DOSE THE RIGHT AMOUNT OF CHEMICALS

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Recently I had come across a case of erratic chemical dosing and boiler water pH dipping below 7.5. It can happen on many occasions.

1. When we base blow down on silica in steam, we may not be able to make up the phosphate level suitably.
2. When we try intermittent blow down, there is a heavy drain of boiler water & phosphate. We will not be able to make up for the drained phosphate with regular dosage rates of chemicals.
3. During start up and during very high load variations, chemical make up may not be sufficient.
4. When there is a time lag between analysis and dosage setting, the chemical level would vary heavily.
5. When the deaerator water temperature is low, the boiler water pH may get upset.
6. When the condensate contamination is possible, then again we may not able to main boiler water chemistry.

When there are several reasons for the boiler water chemistry upset, we need to know how much we need to dose to bring back normalcy. We need to know the fundamentals of chemical dosing calculations. The calculation sheet given in this paper briefs how to calculate the chemical requirement. Instead of looking at the water sample results and then correcting the dosage we can decide how much is to be dosed. If the chemical dosing pump is a limitation, then % dilution can be changed for some time to bring back to normalcy. This calculation is for the boilers where the basic chemicals are used. The calculations will however be similar for proprietary chemical as well. Knowing the water volume in boiler is necessary to decide the dump dosage of chemical during upsets.

WATCH THE EFFECTIVENESS OF CHEMICAL DOSING!

Many boiler users leave the water chemistry management to chemical supplier. The dosage practices are decided by the chemical suppliers. But then how to ensure that the chemicals are protecting the boiler? The best way is to inspect the wetted surfaces of the boiler. In Shell type boiler it is rather easy to see the tubes for scale or pitting. But in water tube boiler, the steam drum only speaks. The best way is to open the steam drum and take a wipe of the drum internal surface with your palm. Generally the water tube boiler is fed with well treated water. Hence scale related problems are not experienced. However the corrosion of economizer / boiler could be a serious problem. The presence of loose reddish powder indicates the boiler is corroding. Presence of grey powder indicates the economizer / pre-boiler system corrosion.

LP / HP CHEMICAL DOSING CALCULATIONS

INPUTS

Steam generation rate Nett =	10000	kg / hr
TDS in feed water =	0.1	ppm
TDS permitted in boiler water =	25	ppm
Oxygen in feed water =	0.02	ppm
Oxygen permitted in feed water =	0.002	ppm
Residual phosphate level in boiler water =	4	ppm
Concentration of phosphate solution =	0.3	gm / 100 ml
Residual sulphite in feed water =	15	ppm
Concentration of sulphite solution =	0.04	gm / 100 ml
Residual Hydrazine in Feed water =	0.02	ppm
Concentration of hydrazine solution =	35	%

HP CHEMICAL DOSING CALCULATION

Chemical Dosed in HP Dosing System = **TRI SODIUM PHOSPHATE**
Maximum steam generation capacity of boiler = 10000 kg /hr
TDS in feedwater = 0.1ppm
TDS permitted in Boiler water = 25 ppm
Percentage blow down = 100 x 0.1 / (25-0.1)
= 0.4 %
Actual blow down rate = 10000 x 0.4/100 kg/ hr
= 40 kg/hr
Recommended phosphate ppm in boiler water = 4 ppm
Loss of phosphate in blow down water = 4 x 40 / 1000 g / hr
= 0.16 gm / hr
Loss of TSP in blow down water = 0.16 x 4
= 0.64 gm/h
Tri sodium phosphate consumption per day = 0.64 x 24 / 1000 kg / day
= **0.01536 kg / day**

LP CHEMICAL DOSING CALCULATION

Chemical dosed = **SODIUM SULPHITE**
Maximum steam generation capacity of boiler = 10000 kg / hr
Oxygen in feedwater = 0.02 ppm
Required oxygen level in feed water = 0.002 ppm
Oxygen to be removed = 0.02 - 0.002 x 10000 x 0.000001 kg / hr
= 0.00018 kg / hr
Oxygen to be removed in moles per hr = 0.00018 / 32
= 0.000005625 kg / hr
Sulphite required in moles per hr = 2 x 0.000005625
= 1E-05
Sulphite required in gms per hr = molecular wt (Na2SO3)x moles/h
= {1000x[(2X23)+ (32)+(3x16)]} x0.00001125gm/hr
= 1.4175 gm / hr
Concentration of sodium sulphite solution = 0.04 gm / 100 ml
Rate of dosing = 100 x 1.4175 / 0.04 ml /hr
= 3543.75 ml / hr
Sodium sulphite consumption per day = (1.4175 x (24 / 1000)) kg / day

= **0.034 Kg / Day**

LP CHEMICAL DOSING CALCULATION

Chemical dosed	=	**HYDRAZINE**
Maximum steam generation capacity of boiler	=	10000 kg / hr
Oxygen in feedwater after deaeration @105 deg C	=	0.02 ppm
Required oxygen level in feed water	=	0.002 ppm
Oxygen to be removed	=	0.02 - 0.002 ppm
	=	0.018 ppm
Hydrazine reqd (30 times depending on reaction kinetics)	=	30 x 0.018 ppm
	=	0.54 ppm
Residual hydrazine to be kept	=	0.02ppm
Total hydrazine required	=	0.54 + 0.02 ppm
	=	0.56 ppm
Total hydrazine required in kg/kg of evaporation	=	0.56 x 0.000001 kg / kg
	=	0.00000056 kg / kg
Hydrazine required per hour	=	10000 x 0.00000056 kg / hr
	=	0.0056 kg / hr
Concentration of hydrazine solution	=	35%
Hydrazine to be dosed @35% conc	=	0.0056x100 / 35 kg / hr
	=	0.016kg / hr
Hydrazine consumption per day	=	0.01600x 24 kg / day
	=	**0.384 kg / day**