**COMBUSTION CHARACTERIZATION OF COAL FINES RECOVERED
FROM THE HANDLING PLANT**

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TABLE OF CONTENTS

	Page No
Abstract-----	1
Executive Summary-----	1
Introduction-----	1
Residence	
Time.....	2
Loss	on
Ignition.....	2
Carbon	Conversion
Efficiency.....	3
Results and Discussion-----	3
Conclusion-----	4

ABSTRACT

Combustion test data were analyzed for loss on ignition and carbon conversion efficiency. In addition, analysis were made on residence time for three firing rates at three different locations for each firing rate. The highest carbon conversion efficiency was found to be 99.58 percent, associated with the firing rate of 669,488 Btu/hr at a swirl setting of 0.2. The lowest carbon conversion efficiency was found to be 98.77 percent associated with firing rate of 508,215 Btu/hr at swirl setting of 0.40.

EXECUTIVE SUMMARY

Data obtained during combustion tests were analyzed for residence time, loss on ignition and carbon conversion efficiency. The residence time data revealed that, as the firing rate decreased the residence time increased. This can be attributed to the increase in the feed rate.

The loss on ignition data at three different locations for each firing rate, revealed that the highest percentage of fuel, about 85 percent is burnt during residence time of 0.6 seconds, bottom location.

The carbon conversion efficiency were computed from unburnt carbon in ash for three firing rates at three different swirl settings. The highest carbon conversion efficiency was found to be 99.58 percent for the firing rate of 669,488 Btu/hr.

INTRODUCTION

1. During this reporting period (January 1 - March 31), research activities were focused on :
2. Analysis of residence time data analysis obtained during three firing rates

at three different locations (bottom, middle and top) locations of the combustion chamber.

3. Analysis of LOI (Loss on Ignition) data.

4. Carbon conversion efficiency.

During this period, a paper entitled “Chemistry of Ash Deposits Resulted from Combustion of Coal-water Slurry Fuel,” was presented at Fifth Annual Historically Black Colleges and Universities and other Minority Institutions Program - Energy Research and Development Technology Transfer symposium, in Baton Rouge, Louisiana.

A summary of work performed with respect to the above mentioned topics is presented below:

RESIDENCE TIME

Residence time is the time the particle is resident in the furnace from the time of entry to the time of exit. The residence time is calculated by taking the volumetric flow rate divided by the cross-sectional area of the furnace multiplied by distance to each port. Figure 1. shows the residence time for three firing rates at bottom, middle and top locations of the combustion chamber.

LOSS ON IGNITION

Loss on ignition data represents the percent burnout of all test samples being combusted. These values are recorded during the combustion testing. Table 1. shows the LOI data for three firing rates at bottom middle and top locations of the combustion chamber.

CARBON CONVERSION EFFICIENCY

The percentage of carbon in ash represents the amount of carbon left unburnt in ash after combustion. Table 2. Shows the percentage of carbon in ash and the carbon conversion efficiency for three firing rates at different burner settings.

RESULTS AND DISCUSSION

At highest firing rate of 834,330 Btu/hr, the residence times were found to be 0.59, 1.10 and 1.69 seconds at bottom, middle and top locations respectively. At the lowest firing rate of 508,215 Btu/hr the residence times were 0.90, 1.71 and 2.65 seconds at bottom, middle and top locations respectively. From these numbers it can be concluded that, as the firing rate decreased, the residence time increased. This is due to the fact that, as the fuel feed rate increased the particles moved at faster rates and hence, the residence time is lower.

It is observed from the Table 1., the majority of the fuel is burnt in the bottom location close to the burner, followed by middle and top locations. At the three firing rates, the LOI was found to be in the range of 84-85% at the bottom location.

It is observed that the carbon conversion efficiency for two highest firing rates was greater than 99% and for the lowest firing rate the carbon conversion efficiency was between 98% and 99%.

CONCLUSIONS

1. For the three firing rates, the residence times were found to be about the same at bottom and top locations.
2. The increase in firing rate resulted in the decrease of residence time.
3. At the three firing rates, LOI were found to be in the range of 84-85 percent at bottom location.
4. The two highest firing rates had the highest carbon efficiency of 99 percent.

Figure 1. Residence time for different firing rates at different locations of the combustion

Table 1. Loss on Ignition Data

Feed Rate, lb/hr	140.2			112.5			85.4		
Firing Rate, Btu/hr	834,330			669,488			508,215		
Sampling Location	Bottom	Middle	Top	Bottom	Middle	Top	Bottom	Middle	Top
LOI %	84.1	22.41	6.4	84.78	15.48	1.45	84.89	19.03	3.65

Table 2. Carbon Conversion efficiency

Feed Rate, lb/hr	140.2			112.5			85.4		
Firing Rate, Btu/hr	834,330			669,488			508,215		
Swirl Setting	0.55	0.40	0.2	0.55	0.40	0.2	0.55	0.40	0.2
Carbon in Ash, %	2.83	1.68	1.94	2.20	1.62	1.35	3.36	3.92	3.88
Carbon Conversion Efficiency %	99.12	99.48	99.40	99.32	99.5	99.58	98.96	98.77	98.80