

Characterization and Failure Analysis of Ceramic Filters Utilized for Emission Control During Coal Gasification

Quarterly Report

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The research activities accomplished on the characterization and failure analysis of Ceramic Candle Filters during the first year of the project are as follows:

- Extensive literature survey, directly and indirectly related to the failure analysis of Ceramic Candle Filters was performed. The literature search was done over a period of time and involved the facilities of Prairie View A&M University library, Rice University library, Texas A&M University library and The University Of Houston library, among others. The search was primarily focused on the acquirement of latest journal articles and publications related to the subject. Numerous related articles were also discovered that provided additional information on the status of relevant research work which is going on at present.
- Ceramic filters were ordered from Industrial Filter and Pump Company and received in April, 1995. The shipment included:
One used Silicon Carbide Candle Filter 1.5 meter long 2.5" O.D. 1.5" I.D.; with maximum top flange O.D.
One unused filter with the same dimensions and material structure as the used filter.
Lot broken candle shards, remnants etc.

The samples will be used for permeability measurements, pressure distribution characterization and microscope and SEM analysis.

- A room temperature test facility is being designed and two of six inches (6 inch.) O.D. and ten feet long plastic tubes were designed as filter testing chamber.
- Fabrication of plastic tubes and other pressure sealing parts for pressure testing were completed and brought to PVAMU in June, 1995.
- Tight tolerance were noticed during assembling the set up. This problem was solved within a very short period of time with the help of the machine shop.
- Filter test assembly was assembled and all the valves and hose connections were completed. The set up passed static pressure test and was ready for filter testing.

- The microprocessor based hand held pressure calibrator, ordered in March, 1995 was shipped to PVAMU.
 - The plastic tube was tested for hermeticity with the help of the hand held calibrator and complete hermeticity was verified.
 - The unused filter was placed inside the plastic tube chamber for pressure testing. The test was performed to find out the filter permeability performance at room temperature with different pressures, up to 100 psi. Pressure supply to the filter test chamber was conducted through the outside of the filter. The filter was highly permeable and the pressure calibrator was connected to the inlet port of the chamber with a small pressure inlet opening; no appreciable result was found.
 - Miscellaneous metallographic equipment and supplies were purchased in the month of June, 1995. Most of the supplies are consumables that will be used with metallographic equipment in the Materials Testing Laboratory. Space was acquired for storage and use of the supplies.
 - The second shipment of used filter samples were received from Industrial Filter and Pump Company on June 14, 1995. The shipment included two large sections of a Laycer silicon carbide filter candle which was used at a Coal Gasification Test Facility in Japan. Life cycle history to failure of the filter was provided with this shipment.
 - Trouble shooting and upgrade of an Amray 1610 Turbo Microprocessor Controlled Scanning Electron Microscope was performed and the following presents some of what was done:
 - (i) Installation of new ion pump;
 - (ii) New filament isolation transformer installed;
 - (iii) Emission chamber refitted and cleaned;
 - (iv) Column adjustment performed;
 - (v) Magnification calibrated;
 - (vi) Vacuum system maintenance;
 - (vii) Camera system maintenance;
- Major Operating features of the SEM are: variable 50 - 60 angstrom resolution and attainable magnification up to 400,000X. The SEM is now ready to be used for the

DOE research project.

- A basic training session on the use of the Scanning Electron Microscope was conducted. Three research assistants attended the session and were instructed on the different operating features and maintenance procedures for the SEM by a representative from Amray.
- An Isomet 1000 Precision Saw and a Minimet 1000 Metallographic Polisher are being purchased from BUEHLER Ltd. to add to and upgrade existing Metallographic Equipment at the Materials Testing laboratory at PVAMU. The precision saw has various low deformation sectioning techniques incorporated in its design making it suitable for preparing metallographic samples. The polisher is attractive due to its ease of operation and versatility; the most important feature is its ability to automatically prepare samples without manual involvement.
- Dr. Jianren Zhou, Dr. Ziaul Huque and Dr. Daniel Mei attended the Coal Fired Power System Conference in June, 1995 at METC. All three investigators met with METC managers and Industrial representatives and reported to them the progress of this project that had taken place and future steps that are underway.

The following are future steps for the project:

- Characterization and failure analysis will be performed on the filters
- Mechanical properties of unused filters will be characterized and compared to those of cracked filters.
- A thorough micro structure analysis will be performed on used and unused filters and comparisons made between the two.
- The Scanning Electron Microscope will be used to perform filter failure analysis and characterization.
- PVAMU has decided to modify the connection with different pressure measurement ports bored along the axis of the plastic pipe and also to the outlet of the filter. Because of this change, some modifications will also be needed on the plastic tube. PVAMU will make the change very soon and then the room temperature permeability performance test for both the used and unused filters will be completed.