HRSG tube cleaning

Back pressure problems are common in HRSG and can significantly affect the boiler´s performance, and the overall plant performance. Generally speaking, according to most OEM's in this industry for every 1/2 inch of back pressure we are able to decrease the plant should see an approximate $100,000 USD gain in efficiency over the next twelve months, due to the increase of the HRSG performance. In other words, for every 1/4 inch of back pressure we are able to decrease the unit will see a 1% gain in efficiency. Therefore, even the smallest reduction in back pressure can mean significant dollars to the plants bottom line. Precision Iceblast has developed a cleaning method capable of reducing the back pressure from 2 to 5 inches, with the subsequent advantages this provides.

Precision Iceblast HRGS tube cleaning system consists in blasting dry ice at very high pressure (350 psi). The dry ice does a great job cleaning the first couple rows of tubes. Beyond that it is just simply the force of air pushing the debris through the tubes.

One of the main characteristics of this cleaning process, that uses equipment manufactured by Precision Iceblast, is the tube spreading technique. When the customer has a larger bundle or a bundle containing very heavy build up then tube spreading is definitely the most effective method to clean the bundles.

These spreader bars are placed in every fourth tube on each face. Spreading the face every four tubes gives us the ability to clean two tubes to the left of the alignment bar and two tubes to the right of the alignment bar. We then move to the next alignment bar cleaning two tubes to the left again and two tubes to the right. This process allows us to open up lanes and have direct access to the face of tubes that are four to five rows deep.

Precision iceblast has formed strong alliances with other large names in the power industry such as Nooter/Eriksen, NEM, Deltak, Siemens, HRST, Donaldson Gas Turbine Systems, and Champion Charter to name a few.

This cleaning system its suitable for different systems within the plant: HRSG tubes, SCR catalysts, stacks, turbine oil reservoir tanks, air filtration systems, generators, rotors/stators, compressor blades and steam turbine blades.

Before and after pictures of the cleaning, using tube spreading process

Successful case study. A Caribbean plant increase its benefit thanks to the its HRSG tube cleaning

In spring 2012 Precision Iceblast Corporation was contacted by Penal Power Station in Syne Village, Trinidad about the issues they were having on their NEM vertical gas flow HRSG units. The plant identified fouling on their tubes which they believed was causing their high back pressure in the HRSG's. Precision Iceblast was brought in for a consultation on how cleaning can remove the fouling and reduce their back pressure closer to their original numbers. Initially, the consultation started through phone conversations and emails. After these initial discussions Precision Iceblast provided a face to face site visit to further discuss the project.

A Precision Iceblast representative gathered information on what were the specific issues and what were the expectations of Penal Power. Precision Iceblast discussed how they could fix the back pressure issues by implemented a very specific system that would provide the greatest level of success. These techniques included the implementation of high pressure ice blasting (350 psi), proper blasting techniques, and the use of spreader/alignment bars which provides a very deep clean throughout the tubes.

After the face to face to face meeting, Precision Iceblast provided a quote to Penal Power. Next, Penal Power called references and performed an evaluation on the potential profits that would be gained from the cleaning (ROI). Once they confirmed that indeed the cleaning should pay for itself very quickly and the

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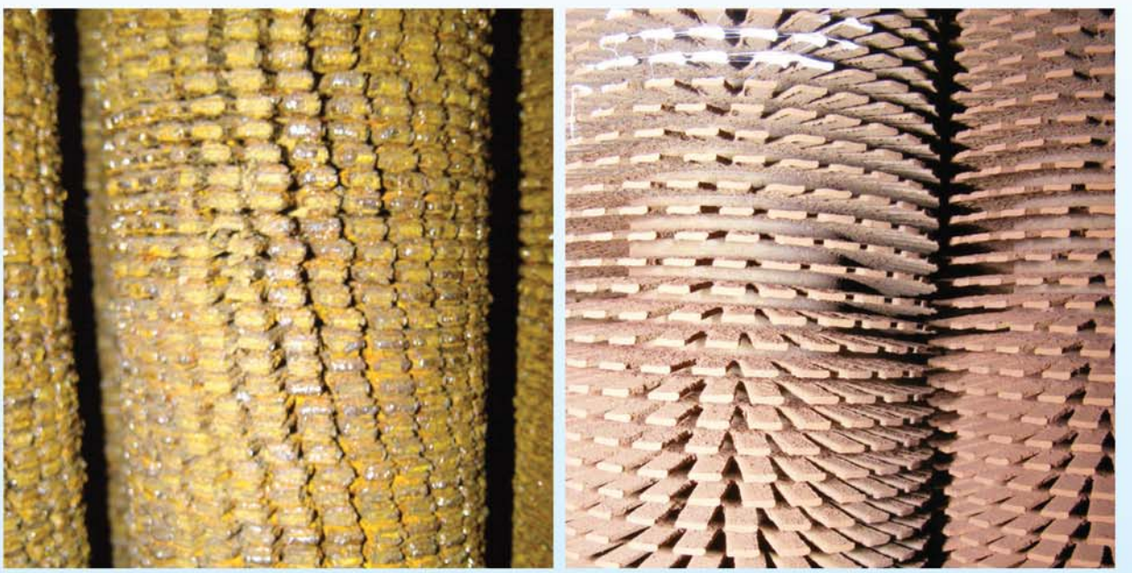

Before **After**

"Where others had failed before, Precision Iceblast succeeded" – *El Dorado Energy*

"I recommend your services to anyone needing this type of work" – *Millennium Power*

"Contractors that we have used in the past to ice-blast our HRSG have not met our satisfaction to say the least. Your crew cleaned the tubes better than the other contractors have done before" – *Calpine*

"I commend them on their ability, attitude, and professional manner in which they conduct their business" – *Contact Energy*

"Your crew was very professional and knowledgeable about the cleaning process and the reason for cleaning HRSG tubes" – *Power South*

To get the most EFFICIENCY out of your HRSG contact:

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plant should see a significant monetary gain from the cleaning a PO was issued and work began to prepare for the mobilization of the crew and equipment.

In this situation Penal Power was able to supply a high pressure compressor and high density dry ice blasting pellets. Precision Iceblast supplied the skilled labor, blasting equipment, confined space equipment, and spreader bars. Precision Iceblast received the heating surface data sheets on the Penal Power's NEM HRSG. Individual spreader bars were then engineered specifically for this HRSG by HRST. Each HRSG requires proper engineering of the spreader bars to insure that no undo stress is created on the tubes which can cause damage and tube leaks if not designed properly.

Once all the equipment arrived on site and cleared through customs, Precision Iceblast mobilized a crew of five skilled workers to Trinidad. A total of three modules were cleaned with each module consisting of an upstream and downstream face. Precision Iceblast provided a turnkey service consisting of ice blasting tube spreading, access, clean up of all headers, tube ties and exhaust outlet duct, and removal of the debris from the unit. The entire project took a total of ten days. The work went as follows:

Day one: Precision Iceblast showed up on site the day before the start date to go through details of the project, training, and site familiarization.

Day two: Precision Iceblast set up the equipment and access to the HRSG. Once set up was completed conventional ice blasting began on the first face. Cleaning commenced on the very top face in order to push the debris downward through the module. Containment was placed on the top side of each module (below the blasting) in order to collect the debris and remove it after each module was cleaned. This procedure is done in order to remove the debris from each module as oppose to trying to push all the debris through the entire unit. Upon completion of cleaning the first face, Penal Power and Precision Iceblast would inspect the area and sign off on it before the crew moved to the next module. Before pictures were also taken on each face.

Day three: Precision Iceblast setup to clean the next two faces (face #2 & #3). The crew spent the day cleaning these two faces. Once cleaning was completed the Penal Power and Precision Iceblast inspected the faces to insure cleanliness.

Day four & five: Precision Iceblast setup to clean the faces #4, #5 & #6. Once cleaning was completed the Penal Power and Precision Iceblast inspected the faces to insure cleanliness.

Day six: Precision Iceblast setup to tube spread the first face (face #1). After demonstrating for the plant the procedure the crew spent the day cleaning this one face. Once cleaning was completed the Penal Power and Precision Iceblast inspected the faces to insure cleanliness and took after pictures of the boiler tubes.

Tube spreading

Day seven, eight and nine: Precision Iceblast repeats this operation during the forthcoming three days in order to clean the faces #2, #3,#4, #5 & #6). The last day all areas were blown down. After the cleaning and blow down was completed the crew packed up all blasting and equipment and set up equipment to clean out the unit the next morning.

Day ten: Precision Iceblast cleaned all areas on the HRSG unit and did a final inspection with the plant. Once the final inspection was completed Precision Iceblast demobilized from the site.

After the boiler tube cleaning was complete, the plant spent the following month finishing their outage work and getting their unit back up and running. Once the plant started running again they were able to calculate the results from the cleaning and further justify the ROI from this project. The crew removed approximately 1,500 pounds of rust and insulation from the tube bundles. The plant was running at 19'' max back pressure before cleaning and reduced it to 15'' max after cleaning. The HRSG dropped from 8,280 kJ/kWh to 8,140 kJ/kWh and increased combined cycle net output from 184.4 to 187.5 MW. Penal Power received the ROI that they were hoping for and is currently scheduling their second unit for the next shutdown.

Penal 10 Power Station before and after cleaning

Parameter	Before		After	
	Measured	Corrected	Measured	Corrected
Gross Output	63.4	59.9	64.6	61.2
CCP Net Output	184.4	175.3	187.5	179.6
CCP Net Heat Rate (kJ/kWh)	8,280	8,587	8,140	8,584
CPD (psig)	135	–	140	–
Back Presure (in H_2O)	19	–	15	–
HRSG Steam Flow (Mt/h)	98.9	102	102	104
Stack Temperature (ºF)	422	427	414	411
Inlet DP (in H_2O)	8.5	8.6	5.1	5.0