

Advances in boiler feed water treatment towards energy conservation in paper industries

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Introduction

With ever increasing cost of paper, with demand far exceeding supply, the need of the hour is total energy management. Steam cost could be contained by increasing thermal efficiency of the boilers and through usage of low grade plant wastes in place of higher cost fossil fuels. Of late, there is a growing awareness towards maintaining high standards in the quality of (a) feed water used in steam generators and (b) steam used in process as well as power generation. The present article dwells on the improved steam economy achieved by the selective usage of polyamine based multi-component products.

The selective usage of polyamines be it in the boiler as additive to feed water or as carryover in steam for improved steam economy in process are detailed in this paper.

Polyamines

The speciality of amino-compounds are detailed as under :—

Amine	Characteristics
— Aliphatic film forming amine :—	Basic protection to metal surface
— Volatile neutralising amine :—	Protection to ingress of CO ₂ both in boiler and post-boiler regions
— Long chained dispersant :—	Extremely effective dispersing agent to increasing salts and silica

Basically the additive is an effective corrosion and scale control agent and even in microquantities in feed water would relate to increased heat transfer not only in the steam generator section but also in the dryer and evaporator areas of the process.

Boiler internal water conditioning with polyamine

The conventional dosing chemicals in low pressure section had been dispensed with. This has paved the way for continued usage of polyamine based reagent in low pressure system ahead of deaerator (Fig. 1). The dosage is restricted to 2.5 ppm in the boiler water and 5 ppm (max.) in condensate return to the deaerator.

The merits of using the multi-component polyamine product to boiler water are summarised in Table 1.

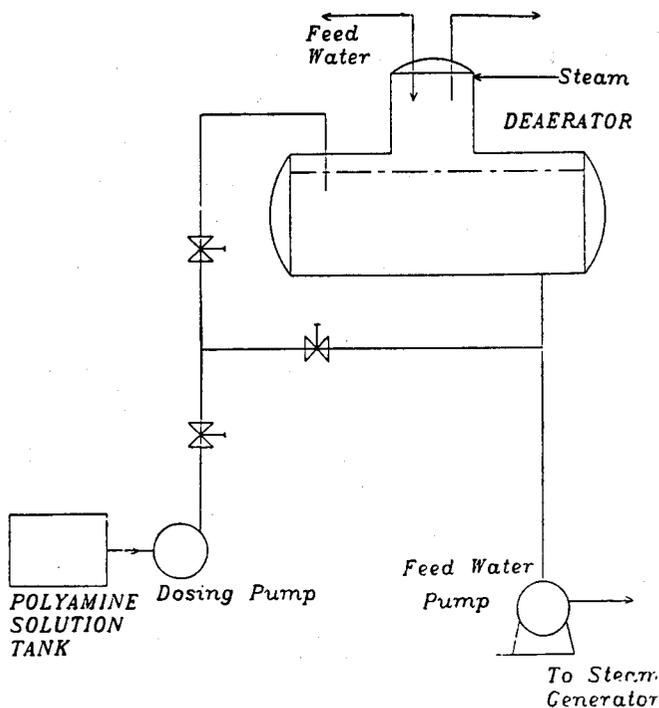
Paper plants which have progressive outlook towards adoption of advanced energy conservation measures are now seriously considering implementation of amino compounds as feed water conditioning agent and restricting the phosphate dosing to a bare minimum. With polyamine feed water treatment as L.P. dosing agent, following benefits accrue:—

*Blow-down reduction

Blowdown quantity which had been earlier around 3-5% had dropped drastically to a bare minimum. Increase in blowdown reduction could be as high as 90%. This results in a saving of ~1% in fuel consumption. This includes D. M. water saving to the tune of 3%. Effect of polyamine on the conductivity of water has been shown in Fig. 2 (a).

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FEEED WATER CONDITIONING SCHEME



(Fig. 1)

TABLE-1

Merits of usage of polyamine compound to boiler feed water

1. Ease of control with single product for dosage and that to be added in low pressure system i.e. to make-up water.
2. Assures total protection to all moist surfaces in the boiler-steam system.
3. Being organic in nature, does not produce salt nor result in increase in TDS.
Blowdown reduction is as high as 80 - 90% resulting fuel and DM water saving.
4. Acts as a dispersant, scale is non-adherent to the heat transfer walls.
5. Heat transfer in boiler increases by 2 to 5%, as no insulating oxides are present.
6. The chemical is devoid of sodium and hence hard silicate deposits on turbine blades are eliminated.
7. Improves longevity of the boiler pressure part because of corrosion inhibition.

SODA RECOVERY BOILER

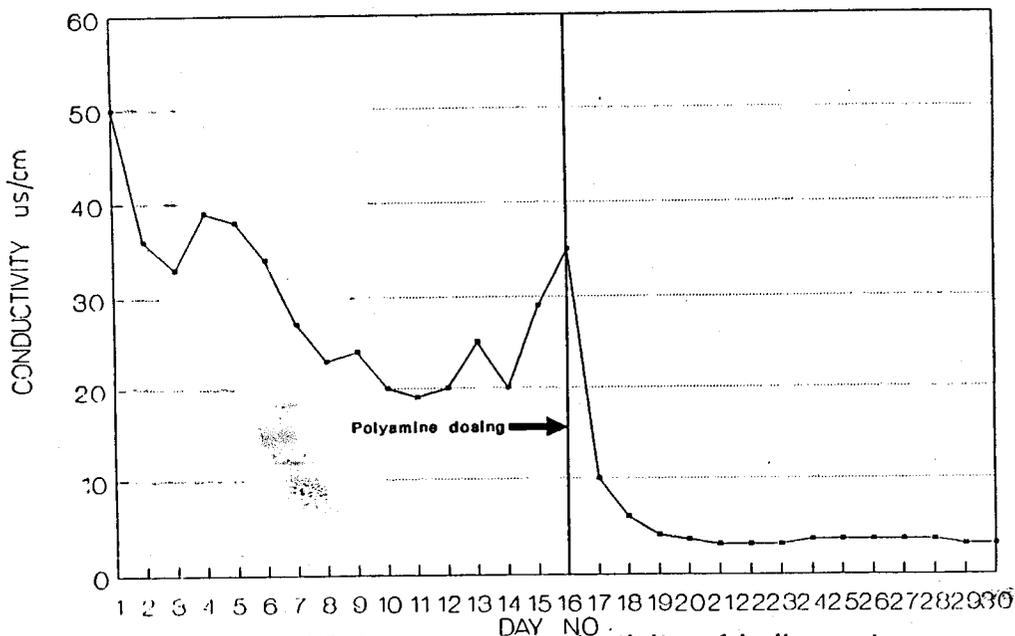


Fig 2a Effect of Polyamine on conductivity of boiler water

*Reduction in TDS and SiO₂ to significant levels.

*Carryover of salts as also SiO₂ in steam are minimal, thus enhancing power generation capacity as also longevity of the turbo-generator. Fig. 2 (b) illustrates the effect of polyamine dosing on silica in boiler water, and it is evident that silica content goes down with it. Tamil Nadu Newsprint & Papers Ltd (TNPL) have resorted to polyamine based multi-component as internal feed water conditioning agent and had derived all the benefits outlined above.

Heat transfer enhancement in drying machines and other heat exchangers through usage of polyamine based reagent.

Steam is allowed inside the horizontal drying cylinder of the paper machine. Steam condenses on the inside of the heat exchanger and heat is transferred to the wet paper passing over the cylinder exterior. The primary objective of the dryer is to evaporate

moisture from the sheet and remove it from the paper making area, thus increasing the dryness of paper continuous. Scoop for removal or syphon for ejection of condensate is recommended for swift removal of condensate, thus ensuring absence of insulating barrier resulting in higher heat exchange.

Normally the mode of condensation of steam is filmwise and a layer of iron oxide as thin scale forms on the surface interior. Both these aspects impede heat transfer.

Through the dosage of polyamine based corrosion inhibitor in feed water, the amino product in traces gets vaporised along with steam and then condense on the walls of the drying cylinder. The drying surface is cleaned off iron oxides.

The mode of condensation changes to dropwise due to non-wettable film of polyamine. Heat transfer is increased considerably to the tune of 10%-15%. With significant increase in heat transfer, the drying

SODA RECOVERY BOILER

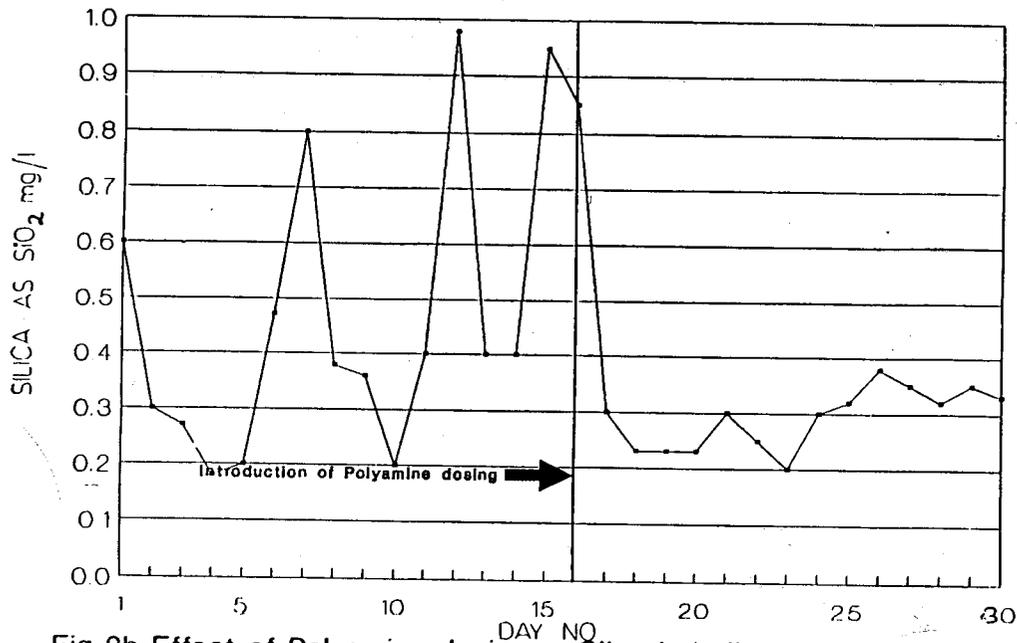


Fig 2b Effect of Polyamine dosing on Silca in boiler water

TABLE-2

Advantages of usage of polyamine compound in process side

Feature	Benefit
<ul style="list-style-type: none"> Removes Fe_2O_3 from the coating of $FeO + Fe_2O_3 + Fe_3O_4$. Through this, even $FeO + Fe_3O_4$ also get removed 	<p>Clean metal atmosphere (no insulating FeO layer) with Fe_3O_4 layer is now exposed.</p> <p>Heat transfer efficacy is higher.</p>
<ul style="list-style-type: none"> Mode of condensation during drying operation changes from filmwise to dropwise. 	<p>Heat transfer is enhanced to the tune of 10-15%.</p>
<ul style="list-style-type: none"> Product form film even on non-ferrous surfaces. 	<p>Admiralty brass instead of stainless steel can be used which improves heat transfer.</p>

capacity on existing dryer would be increased by as much as 15%. This aspect is brought out clearly through a case study (illustrated in Table 2) of a running Finnish Paper Plant, where through the usage of polyamine reagent in boiler feed water, the overall heat transfer coefficient in paper machines had increased by 12%, (Fig 3) thereby paper production capacity had gone up as also the longevity of the equipment

was enhanced. The advantages of using polyamine based reagent are summarised in Table - 2.

Conclusions

From the above, the following conclusions are arrived at supporting the usage of polyamine based reagent for feed water treatment :-

- Reduction in scaling and iron oxide formation on heat transfer surfaces.
- Reduced boiler blow-down
- Saving in fuel consumption
- Increased heat transfer due to change of mode of condensation in drying cylinders of paper machine.
- Increase in turbine efficiency and availability.
- Reduction in corrosion, thereby increasing longevity of the equipments.

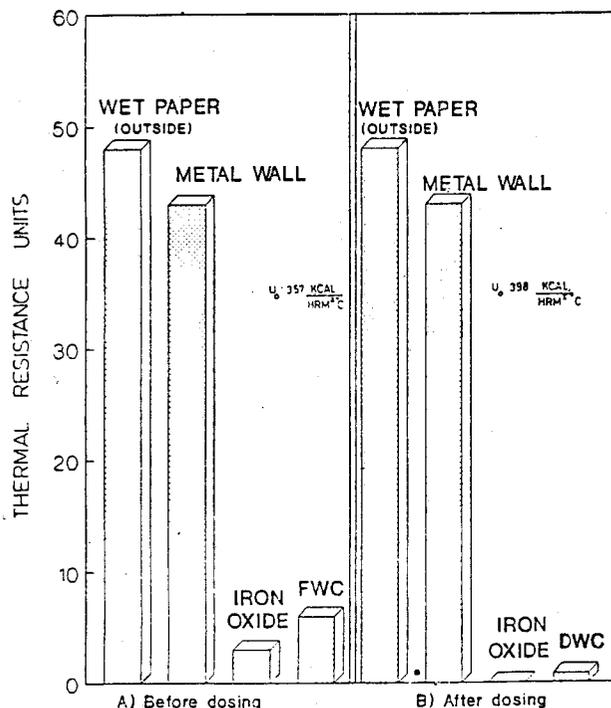


Fig.3 Improvement in heat exchange efficiency of drying cylinder in presence of polyamine in steam

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