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SUMMARY REPORT OF THE EFFECT OF A FERROUS PICRATE CATALYST ON THE EMISSIONS OF SULFUR DIOXIDE IN OIL FIRED BOILERS

REPORT PREPARED BY UHI CORPORATION
PROVO, UTAH

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ABSTRACT

The following report is a summary of earlier testing conducted at several field locations to determine the effect of a ferrous picrate catalyst (FPC) on the emission levels of sulfur dioxide (SO2) in oil fired boilers. All tests were conducted by Eugene S. Adams, P.E., of Adams Industrial Sales, Charlotte, North Carolina.

INTRODUCTION

Preliminary testing in oil fired boilers documented the ability of a ferrous picrate catalyst to reduce the rate of acid build up and the subsequent acid corrosion of cold end boiler components. These tests prompted UHI Corporation engineers to investigate the possibility of the catalyst having a positive effect on SO2 emissions; since SO2 is an important precursor in the formation of both corrosive internal boiler acid and the serious pollution problem, acid rain.

Mr. Eugene S. Adams conducted the initial SO2 reduction tests in oil fired boilers operating at the Armtex Plant, Mt. Pilot, N.C., Holly Farms, Temperance, Va., and Westpoint Pepperel, Eastown and Clinton, N.C. plants. Later more conclusive tests were conducted with Holly Farms and Dayco Corporation, both located in North Carolina. The first series of tests used a single data point comparison of actual sulfur yield to theoretical sulfur yield at each test site. The second series of tests were multiple data point studies over an extended period of time beginning May 11, 1984, and ending July 12, 1984.

METHODOLOGY

EPA methods 3 and 6 for determining SO2 emissions concentrations were used at all test sites. Along with these recommended procedures, analytical equipment required by the EPA for SO2 testing was also used. The equipment included the following:

Neotronics 022 - CO Analyzer Model PLO 961

IMC Instrument Model 6100 Digital Thermometer

Hays - Republic Model 00612 Orsat

Nutech Model 220 - 200 WM Method "6" Sampling Train

Nutech Model 218 - 200 Integrated Bag Sampler

Nutech Model S - 200 Gas Meter

S.K.C., Inc. Detector Tubes Model 800 - 242

EPA methods 3 and 6 require oil samples be taken and analyzed at each location with each data point or series of data points taken. These samples were taken by Mr. Adams and analyzed for sulfur and BTU content of the oil by Chem Bac Laboratories, Charlotte, NC.

By determining the percent sulfur content of the oil used, the theoretical yield of SO2 by percent can be tabulated using EPA tables. This theoretical number can then be compared to the actual percent SO2 yield recorded during catalyst testing.

RESULTS

The sulfur content of the fuel determines the volume of sulfur emitted from the stack during normal boiler operation. The EPA uses the " percent sulfur in the fuel number " to determine the permissible SO2 level from EPA tables. The actual SO2 yield is important, in that, this number can only vary from the theoretical number if a change in the combustion process occurs.

This study verifies that the addition of the ferrous picrate catalyst created a significant change in the combustion of the #6 fuel oil tested as manifested by the reductions in the actual SO2 yield over the expected theoretical yield.

Tables I and II summarize the data accumulated during testing and make comparisons of the actual to the theoretical SO2 yield. Preliminary single data point testing at four locations showed SO2 reductions ranging from 14% to 31% and a mean reduction of 23.9%. Extended multiple data point tests at three locations document reductions ranging from 4% to 51% with a mean reduction of 30.7%.

CONCLUSION

The addition of the ferrous picrate catalyst to fuel created a change in the combustion process which in turn caused a significant reduction in the emission of SO2 from those oil fired boilers tested.

TABLE I

EFFECT OF FPC CATALYST ON SO2 EMISSIONS
IN OIL FIRED BOILERS (#6)

Site	Sulfur in Oil (wt.%)	Theoretical SO2 Emissions (lbs./MM BTU)	Actual SO2 Emissions (lbs./MM BTU)	% Change
Armtex	2.86	3.16	2.19	- 31
Holly Farms	2.50	2.79	2.04	- 27
Pepperell E	2.27	2.51	1.95	- 22
Pepperell C	2.19	2.42	2.09	- 14
Average	2.46	2.72	2.07	- 23.9

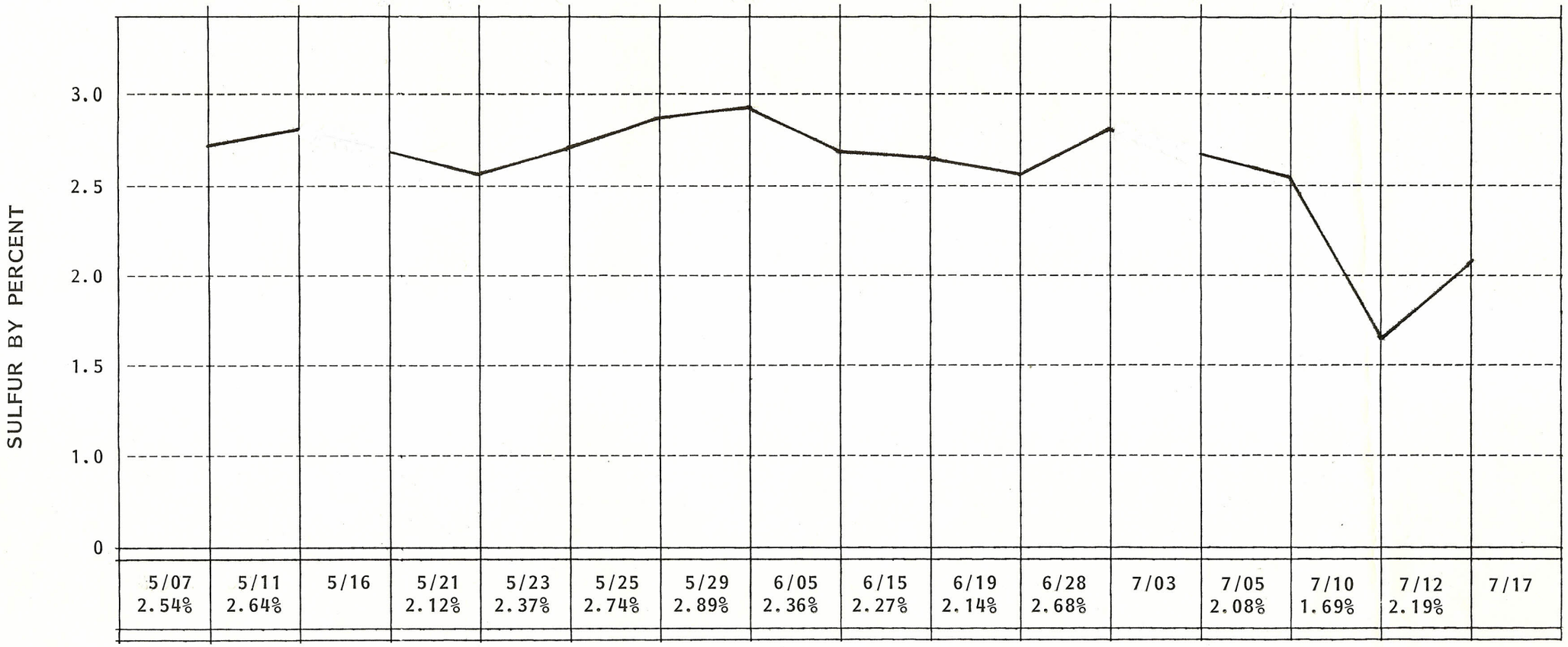
Note: The above are single data points taken at each location.

TABLE II

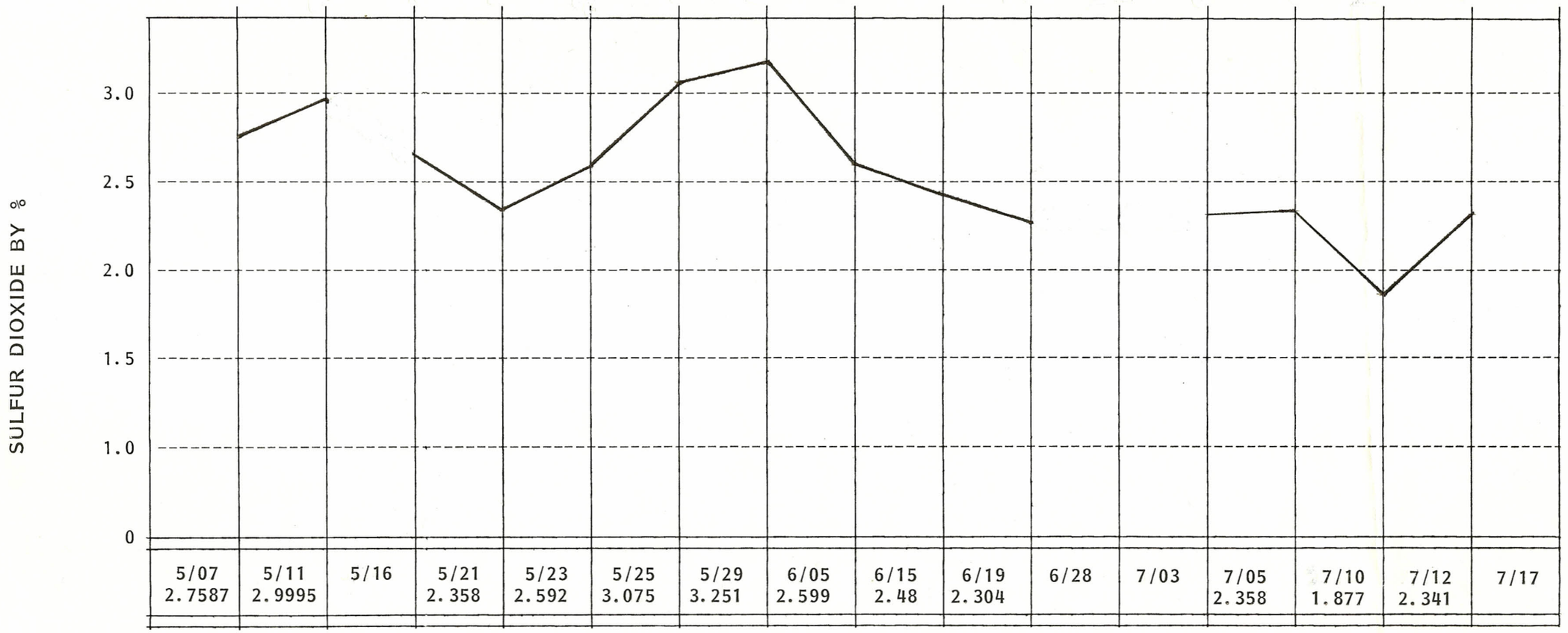
COMPARISON OF SO2 LEVELS
WITH FPC CATALYST (#6)

Date	(% wt.)SULFUR IN OIL	(lbs.SO2/MM BTU) Theoretical Yield	(lbs.SO2/MM BTU) Actual Yield	DIFF.
5/11	2.64	2.999	1.928	-35.7
5/21	2.12	2.358	2.005	-15.0
5/23	2.37	2.592	1.817	-29.9
5/25	2.74	3.075	2.040	-33.7
5/29	2.89	3.237	2.019	-37.6
6/05	2.36	2.599	1.944	-25.2
6/15	2.27	2.480	1.199	-51.2
6/19	2.14	2.304	1.385	-39.9
7/05	2.08	2.358	1.760	-25.4
7/07	2.54	2.758	1.884	-31.7
7/10	1.69	1.877	1.797	- 4.3
7/12	2.19	2.341	1.707	-27.1

PERCENT SULFUR IN OIL



THEORETICAL SULFUR DIOXIDE (SO_2)



ACTUAL SULFUR DIOXIDE (SO_2)