ADVANCED POWER SYSTEMS INTERNATIONAL INC.
558 Lime Rock Road
Lakeville, CT 06039
tel 860-435-2525 fax 860-435-2424
Website – www.fitchfuelcatalyst.com

Technical Bulletin #4-B

Study of the Effects of Fitch Fuel Catalyst on Microbial Contaminated B20 Bio-Diesel Fuel

TREATMENT OF BIO CONTAMINATED B20 BIO-DIESEL FUEL WITH METAL ALLOY FUEL CATALYST

January 4, 2006

By
Ruma Ghosh and Fabian Garces
University of Connecticut- Dept. of Chemistry - U 3060
55 North Eagleville Rd - Storrs, CT 06269-3060

OBJECTIVE

Investigation was carried to measure the effect of the Fitch Fuel Catalyst C on the growth of bacteria in contaminated biodiesel blend (B20).

EXPERIMENTAL METHODS

Pseudomonas Oleovorans (ATCC 29347) was the bacterial inoculum used for infecting the 1.5 L of biodiesel blend for ~ 3 months. The flow of the biodiesel blend was maintained at 500 mL per minute through a circulating system. The system had provisions for product draw off. The quality of the biodiesel was monitored using UV-Visible spectroscopy.

The same inoculated Bio diesel was observed in standing flasks with and without the presence of an element of Fitch Fuel Catalyst C.

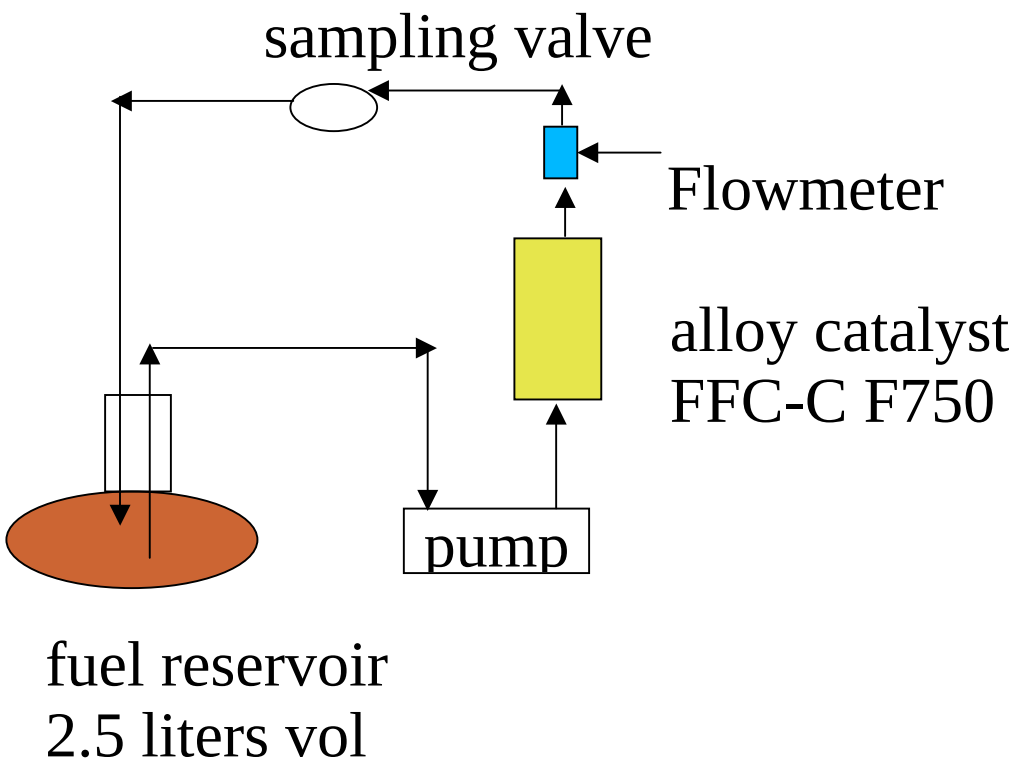
CONTROL EXPERIMENTS

An identical circulating systems for testing uninfected biodiesel blend served as control.

FUEL PREPARTION

Circulating System

The 1.5 liters of biodiesel blend was prepared in a 2.5 L glass jar (which served as the reactor). The biodiesel blend used in the experiment was a mixture of 80% (v/v) DF-2 (commercially available diesel) and 20% (v/v) Soy Gold AL-25842 (B -100 supplied by Southwest Research Laboratory). The bacteria infected biodiesel was subjected to forced circulation through an In Line system.



Flask System

Culture flasks labeled 1 and 2 containing 50 mL of BHB (Bushnell Haas Broth) + 5% (v/v) blended biodiesel (B20) with 1 mL of *Pseudomonas Oleovorans* (ATCC 29347) inoculum were prepared. Flask 1 is the blank (no catalyst) while flask 2 containing a catalyst C element cut into half. Only the characteristic surface or thin slice of the top part of the catalyst element was used in the culture flask. The flasks were inspected visually for any differences in turbidity or appearance or disappearances of the blended biodiesel layer. The BHB salts medium is a typical aqueous inorganic salt medium. The floating biodiesel blend layer can be distinguished by a distinct yellow-orange color. The gradual disappearance of the biodiesel blend layer is indicative of the decomposition of the biodiesel blend components by the bacterial inoculum.

RESULTS

The contaminated biodiesel in the In Line circulation system that included the In Line Catalyst, showed marked differences as evident in the absorbance of UV-Visible spectroscopy. A fresh biodiesel blend was used as the blank for this analysis. The appearance of a peak in the UV-Visible spectrum from the inoculated biodiesel blend shows that the bacteria produce measurable differences in the composition of the biodiesel blend compared to the uninfected biodiesel blank. In addition differences in visual color were also evident (Figure 1). Suspended particulate matter was evident in the infected biodiesel blend. These particulates settled at the bottom of the glass jar. The same particulates were not evident after exposure to the In Line Catalyst.

Figure 1. Biodiesel B20 after treatment by on line catalyst system

The UV-Visible spectrums results (Figure 2) show a peak at around 400 nm and 428 nm in the visible wavelength range. The peaks are more obvious in the untreated inoculated biodiesel blend than in the same inoculated biodiesel blend that went through the In Line catalyst system.

Figure 2. Gradual decrease in the peak heights over time in infected bio-diesel blend subjected to the influence of Fitch Fuel Catalyst In line system

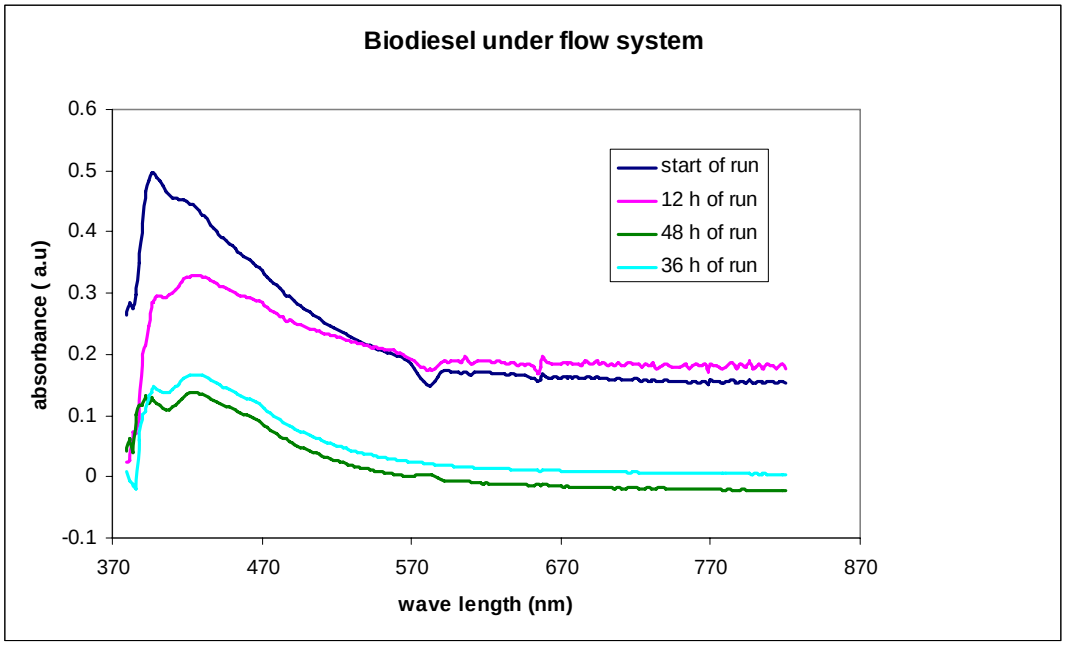


Figure 2. The peaks that appear in the UV-Visible spectra, from the infected biodiesel blend when compared to the uninfected biodiesel blend are due to changes in the chemical composition of the biodiesel blend from bacterial action. When the inoculated biodiesel blend is exposed to the Inline Catalyst through the circulating system, we see the extra peaks that show in the UV-Visible spectra, decrease with time and reach a saturation level. Control experiments were run with uninfected biodiesel blends through the online catalyst system. There was no appearance of the extra peaks in the UV-Vis spectrum in the control.

The culture flasks that remained for the 4-5 months under still conditions exhibit obvious differences in appearance as shown in Figures 3, 4, 5a and b. Culture flask 1 is inoculated biodiesel blend without catalyst and culture flask 2 is inoculated biodiesel blend with the a catalyst element present.

Figure 3. Appearance of culture flasks

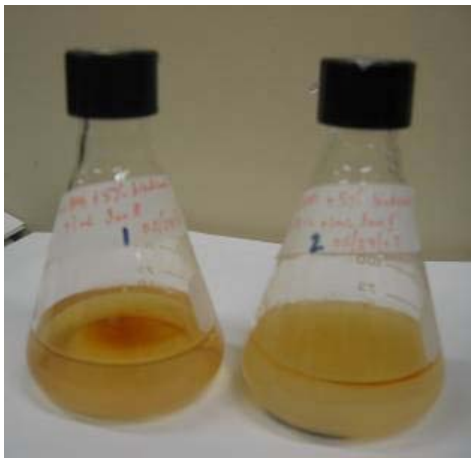
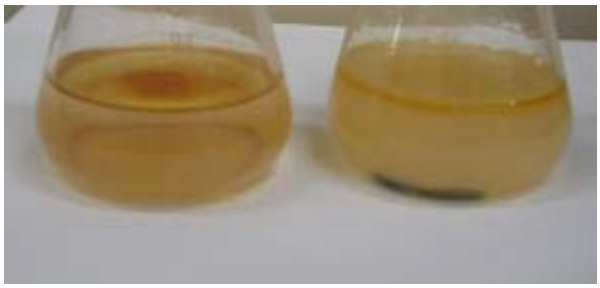


Figure 4. Culture flasks after shaking

Figure 5a. Illuminated view of culture flask

1 **2**

Figure 5b. Non-illuminated view of culture flask



1 **2**

Figures 3, 4 and 5 show that the culture flasks without the catalyst have gone through severe decomposition of the biodiesel blend layer, as the separate floating layer is practically absent. Flask 1 in Figure 3 and 5b, showed only a patch of the biodiesel blend left on the top layer and much of the biodiesel layer is lost / disintegrated as is evident from the particulate matter that has settled at the bottom. When flask 1 was shaken the remainder of the biodiesel layer got encapsulated by the aqueous phase and formed oily minuscule droplets (Figure 4). Such observation was absent in flask 2 which had an element of the catalyst C present.

DISCUSSION

A similar study was also done on pure diesel DF-2. (See APSI - Technical Bulletin #4). The most remarkable difference between the effect of the bacteria on pure diesel (DF-2) and on B20 biodiesel is that in the DF-2, the turbidity in the infected fuel is evident while in the B20 the appearance of particulates is more evident. Biodiesel is an oxygenated fuel or blending component made from vegetable oils, waste cooking oil, or animal fats by reaction of the triglyceride fats with methanol to form methyl esters via transesterification. From past literature when methyl soyate is used as biodiesel blend component, microbial growth from *Bacillus* species was inhibited compared to bacterial growth in pure diesel. Therefore, evidence suggests that the bacterial action in a biodiesel blend is far different from pure diesel (DF-2). The breakdown of the biodiesel blend components by the *Pseudomonas* species in this study, as seen from the culture flasks experiments, shows that biodiesel by itself is more susceptible to bacterial spoilage. The appearance of turbidity in the aqueous phase in the culture flask 2 shows the presence of bacterial growth, but at the same time the biodiesel blend layer is not destroyed as evident from the top layer color. The catalyst slows down the biodiesel spoilage. The appearance of the extra peaks in the UV-Vis spectra (Figure 2) may be a result of the changed chemical composition , the waste metabolites or the fragments of the bacterial cell.

Acknowledgements:

Dr. Al Berlin Director Research Advanced Power Systems International, Inc.
Dr. Steven Suib, Board of Trustees Distinguished Professor
Dept of Chemistry - University of Connecticut

Funding Support:
Advanced Power Systems International, Inc. Lakeville, CT USA
US Army TACOM / TARDEC Warren Michigan, USA Contract W56HZV