

CASE STUDY: RUST & SCALE REMOVAL/PREVENTION IN BOILERS
CLIENT: KANOM SAKOL CO. LTD, BANGKOK, THAILAND

SITE



Water tanks that feed water into closed-system boilers at Kanom Sakol Co. Ltd. – a Japanese snack foods factory located in the suburbs of Bangkok, Thailand.

PROBLEMS

Rust and scale are both prevalent and problematic to industrial areas such as ship hulls, steam generators, water transport lines, flush water lines/tanks (in toilet systems), water compressors, spray nozzles, shower heads, etc. Boiler systems are no exception.



Problem 1 – In order to clean the boilers, the factory must be completely shut down, and the machinery opened and drained. Decreased productivity and the cost of maintenance are two setbacks.

Problem 2 – Cleaning is done by soaking equipment in harsh chemicals (e.g. a weak phosphoric acid solution.) These chemicals are detrimental to the environment and to the health of employees. The alternative to chemical soaks is mechanically brushing the machine parts. This requires hundreds of hours of manpower over the life span of the equipment.

Advanced technologies exist but these require a high capital investment in the hundreds of thousands of dollars. It includes plasma spark water treatment systems, or using sacrificial zinc anodes. The former works by sending acoustic shockwaves through the water to remove biofilm and the latter is a technique used to clean ship hulls and in ballast water.

THE KIKO TECHNOLOGY SOLUTION

Kiko Technology solves the above problems. It is non-chemical; rather, it works on the basis of physics in the removal of rust and scale. Capital investment is low; both relative to return, and in absolute dollar terms. Operating costs are minimal to none.

INSTALLATION PROCEDURES



The installation site – One of the water tanks at the food processing plant that permanently contains five filter cartridges.



Product/Dosage: 5-6 x Stainless Steel filters for every ten tons of hot or cold water
Cost of filters: HKD \$1,000 per filter

Installation area:

Any water tank connected to a boiler system. (*Temperature inside tank must not exceed 80° C*)

Directions:

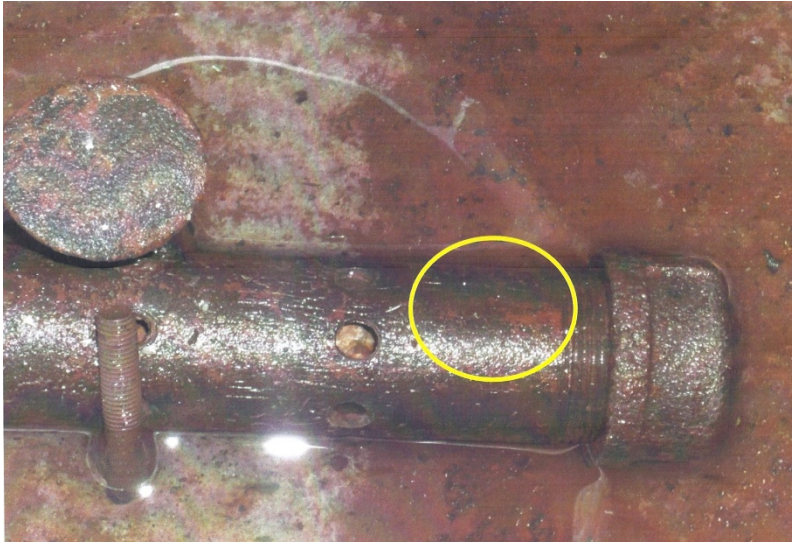
Immerse filters in the tank(s) in direct and continuous contact with water. Filters can be bundled on a cord or line so it is retrievable without having to drain the tank. The filters will energize the water immediately upon contact. In closed-systems, energized water containing the ability to reduce scale and rust is then pumped into the boilers.

RESULTS TIMELINE

RUST REMOVAL	
1-14 days after installation	Rust removal begins – ejected water starts to run red.
2-3 weeks after installation	Pipes and parts become visibly less rusty when the system is opened for preliminary inspection. The ejected water begins to run clearer.
SCALE REMOVAL	
2 weeks after installation	Scale removal begins.
2-4 months after installation	Pipes and parts gradually become scale-free when the system is opened for preliminary inspection.
BOTH RUST AND SCALE	
1 year after installation	Open system for inspection.
Every 3 years	Change filter cartridge.



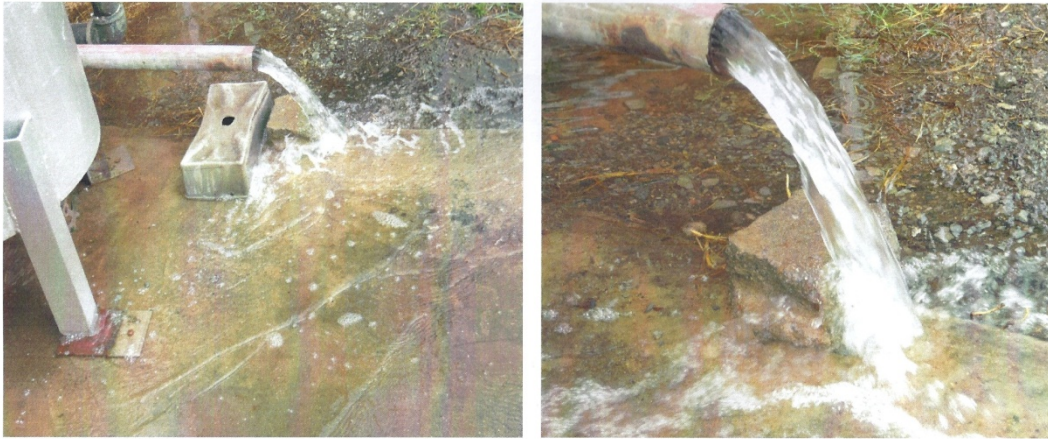
Clean pipes three months after Kiko Technology was installed (note this particular boiler was manufactured in 1978.)



Clean parts three months after Kiko Technology was installed – the shiny steel is visible where the rust has fallen away.



Ejected water runs red – the water contains suspended particles of rust that have dislodged from pipe walls.



Ejected water eventually runs clear as more water is passed through the system and as the rust suspension is pumped out of the system.

Boilers consume more energy than any other equipment in most industrial/processing plants. This area is where substantial energy savings can and should be made. A 3-5mm layer of scale on the inside of the boiler tubes/pipes can add between 5-15% more fuel costs. Excessive scale build-up can lead to ruptured tubes requiring frequent replacement, increasing the workload for engineering and maintenance personnel.

OTHER METHODS TO TEST THE REMOVAL OF RUST AND SCALE

1. Conduct a chemical test on the water for iron (Fe) and other total dissolved solids (e.g. calcium and magnesium bicarbonate and other similar salts) – there should be a higher quantity of dissolved solids in the water after the filter is installed as rust and scale is encouraged to fall off pipe walls and the surfaces of equipment parts.
2. Conductivity tests repeated regularly on the filtered water will determine the rate of rust and scale removal. The higher the conductivity, the more dissolved solids that water contains.

HOW RUST AND SCALE FORMS

Rusting is the common term for corrosion of iron and its alloys, such as steel. Rust is a general term for iron oxides; colloquially, red oxides, formed by the reaction of iron and oxygen in the presence of water or air moisture (but not pure water or oxygen, in which iron metal remains relatively unaffected.) Given sufficient time, oxygen, and water, any iron mass eventually converts entirely to rust and disintegrates.

The result of the reaction of iron and chlorine in an environment deprived of oxygen (e.g. underwater) generates green rust. Several forms of rust are distinguishable visually and by spectroscopy. Surface rust provides no protection to the underlying iron unlike the formation of patina on copper surfaces. Rusting occurs faster if salt is present (e.g. in saltwater.)

Limescale is the hard, off-white, chalky deposit found in kettles, hot-water boilers and the inside of inadequately maintained hot-water central heating systems. It is similarly found on the inner surface of old pipes and other surfaces where "hard water" has evaporated. The type found deposited on the heating

elements of water heaters etc. has a main component of calcium carbonate, precipitated out of the (hot) water. Hard water contains calcium (and often magnesium) bicarbonate and/or similar salts.

Calcium bicarbonate is soluble in water, however at temperatures above 70 °C (158 °F) the soluble bicarbonate is converted to poorly-soluble carbonate, leading to deposits in places where water is heated. Local boiling “hot spots” can also occur when water is heated, resulting in the concentration and deposition of salts from the water.

It can also be found on taps where hard water has been continually running through and has deposited calcium carbonate. This can build up, reducing water flow and can eventually block the tap.

Other than being unsightly and harder to clean, lime scale can impair the operation of various components or damage them. In kettles, lime scale acts as an insulator, impairing heat transfer. Additionally, it can damage the heating element, which overheats due to accruing lime scale.