Energy Focus

Energy efficiency - the challenge of the 1990s

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Hospital cuts chemical and energy costs with new magnetic feed water treatment

A boiler feed water treatment system which relies on magnetics only and does away with the need for chemicals sounds almost too good to be true.

The first reaction by the highly experienced Chief Engineer at Sydney Hospital, Des Phillips, was to discount any possibility of treating feed water by strapping a couple of magnetic devices to the inlet pipe.

"I did not believe that it would be possible for the magnetic devices to carry out the claims being made for them" Des said, "but after having them in operation on three different applications since 1987 I am finally convinced that they work. The results have far exceeded my expectations".

"I have not kept figures on our electricity savings because there are too many variables with other changes that have taken place at the Hospital but I know that we are saving money on our electricity bills because the boiler heat transfer surfaces are cleaner".

"I have been surprised to find heat transfer surfaces in the boilers fitted with the magnetic devices so free of scale and sediment they looked as if they had been brush cleaned."

Assistant Engineer Chris Foulstone said the hospital is saving about $2500 a year on chemicals as well as saving electricity.

He said the magnetic devices were expected to have an indefinite working life.

"The only stipulation the suppliers make on the installation of the magnets is that they should not be closer that 3m to an induction motor," Chris said.

"When we moved our magnets away from the feed water pump it certainly improved their effectiveness.

"The results we have achieved so far have been satisfactory and we are thinking of installing the magnets on our evaporative cooling towers."

The Hospital has a bank of four 80kW Lucas electric steam boilers supplying process and heating steam. The four boilers are unattended and fully automatic and were being fed chemically treated feed water.

In 1987 one of the boilers was cleaned and inspected and the

Continued next page

Sydney Hospital

ap

IN THIS ISSUE......

THE NEW SOUTH WALES GOVERNMENT
Putting people first by managing better

Department of Minerals and Energy

From page 2.

magnets were installed. **The chemical treatment to the boiler feed water was turned off.**

After six months the boiler was inspected and some rust-like deposits were found on the heating surface and the electric elements. It was decided to move the magnets further along the feed water pipe away from the electric feed water motor.

When the boiler was inspected after a further 12 months the heating surfaces and the electric elements were as clean as those on the boilers being chemically treated and there was no pitting or damage to the boiler surfaces or to the ancillary fittings.

As well as saving on the cost of chemicals the boilers fitted with magnets require fewer blow downs to keep them clean.

An electric Athertons Cyclomatic steriliser has been fitted with the magnets with very satisfactory results.

The steriliser had not previously been fitted with water treatment equipment and at each annual inspection four to six kilograms of sludge were removed from the boiler heating surfaces.

Since the magnetic devices have been installed the heating surfaces in the sterliser have stayed free from scale and sediment and the energy efficiency of the unit has improved.

The magnets have also been fitted to an Hitachl electron microscope. The microscope was cooled by water passing through a bank of two. five micron filters. Before the magnets were installed the filters had to be changed at fortnightly and sometimes even weekly intervals because the build up of foreign matter in the filters caused the water pressure to the microscope to drop below predetermined levels.

The filters were removed when the magnets were installed and after more than two years there have been no problems with the cooling system. The cooling coils are clean and there has been no evidence of scaling or sediment

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Magnetic feed water treatment – how it works

summarised from *Process Engineering*, March 1989 pp27,28

Studies carried out by the Chemistry Department of City University, London. England have shown that magnetic fields affected precipitation and could change:

- the size of particles of precipitated compounds
- the ability of crystals to form
- their shape
- the solubility of compounds.

In the case of calcium carbonate it was shown that particles precipitated from hard water increase in size when the water was passed through a magnetic field.

An increase in the size of the particles can have three beneficial effects:

- larger crystals will not coagulate to form scale in the same way as smaller crystals
- the presence of the larger crystals disrupts the equilibrium between the fluid and any existing scale
- smaller particles, in general, dissolve more easily so larger particles will reduce the local concentration of calcite in solution and remove existing scale.

On a crystal, the external faces are the slowest to grow as the crystal develops. Adding chemicals to a saturated solution can change the growth of crystal planes relative to other planes. altering the shape of the crystals.

There is considerable evidence that applying a magnetic field to growing crystals also changes the relative rate of growth of the external faces.

These changes in crystallinity and in crystal structure must arise because of the interaction between the field and the nucleating and growing crystals.

Evidence from the precipitation of calcium carbonate and zinc phosphate suggests that, under certain conditions, the chemical phase of these precipitates can be altered if the fluids containing them are treated with magnet fields.

This could result only from changes in the equilibrium between the fluid and the precipitate altering the relative stabilities of two phases with closely matching lattice energies.

When hard water was evaporated, it was found that before treatment with a magnetic field the precipitate of calcium carbonate contained calcite and aragonite in the ratio of about 4:1. After treatment the ratio of these phases was about 1:4. Electron micrographs and X-ray diffraction patterns clearly show these changes.

An explanation of why magnetic devices prevent scale formation and cause scale to dissolve could be the Lorenz effect. The combined effects of an applied magnetic field, a charged species, the induced magnetic field on the charged species and the rate of flow in the fluid could together produce energy that, by normal collision processes between molecules, could act downstream in the system.

Although it may contribute to the overall process, it seems unlikely that it explains the phenomena fully.

Another explanation is that the magnetic field is modifying crystal nuclei. The nuclei on which the crystals start growing and the growing crystallites are very small and **will have charged surfaces**. **As they pass through the magnetic field these charged particles encounter considerable forces** as the magnetic field interacts with them. This distinguishes fluids treated magnetically from untreated fluids.

At the interface between solids and fluids, a diffusion layer arises between the solution and the faces of the growing crystal. The growing faces each carry a distinctive charge. How the magnetic field affects the surface of the crystal and the diffusion layer is critical.

These phenomena govern the effect that the field will have on crystal growth.

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