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AIS **Adams Industrial Sales**

ROUTE 7, BOX 712 • MOORESVILLE, NORTH CAROLINA 28115 • 704-663-7785

June 14, 1983

Mr. Carl Lindler
Mobay Chemical
P.O. Box 10288
Charleston, SC 29411

Re: F.P.C.-3 Combustion Fuel Catalyst

Dear Carl,

This is to confirm the completion of the F.P.C.-3 evaluation at your facility, and to report the results, which shows an improvement in the overall operation of your boiler facility. As a result, we feel you will agree that when fuel oil is being burned, it will be to your advantage to continue to use F.P.C.-3, as it is indeed cost-effective, compared to all other additives you have reviewed in the past.

The results of the complete evaluation are as follows:

1. The combustion of oil improved substantially at all load levels, as indicated at the 40,000#/hr load condition, where baseline showed a 4.2% O_2 level, and 10 ppm CO without additive; and yet upon completion, the conditions dropped to 3.1% O_2 levels, at 0 ppm CO.

2. Cleaning of your boiler tubes was accomplished by using F.P.C.-3, as indicated from the reduction in stack temperatures from 520° at 40,000 #/hr, down to 495° at the same load condition. At 60,000 #/hr, there was an even greater improvement, which was originally 585°F that dropped to 525°F, which is attributed to the ability of F.P.C.-3 to remove carbon deposits from boiler tube surfaces.

3. The rate of acid formation was also substantially reduced from the previous baseline data. The reduction was anywhere from 1/2-75% of the original baseline data. This reduction in rate of acid formation indicates, as before, improvement in combustion, but also the elimination of vanadium pentoxide deposits on boiler surfaces.

4. The overall boiler efficiency also improved at two load conditions, as indicated by the computer printout, which is attached. At the 40,000 #/hr load condition, you improved from 81.69% to 82.97% efficiency; and at the 60,000 #/hr load, you improved from 79.37% upto 80.88%, which is between a 1-1 1/2% improvement in the overall boiler efficiency. Please recall that this is before your feedwater economizer system, and does not show the additional boiler efficiency added to the system by means of this equipment.

As compared to many boilers we have already tested, with respect to acid attack, your acid rate of buildup is substantially below that of most of the boilers we have reviewed. This is primarily due to the fact that you have been burning natural gas for an extended period, and as a result, you did not have any significant vanadium pentoxide deposits on your boiler tubing. As time progressed and vanadium pentoxide deposits formed, your rate of acid buildup would have increased substantially, and could have caused deterioration of your economizer systems. As it is now, the rate of acid buildup and vanadium pentoxide formations are under control, and your economizers should have an extended life of an additional 5-10 years without any acid attack problems. We recommend on the smaller Cleaver-Brooks boiler that you run this system entirely in the counter-flow mode for full efficiency of recovery, whether you burn natural gas or oil. This is due to the control of F.P.C.-3 on your rate of acid buildup, so that you are not causing any deterioration, as long as this additive is being used.

During the test procedure, it was observed that your O_2 trim system is not operational and should be updated or removed from service. The current problem is that on increased loads, the air leads to oil, as it is supposed to to prevent a hazardous operating condition. However, on decrease in load, the same condition occurs, and thereby can substantially increase the combustible levels within the boiler and cause not only sooting but a potentially hazardous condition. Other than this area, the boiler appears to be operating very well, and should give you many years of service.

In conclusion, the F.P.C.-3 evaluation was indeed a success, and should be continued in the future, as the economics are indeed there based on fuel savings resulting from F.P.C.-3 being used. We also recommend that a poorer quality of fuel be investigated, if a fuel savings can be obtained from your supplier. As long as the fuel is no higher than 3% sulfur and 600 ppm vanadium, the ratio of 7000:1 will protect your system, and no deterioration will occur. As compared to other magnesium oxide based additives, this is not the case, as you have to change your ratio based on vanadium and sulfur deposits in each fuel load.

Yours truly,

ADAMS INDUSTRIAL SALES

Eugene S. Adams, PE
Representing F.P.C.-3

/dh
Attachments
cc: Mr. Bob Kobelak
Mobay-Pittsburgh, PA

LER EFFICIENCY TEST DATE: 4 19 83

INPUT DATA: MOBAY CHEMICAL CHARLESTON SC BASELINE

STEAM FLOW RATE: #/HR OR % 40000
AMBIENT AND FURNACE INLET TEMP: 101
WET BULB TEMPERATURE: 71
FLUE GAS TEMPERATURE: 520
FLUE GAS O2 CONCENTRATION: 4.2
HHV H1=: 18500

FUEL IN EXHAUST F1: 54.0540541
MOISTURE IN DRY AIR W1 8.44978286
WATER FORMED BY COMBUSTION W2: 57
TOTAL PRODUCTS OF COMBUSTION P1: 975.195684
DRY PRODUCTS OF COMBUSTION P2: 909.745901

CALCULATED LOSSES:

FLUE GAS LOSS: 9.14840478
AIR MOISTURE LOSS: .162861115
COMBUSTION MOISTURE LOSS: 6.99504
RADIATION AND UNACCOUNTED LOSS: 2

EXCESS AIR X1=: 22.818884
BOILER EFFICIENCY: 81.6936941
****

BOILER EFFICIENCY TEST DATE: 5 25 83

INPUT DATA: MOBAY CHEMICAL CHARLESTON SC F.P.C.-3

STEAM FLOW RATE: #/HR OR % 40000
AMBIENT AND FURNACE INLET TEMP: 108
WET BULB TEMPERATURE: 82
FLUE GAS TEMPERATURE: 495
FLUE GAS O2 CONCENTRATION: 3.1
HHV H1=: 18500

FUEL IN EXHAUST F1: 54.0540541
MOISTURE IN DRY AIR W1 15.5745162
WATER FORMED BY COMBUSTION W2: 57
TOTAL PRODUCTS OF COMBUSTION P1: 918.298074
DRY PRODUCTS OF COMBUSTION P2: 845.723558

CALCULATED LOSSES:

FLUE GAS LOSS: 7.85508041
AIR MOISTURE LOSS: .277257538
COMBUSTION MOISTURE LOSS: 6.88959
RADIATION AND UNACCOUNTED LOSS: 2

EXCESS AIR X1=: 15.232536
BOILER EFFICIENCY: 82.9780721
****

EFFICIENCY TEST DATE: 4 19 83

INPUT DATA: MOBAY CHEMICAL CHARLESTON SC BASELINE

STEAM FLOW RATE: #/HR OR % 60000
AMBIENT AND FURNACE INLET TEMP: 101
WET BULB TEMPERATURE: 71
FLUE GAS TEMPERATURE: 585
FLUE GAS O2 CONCENTRATION: 5.2
HHV H1=: 18500

FUEL IN EXHAUST F1: 54.0540541
MOISTURE IN DRY AIR W1 9.00020295
WATER FORMED BY COMBUSTION W2: 57
TOTAL PRODUCTS OF COMBUSTION P1: 1035.19898
DRY PRODUCTS OF COMBUSTION P2: 969.198781

CALCULATED LOSSES:

FLUE GAS LOSS: 11.258213
AIR MOISTURE LOSS: .200380518
COMBUSTION MOISTURE LOSS: 7.16775
RADIATION AND UNACCOUNTED LOSS: 2

EXCESS AIR X1=: 30.819324
BOILER EFFICIENCY: 79.3736565
****

BOILER EFFICIENCY TEST DATE: 5 25 83

INPUT DATA: MOBAY CHEMICAL CHARLESTON SC F.P.C.-3

STEAM FLOW RATE: #/HR OR % 60000
AMBIENT AND FURNACE INLET TEMP: 108
WET BULB TEMPERATURE: 82
FLUE GAS TEMPERATURE: 525
FLUE GAS O2 CONCENTRATION: 5.5
HHV H1=: 18500

FUEL IN EXHAUST F1: 54.0540541
MOISTURE IN DRY AIR W1 18.0332845
WATER FORMED BY COMBUSTION W2: 57
TOTAL PRODUCTS OF COMBUSTION P1: 1054.73735
DRY PRODUCTS OF COMBUSTION P2: 979.70407

CALCULATED LOSSES:

FLUE GAS LOSS: 9.80487833
AIR MOISTURE LOSS: .345914463
COMBUSTION MOISTURE LOSS: 6.96825
RADIATION AND UNACCOUNTED LOSS: 2

EXCESS AIR X1=: 33.42444
BOILER EFFICIENCY: 80.8809572
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AIS **Adams Industrial Sales**

ROUTE 7, BOX 712 • MOORESVILLE, NORTH CAROLINA 28115 • 704-663-7785

June 20, 1983

Mr. Curt Phillips
Cutter Labs
P.O. Box 507
Clayton, NC 27520

Re: F.P.C.-3 Combustion Catalyst Evaluation

Dear Curt,

We are pleased to provide you with this final report and evaluation on the recent study conducted at your plant on F.P.C.-3 Combustion Fuel Catalyst. This product is indeed superior to your previous fuel additive program, as indicated by the following results:

1. Your combustion efficiency improved from 83.05 to 83.95, as the result of F.P.C.-3 removing carbon deposits from your boiler tubes. This is shown on the boiler efficiency computer run (attached) for 5-3 and 5-24. We realize the main data for acid was run on 6-6-83, but due to a control problem the week before, your boiler tubes had become severely sooted, and therefore your stack temperatures were no better - actually, worse - than the original baseline data. The results of combustion improvement are based on the 5-3 and 5-24 data, during which times there were no mechanical upsets to interfere with this evaluation. You will also note that when we first visited your plant, you were able to run 2.1% O_2 levels, while during the balance of the test, we had to run 3.4 to eliminate all combustibles. However, your stack temperatures decreased from 480° down to 430° at the same load conditions. The net result is a savings of almost 1% boiler efficiency.

2. We have also enclosed a curve showing before and after conditions with respect to acid buildup and dewpoint temperatures. Since we used mid-test data for your combustion efficiency, we used this also to demonstrate the overall improvement in the rate of acid formation for the two dates since treatment was performed. You will note that on 5-24, there was a reduction of almost 50% or more in the rate of acid buildup; while on 6-6, the final evaluation showed absolutely no acid formation, as all numbers were zero, indicating that no longer will you have deterioration of any boiler feedwater economizers as a result of acid attack during operation.

3. Due to the reduction in the rate of acid buildup, this also indicates the complete elimination of any formation of vanadium pentoxide deposits within your boiler tubes, which means that if you can keep you controls operational and the carbon deposits are removed, you should find a potential reduction in overall stack temperatures, which will be maintained from year to year, between boiler inspections.

4. As determined by looking at your stack during the test program, as well as reviewing the odor relating to your boiler stack, we have substantially reduced the amount of sulfur emission to the atmosphere and to your surrounding building area. This should eliminate many of the problems pertaining to your air conditioning intakes and stop the acid attack which has been occurring on your cooling tower system located immediately adjacent to your boiler house.

5. Due to the significant improvement in combustion efficiency and operation of the boilers, we recommend that you go to using a poorer quality fuel, if a savings can be obtained from your supplier. As long as the fuel is no higher than 3% sulfur and 600ppm vanadium, F.P.C.-3 at a 7000:1 ratio - will handle the problem and maintain proper system efficiency. This feature alone could save you upto four-five cents per gallon, if purchasing can team up with the right suppliers.

As you can see from the above, F.P.C.-3 has indeed performed as originally described, and has more than paid for itself by the improvement in boiler efficiency. In comparing F.P.C.-3 to other fuel additive programs, which we have conducted this test with, we find that the net difference between the F.P.C.-3 and products such as Drew Chemical, was only $0.37/1000 gallons to treat the system. The biggest advantage you can maintain from this evaluation and continuation is that if, in the future, more economizers are installed, you can reduce your stack temperatures very easily to the 250°F range without concern for acid attack, since there is none. If you could find some colder water for process requirements, you could take it down even further, since there is - as indicated - no acid attack, even as low as 200°F stack temperatures. This can also be noted by inspection of your boiler stacks, which as you will recall, showed a significant improvement from the black sooty condition, to a relatively clean stack where even the elemental sulfur deposits were visible, where in the past they had been covered up. This means we could remove the carbon deposits as far away as 30 feet from the combustion chamber.

In conclusion, F.P.C.-3 has out-performed the previous fuel additive program being used, and this was expected because of the unique properties of our iron-based additive. We are also enclosing acid curves and combustion tests from our other completed test sites, and as you can see, their results are identical to yours in overall improvement of boiler efficiency and elimination of acid attack problems. If upon reviewing the enclosed information, you should have any further questions, please feel free to contact us. Otherwise, we look forward to being of service to you in supplying more fuel additive as needed.

Yours truly,

ADAMS INDUSTRIAL SALES

E S Adams

Eugene S. Adams, PE
Representing F.P.C.-3

/dh

BOILER EFFICIENCY TEST DATE: 5 3 83

INPUT DATA: CUTTER LABS CLAYTON NC BASELINE 400HP BOILER

STEAM FLOW RATE: #/HR OR % 50
AMBIENT AND FURNACE INLET TEMP: 80
WET BULB TEMPERATURE: 68
FLUE GAS TEMPERATURE: 480
FLUE GAS O2 CONCENTRATION: 2.1
HHV H1=: 18500

FUEL IN EXHAUST F1: 54.0540541
MOISTURE IN DRY AIR W1 9.53124938
WATER FORMED BY COMBUSTION W2: 57
TOTAL PRODUCTS OF COMBUSTION P1: 874.851174
DRY PRODUCTS OF COMBUSTION P2: 808.319925

CALCULATED LOSSES:

FLUE GAS LOSS: 7.75987128
AIR MOISTURE LOSS: .175374988
COMBUSTION MOISTURE LOSS: 7.00986001
RADIATION AND UNACCOUNTED LOSS: 2

EXCESS AIR X1=: 9.43961601
BOILER EFFICIENCY: 83.0548938
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BOILER EFFICIENCY TEST DATE: 5 24 83

INPUT DATA: CUTTER LABS CLAYTON NC F.P.C.-3 400HP BOILER

STEAM FLOW RATE: #/HR OR % 50
AMBIENT AND FURNACE INLET TEMP: 90
WET BULB TEMPERATURE: 72
FLUE GAS TEMPERATURE: 430
FLUE GAS O2 CONCENTRATION: 3.4
HHV H1=: 18500

FUEL IN EXHAUST F1: 54.0540541
MOISTURE IN DRY AIR W1 11.012077
WATER FORMED BY COMBUSTION W2: 57
TOTAL PRODUCTS OF COMBUSTION P1: 932.869525
DRY PRODUCTS OF COMBUSTION P2: 864.857447

CALCULATED LOSSES:

FLUE GAS LOSS: 7.05723677
AIR MOISTURE LOSS: .172228885
COMBUSTION MOISTURE LOSS: 6.82176001
RADIATION AND UNACCOUNTED LOSS: 2

EXCESS AIR X1=: 17.175396
BOILER EFFICIENCY: 83.9487744
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