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Biodegradation of municipal wastewater with local and commercial bacteria

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Abstract

This study was undertaken to evaluate the degradation of synthetic and real municipal wastewater by commercial bacteria known as SludgeHammer bacteria and some local isolated strains. TOC removal efficiencies in the synthetic wastewater were 70%, 54%, 52%, 42% for the SludgeHammer, *B. subtilis*, *B. laterosponus* and *P. aeruginosa*, respectively. TOC degradation experiments using municipal wastewater found that the mixed bacteria culture of selected strain of *B. subtilis* and *P. aeruginosa* increased treatment performance by 6 to 16% higher than other strains. However, they took relatively longer time to reach the maximum degradation rate compared to the SludgeHammer bacteria.

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1. Introduction

Allowing municipal wastewater to be released to the environment can make a lot of problems. The wastewater may be treated by physicochemical or biological processes. Biological treatment is preferred solution for improving the municipal wastewater treatment. Recently the biological process is the main treatment system in municipal wastewater plant. The performance of a biological process is often enhanced through bioaugmentation of one or more species of specialized microorganisms (Semrany et al. 2012, Erdogan et al. 2011, Karamalidis et al. 2010).

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The microorganisms usually bacteria are selected on the basis of accelerated rates and their ability to degrade specific compounds. Many researcher have reported that introduce of indigenous strains of bacteria can enhance the degradation of organic pollutants in wastewaters. Qu et al. (2011) have found that *pseudomonas spp.* (isolated from activated sludge) was very effective in removing phenol from industrial wastewater compared to the non-augmented one. Tuo et al. (2011) found *Bacillus spp.* have high ability for quinoline removal. Other work by Chen et al. (2009) investigated the treatment of municipal wastewater with single strain of bacteria and bacterial consortium and found that bioaugmentation with three strains of *E. cloacae*, *Gordonia* and *P. putida* would be more effective in removing TOC compared with that of single strain treatments. Similar results by Mongkolthananaruk et al. (2002) found that treatment of lipid-rich wastewater by a mixed culture of *pseudomonas aeruginosa*, *Bacillus sp.* and *Acinetobacter calcoaceticus* reduced the BOD and lipid content from 3600 mg/l and 21,000 mg/l, respectively, to less than 20 mg/l within 12 days. Moreover, these 3 strains were more effective in treatment of wastewater when compared to a single strain treatment. In other study by Schneider and Topalova (2011) reported that municipal wastewater treatment inoculums was as efficient as commercial inoculums (namely: hydropacks; Bilikuk and Laktazyme), in removing the COD and phenols from dairy wastewater. This work aims to compare the bioaugmentation of municipal wastewater with indigenous and commercial bacterial strains.

2. Methods

2.1. Sample collection

Sewage water samples were collected from different sewage water treatment station in Tripoli. The sample were collected in sterile conical flask from the aeration thank, by using sampler and kept in refrigerator for future use.

2.2. Isolation, identification and preparation of inoculums

Isolation of bacteria was done by using serial dilution method. 0.1ml from each dilution bottle was streak on Nutrient agar plates by spread method. The Petri dishes were incubated aerobically at 37 °C until colonies have appeared. The isolates were re-cultured on new media for purification to get a single pure strain. Gram stain was performed for each isolate. Biochemical tests were studied by using standard biochemical assays according to the scheme Berge's manual and confirmed by Analytical Profile Index 20(API 20E) system technique. To obtain the appropriate biomass of bacterial isolates, the isolates were inoculated separately in individual Erlenmeyer flask contain nutrient broth medium and were incubated for 24h at 37°C in the rotary shaker incubator. The cells harvested by using centrifugation at 4000 rpm for 10 min and the supernatant was discards. The cell concentration of each strain measured using spectrophotometer at 600nm (OD600) in order to obtain a 0.5mcf or 1.5×10^8 cfu/ml.

3. Biodegradation Experiments

3.1. Media preparation

A synthetic wastewater containing the following compositions was prepared as described by Chen (2009): (g/l) 7.5 glucose, 1.15 NH₄Cl, 0.2 KH₂PO₄, 0.2 g MgSO₄7H₂O, 0.25 CaCl₂. The solution diluted to a desirable concentration of TOC 220mg/l and used as the synthetic wastewater in the single strain. 0.5 ml of the trace element solution was added for this medium with the following composition: (mg/l) H₃BO₃(50), ZnCL₂ (50), CuCL₂ (30), MnSO₄(500), COCL₂.H₂O(30), (NH₄)₆MOO24H₂O(50). The pH was adjusted to 7.1 and the media was autoclaved at 121°C for 15 minutes.

3.2. Experiment study

Commercial strain of SludgeHammer and local isolated strains of bacteria identified as *Bacillus spp.*, *Bacillus subtilis*, *Bacillus laterosponus*, *Bacillus agri*, *Pseudomonas aeruginosa*, and *Pseudomonas putida* were used.

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