ALTRET Industries Private Limited

A

R E P O R T

ON

INFLUENCE OF "CMC" 2KSR COMBUSTION MONITORING CHEIMCAL (C.M.C) ® ON IMPROVEMENT IN REDUCTION OF SO2 EMISSION FROM PETCOKE FUEL FIRED 06 TPH, 10.5 kg/cm2, PACKAGE BOILER

AT

TEXTILE PROCESS UNIT, BHILWARA, RAJASTHAN

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CMC™ Per Mole™

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PREFACE

"ALTRET" Industries Pvt. Ltd. is a leading manufacturer of specialty chemicals for Water/ Fire side treatments for precious capital equipment like Boilers, Cooling Towers and process heating equipment like Heat Exchangers, Jacketed Vessels, Compressors, Condensers, Chillers, etc. The company is certified by the most reputed Certification of ISO 9002 from DNV Accredited by Rva.

The company has established the Combustion Monitoring Chemical "CMC" 95 & 2K series of products (Solid Fuel Additives) in High Pressure Water Tube Coal & Lignite Fired Boiler in Process Industry, Captive Power Plants, Thermal Power Plants and Agro-based fuel like rice husk, mustered husk, bagasse in Sugar industries. These solid fuel additives are manufactured in Technical collaboration with technical cell, Regional Engineering College, Surat, headed by Dr. S. A. Channiwala.

Combustion of solid fuels like coal and lignite may be improved through use of suitable fuel additives depending on type of boiler and operating parameters. "**CMC**"
95 & 2K Series of Combustion Monitoring Chemical (C.M.C) is a multi-effect, indigenously developed, combustion-monitoring chemical. This Combustion Monitoring Chemical (C.M.C) possesses several desirable qualities for monitoring the combustion. Few such qualities associated with this additive include the following:

1. *It acts as combustion catalysts and thereby improves combustion efficiency. Loss due to unburnts in ash gets minimized with the use of this chemical.*
2. It permits boiler operation at reduced excess air levels, which in turn reduces stack losses.
3. It acts as anti-fouling agent and thereby keeps heat transfer surface clean and thus improves the overall thermal efficiency of the boiler.
4. It softens the hard clinker and reduces the tendency of hard clinker formation. This property helps in reducing the boiler maintenance, provide ease in cleaning and increase the boiler availability for long term operation.
5. It minimizes the escape of unburnt volatiles with flue gas. This not only reduces the unaccounted losses, but also reduces the emission levels.
6. It also helps in reducing stack emission levels through oxidation and reduction catalyst.
7. It improves the conductivity of ash and thereby improves ESP performance and reduces SPM levels in stack.

CHAPTER 1

INTRODUCTION

The present report summarizes the investigation on the qualitative and quantitative aspect of "CMC" 2KSR Combustion Monitoring Chemical for reducing the SO2 emission of 06 T/hr, 10.5 Kg/cm^2 pressure, PETCOKE FUEL fired boiler at **one of the textile process unit situated at Bhilwara Rajasthan.**

ULTIMATE ANALYSIS OF POTCOKE

Ultimate analysis of the Petcoke is considered are as below; -

PARAMETERS %	Petcoke
CARBON	86.14
HYDROGEN	2.68
OXYGEN	1.39
NITROGEN	0.39
SULPHUR	7.0
ASH	0.78
TOTAL MOISTURE	1.08
G.C.V(Kcal/Kg)	8000

What is (CMC) ™ 2K SR?

"CMC" 2K SR is a specialty combustion monitoring chemical to reduce SOx emission where high Sulphur fuel like lignite & PETCOKE is being used. It combines slag modifying and heat transfer surface cleaning agent. It absorbed the SOx in ash by

selective reduction catalyst and converts it in free flowing ash. It also retards the rate of reaction to formation of SO_3 from SO_2.

In presence of excess air and moisture **"CMC" 2K SR** make an equilibrium to maximum absorbent of SO_2 with alkali earth at convection zone.

$2CaO \downarrow + 2SO_2 \downarrow + O_2$ (Excess air) -----> $2CaSO_4$

History:

Before we get into detailed of **"CMC" 2K SR**, let us scan through the history of the additives. In a broad sense there are two branches of Fuel Additives:

a) **Accelerator**: Most of the fuel additives available in the world are acting as an accelerator, which accelerates the fuel combustion reaction, ultimately resulting in fuel saving for short term. However it has been proved that usage of such accelerators result into large carbon depositions on boiler tubes and consequently resulting in huge deposition of clinkers in boiler in longer usage. Thus the initial saving is not visible in longer period.

b) **Combustion Monitoring Chemical (CMC)™ :** Then after duel effect fire side chemicals introduce as it is having Accelerator and anti clinker characteristic property. But we are proud to be state that ALTRET is the first company to introduce Triple Effect Combustion Monitoring Chemical. Thus the chemical has got the property of catalytic reaction for better burning of fuel. Anti-fouling property to keep the heat transfer surface clean and anti-emission property to reduce the emission causing air pollution.

The oxidation of Sulphur is produce Sulphur dioxide and in presence of excess air it produces to Sulphur trioxide.

$S + O_2 = SO_2$

$SO_2 + ½\ O2 = SO_3$

Here we can reduce the activity of conversation of SO_2 to SO_3 by selective reduction catalytic.

SO_2 to **SO_3** ions.

Now in presence of alkali earth metal like Na & K it leads to pyro-sulphate that is having very low melting points and it make low melting eutectites of ash, which make a coating on the tubes of convection zone.

	Sulphur %	Excess Air Levels				
		0.00%	20.00%	40.00%	60.00%	100.00%
1.	1.00	1988	1646	1405	1225	976
2.	2.00	3544	2987	2581	2273	1834
3.	3.00	5267	4439	3836	3377	2725
4.	4.00	6960	5865	5068	4461	3600
5.	5.00	8622	7265	6277	5525	4458

SO_2 emission (ppm): as a function of Sulphur Content in fuel and Excess Air Levels.

THOUGHT OF THE PROJECT

The lime is usually added to reduce the problem of SOx emissions. It is also believed that it softens the clinker. But the addition of lime is having an endothermic reaction and it leads to formation of slag at convection zone due to impurity available in lime. The system is being installed for lime feed having error and lime feed is not control effectively.

Ca++ ion has a strong affinity towards the SO_2 and forms $CaSO_4$ & thereby reduces SOx in the flue gas as per following reaction:

$$2CaO + 2SO_2 + O_2 \longrightarrow 2CaSO_4$$

This reaction creates local deficiency of O_2 and a reducing atmosphere is created. In the presence of SO2 and lime impurities like silica, alumina, iron

(other trans metal) and alkali metal (Na, K) produces pyrosulphate low melting eutectics, which enhances the clinker-forming tendency.

The usual belief that lime softens the clinker may be due to porosity of high melting point eutectics but in fact addition of lime certainly increases the fouling tendency in presence of SOx and lime's impurities. This will leads to under deposit corrosion at the convection zone.

Also the higher porosity clinker may chock up the unburnt carbon, which will result in high unburnt in Ash and hence higher losses in ash, which will reduce the efficiency of boiler and thereby consume more fuel.

In general, lime addition will certainly reduce SOx emission but at the cost of reduced boiler efficiency, increase fan power consumption & increased fuel consumption along with the increase in tendency of fouling which will further reduce the heat transfer and further resulting in higher fuel consumption.

As per detail given the average 1% of Sulfur produce 1000 ppm sox in stack. Available CaO and MgO in ash is neutralize the SOx and form CaSO4 & MgSO4. As CMC product concept our chemical content Mg and NH4 base chemical which will further precipitate the SO3 in SO4 (IN ASH). In presence of catalyst and NH4 having vapor phase reaction we found reduction in SOx without any mass balancing.

Now addition of lime has following basic reaction

$CaCO3$ -----heat ---------- $CaO + CO2$

$CaO + SO3$ ----------$CaSO4$

So to neutralize the 1% of sulfur required 1% of pure (>95% purity) lime. Now power plant is using over burden lime of mine having purity 40% they need 2.5 to 3 % limes.

Here also the neutralization of SOx is only by alkali elements like Ca, Mg....

Now addition of Altret CMC 2K SR having properties to convert all Oxide available in ash as a zeolite Catalyst by developing SORBSON properties. Hence addition of 200- 300 ppm dosage will reduce more SOx level.

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I N V E S T I G A T I O N S

The boiler experiencing the problem of higher emission of so2 due to high % of Sulphur present in pet coke at one of the textile unit Bhilwara Rajasthan is specifically selected for critical evaluation of Catalytic action of **"CMC" 2KSR combustion** monitoring chemical. The specifications of this boiler are as follows:

2.1 Boiler Specifications.

Name of the manufacturer:		XYZ
Type	:	Smoke Tube.
Rating	:	06 TPH
Working Pressure	:	10.5 kg/cm^2
Fuel	:	Petcoke
Furnace Type	:	FLUIDISED BED
Fuel consumption	:	13 TPD

2.2 Methodology:

The investigations for ascertaining the overall reduction for so2 emission in the boiler **"CMC" 2KSR** Combustion Monitoring Chemical is carried out in four stage stages:

2.2.1 Base Data Generation Without Use of LIME & "CMC" 2KSR Combustion Monitoring Chemical:

In this stage the SO2 emission through stack in flue gas was analysed by Flue gas analyzer along with O2, CO & Temperature of flue gas at boiler out let, was collected for the duration of days at an interval of 1 hour. The other data from the flue gas analyzer like excess air,co2 combustion efficiency also being taken in every hour and all the parameters continuously noted down and the observation table is being prepared.

2.2.2 Data Generation With Use of Lime

In this stage A dosing of 2 kg lime per hour in feeding petcock to the boiler in furnace was introduced. Then we have taken the analysis of flue gas SO2 emission through our analyzer also. The specific attention was given to careful recording at different level of excess air in flue gas, as these parameters are the good indicators of practical emission.

2.2.3 Data Generation With Use of CMC 2KSR

In this stage a dosing of 200 g per ton of pet coke in feeding petcock to the boiler in furnace was introduced. Then we have taken the analysis of flue gas SO2 emission through our analyzer also. The specific attention was given to careful recording at different level of excess air in flue gas, as these parameters are the good indicators of practical emission.

The hourly data so collected is then transformed into per day average data. This data not only formed the base data for comparison but provided sufficient insight on the actual operation and performance of the boiler and plant with use of CMC 2KSR & Lime.

2.2.4 Data Generation With Use of CMC 2KSR & LIME

In this stage A dosing of 200 g per ton of pet coke & 2kg lime per hour in feeding petcock to the boiler in furnace was introduced. Then we have taken the analysis of flue gas SO2 emission through our analyzer also. The specific attention was given to careful recording at different level of excess air in flue gas, as these parameters are the good indicators of practical emission.

CHAPTER 3

RESULTS AND DISCUSSIONS

The results of this investigation are presented in tabular form and the complete observations are presented in this chapter.

The salient features of these results are as follows:-

1) Average reduction in SO2 level clearly signifies the Catalytic Combustion characteristics of "**CMC**" 2KSR. Because SO2 gets converted in SO4 & some SO2 is absorbed by Zeolite catalyst prepared by CMC 2kSR with alkali present in lime & petcoke ash.

2) We have achieved very good reduction in SO2 level in range of 80-90 % because of higher excess air level in flue gas during addition of chemical & lime. So we will have to reduce excess air & increase lime consumption up to 5% for energy conservation & energy saving measures to contribute in national saving.

"Outer layer of ash material enrich with ultra-disperse mineral phase removed from the surface of Ceno-sphere generation stage due to combustible gases absorbed because of Altret CMC product . Means Altret CMC product generate modification of Ceno-sphere material which act as a zeolite catalyst and absorbed ACIDIC gas (SOx) by Oxides available in Ash ultimately reduce the emission of SOx from stack." So ash becomes more SORPTION (Action of both absorption and adsorption) taking place simultaneously for SOx & Acidic Combustibles Gases along with antifouling characteristics with Altret CMC Treatment.

By addition of Altret CMC product we could get the following observations also if we had analyzed: -

3) The conversion of porous ash confirms the process of development of zeolite catalyst.
4) % of SO4 increase in ash during the chemical addition confirms the conversion of high melting ash eutectic and reduction of SO3 at stack.

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FLUE GAS ANALYSIS ON PETCOKE FIRED PACKAGE BOILER WITHOUT CMC 2KSR & LIME										
DATE	TIME	CO	S.TEMP	A.TEMP	CO2	Efficiency	EA	SO2	NO	O2
13/06/2009	5 P:M	1230	150	42	8.4	86,3	105	3064	183	11.5
13/06/2009	6 P:M	1124	146	43	8.6	87.9	102	3075	257	11.2
27/02/2009	2 P:M	2089	169	34.7	17.3	94.3	19.4	3560	745	3.3
27/02/2009	3 P:M	3543	169	35.6	18.7	94.8	9.4	4200	645	1.9
01/04/2009	11:30	2933	99	29	10	87.1	77	2684	728	9.2
01/04/2009	12.15	1296	102	36	8.5	86.4	106	2419	899	11
AVERAGE		2036	139.167	36.717	11.92	90.1	69.8	3167	576	8.01

FLUE GAS ANALYSIS ON PETCOKE FIRED PACKAGE BOILER WITH LIME @1% ONLY										
DATE	TIME	CO	S.TEMP	A.TEMP	CO2	Efficiency	EA	SO2	NO	O2
01/04/2009	1:00 PM	2790	103	32	8.7	86.1	100	663	448	10.7
	2:30	552	105	34	8	85.4	119	360	326	11.6
	3:00	946	106	33	6.8	83.7	156	255	288	12.9
	4:00	1361	101	33	4	77.9	314	329	256	16.2
	4:30	494	140	33	7.6	93.6	130	197	277	12
	5:30	1992	100	34	7.8	85.8	125	511	310	11.8
AVG.		1356	109.167	33.167	7.15	85.41667	157	385.8	318	12.53

FLUE GAS ANALYSIS ON PETCOKE FIRED PACKAGE BOILER WITH CMC 2KSR										
DATE	TIME	CO	S. TEMP.	A.TEMP	CO2	Efficiency	EA	SO2	NO	O2
02/04/2009	9:30	551	108	28	4.2	76.9	282	433	229	15.7
	10:30	51	105	30	5.5	80.8	217	192	247	14.5
	11:30	1350	101	32	4.6	79.5	272	416	259	15.5
	12:15	1696	102	32	4.9	80.4	252	469	318	15.2
AVERAGE		912	104	30.5	4.8	79.4	256	377.5	263	15.22

FLUE GAS ANALYSIS ON PETCOKE FIRED PACKAGE BOILER WITH CMC 2KSR&LIME@1%										
DATE	TIME	CO	FG TEMP.	A.TEMP	CO2	Efficiency	EA	SO2	NO	O2
02/04/2009	1:00	1268	102	34	3.9	77.3	326	206	253	16.4
	2:30	1210	102	23	2.5	67.2	465	323	246	18.6
	3:00	1181	105	33	2.2	67.2	495	247	213	18.3
	4:00	614	99	30	2.6	67.2	351	85	152	19
	4:30	1337	102	31	6.7	83.8	160	267	297	13.1
	5:30	1209	105	31	5.8	81.8	197	142	186	14
AVERAGE		1137	102.5	30.333	3.95	74.08333	332	211.7	225	16.56

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FLUE GAS ANALYSIS ON PETCOKE FIRED THERMIC FLUID HEATER WITHOUT CMC2KSR&LIME										
DATE	TIME	CO	S. TEMP	A.TEMP	CO2	Efficiency	EA	SO2	NO	O2
27/02/2009	4:00	94	130	35.1	12.5	90.2	60.7	2750	430	7.5
01/04/2009	11:45	49	120	34	5.5	79.1	215	290	336	14.4
	12:10	122	116	36	6.4	82	172	241	366	13.4
	1:00	63	122	34	5	77.3	244	117	291	15
AVERAGE		82	122	34.775	7.35	82.15	173	849.5	356	12.57

CHAPTER 4

C O N C L U S I O N S

The results of present investigations to study the influence of "**CMC**" 2KSR Combustion Monitoring Chemical on boiler performance, Reduction of SO2 in flue gas and other anti-emission characteristics of petcoke fuel fired AFBC boiler, at Bhilwara, leads to the following conclusions:

1. General operating parameters i.e. load, main steam pressure and main steam temperature of the boiler is maintained well within the normal operating range during both the stages of investigations.

2. The SO2 level in stack is reduced by 93 % (from 3167 ppm to 211 ppm), during usage of 1% lime & 200 ppm 2KSR. This reduction in SO2 level signifies strong catalytic effect of "**CMC**"2K series of Combustion Monitoring Chemical.

3. The SO2 level in stack is reduced by 87 % (from 3167 ppm to 385 ppm), during usage of 1% lime only. This reduction in SO2 level signifies lime capacity to reduce So2 level.
4. The SO2 level in stack is reduced by 88 % (from 3167 ppm to 385 ppm), during usage of 2k SR @ 200 ppm only & no lime. This reduction in SO2 level signifies catalytic effect of "**CMC**"2K series of Combustion Monitoring Chemical.

If we consider bhilwara market – In this market 100% petcock is being used which contain very less ash, so only chemical addition will not help to reduce the SOX. In that case we need minimum 5-6 % lime feeding along with altret cmc 2k SR @ 150- 200 PPM dosage level.

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L I M I T A T I O N S

Perfection is divine. No claim can be made about perfection. Few of the limitations of these investigations are summarized below:

All the results presented in this report are based on available condition of boiler and flue gas analysis. No counter check on the accuracy of this data is available due to both time & site limitations.

The result and conclusion of the present study are based on four term trials. One without and 3 with **"CMC" 2KSR & LIME** Combustion Monitoring Chemical. The better results can be achieved at the continuous dosing with the right quantity dosing through use of chemical doser. SO2 level can also be reduced more if we are able to install automatic dosing system for Lime & Additive. Their was also the change in the air supply which causes the variation in the SO2 level at stack of the boiler due to change in the O2.

If we will able get So2 emission data on line than we can achieve more authentic data