CALIFORNIA SCIENCE & ENGINEERING FAIR
2019 PROJECT SUMMARY

Name(s)

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Project Number

J1119

Project Title

Using Bioremediation as a Cost-Effective, Environmentally Safe, Alternative for Disposing Oil: A Commercial Application

Abstract

Objectives

It is estimated that 200 million gallons of oil is disposed of improperly in the United States annually, a portion of which is used engine oil. This project is designed to determine if bacteria could degrade used engine oil, and if certain additives would increase the rate of degradation. I calculated the cost of this method and compared it to the cost of incinerating used engine oil. I determined that this is environmentally safer than the current methods of disposing used engine oil. Lastly, I designed a comprehensive model to process used engine oil, which can be scaled up or down. Since 70-90 percent of engine oil consists of refined crude oil, and since some bacteria degrade the alkanes in crude oil, I hypothesized that some bacteria will also degrade engine oil. I also hypothesized that certain additives will increase the rate of degradation, that the byproducts are biologically safer than the byproducts of incineration, and that this method is cheaper than the current incineration method.

Methods

This experiment was performed in the Microbiology Laboratory of Adventist Health Glendale. I treated used engine oil with the bacteria Acinetobacter Venetianus, and the additives sodium nitrate, sodium chloride, and iron oxide. Bacteria was first cultured in nutrient broth and then added to used engine oil, divided into nine different testing conditions, and placed on a stirring hot plate. The first set of results were analyzed in three days, the second set in 13 days, and the final set in 23 days. The byproducts were analyzed with UV and IR spectrophotometers at the Chemistry Laboratory of Los Angeles City College. The cost of incineration was then calculated using the Waste to Energy International formula and compared to the cost of obtaining supplies and equipment needed for using the stated method of biodegradation.

Results

The bacteria did degrade engine oil. The test tubes with additives showed a higher rate of degradation. Of the additives, sodium chloride and sodium nitrate were the most effective minerals, and the test tubes with all three additives showed the biggest difference on the spectrophotometry graph. The calculated cost of biodegradation is significantly less than the cost of incineration, and I have designed two industrial models to scale this method for commercial applications.

Conclusions

My hypothesis was supported by my data. I believe this method can become a new standard for disposing of oil since it will cost a fraction of the current cheapest alternative, which is incineration. This new method also requires less maintenance, can be scaled up or down, and likely more gentle towards our planet.

Summary Statement

I demonstrated that engine oil can be degraded by some bacterial strains, and that certain additives aid in the degradation; I also designed a bioremediation model that can be installed in communities which improperly dispose of oil.

Help Received

I conducted the experiment by myself. However, Dr. Michele Cosgrove, Pathologist, Adventist Health Glendale, allowed the use of all microbiology equipment, and demonstrated sterile technique. Professor Marcos Alvarez, Laboratory Director, LACC, demonstrated correct spectrophotometry technique.