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Texas Commission on Environmental Quality
New Technology Research & Development (NTRD) Program
Monthly Project Status Report

Contract Number: ____582-5-70807-0007_____

Grantee: _____Lamar University_____

Date Submitted: _____October 15, 2006 _____

Report for the Monthly period:

Starting Date __September 15, 2006__ Ending Date ___October 14, 2006__

Section I. Accomplishments (*Please provide a bulleted list of project accomplishments as well as a description of their importance to the project.)*

- **NOx Data Analyzed and Additional NOx Tests Conducted**

  In addition to performing NOx data analysis, several addition DeNOx tests have been carried out with a new catalyst in the test unit using the NO standard (1021 ppm). A typical set of results is shown in Figure 1. The new catalyst was prepared by adding silicone carbide granule between silicone carbide foam and platinum gauze to improve catalyst heating. It appears that CO is coming from a reaction of SiC and NO, however, no CO_2 was detected.

- **DPF Data analyzed and Additional DPF Regeneration Tests Conducted**

  In addition to performing DPF data analysis for the previously-conducted DPF regeneration experiments, several addition soot loading and off-line regeneration tests have been repeated to check the efficiency of filter regeneration after several regeneration cycles. A typical set of results is shown in Figure 2 where DPF pressure drop is observed to return to the initial DP.

- **Abstract Submitted for Presentation**

  An abstract reporting the current DPF results, entitled "Active Regeneration of Diesel Particulate Filter Employing Microwave Heating," has been submitted to the NASCRE-2 (North American Symposium in Chemical reaction Engineering 2) Meeting for presentation. The Meeting will be held in Houston from February 4-7, 2007. A copy of the submitted abstract is included in this report.

Indicate which part of the Grant Activities as defined in the grant agreement, the above accomplishments are related to:

The above accomplishments are related to Tasks 1, 2, 3, 4 and 5 described in the Scope of Work of the project.

Section II: Problems/Solutions

Problem(s) Identified (*Please report anticipated or unanticipated problem(s) encountered and its effect on the progress of the project)*	None
Proposed Solution(s) *(Please report any possible solution(s) to the problem(s) that were considered/encountered)*	N.A.
Action(s) Conducted and Results *(Please describe the action(s) taken to resolve the problem(s) and its effect)*	N.A.

Section III. Goals and Issues for Succeeding Period (*Please provide a brief description of the goal(s) you hope to realize in the coming period and identify any notable challenges that can be foreseen)*

The goals for the next month are to:

1. continue to perform detailed analysis on the observed results from DPF regeneration experiments to establish optimal regeneration schemes and conditions;

2. continue to perform detailed analysis on the observed results from long-term NOx control experiments to establish optimal NO_x reduction conditions; and

3. continue to prepare the technical reports to summarize the results from the analyses.

The next Monthly Progress Report will be submitted to TCEQ on November 15, 2006.

Figure 1. DeNOx Test
NO and CO Concentration

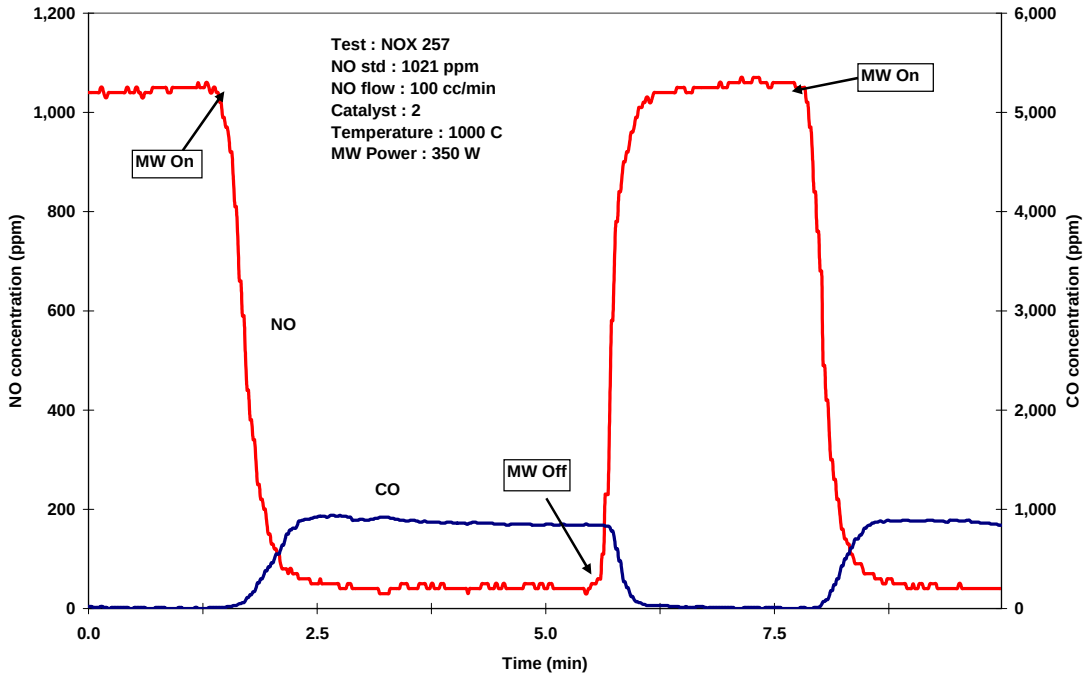
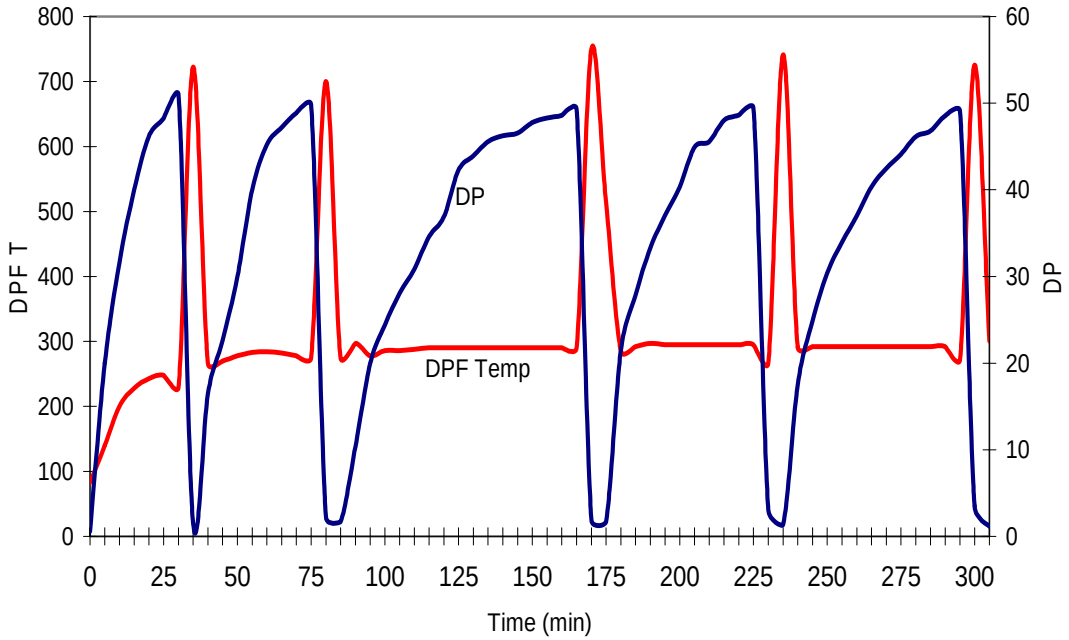


Figure 2. DPF Regeneration
DPF DP and Temp



_____ Date:_____*10/15/06*_____

Authorized Project Representative's Signature

NOTE*: Please attach any additional information that you feel should be a part of your report or that may be required to meet the deliverable requirements for tasks completed during this reporting period.*

Active Regeneration of Diesel Particulate Filter Employing Microwave Heating

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Abstract

Wall-flow diesel particulate filters (DPFs) are considered the most effective devises for the control of diesel particulate emissions. A requirement for the reliable operation of the DPFs, however, is the periodic and/or continuous regeneration of the filters. While microwave heating has been considered a potential active regeneration method for the DPFs, past studies on the technology have identified several technical problems leading to filter failure. The problems are mainly associated with the use of inappropriate filter materials for the microwave system and the generation of local hotspots due to uneven microwave heating, resulting in the physical damage to the filters. The objective of this study was to develop and demonstrate the technology employing a microwave-absorbing filter material coupled with an effective waveguide design for the reliable regeneration of DPFs.

In this study, a well-equipped diesel emission control laboratory was established to conduct the experiments. The experimental facilities included a 6-kw diesel generator, an exhaust flow control system, a diesel particulate filter system, a microwave energy supply system, a soot-sampling system, a differential-pressure measurement system, and a temperature measurement system. In the DPF set up, a silicone carbide wall-flow monolith filter (50mm diameter x 150 mm length, cell density = 200 cpsi, pore size = 20 micron) was enclosed in a quartz filter holder. A commercial 1.4-kw microwave oven was modified to accommodate the quartz holder and a waveguide was engineered to evenly supply the microwave energy to the enclosed filter to achieve filter regeneration. In the experiments, the diesel engine exhaust was lined up to flow through the filter with a fixed flow rate. The microwave regeneration was triggered after a specific soot loading was generated based on the differential pressure drop reading.

The results have indicated that the designed system has been able to achieve uniform temperature profiles both in the radial and the vertical DPF positions. The regeneration of DPF by microwave energy has been observed to be highly efficient. The soot filtration efficiency has remained to be comparably high after more than five cycles of microwave regeneration with no apparent physical damage to the DPF being observed. The detailed results will be reported at the meeting.