



The biggest problem with heat exchangers is fouling. Fouling occurs when the fluids flowing through the heat exchangers leave deposits behind. There are various types of fouling including chemical, biological, deposition and corrosion. In each case, deposits left behind either plug the fluid flow or build up on the walls of the heat exchanger (HX), changing the HX's thermo conductivity properties.

Regardless of the type of fouling, the consequences are the same: a lower rate of heat transfers between the process fluids which results in operational inefficiencies. Secondary consequences include the following:

- Plant processes may have to be slowed down to allow the primary fluid more time in the heat exchanger

- Greater thermal differentials may need to be applied. For example, by increasing the flow on the secondary side of exchanger or by changing the secondary side temperature
- Higher energy costs may be associated with decreased efficiency
- Process yield/quality could decrease as HX efficiency declines

There are many critical issues that effect efficiency and performance of a heat exchanger. These include fouling, inefficient operating points, leakage between hot and cold side process fluids and out of design range thermal and pressure stresses. It is critical that the maintenance department has a tool that provides visibility into the HX so that the end user can make informed decisions.

The Heat Exchanger Asset Monitor (HXAM), identifies condition changes on any heat exchanger equipment visible to an 800xA control system. Simple installation and configuration, followed by automatic training, permit the HXAM to continuously monitor heat exchanger performance over the long term, indicating when fouling or operational changes have affected the heat transfer efficiency of the equipment. Resulting notifications can alert operations and maintenance staff to situations which are making heat exchanger operation significantly more costly and less efficient.

Functional description

ABB's Heat Exchanger Asset Monitor or HXAM is a condition-based monitoring tool that identifies performance changes and operational degradation of heat exchanger operations and reports them back to the end user. It is geometry independent, so it works with all types of heat exchangers. It requires only four temperature measurements: Hot In and Hot Out on the hot fluid input side, and Cold In and Cold Out on the cold fluid output side. Fluid mass flow and pressure are helpful measurements but are not required. Unlike other heat exchanger monitoring tools, no other physically invasive measurements are needed to detect operational degradation including fouling or moving away from optimal flow. HXAM is an integral part of System 800xA Asset Optimization, which monitors heat exchanger performance 24/7.

The HXAM calculates equipment effectiveness using a proprietary algorithm while the heat exchanger is running satisfactorily. In this training phase, the HXAM calculates effectiveness and creates a Base Operating Point Set or BOPS. The training phase lasts about 1% of the heat exchanger's typical maintenance interval. The HXAM can work with multiple BOPS and it can train on live or historical data. See Figure 1 below. The Variations plot is comprised of % Relative Effectiveness versus Time. There are four distinct BOPS in the plot. After the training phase is complete, the HXAM will determine the BOPS in which the heat exchanger is running. Should the heat exchanger deviate from the BOPS, alerts will be generated.

Applications

The HXAM is suited for single-phase process fluid operation, as well as evaporating and/or condensing applications.

The HXAMs available are:

- HXAM-G for Generic Heat Exchangers such as:
 - Plate & Frame
 - Finned-tube
 - Plate
 - Spiral Plate
 - Double Tube
 - Plus many other types
- HXAM-ST for Shell & Tube type Heat Exchangers

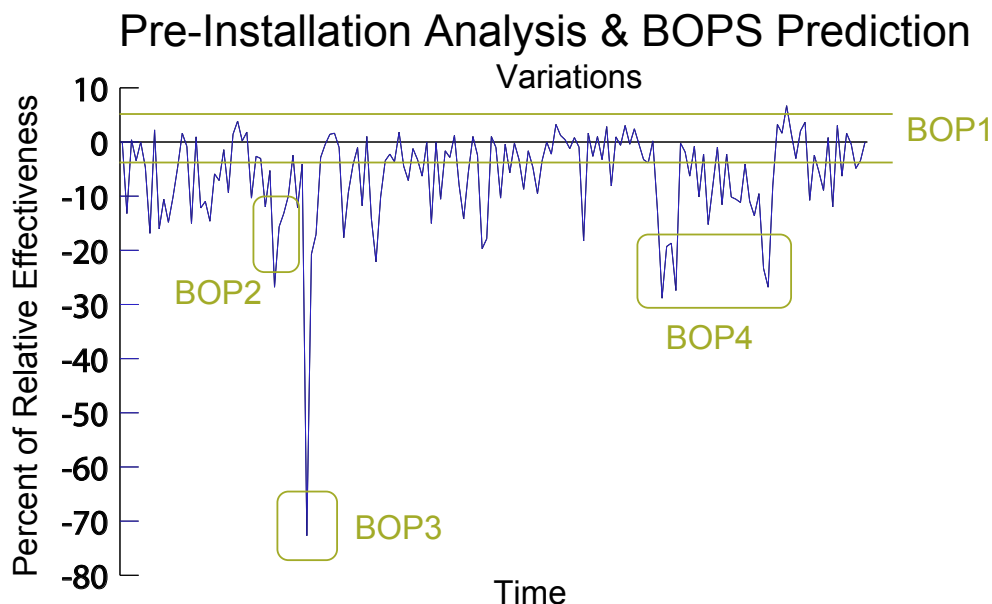


Figure 1 – Analysis and identification of Base Operating Point Sets (BOPS)

Operation and Workflow

At every scheduled execution, HXAM reads the four leg temperatures, as well as available flow and pressure data. See Figure 2.



Figure 2 – Black box view of a heat exchanger

Using these values, HXAM assesses the current thermal performance of the heat exchanger relative to performances measured during an initial training phase. This is done via a unique and ABB-proprietary algorithm. Freshness of training data is checked prior to performing each assessment. Additional monitors, enabled per the above, are also evaluated.

If performance or heat transfer effectiveness declines or improves to a preset degree, an alert is generated. The alert is then sent out to the appropriate persons. These contacts can be pre-determined by the end user, who can indicate one list, lists that vary by recipe or shift, etc. Alarms can be directed to notify via email to client PCs, data automatically entered into Excel Reports, email, paging, text messaging or via CMMS (Computerized Maintenance Management System). Figure 3 shows the workflow of the HXAM. If a Computerized Maintenance Management System (CMMS) is configured, it is possible to quickly generate a Work Order for a maintenance request on the heat exchanger equipment, as might be required when cleaning is needed due to fouling. After installation and configuration, the HXAM briefly trains on live process data, and then will monitor heat exchangers for efficiency changes resulting from fouling or changes in operating point.

Software dependencies

The following ABB software is required for installation, configuration and operation of the HXAM:

- 800xA Core System
- Asset Optimization
- Optional System Extensions:
 - CMMS connectivity for Maximo, SAP Plant Maintenance, IFS, and many other CMMS providers
 - SMS & Email Messenger (Sending messages based on alarm and event information to user devices such as mobile telephones, e-mail accounts and pagers)

Configuration

Configuration and operation are simplified with the help of the HXAM faceplate. See Figure 4. Each step in the configuration of the HXAM is identified with a tab. The end user simply goes through each tab and enters the requested information. Once completed, the HXAM monitors the heat exchanger and reports performance changes, making the heat exchanger health visible to the maintenance department.

The HXAM can be configured to monitor limits on the various process measurements made on the heat exchanger, as well as standard monitoring of relative performance and staleness of trained data. Additionally, it also monitors the heat transfer efficiency in the HXAM-ST version.

To enable these features, the HXAM is configured via checkboxes found on the built-in faceplate elements.

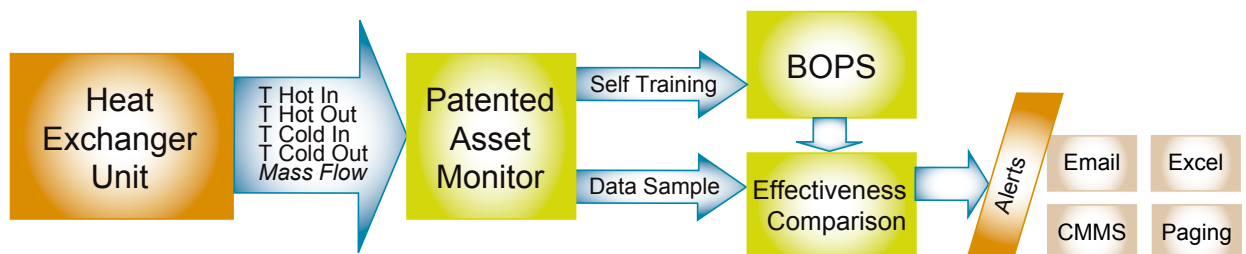


Figure 3 – Workflow of a HXAM

The user can enable limit checking asset monitors for the following process data:

HXAM-G and HXAM-ST

- ΔT -hot, ΔT -cold, ΔT -cross
- ΔP -hot and ΔP -cold side
- Mass Flows hot and cold side
- Heat Duty hot-side
- Heat Duty cold-side
- Δ Heat Duty

HXAM-ST only

- Tube velocity
(HX-ST version only)
- Limit Approach Temperature
(HX-ST version only)
- Shell Side Flow
(HX-ST Version only)
- Thermal Crossover Detection
(HX-ST version only)
- Heat Transfer Efficiency [U]
(HX-ST version only)

Notes

P = Pressure

ΔT -hot = T Hot In – T Hot Out

ΔT -cold = T Cold Out – T Cold In

ΔT -cross = T Hot In – T Cold In

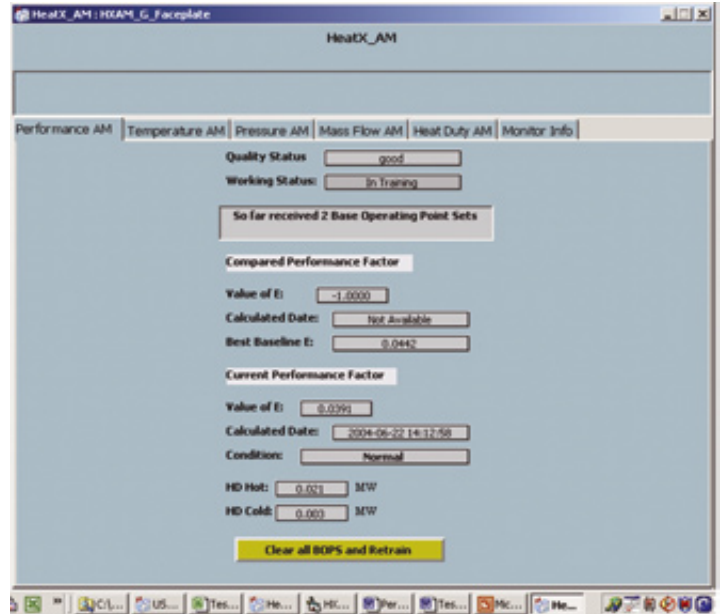


Figure 4 – Faceplate of a HXAM

For the latest information on Asset Optimization at ABB, visit us at www.abb.com/controlsystems.



ABB
Process Automation Division
 Västerås, Sweden
 Phone: +46 (0) 21 32 50 00
 Fax: +46 (0) 21 13 78 45
www.abb.com/controlsystems
 email: processautomation@se.abb.com

ABB
Process Automation Division
 Singapore
 Phone: +65 6776 5711
 Fax: +65 6778 0222
www.abb.com/controlsystems
 email: processautomation@sg.abb.com

ABB
Process Automation Division
 Wickliffe, Ohio, USA
 Phone: +1 440 585 8500
 Fax: +1 440 585 8756
www.abb.com/controlsystems
 email: industrialitsolutions@us.abb.com

ABB
Process Automation Division
 Mannheim, Germany
 Phone: +49 (0) 1805 26 67 76
 Fax: +49 (0) 1805 77 63 29
www.abb.de/controlsystems
 email: marketing.control-products@de.abb.com

3BUS094354 en

© Copyright 2008 ABB. All rights reserved. Specifications subject to change without notice. Pictures, schematics, and other graphics contained herein are published for illustration purposes only and do not represent product configurations or functionality. User documentation accompanying the product is the exclusive source for functionality descriptions. The IndustrialIT wordmark, Aspect Objects, and all above-mentioned names in the form XXXXXX^{IT} are registered or pending trademarks of ABB. All rights to other trademarks reside with their respective owners.