LEARNING GUIDE

Programs Environmental Technology

Module RENEWABLE ENERGY

Learning Unit Catalyst Titration Process

Introduction

The most technical part of manufacturing biodiesel fuel from used vegetable oil is the titration process. Titration is necessary for calculating the amount of catalyst required in biodiesel manufacturing. The learning guide will teach you the order of the steps involved in the titration process. This learning unit will also review the scientific math, chemistry and conversions necessary in titration.

Written by:
Nolan D. LeRoy
Upper Cape Cod Regional Technical School

UPPER CAPE COD REGIONAL
TECHNICAL HIGH SCHOOL

Biodiesel Titration Process for Determining Catalyst amounts

Performance Objective: The student will calculate and complete the titration process used for determining catalyst amounts

Given: An instruction sheet, conversion book, instructor oversight, tools and materials

The Student Will: Calculate and complete the biodiesel titration process

How well: You must successfully pass a knowledge test and performance test.

Name: _____

Date: _____

Grade: _____

INSTRUCTION SHEET

The Titration Process is used to determine how much catalyst is needed to neutralize the free fatty acids in used vegetable oil. A titration is a reaction between the catalyst and the vegetable oil. Isopropyl alcohol is used in the titration instead of methanol because the isopropyl alcohol does not react with the vegetable oil. Be sure to make precise measurements and follow procedures closely to avoid mistakes. (*From the Fryer to the Fuel Tank,* by Joshua Tickell Joshua Tickell Media Productions, Third Edition New Orleans, Louisiana © 2003)

Follow these Steps

1. Measure 1 gram of KOH (Potassium Hydroxide) onto a petri dish on a scale.
2. Measure 1 liter of distilled water into a 1500-ml beaker.
3. Pour the 1-gram of KOH into the 1-liter of water.
4. Label this beaker with a piece of masking tape and a marker "caustic/water solution, do not drink."
5. Measure 10 ml of isopropyl alcohol into a 20-ml beaker.
6. Dissolve 1 ml of used vegetable oil into the isopropyl alcohol.
7. Label this 20-ml beaker "oil/alcohol solution".
8. Use a graduated eyedropper or pipette to drop 1 ml of the KOH and water solution into the oil/alcohol solution.
9. After 1 ml of KOH/water solution is added, check the pH of the diluted vegetable oil. Do this by inserting the strip of litmus paper into the oil/alcohol container. Compare the litmus strip's color with the color chart. Or use a pH meter to get an immediate reading.
10. Repeat steps 8 and 9, counting the milliliters of KOH/water solution you add, until the oil/alcohol reaches a pH of between 8 and 9. The pH increase will usually occur suddenly. You will usually add no more than 3 milliliters of lye/water solution.
11. Use the following equation:
    - the number of milliliters of KOH/water solution dropped into the oil alcohol mixture = (x).
    - (x + 7) = K.
    - K = the number of grams of lye necessary to neutralize and react one liter of used vegetable oil.
    - K will usually be between 10 and 13 grams, but it can be as high as 20.

Resources

(*From the Fryer to the Fuel Tank,* by Joshua Tickell Joshua Tickell Media Productions, Third Edition New Orleans, Louisiana © 2003)

Knowledge Test

1. Why is the titration process performed?

2. What is a catalyst?

3. Why is isopropyl alcohol used instead of methanol during the titration process?

4. Explain how any errors made during the titration process will be magnified during biodiesel manufacturing.

5. Explain why the pH increase to 8 or 9 is usually a sudden change.

Essay Question:

Explain in essay format the process of titration.