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FOA-55HD™

REPORT

PERFORMANCE REPORT
TOTAL ADDITIVE PACKAGE
SPECIFICALLY DESIGNED FOR
FUEL OIL APPLICATIONS

"Friendly, Experienced, & Dependable"

CONTENTS

FOA-55HD
Fuel Oil Additive

INTRODUCTION

Fuel Oil Additive-55 (FOA-55HD) is a total additive package combining the latest petroleum technology advances for improving fuel oil quality. The additive is composed of ashless, nonmetallic, organic surface active polymeric amine compounds based on nitrogen chemistry.

FOA-55HD is specifically formulated to improve fuel oil atomization and combustion efficiency, retard system sludge, reduce soot and fireside deposits, and inhibit pre-combustion and post-combustion corrosion. FOA-55HD is the only treatment required for fuel oil storage, supply, filtering and burner systems.

The treatment has been used effectively in both light and heavy fuel oil applications with reductions of 3 to 7 percent in fuel oil consumption (cost per pound of steam). The treatment allows boilers and furnaces to be operated more closely to their optimum performance settings to maximize energy utilization and lower overall operating costs.

FOA-55HD exhibits a high tolerance to water and system condensation to help prevent the emulsification of water with fuel oil. By dropping the water to the bottom of the storage tank, many of the problems associated with water in a fuel oil system will be eliminated.

FOA-55HD is readily miscible and will remain in suspension to insure proper protection and stability during long term storage. The antioxidants in FOA-55HD help prevent tank scale and rust deposits inherent with long term fuel oil storage.

FOA-55HD is surface active and will reduce fuel oil surface tension to allow finer atomization and induce more rapid and more complete combustion with lower excess air. The additive compounds are adsorbed by metallic surfaces, and provide a buffer which helps keep oxides from adhering to the surfaces. The additive compounds will cause existing oxide deposits to loosen and flake off or scavenge from the system more readily, thus improving heat transfer and lowering stack losses.

FOA-55HD Fuel Oil Additive Concentrate provides the following functions:

1. Combustion acid neutralizer
2. Nozzle and system cleaner
3. Antioxidant
4. De-emulsifying agent
5. Detergent-dispersant
6. Combustion improver
7. Ashless-non-metallic
8. Fuel oil stabilizer
9. Surfactant

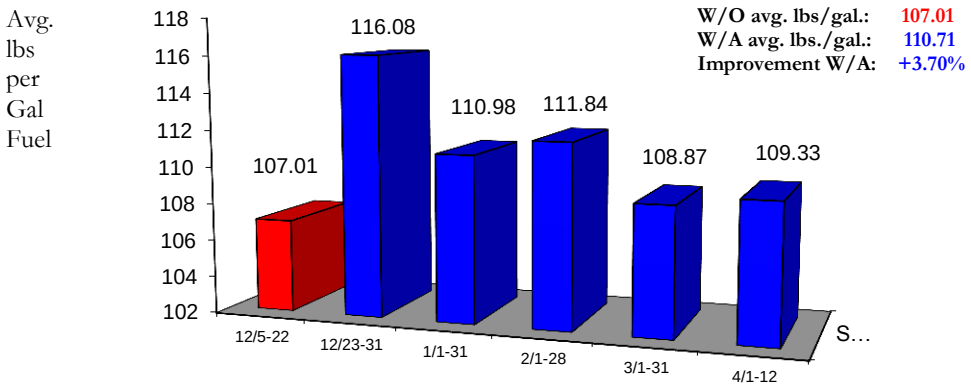
Recommended treatment ratio (FOA-55HD/fuel oil ----- 1/2000-4000.)

FIELD TEST APPLICATION

Steam production improvement with No. 6 fuel oil. The system treated was an industrial foundry and manufacturing plant with two coal converted 100,000 pound per hour boilers. Each boiler has two steam atomized guns. Atomizing steam and oil pressures average approximately 100 and 80 pounds, respectively. Average steam loading for each unit is 75-80,000 pounds per hour per day at 150 psi header pressure. The FOA-55HD was metered into the storage tanks at a 1/4000 ratio. No adjustments to the equipment were made (other than normal daily F/A ratio adjustments for load) during the program with FOA-55HD. Reductions in smoke emissions and cleaner nozzles were noted with FOA-55HD.

Graph 1 shows the improvements in steam production per gallon of fuel oil with the addition of the FOA-55HD treatment in No. 6 fuel oil.

GRAPH 1 - No. 6 Fuel Oil Steam Production Improvement



FIELD TEST APPLICATION

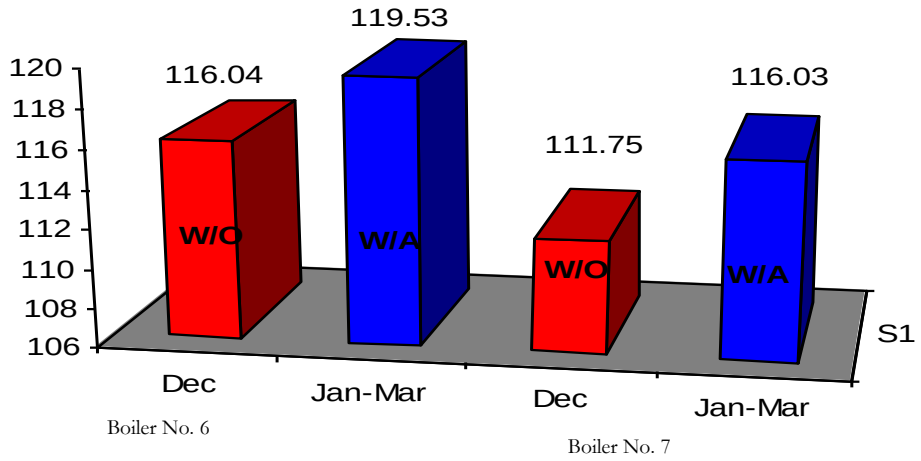
Steam production improvement with No. 2 fuel oil. The system treated was an industrial rubber processing plant with two 50,000 pound per hour air atomized boilers. Each boiler has one gun with average atomizing pressures for air and oil of 55 and 22 pounds, respectively. Average steam loading is 25-35,000 pounds per hour per day per boiler at 185 psi header pressure. The treatment was added directly to storage facilities at a 1/4000 ratio and the steam production improvement recorded as depicted by Graph 2.

The facility normally experiences extreme fuel filter jelling during sub-zero operation due to exposed fuel oil lines from storage to the boiler room. The additive completely eliminated this operating problem during the first winter, and the usual practice of blending No. 1 diesel fuel with the No. 2 fuel oil (at a ratio of 25 and 75 percent, respectively) was not required with the FOA-55HD additive.

GRAPH 2 - No. 2 Fuel Oil Steam Production Improvement

Improvement with FOA-55HD:

Boiler No. 6: 3.01%
Boiler No. 7: 3.83%



FIELD TEST APPLICATION

Furnace application with No. 2 fuel oil. The system treated was an industrial fiberglass continuous fired compound furnace. The FOA-55HD was added at a ratio of 1/4000 to the storage facilities and a six month comparison analysis was made. A direct comparison of fuel oil usage (BTU) per pound of glass compound produced during the program showed a reduction of 4 percent with FOA-55HD. A noticeable improvement was shown in fuel oil nozzle cleanliness with the treated fuel oil. The need for burner nozzle cleaning was reduced from once per each two weeks to once per month with FOA-55HD in the fuel oil.

Combustion efficiency improvement with No. 6 fuel oil. The system treated was a food processing plant with one 65,000 pound per hour boiler and two 45,000 pound per hour boiler units.

The boilers use steam atomized burners and generate 165 psi steam with average boiler loadings of 65 and 70 percent capacity per hour. The FOA-55HD was added directly to each of five 20,000 gallon storage tanks as fuel oil was delivered. Combustion efficiency (stack gas analysis by Bacharach equipment) readings were taken prior to and during the use of FOA-55HD treated fuel oil and the improvements achieved are listed in Chart A.

CHART A - No. 6 Fuel Oil Combustion Efficiency Improvement

Steam Load- lbs./hr.	Stack Temp.	% CO_2	% O_2	Smoke No.	Combustion Efficiency	Improvement With FOA-5HD
(*Results With competitor additive)*						
26,000	3650	9.0	11.0	1	82.40%	-
33,000	3950	10.0	10.0	1-	82.60%	-
38,000	3850	10.6	7.2	0	83.40%	-
41,000	3950	10.0	8.5	0	82.71%	-
43,000	4150	11.0	8.6	1-	83.10%	-
*(Results With **FOA-55HD**)*						
30,000	2900	11.8	9.0	0	86.09%	+ 3.49%
40,000	2850	12.0	8.6	0	87.70%	+ 5.00%
42,000	3100	13.0	7.8	0	87.40%	+ 4.50%
43,000	3150	13.0	6.0	0	87.-30%	+ 4.20%
43,500	3250	12.6	8.0	0	86.72%	+ 3.61%
47,000	3300	13.6	8.0	0	87.20%	+ 4.10%

The improvements recorded were over-and-above the competitor additive being used prior to the program. Smoke emissions were eliminated with the addition of FOA-55HD and the burner nozzles were much cleaner.

Combustion efficiency improvement with No. 2 fuel oil. The system being treated was a chemical processing plant with one 140,000 pound per hour coal converted boiler operating at approximately 55-60 percent capacity. The FOA-55HD was metered into the fuel oil intake line at a ratio of 1/4000 during the program. The boiler was adjusted to the lowest 0_2 possible (3.5 to 4.0 percent) without smoking prior to the addition of FOA-55HD. Stack combustion readings were taken at similar steam loadings prior to and during the use of FOA-55HD treated fuel oil. The improvements achieved are recorded in Chart B.

CHART B No. 2 Fuel Oil Combustion Efficiency Improvement

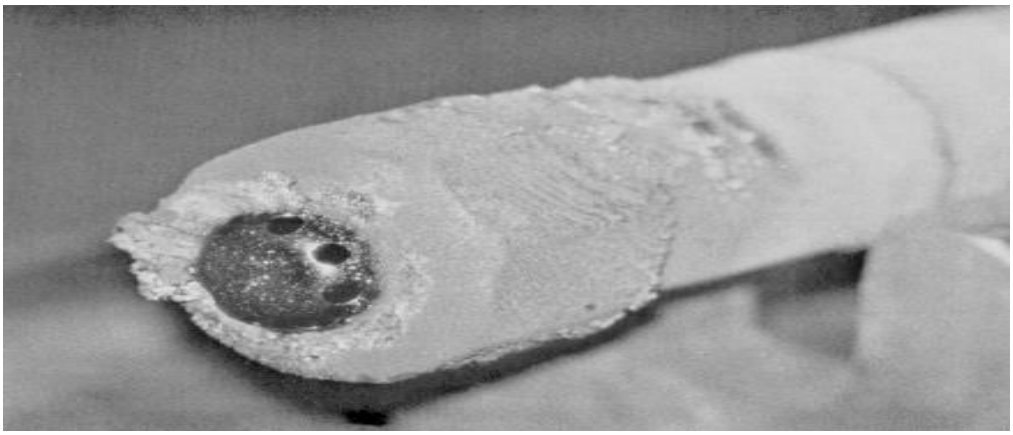
Steam Load- lbs./hr.	Stack Temp.	% CO_2	% O_2	Smoke No.	Combustion Efficiency	Improvement With FOA-5HD
Data Without additive						
36,500	4250	9.5	6.0	1^+	82.90%	-
53,500	4550	10.2	5.0	1^+	82.66%	-
95,000	4250	12.0	4.5	0	82.95%	-
98,000	3800	10.0	3.0	0	83.20%	-
Data With FOA-55HD						
95,000	4150	14.5	3.0	0	84.97%	+ 2.02%
70,000	3500	13.5	3.4	0	85.72%	+ 3.06%
70,000	3400	13.5	2.2	0	86.35%	+ 3.68%

During the second phase of the program the excess air (0_2) was reduced with treated fuel oil being used (ref.: 70,000 lbs./hr. readings). The boiler was operated at 2.2 percent excess air without smoking with FOA-55HD treated fuel oil. This reduction was not possible without the additive according to the plant operator. By reducing the excess air with the use of FOA-55HD additive, the stack losses were kept to an absolute minimum.

FIELD TEST APPLICATION

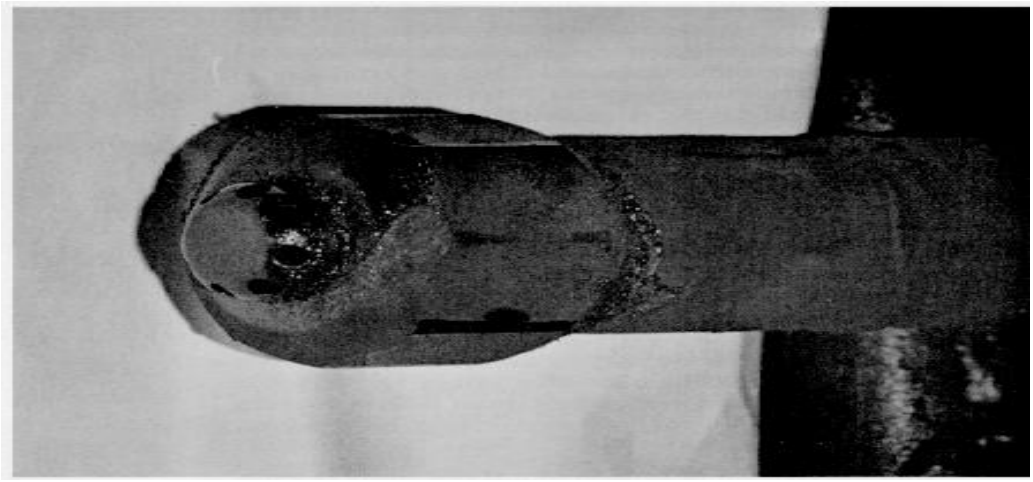
Nozzle cleaning improvement with No. 6 fuel oil. The system treated was an electric utility using high sulfur (2.5%) and high vanadium (180^{+}ppm) fuel oil. The boiler treated was a 600,000 pound per hour nine gun steam atomized boiler generating 950° F superheated 1500 psi steam. The additive was metered into the incoming fuel oil line after the pre-heater at a ratio of 1/4000. Photos were taken prior to and during the use of FOA-55HD at the same number of days on the nozzle (one week after nozzles were changed). Comparison of Photos 1 and 2 clearly shows a substantial reduction in build-up with the use of FOA-55HD treated fuel oil.

PHOTO 1



Without additive-one week fuel oil usage approximately 65,000 gallons No. 6 fuel oil.
Photo not retouched.

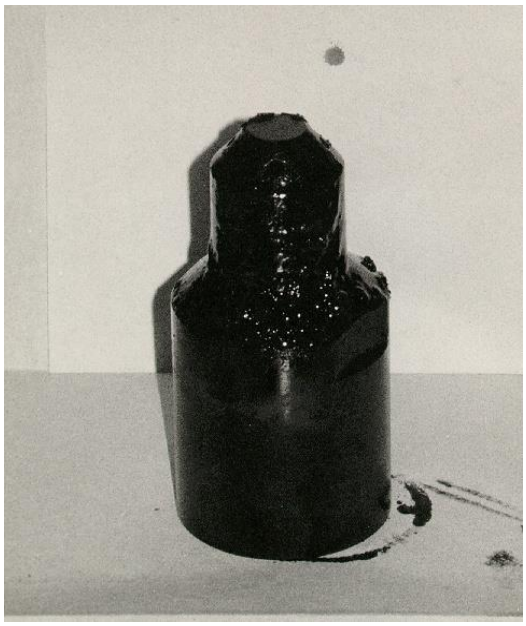
PHOTO 2



With **FOA-55HD** additive-one **week** fuel oil usage approximately 65,000 gallons **No. 6** fuel oil. Photo not retouched.

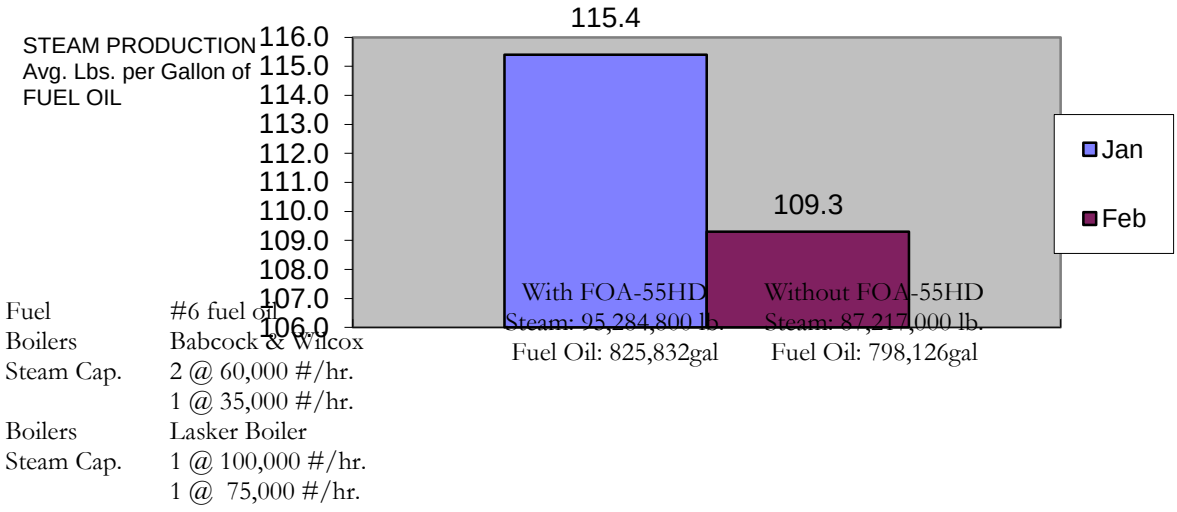
Comparison of efficiency improvements with and without FOA-55HD fuel oil additive

Nozzle without Additive

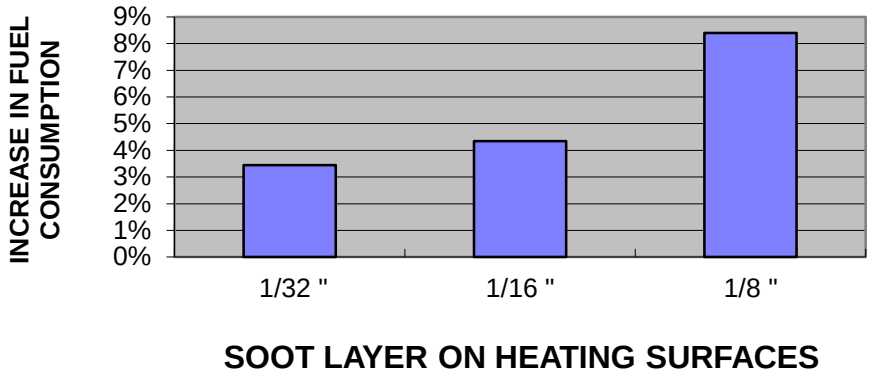


Nozzle with FOA-55HD Additive

The above photos were each taken after 8 hours of oil usage in a 60,000 lb. per hour high-pressure steam boiler. The chart below represent a 30 day comparison of steam production with and without additive in this 60,000 lb. per hour high-pressure steam boiler.



EFFECT OF SOOT ON FUEL CONSUMPTION



The active ingredients of FOA-55HD are based on nitrogen chemistry and are composed of polymeric amine compounds. These compounds are chemically basic and have the capability of neutralizing acids. They also have a high affinity for metal surfaces, an affinity higher than that of vanadium pentoxide and most other metallic oxides. Because of this higher affinity for metals, these compounds become absorbed to metallic surfaces to which they come in contact. Once on the surfaces these compounds keep the oxides from adhering to these surfaces. On surfaces already coated with oxides these compounds find their way between the oxides and the metal surfaces thereby causing the oxides to flake off and scavenge from the system. The mechanism is one of surfactant action.

This action is somewhat different than that of metallic compounds such as magnesium oxide and manganese compounds which react chemically with vanadium. While the metallic compounds act faster than polymeric amines, over the long run these metallics have the disadvantage of building up in an ash deposit. FOA-55HD is ashless and assure cleaner, more efficient systems.

It is a well known fact and well documented in the chemical literature that polymeric amine compounds are effective even at the temperatures experienced in the combustion chambers of internal combustion engines and in boilers and heating equipment.

DEPOSIT REDUCTIONS AND IMPROVEMENTS IN HEAT TRANSFER

The FOA-55HD additive is a highly concentrated surface active compound which is adsorbed by boiler heat transfer surfaces and metallic areas within the system. Once in contact with the system the additive will help to prevent oxide deposits by acting as a buffer between the deposits and the metal surfaces. The additive will find its way between existing deposits and cause a flaking or scavenging-off of those existing deposits. This effect will be noted in improved steam production and heat transfer, and reductions in stack temperatures and improved air preheating efficiencies with FOA-55HD. The additive effectively enhances boiler soot blower operations.

The deposit reduction effects from FOA-55HD treated fuel oil were clearly noted in the previous program with the utility boiler (ref.: "Nozzle cleaning improvement with No. 6 fuel oil" program). In the program period the boiler showed an improvement of 1.4 percent in superheat temperatures and a 10.9 percent improvement in air preheater efficiencies from the reduction of existing oxide deposits present in the respective areas. These improvements in heat transfer resulted in significant reductions in BTU input per kilowatt output at similar untreated load demands.

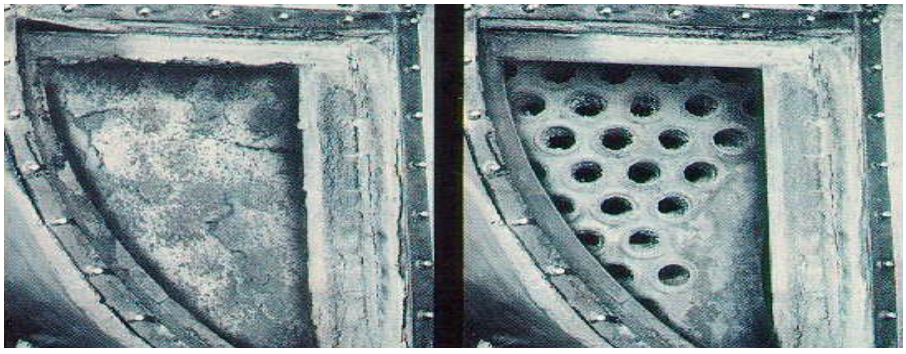
STABILITY

The FOA-55HD helps prevent fuel oil oxidation and the formation of gums, sludges and other catalytic action within fuel oil storage and supply systems. The current practice of blending residuals and distillates for today's market (by fuel oil suppliers) hastens the precipitation of heavy asphaltene compounds which fall out as sludge. Improper blending (or the use of more than one supplier) can cause separation (stratification) of fuel oil layers in storage tanks. The above situations cause system deposits and burning problems (sludge, preheater coking, soot, smoke, nozzle build-up, etc.).

With the addition of FOA-55HD to fuel oils, many of these common occurring problems can be minimized or eliminated during normal operations. The FOA-55HD additive helps reduce system start-up problems following summer periods of alternate fuel use or system shut down.

FOA-55HD
REDUCES BOILER TUBE DEPOSITS UP TO 65%

AMALGAMATED BOILER FUEL ADDITIVES REDUCE DEPOSITS



WITHOUT ADDITIVE

WITH AMALGAMATED ADDITIVE

Amalgamated FOA-55HD additive reduces combustion chamber deposits by as much as 65%. Boiler tube deposits that are formed are friable and easy to remove. Man-hours (boiler downtime hours) required for heat exchanger surface cleaning and associated costs are drastically reduced. The above photographs were taken of a fire tube area showing deposit buildup amounts after similar hours of operation using #2 fuel oil treated with FOA-55HD compared to untreated fuel oil.

SUMMARY

The results of field tests verify the use of FOA-55HD for improving steam production per gallon of fuel oil and maximizing energy conservation. The FOA-55HD treatment also enables reductions in stack heat losses and lower excess air settings with no increases in smoke. The improved atomization ability of both light and heavy fuel oils treated with FOA-55HD allows more complete combustion efficiency and minimum heat losses at the burner.

Cleaner burner nozzles with FOA-55HD treated fuel oil result in improved maintenance benefits, fewer burning related problems, the reduction of boiler tube deposits through replacements.

The use of FOA-55HD Fuel Oil Additive will result in reductions of overall steam production costs and maximum industrial and commercial utilization of energy dollars. Further information about particular fuel oil applications for FOA-55HD can be obtained from the address on this publication.