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

Title: FEEDLOT BIOMASS: A REBURN FUEL FOR "MAXIMUM NOX" REDUCTION IN COAL-FIRED POWER PLANTS

Contract Number: _____*TCEQ Grant # 582-5-65591 0015*

Grantee: _____Texas Engineering Experiment Station, Texas A&M University

Date Submitted: _____July 06, 2005

Report for the **Monthly** period:

Starting Date _____June 1, 2005_____Ending Date _____June 30, 2005_____

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

The overall objectives of the project are i) to develop a retrofit technology of using processed low-ash feedlot biomass (FB) as reburn fuel for potential reduction of the NOx in coal-fired power plants by 80-90% and ii) determine the possible capture of Hg for low rank coals, reduction of CO_2 and other benefits of using animal wastes (alternately known as feedlot biomass, FB) as fuels.

1. Task 1: A Vortec impact mill was purchased in June 2005 to process manure and coal used in the combustion studies. The impact mill will provide a finely ground finished product that is acceptable for combustion testing. This Vortec mill will be capable of processing ~500 lbs of material/hour.
2. Task1 : About 28 tons of HA-RM (high ash raw manure collected from soil surface feed pens or alternately termed as high ash feedlot biomass, HA-FB-Raw) was collected for composting process by July 31st, it will be converted into HA-PC manure (high ash partially composted (PC) or alternately termed as HA-FB-PC). Abut 700 lbs of HA-FB-Raw was coarsely ground for greenhouse drying to reduce moisture < 10 % for further grinding. Similarly about 40 tons of LA-RM (low ash raw manure collected from fly ash surfaced feed pens or alternately known as low ash feedlot biomass, LA-FB-Raw) was collected for composting process. The LA-FB-Raw contained 20 % moisture. It was coarsely ground for greenhouse drying to reduce moisture < 10 % for further grinding. By July 24th, it will be converted into LA-PC manure (low ash partially composted, alternately termed as LA-FB-PC). On June 24, 2005, 6 containers of HA-FB-Raw were shipped to Hazen Research Inc. to be analyzed for ultimate and proximate analyses. More details are given in Attachment A. The ultimate analysis of DB reported elsewhere is presented in Attachment B.
3. Task 1: Contact was made with Panda Energy of Dallas which plans to establish ethanol plan at Hereford which will make use of manure as energy source; it plan to use remaining HA-FB for use in a test burn at Energy Products of Idaho (EPI) in July 2005.
4. Contact was made with Texas Utilities (TXU) at Dallas for acquiring Texas Lignite samples for test firing at TAMU facility.
5. Task 1: The specifications for Thermo-gravimetric Analyzer (TGA) equipment have been finalized. However there is a delay in sending purchase requisition from TAMU due to contract set up problems.

6. Task 2: It deals with small scale reburn experiments for NOx reduction. The set has been modified and assembled. New ceramic sections were cast, and new injectors were fabricated. The laboratory layout is currently being changed to conduct the experiments.
7. Task 2: The task 2 also deals with Hg studies. In view of safety concerns in Hg experiments, it was decided that a new burner facility setup will be fabricated exclusively for conducting mercury experiments. The setup is currently in design phase.
8. Task 3 deals with pilot scale studies to be conducted either at the DOE-NETL facility, Pittsburgh, PA or their recommended facility. Dr Kalyan Annamalai (KA) plans to attend the DOE-Hg Contractors meeting at Pittsburgh during July 11-15. Arrangements were made for KA and John Sweeten to meet with DOE Personnel at the NETL facility in Pittsburgh, PA on July 15 th. The items to be discussed are as follows: i) Modalities of the pilot scale testing, ii) Recent research activities with TCEQ and DOE-NREL, and iii) Explore the possibility on filing a second patent by TAMU and DOE on NOx reduction with FB as reburn fuels. It should be mentioned that the first patent on NOx reduction will be issued to Kalyan Annamalai and John Sweeten of TAMU sometimes in July 2005.
9. Task 4 deals with zero dimensional reburn model for predicting the NOx capture by biomass fuels. The subroutines for calculations in the main burner section have been completed, and currently subroutines are being written to determine the volatile matter composition of coal and FB. This is being done by using the Gibbs Minimization Method.
10. Task 4: Mercury modeling. The earlier isolated particle combustion codes developed by Prof. Annamalai with DOE grants are being modified to include both homogeneous and heterogeneous mercury reactions.

APPENDIX A:

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

Task 1: Fuel characteristics
Task 2: Small Scale Reburn Experiments for NOx reduction
Task 3: Pilot scale rebunn studies at DOE-NETL.
Task 4: Reburn modeling to predict NOx and Mercury capture by biomass fuels

Section II: Problems/Solutions

Problem(s) Identified (*Please report anticipated or unanticipated problem(s) encountered and its effect on the progress of the project)*	Task1: The TAMU initial contract set up did not allow us to proceed with large purchase (equipments costing > $ 5000; e.g. TGA) due to use different “Excel” files. Task 2: The current burner set up is specifically set for NOx reduction studies; further it has limited residence time and there is no over-fire facility. There was safety concerns in Hg experiments and different mode of injection of Hg Task 3: The DOE –Pittsburgh pilot scale facility was operated by Parsons technology; however they were not allocated funds by the DOE Office to operate their pilot scale facility during the year 2005-2006. Thus they may not be able to cost share the pilot scale test expenses.

	Task 4: i. Mercury modeling: Problems likely to be faced might be related to the numerical code. We might face some coding errors while running the numerical code. ii. The present code for the isolated coal particles is 10-15 years old. The program did not run when attempted with recent computers.
Proposed Solution(s) *(Please report any possible solution(s) to the problem(s) that were considered/encountered)*	Task1: The problem with TAMU contract set up is being corrected in the week of July 5th, 2005 and purchase requisition will be sent during the week of July 5th Task 2: Due to safety concern, it was decided that a new burner facility setup will be fabricated exclusively for conducting mercury experiments. A new improved combustor is being designed, specifically to handle hazardous species like mercury. The new combustor will be 66% longer than the current setup; this will give a longer residence time in the furnace. A longer residence time will ensure higher particle burn fraction, lower CO concentrations etc. The insulation shall be improved to enable achieving steady state operating conditions. Task 3: Dr. Iyan Annamalai and John Sweeten will visit with DOE Personnel on July 15th at the NETL facility in Pittsburgh, PA. The preliminary phone conversation with DOE personnel leads to the following solutions: a) Persuade DOE to allocate funds for pilot scale tests either for 2005-2006 or for 2006-2007; b) Suggest alternate pilot scale test facilities (e.g. General Electric inn California, Southern Services etc). Task 4: i. Hg modeling: The possible solution to the above mentioned problem is make proper implementation of the changes to the present numerical code and time to fix the problems.

Action(s) Conducted and Results *(Please describe the action(s) taken to resolve the problem(s) and its effect)*	Task1: i. Appropriate TAMU contract personnel were contracted already and contract set up has been corrected to purchase equipment. Task 2: ii. Finished burner modifications iii. Began assembling burner iv. Contacted personnel at Amarillo regarding fuels needed for experimentation v. Made 45° injectors for reburn fuel injection vi. Set up instrumentation panel for burner vii. Design of the new combustor for mercury studies in progress. Task 3: Task 4: i. The formulation for implementing the pyrolysis model in the numerical code for mercury and chlorine is done. *ii.* The required changes are made in order to bring back the numerical code in working condition and recently started running. Task 5:

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)*

Proposed activities for month 3 (07/01/2005 – 07/31/2005)

Task 1:

1. Begin the purchase requisition for acquiring equipments.
2. Acquire Texas Lignite fuel and send for ultimate, proximate and ash analyses.
3. Partially composted Diary biomass (DB-PC) will be acquired and sent for ultimate, proximate and ash analyses.
4. Begin training in the use of the TGA (Assuming TGA is delivered before the end of the period).
5. Perform preliminary testing on old samples to complete training (Assuming TGA is delivered before the end of the period).

Task 2:

1. Perform preliminary experiments on NOx reduction studies using the modified set up. Finalize the new combustor design for Hg experiments and start fabrication work.

Task 3:

1. Finalize the date and venue for the pilot scale tests

Task 4:

i. Numerical subroutines/subprograms for the different sub-processes in the reburn process will be initiated. Particularly the subroutine for the volatile matter composition determination for different fuels using the Gibbs Minimization Method shall be completed. The extent of progress will be reported in the next monthly report.

ii. **Mercury modeling**: The new model will include Hg and Cl present in coal along with Carbon, Hydrogen, Oxygen and Nitrogen. The code will be modified to study the behavior of mercury and chlorine and their chemistry.
   - The pyrolysis model for the mercury and chlorine will be implemented.
   - The gas phase reactions between mercury and chlorine will be simulated.

Task 5:

1. Begin the work on the economics of using FB as reburn fuel for NOx reduction.

_____ _____ Date:___*06/07/05*_____

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.