Biological and photochemical treatment of greywater

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INTRODUCTION

The day-to-day household activities led to the generation of greywater from kitchen sinks, washbasins, bathroom sinks, and washing machines. Greywater is composed of wide variety of contaminants such as cleansers (detergents, hair soaps, body wash, dish wash cleaners, etc.), food debris, suspended particles, nutrients, organic matter, and emerging contaminants

OBJECTIVES

- To prepare visible light-active modified nano-TiO_2 catalysts supported on low cost material and to analyze the surface properties, crystallinity, and elemental composition of the prepared catalyst.
- To explore the degradation of greywater pollutants by nitrogen-doped titanium dioxide (N-doped TiO_2) coated on gravels in a tray-type solar photocatalytic reactor.
- To evaluate the performance of sequencing batch reactors for greywater treatment using simultaneous nitrification, denitrification, and phosphorus removal (SNDPR) system.

SYNTHESIS OF SOLAR PHOTOCATALYST

Stirring for 30 min | Ultrasonication | Dried in hot air oven | Crushed and calcined at 300°C (Ananpattarachai *et al.*,2016)

N-doped TiO_2 Characteristics

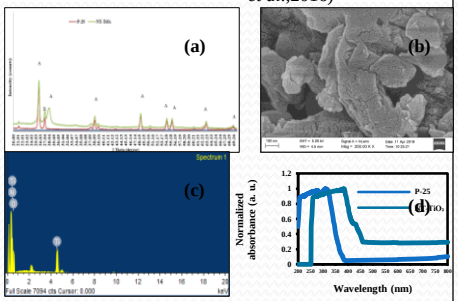


Fig. (a) XRD patterns (b) SEM image (c) EDX analysis (d) UV-visible absorption spectra

GREYWATER TREATMENT USING SOLAR PHOTOCATALYSIS

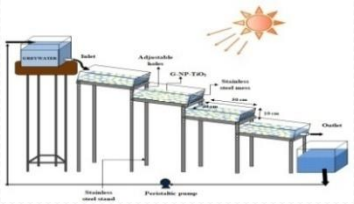


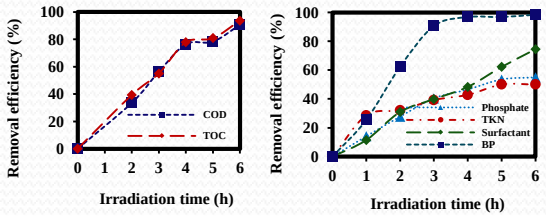
Fig. Experimental-setup of the tray-type solar photocatalytic reactor with gravel coated N- doped TiO_2

(Experimental conditions: H_2O_2 dosage - 0.5 g L^{-1}, 6 g catalyst dosage/ tray, light intensity- 18.3- 45.7 kilo lux)

Preparation of gravel coated N-doped TiO_2

- Pre-treated gravels were dip-coated with a 2% N-doped TiO_2 in 80:20 ethanol-water mixtures followed by airflow drying at 60-70°C.

Removal of greywater pollutants



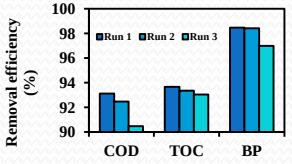
- COD - 92.45%, TOC - 93.35%, TKN-50% phosphate 55% , surfactant-75%, BP-98.5% removal

Toxicity analysis

- Obtained toxicity results exhibited significant decrease in bioluminescence inhibition from 13.6 to 4% after 6 h treatment time.

Catalyst reusability

- <3% decrease in degradation efficiency even after three cycles



GREYWATER TREATMENT USING SEQUENCING BATCH REACTOR

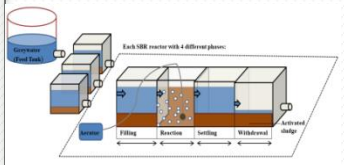
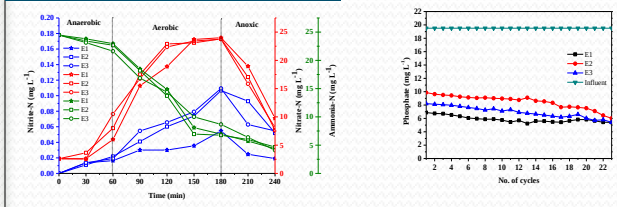


Fig. Schematic diagram of laboratory-scale SBRs

(Experimental conditions:Fill-15 min, React- 1h anaerobic, 2 h aerobic, 1 h anoxic, Settle-1h, Decant- 15 min)

Nutrients removal



- Significant removal of phosphate (72%), ammonia (81.68%).
- Organics removal - COD (96.62%), BOD (97.38%).

Adsorbent (corn cob) studies

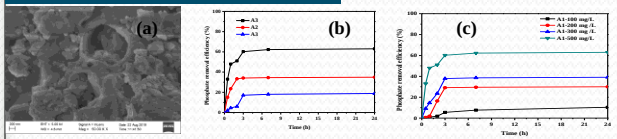


Fig. (a) SEM image of adsorbent (b) effect of activation temperature (c) effect of initial adsorbent dosage (A1(550°C, 30 min), A2(250° C, 3 h +550°C, 30 min), A3(700°C, 30 min))

- Adsorbent A1 with an activation temperature of 550°C and initial adsorbent dosage of 500 mg L^{-1} showed maximum phosphate removal. In SBR, overall phosphate removal efficiency at this optimum condition is 82.1%.

PUBLICATIONS

- Priyanka, K., Remya, N., & Behera, M. (2019). Comparison of titanium dioxide based catalysts preparation methods in the mineralization and nutrients removal from greywater by solar photocatalysis. *Journal of Cleaner Production*, *235*, 1-10. (Accepted)
- Priyanka, K., Behera, M., & Neelancherry, R. (2020). Graywater Treatment in Sequencing Batch Reactor Using Simultaneous Nitrification, Denitrification, and Phosphorus Removal, with Kinetic Studies of Phosphate Adsorption onto Corncob. *Journal of Hazardous, Toxic, and Radioactive Waste*, *24*(3), 04020017. (Accepted)
- Priyanka, K., Remya, N., & Behera, M. (2020). Greywater treatment using modified solar photocatalyst- degradation kinetics, pathway, and toxicity analysis. Separation and Purification Technology, 117319. (Accepted)

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- Ananpattarachai, Jirapat, Seraphin, Supapan, Kajitvichyanukul, Puangrat, 2016. formation of hydroxyl radicals and kinetic study of 2-chlorophenol photocatalytic oxidation using C-doped TiO2, N-doped TiO2, and C,N Co-doped TiO2 under visible light. Environ. Sci. Pollut. Res.

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