INSPECTION OF COOLER TUBES IN A MINING PLANT

INTRODUCTION

Mining is the economic foundation of many countries. In mining/mineral processing, industrial equipment is often jacketed (sleeved) with flowing water to cool fluids and absorb process heat. This equipment generates a very large heat load that can disrupt operations, if not properly handled. Leaks in the process can cause hydrocarbons to contaminate the cooling water and vice versa. Lower quality, non-potable water is often used to cool plant processes. Meeting environmental regulations limiting hydrocarbons, water usage and drift rates present challenges to plant operators.

THE PROBLEM

Though hefty of heat exchangers are utilized for mineral processing, not every heat exchanger gets inspected due to their short downtime. In most of the cases, fraction of heat exchangers or only high critical heat exchangers gets inspected. One of such critical equipment is cooler and as per their Risk Based Inspection (RBI) team, nearly six coolers gets inspected every year.

Each cooler shall be offloaded for 2 days but not all tubes gets inspected because the conventional technology (Eddy current/Ultrasonic/Magnetic flux leakage) takes more than the allotted time horizon to complete the inspection and then to offer the results.

Hence, they do inspection on a sampling basis using ECT and then plug the tubes greater than 60%. In past few cases, their efficiency was dropping drastically after three to four months of operation. Whilst doing the investigation, they found that few of the tubes punctured during the operation and they presume that tubes would have had more than 60% pits. Due to time constraint, the quality of inspection and result wasn't delivered appropriately. Hence, they started to look for solution where they can inspect all the tubes in 4 hours and then produce the result within 3 hours indicating leaks, deposits and pits greater than 60%. They have also decided to do hydro test after conducting 100% inspection of coolers.

SOLUTION

APRIS was introduced by our customer named Ingal in Chile. On looking into the advantages such as

1. Ultra-fast inspection (10 seconds per tube)
2. Any tube material (ferrous/non-ferrous/graphite/composite) shall be tested
3. Different tube configuration (straight/ bend/multiple bend/fins)
4. Quick report generation support

The maintenance team decided to inspect their cooler tubes with APRIS and would like to compare the results with Eddy Current Test conducted on Jan 2020.

DATE OF INSPECTION	5 Apr 2020	TOTAL NO. OF TUBES	452
LOCATION	Chile	TOTAL NO. OF TUBES INSPECTED	420
INSPECTION SITE	Atacama	CONFIGURATION OF TUBES	Straight
END CUSTOMER	Planta 2	TUBE OUTER DIAMETER	19.05mm
COMPANY PERFORMING INSPECTION	Ingal	TUBE THICKNESS	1.6mm
DESCRIPTION OF INSPECTION	Cooler Tube Inspection	TUBE LENGTH	9.1m
INSPECTION TECHNICIANS	Rafael	INSPECTION STANDARD	ASTM E2906/E2906 M-13/ASME BPVC 2019

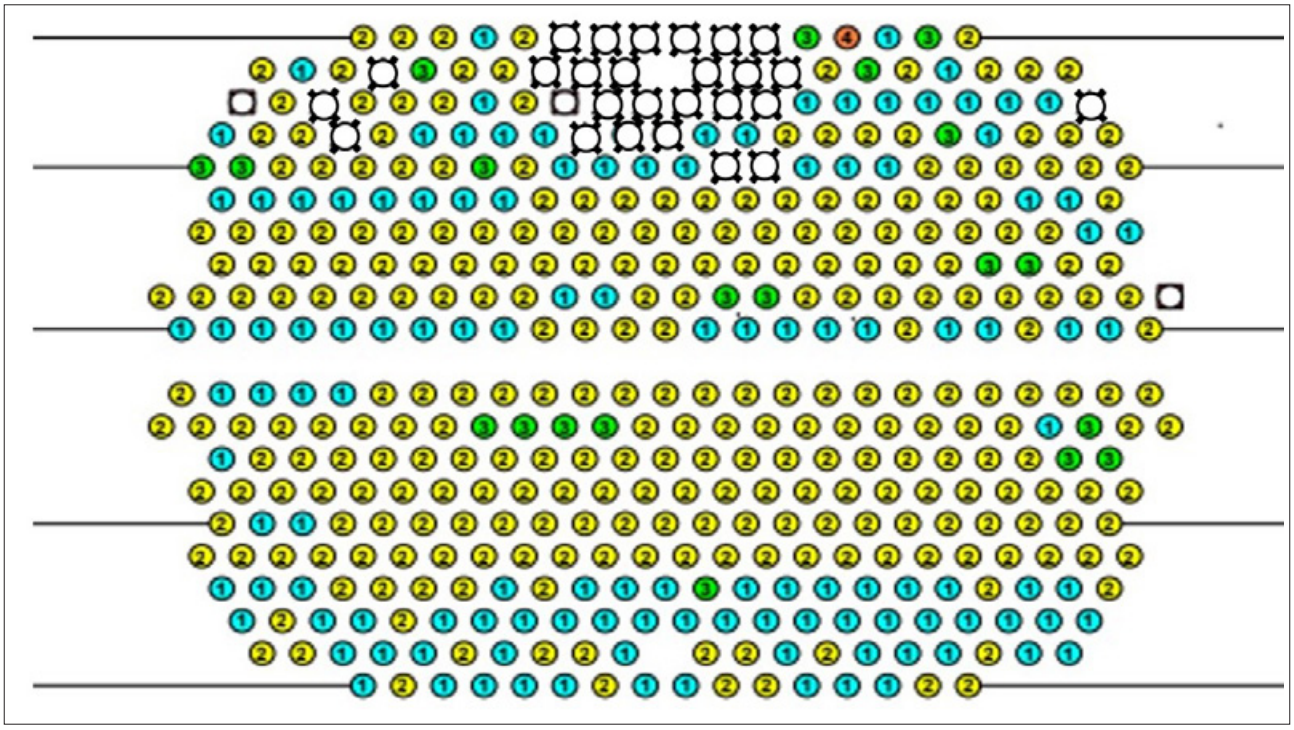

Figure 1: *Tube mapping of the Heat Exchanger*

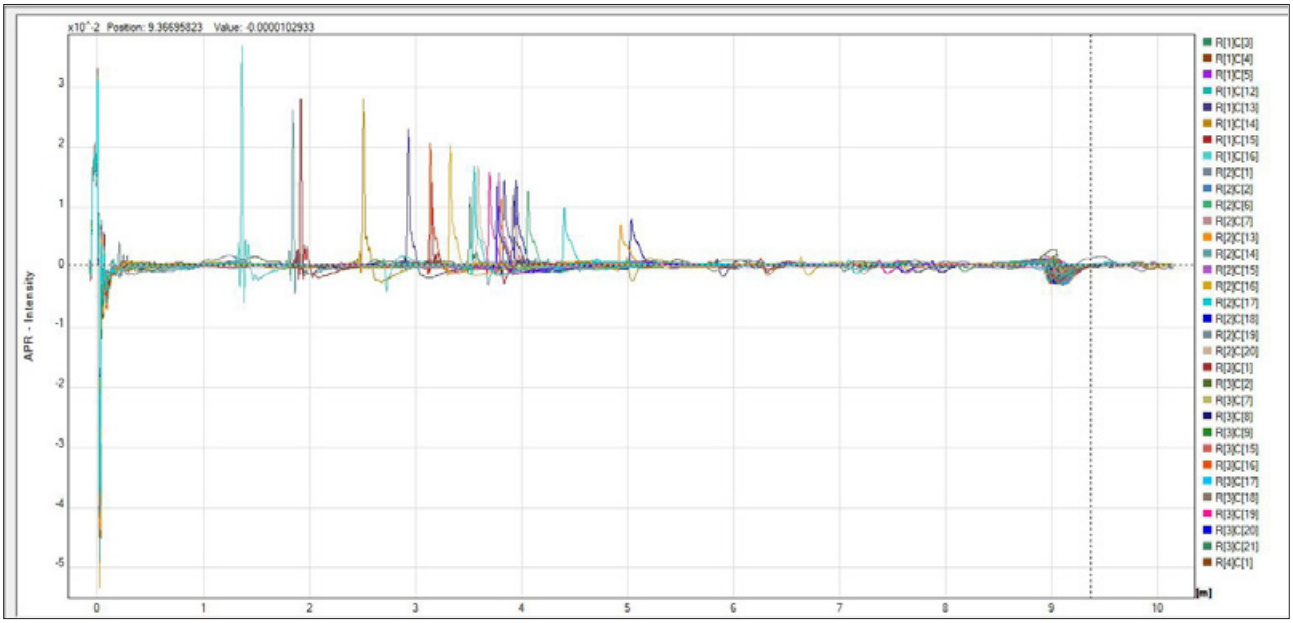

Figure 2: *Signals indicating defects.*

The inspection was started at 8:30 am (Chile Time) on 05 April 2020. It took 1hour and 45 minutes to complete the inspection of 420 tubes. The data was analyzed, and preliminary report was issued at 01:00 pm (Chile time) to maintenance supervisor of the mining plant.

Summary of the inspection results:

DEFECTS	NO. OF TUBES
Blockages	31 tubes
Wall loss (>60.1%)	2 tubes
Wall loss (40.1% - 60.1%)	11 tubes
Wall loss (20% - 40%)	370 tubes

Tubes that are reported as wall loss greater than 60% are plugged by the maintenance team. After plugging the tube, hydro test was conducted on the cooler and no leaks were reported.

CONCLUSION

The shutdown time of 60 hours was reduced to 48 hours and operations team noticed that efficiency was higher than earlier because of the appropriate corrective actions taken after the inspection. Maintenance team decided to use APRIS for other heat exchangers in the plant and they are confident as APRIS offers fastest and reliable solution which exceeds their requirements.