TRIANGULAR WAVE
Fact Sheet

Energy Savings From Deposit Control

When a scale-forming environment is present, meaning to many dissolved minerals are in solution and are not being controlled, deposits form on the inside of pipes and tubes called scale. Scale and bio-film contribute to reduced heat transfer, reduced equipment life cycle, and increased energy costs.

Kessler's, Inc. produces a variety of meat products for distribution in 14 Eastern states. For over 80 years the company has produced quality products and remained competitive in the marketplace. Efficiency in plant operations and cost control for Kessler's, as with many corporations, are top priorities.

Besides cost savings from reductions in chemical and maintenance due to the TWT Deposit Control System, Kessler's experienced a cost savings they did not expect. It started as a mystery to Ed Byrem, Kessler's Plant Manager, and the management team at Kessler's. "Our controller approached me one day and asked me why our electrical costs had dropped significantly over the past year. At first, we had no explanations as production hours, etc. were the same as the prior year. In evaluating all potential explanations, with the help of refrigeration and engineering consultants, we determined that our compressors were the difference.
The heads on the compressors were deposit-free and running cooler, which uses much less electricity. After extensive evaluations of electrical usage, we believe that we have conservatively achieved a 9% savings on total plant electrical use as a result of the Triangular Wave System and its effect on our compressors," commented Byrem.

The actual field results from Kessler's, Inc. are supported by conclusions published in Federal Technology Alerts – Non-Chemical Technologies for Scale and Hardness Control (http:/www.pnl.gov/fta/11_non.htm)

Energy Savings Mechanism

The primary energy savings result from a decrease in energy consumption in heating or cooling applications. This savings is associated with the prevention or removal of scale build-up on a heat exchange surface where even a thin film (1/32" or 0.8 mm) can increase energy consumption by nearly 10%. Examples of savings resulting from the removal of calcium-magnesium scales are shown in Table 1.
A secondary energy savings can be attributed to reducing the pump load, or system pressure, required to move the water through scale-free, unrestricted piping.

Table 1,
Example Increase in Energy Consumption as a Function of Scale Thickness

Scale Thickness (inches)	Increase Energy Consumption (%)
1/32	8.5
1/16	12.4
1/8	25.0
1/4	40.0

Estimated Savings and Market Potential

As part of the NTDP (New Technology Demonstration Program) selection process, an initial technology screening activity was performed to estimate the potential market impact in the Federal sector. Two technologies were run through the assessment methodology. The first technology was assessed assuming the technology was applied to the treatment of boiler make-up water. The second technology was assessed assuming the technology was applied to both the treatment of boiler make-up water and cooling tower water treatment. The technology screenings used the economic basis required by 10 CFR 436. The costs of the two technologies were different based on information provided by the manufacturers, thus leading to different results.

The technologies were ranked on a total of ten criteria. Three of these were financial, including net present value (NPV), installed costs, and present value savings.
One criterion was energy related, annual site energy savings. The remaining criteria were environmental and dealt with reductions in air emissions due to fuel or energy savings and included SO_2, NO_x, CO, CO_2, particulate matter and hydrocarbon emissions."

The ranking results from the screening process for this technology are shown in Table 2. These values represent the maximum benefits achieved by implementation of the technology in every Federal application where it is considered life-cycle cost effective. The actual benefit will be lower, because full market penetration is unlikely to ever be achieved.

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Table 1, Screening Criteria Results

Screen Criteria	Results First Screen	Results Second Screen
Net Present Value ($)	147,518,000	158,228,000
Installed Costs ($)	52,819,000	35,299,000
Present Value of Savings($)	200,336,000	193,527,000
Annual Site Energy Savings (Mbtu)	**4,166,000**	**3,761,000**
SO_2 Emissions Reductions (lb.yr)	3,292,000	427,000
NO_x Emissions Reduction (lb/yr)	1,028,000	550,000
CO Emissions Reduction (lb/yr)	304,000	128,000
CO_2 Emissions Reduction (lb/yr)	303,000	234,000
Particulate Emissions Reduction (lb/yr)	60,000	29,000
Hydrocarbon Emissions Reduction (lb.yr)	7,000	3,000

Note: First Screen: Boiler make-up water treatment
Second Screen:Cooling tower water treatment and boiler make-up water treatment

Energy Savings

Energy savings result from both reductions in pumping energy input to the system and reduction in fuel consumption. It is important to understand that even the smallest amount of scale and bio-fouling can effect the heat transfer efficiency.

When heat transfer is at its peak, only minimal amounts of fuel (energy) are necessary to improve the amount of steam/heat your production system demands. The increased scale and bio-fouling impedes heat transfer, requires more fuel (energy) to create the necessary steam/heat production.

Fuel consumption has been lowered in every situation. The exact savings are a result of a number of factors:

- How effective the chemical scale control program may have been relative to the input water hardness.
- How often the heat exchange system was taken down for maintenance and cleaning.

On systems that were descaled frequently or had low scale formation, due to low hardness and/or an effective chemical control program, the savings in fuel consumption were lower, often ***from a few percent to as much as 15%***. The lower savings were at an installation using ion exchange softening of moderately hard water (less than 150mg/L as calcium carbonate hardness). On systems where descaling was frequent, or absent altogether, or where the chemical scale control program was not as effective in controlling scale formation,

fuel consumption savings ranged up to 30%. This was found to be the case in a installation using very hard water (hardness in excess of 300mg/L as calcium carbonate), and a chemical scale control problem,with heat exchange tubes closing due to scale formation after less than one year. In each case the fuel consumption savings was proportional to the thickness of the scale layer removed.

One important note was that fuel consumption savings often trailed installation of the technology by a significant period due to the fact that the savings is driven by the amount of scale on the heat exchange surface.
The accumulated scale will erode over time, resulting in fuel consumption reductions. For this reason, many of the manufacturers recommend installing the technology only after the system has been descaled, thus savings in fuel consumption should be immediate.

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