O18-2

Treatment of wastewater contaminated with atrazine using a packed bed reactor packing with an organic biomixture

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The packed bed reactor is considered a good wastewater treatment system due to organic pollutants removal through adsorption and degradation process. Therefore, the aim of the present work was to evaluate the operational conditions of a packed bed reactor using an organic biomixture to wastewater treatment contaminated with atrazine in continuous system. The reactor was made of high quality glass material (15 cm × 8 cm) packed with an organic biomixture. The stock solution was prepared with commercial atrazine. Effect of pH (4, 6 and 8), atrazine concentration (5, 10, and 15 mg L^{-1}) and flow rates (10, 30 and 50 mL h^{-1}) were evaluated. Atrazine concentration and degradation products in the effluent were analysed by HPLC. Data obtained were evaluated through the surface response methodology (RSM). From the results obtained it was demonstrated that the most important factor in the process was pH. Because, to acidic pH (pH 4), atrazine removal was greater (>90%) without significant differences ($p < 0.05$) according to concentration and flow rate analysed. While, at alkaline pH (pH 8) atrazine removal was lowest (19.96%). The adsorption process is more significant at pH 4 than pH 6 and 8, with optimum result of 152.22 mg atrazine adsorbed per gram of biomixture under operation conditions: pH 4, 15 mg L^{-1} of atrazine and flow rate of 50 mL h^{-1}.

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O18-3

Microbial and enzymatic approach for the reduction of terpenes in pinewood

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Terpenes are among the main sources of volatile emissions in the wood processing industry. Especially long-term exposition to volatile organic compounds (VOC) is suspected to cause harmful conditions in indoor environments. The aim of this study therefore was to lower the total emission level of pinewood, the basic raw material for oriented strand boards (OSB), by applying terpene degrading microorganisms or enzymes onto wood. The main focus was laid on the three major terpenes in pine wood: α-pinene, β-pinene, and Δ3-carene. While both pinenes were efficiently degraded by specifically selected and adapted Pseudomonas strains, Δ3-carene appeared to resist degradation. Therefore, we applied the fungus Penicillium nigricans in combination with the bacteria strains and accomplished for the first time a simultaneous reduction of the three major pinewood terpenes including Δ3-carene. Degradation rates for Δ3-carene were 80% and 30% in 4 and 2 days, respectively. In order to boost Δ3-carene degradation to a level that meets industry demands, we attempted to decompose Δ3-carene by oxidation using the oxidoreductase laccase isolated from the white-rot fungus *Trametes pubescens* as a biocatalyst. Laccase achieved an almost complete oxidation of Δ3-carene in defined liquid medium and a 30% reduction in pinewood particles after 24 h of incubation at optimum conditions. In liquid culture, carenones (car-3-ene-5-one, car-3-ene-2-one and car-2-ene-4-one) were detected as final metabolic products, which were also found in other research studies. These results provide a solid basis for future studies and integration into the industrial OSB production process.

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O18-4

Ability of *Fusarium culmorum* to degrade the endocrine disruptor di(2-ethyl hexyl) phthalate: Enzymes production and pathway of biodegradation

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Di(2-ethylhexyl) phthalate (DEHP) is a plasticizer widely used in the manufacture of plastics, and it is an environmental contaminant. The presence of this compound in the environment as a pollutant raises concern because of its endocrine-disrupting toxicity. *Fusarium culmorum* has the ability to produce esterase enzymes. Esterases are of great importance because they can break the ester bonds present in the plasticizers. Biodegradation of DEHP by *F. culmorum* and its induction of esterases were studied. *F. culmorum* was grown on media containing DEHP (initial concentration 1000 mg/L) as sole carbon source at 25 °C for 8 d in submerged fermentation. Growth kinetics and esterases activity characterized by biochemical tests and polyacrylamide gel electrophoresis were evaluated. Biodegradation constant of DEHP (k), half-life of DEHP biodegradation ($t_{1/2}$) and percentage of removal efficiency (%E) were also determined. Intermediate compounds of biodegraded DEHP were identified by GC-MS and a DEHP biodegradation pathway was proposed. *F. culmorum* degraded 100% of DEHP after an incubation period of 144 h. %E, k and $t_{1/2}$ were 99.9, 0.0256 h^{-1} and 27 h, respectively. DEHP was metabolized to mono ethyl hexyl phthalate and ethylhexanol. Maximum esterase activity was 845 U/L and esterase activity bands were observed in the DEHP-supplemented media, having a molecular weight of about 75 kDa. *F. culmorum*

has a promising ability for bioremediation of environments polluted with DEHP because it efficiently degrades DEHP and uses high concentrations of this compound as carbon and energy source.

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O18-5

Isolation and identification of erythromycin-mineralizing bacteria

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Antibiotics are widely used in human and veterinary medicine to treat and prevent bacterial infections. Often being only partially removed in wastewater treatment plants (WWTP), they are released into the environment with the treated effluents. The presence of antibiotics is associated with the development of resistant bacteria, which poses a public health risk. Due to its frequent presence in WWTP effluents, the antibiotic erythromycin is on the EU Watch List for emerging water pollutants.

The aim of this study is to isolate and identify erythromycin-degrading microorganisms. Activated sludge from a local WWTP was incubated in semi-continuous sludge reactors. Weekly, the medium in the reactors was exchanged by fresh mineral medium containing erythromycin (1 mg/L) and yeast extract (0.5 g/L). After six weeks of incubation, a dilution series was incubated with ^{14}C-[N-methyl]-erythromycin to allow for liquid scintillation counting of $^{14}CO_2$ formed from erythromycin by microbial metabolism. Further dilution series were set up when apparent partial mineralization reached 50% in diluted samples. In the course of eight dilution series, we decreased stepwise the concentration of yeast extract to 0.005 mg/mL, while increasing the concentration of erythromycin to 100 mg/L to select strictly for erythromycin degraders. Currently, the isolation of strains from these enrichment cultures by agar plating and the verification of their ability to degrade erythromycin are ongoing.

Results from this study will contribute to a better understanding of the processes involved in the degradation of erythromycin during the wastewater treatment process.

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O18-6

Biological recycling of metals contained in lithium-ion batteries (LIB)

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The need to replace fossil fuels with cleaner alternatives with a lower carbon footprint has led to an increasing popularity in the use of electric vehicles (EV). Lithium-ion batteries (LIB) are one of the most common forms of energy storage in EV and electronic devices due to their advantages over other battery types, such as being smaller and lighter with higher energy density. LIB are considered a safe and clean technology; however, due to their high demand, there are environmental and socio-economic concerns over the scarcity of the raw materials required, accumulation of waste at the end of the LIB life cycle, and the hazards associated with the metals contained in the spent LIB. In this context, the aim of the present project involves the bioremediation and up-cycling of metals contained in LIB at the end of their life. Current work is being developed with two different bacterial strains from the *Desulfovibrio* and *Morganella* genera. The tolerance of these two species to relevant metals is being investigated together with their ability to reduce metal bioavailability and the production of valuable nanoparticles from waste material. Synthetic biology tools are being developed in parallel to enable the domestication of these organisms and to improve their applications for bioremediation and nanoparticle synthesis purposes.

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