment

Speaker :

Assoc. Prof. Ir. Ts. Dr. Chien Hwa Chong

- *Associate Professor, Department of Chemical and Environmental Engineering, University of Nottingham.*
- *Professional Engineer (Board of Engineers Malaysia), Chartered Engineer (UK), Fellow of Higher Education Academy (UK), and numerous prestigious accolades.*
- *Recipient of Vice Chancellor's Medal 2023, University of Nottingham, Diamond Award VIC22, and multiple gold medals in international exhibitions.*
- *Expert in advanced wastewater treatment technologies.*

19th Feb 2025, Wednesday
2.00 pm - 4.00 pm

Online

Discover how 3D printing technology is revolutionizing wastewater treatment through innovative adsorbents. This talk explores advanced techniques such as silane-grafted chitosan monoliths and magnetic chitosan coatings for efficient dye removal. Participants will gain insights into surface functionalization, drying methods, and optimization strategies to enhance adsorption performance and reusability in real-world applications.

Registration Fees
IEM Students : Free
IEM Members : RM 15
Non-IEM Members : RM70

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Innovative 3D-Printed Adsorbent for Wastewater Treatment

Synopsis

What is 3D printing? How Chemical Engineers can use 3D printing technology to print adsorbent for wastewater treatment. First case study is related to a robust approach of integrating 3D printing and surface grafting of chitosan is one of the emerging adsorbents for removing pollutants from wastewater, particularly dye pollutants. This study investigated and compared the effects of drying methods on silane-grafted chitosan of 3D-printed PEGDA monolithic structure using convective hot air drying, vacuum drying and freeze-drying methods. It was found that convective hot air drying of chitosan (ODC) silane-grafted monolith was more desirable than vacuum drying chitosan (VDC) and freeze drying of chitosan (FDC). To test the efficacy of methyl orange (MO) dye removal, a batch adsorption performance was tested at 50 mg/L of MO dye at optimal conditions found using response surface methodology (RSM). It was found that the maximum dye removal efficiency of ODC silane-grafted monolith is 90% with an uptake capacity, K of 12.7 mg/g. The recycle ability of all three absorbents was verified by evaluating their adsorption for five cycles and retained its performance after the second cycle. The convective hot air-drying method is better than the vacuum drying and freeze drying method as the silane-grafted chitosan monolith obtained has excellent surface properties and adsorption capability for dye removal.

Second case study is related to a robust Poly (ethylene glycol) diacrylate PEGDA - based monolithic support structures in which magnetic chitosan fluid (MCF) integrated with dispersed magnetite nanoparticles was coated on, forming a reusable adsorbent for wastewater treatment. The physical adsorption and desorption process, aided by the formation of intermolecular bridge between MCF and (3-aminopropyl) trimethoxysilane (APTMS) crosslinker, as well as exposure to alternating magnetic fields respectively, showed promise for wastewater treatment applications. Surface functionalisation, enhanced with rose petal effect-inspired novel grafting technique, possible through spray coating crosslinker between 0.25 and 2.00 bar establishes strong covalent bonds between APTMS and MCF, enhancing affinity and adhesion. The nanostructure fosters hydrogen bond formation between amino and hydroxyl groups, inducing crucial surface hydrophobicity for optimal adsorption in acidic wastewater. Experimental validation through weight loss calculation confirmed the adsorbent's resilience to prolonged contact with synthetic methyl orange (MO) dye for 6h without leaching. Optimisation studies using response surface methodology (RSM) with central composite design (CCD) evaluated the effect of hot air drying (HAD) parameters including solvent deposition time (0.5 to 2.5h), drying temperature (50 to 80 ^0C), and drying time (1 to 5h) on adsorption performance.

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