Report for 2003DE23B: Undergraduate Internship: Biological and Enzymatic Treatment of a Food Processing Wastewater

- Water Resources Research Institute Reports:
  - McDermott, Alice, Anastasia Chirnside, 2004, Biological and Enzymatic Treatment of a Food Processing Wastewater, Delaware Water Resources Center, University of Delaware, Newark, Delaware, 8 pages.

Report Follows

Undergraduate Internship Project #4 of 10 for FY03

This project is co-sponsored by the ***University of Delaware College of Agricuture (CANR) and DWRC***. Ms. McDermott is investigating both the effectiveness of adjusting pH and of using an enzyme culture in wastewater treatment.

"I want to understand how excess nutrients like nitrogen can be successfully removed from wastewater discharges from industry. It's important that we know and apply the best available technology for clean surface water quality."
-- Alice McDermott, University of Delaware undergraduate freshman, Art History major.

Abstract:

Soy flour is an excellent low-fat source of isoflavones and protein, providing eight amino acids necessary for human health. However, the processing of soy flour is not environmentally friendly. The soy processing wastewater has extremely high amounts of Total Kjeldahl Nitrogen (TKN), Chemical Oxygen Demand (COD) and a high pH. We have developed an attached growth, packed-bed bioreactor (PBR) containing the white rot fungus (WRF), *Phanerochaete chrysosporium*. This fungus secretes enzymes that catalyze oxidation reactions resulting in degradation of recalcitrant compounds. Previous studies utilizing the fungus in the bioreactor found that the high pH of the wastewater caused inhibition of TKN and COD degradation. We hypothesize that adjustment of the wastewater pH before introduction into the bioreactor would overcome this inhibition and result in a greater reduction of the TKN and COD.

The first objective was to investigate the effectiveness of pH adjustment of the wastewater before treatment in the bioreactor and to evaluate the continuous recycling of the pH adjusted effluent throughout the experiment.

The second objective was to investigate the effectiveness of treating the wastewater with the enzyme culture solution obtained from the reactor in order to overcome the inhibitory effect of high pH on fungal activity within the reactor.

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Objective 1: The pH of the wastewater was adjusted to 7.52. It was then fed to the PBR at a pumping rate of 0.7 ml min^{-1} with the recycle flow (2:1). The effluent was sampled daily and measure for TKN, COD and pH. The overflow effluent was collected, the pH was readjusted to 7.0 and then pumped into the PBR.

Objective 2: Inorganic N was removed from the wastewater. The pH was adjusted to 7.0. Two wastewater dilutions (10% and 20%) and 2 enzyme concentrations (5% and 10%) were examined. The diluted wastewater was treated with the enzyme solutions and monitored for changes in TKN, pH and COD for 24 hours.

Results and conclusions:
Continuous adjustment of pH during recycling of the wastewater within the PBR resulted in an increase in the amount of TKN and COD degraded. Over 90% of the TKN and 33% of the COD were removed during treatment within the PBR. Treatment of the wastewater with the fungal enzyme solution had little effect on TKN concentration. However, there was a 50 to 67% decrease in the total amount of COD found in the wastewater. The pH remained constant.

With the improved pH control in the PBR during recycling events, a greater amount of TKN and COD was removed from the wastewater. Treatment of the wastewater with fungal enzymes resulted in a significant decrease in COD concentration. These positive results indicate that treatment of recalcitrant wastewater with the WRF deserves further investigation. A combination of treatments, inside and outside the PBR, could lead to complete removal of both COD and TKN thus allowing for discharge of the treated wastewater into surface water streams.