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ArcelorMittal Burns Harbor Operation Uses AssetWise Performance Management to Achieve USD 2.1 Million in Savings in One Year

Project Summary

Organization:
ArcelorMittal USA

Solution:
Metals and Mining

Location:
Indiana, United States

Project Objective:

- Senior leadership directive to develop and implement a reliability business process to reap the benefits of capital expenditure.
- Launch a World Class Equipment Reliability effort to drive and support reliability improvement activities.

Products Used:
AssetWise Performance Management

Fast Facts

- ArcelorMittal Flat Roll Operations has 12 operating facilitates and employs over 17,000 people.
- AssetWise Performance Management Health Indicator Panel consolidates all sources of condition data and provides a central view of the health of assets.

ROI

- Saved a total of USD 2.1 million in the first year.
- Avoided equipment failure.
- Improved efficiency of corrective work.
- Lowered energy usage.
- Improved safety and working conditions.
- RCM recommended redesign saved USD 200,000 per year by avoiding unnecessary bearing failures.

The ArcelorMittal USA Flat Roll Operations is comprised of 12 operating facilities employing over 17,000 people. The World Class Equipment Reliability (WCER) team at the ArcelorMittal Burns Harbor hot strip mill has achieved very dramatic results in a one-year period. Total savings in the first year were USD 2,076,900. Other positive benefits include increased safety and a cleaner work environment.

Situation

Senior leadership determined that in addition to investing capital in production equipment replacement or upgrade, a complete and consistent reliability business process would be developed and implemented and coupled with world-class reliability practices and tools to reap the full benefits of any capital expenditure.

To launch its World Class Equipment Reliability (WCER) effort, ArcelorMittal USA formed a central team with members from each U.S. site. It partnered with Bentley to learn and utilize the renowned Bentley reliability process, practices, technology, and methodology. This central team was trained by Bentley consultants and the team members deployed to their plant site to launch the WCER initiative within the specific business unit.

The objective of the training and coaching was to prepare the ArcelorMittal USA central team members to be the internal WCER trainers and coaches for personnel throughout their operations. This development effort enabled each plant site with a central WCER team of internal reliability practitioners to drive and support their reliability improvement activities going forward.

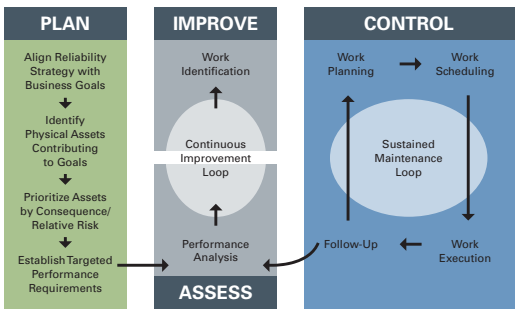
Bentley's AssetWise Performance Management software was selected as a tool to support the ArcelorMittal USA WCER implementation. The software was installed on its corporate servers using a single database for all U.S. operations. In order to effectively manage the full scope of the WCER business process, a custom interface to the Tabware computerized maintenance management system (CMMS) was designed, tested, and implemented.

The Burns Harbor hot strip mill (HSM) operation was identified as a high priority candidate for WCER implementation. It was experiencing an average delay rate of greater than 22 percent. In order to achieve the business plan of 17.58 percent average delay rate, significant improvements in production equipment reliability were necessary. Through much of the year, the HSM was not operating at full capacity. However, as economic conditions improved, the production requirements for the facility increased significantly. This opportunity was another reason to take action to reduce the high delay rate for the HSM in a sustainable manner.

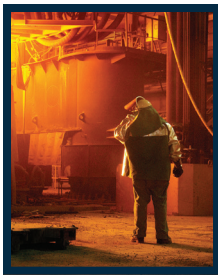
Solution

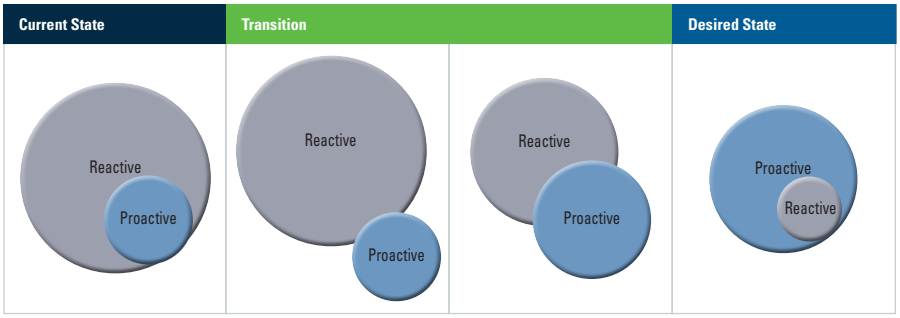
To begin addressing the reliability issues within the HSM at Burns Harbor, a team was assembled to focus exclusively on applying the WCER approach and methodologies within this business unit. This began with the implementation of a proactive asset management business process. The initial area of focus was the finishing mill, which consistently experienced the highest delay rates for all of the HSM.

Critical to the program's success was ensuring that the HSM WCER team, which represented 6 percent of the total maintenance workforce, be able to focus exclusively on proactive activities and not be pulled away to deal with day-to-day reactive duties. Area leadership demonstrated its support of the improvement effort by dedicating a total of 10 full-time



ArcelorMittal WCER Asset Management Business Process





The Process of Moving From Reactive to Proactive – How ArcelorMittal Successfully Made the Transition

resources from within the HSM to the WCER effort. These resources included seven individuals from the HSM maintenance group, one from the operations group and two from the operations technology group. In addition, an external resource was brought in to lead the effort in the role of Asset Coach.

The Burns Harbor Central Reliability Team provided WCER skills training and coaching to the HSM team members and ensured that the improvement effort was performed in accordance with the overall ArcelorMittal USA WCER standards.

In preparation for the effort, training profiles and collaterals were developed to support all of the key roles within the WCER organization. Where possible, computer-based training that incorporated knowledge testing was used to deliver the skills training. This was supplemented with classroom training as needed to fulfill role requirements. All personnel within the HSM WCER team have a competency profile that identifies the training they have completed and the certifications they have attained in their development. Providing comprehensive skills training followed by field coaching has effectively prepared this team to deliver strong results while also enabling it to educate other personnel at the HSM on the value of a proactive approach.

Team Roles and Responsibilities

The HSM-WCER team was built to ensure the delivery of all elements of a world class equipment reliability business process. Role responsibilities are as follows:

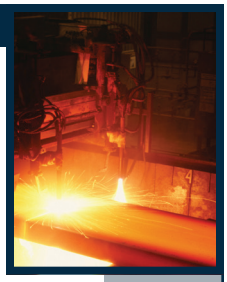
- Asset Coach (one position) – Responsible to coordinate overall WCER development and implementation effort for HSM.
- Reliability Practitioner (two positions) – Responsible to facilitate all of the work identification activities (RCM2 – Reliability-centered Maintenance, MTA2 – Maintenance Task Analysis, CII – Current Inspection Implementation, and Root Cause Failure Analysis (RCA)) used to build technically valid maintenance programs for production equipment.
- Equipment Specialist (two positions) – Responsible to implement the action plans recommended by RCM2/MTA2 analyses in the form of indicators, inspection routes, and corrective tasks within the AssetWise Performance Management software. The Equipment Specialist is also responsible for the acknowledgement of indicator alarms within the AssetWise Performance Management software and the continuous reliability improvement of production assets within their area.
- Equipment Inspector (two positions) – Responsible to perform the equipment inspections following the routes built in AssetWise Performance Management and enter the equipment conditions in their handheld inspection devices. The Equipment Inspector is also responsible to provide feedback to the equipment specialists as needed to improve the quality of the indicators and routes.
- Lead Planner/Scheduler (one position) – Responsible for planning and scheduling proactive inspection and corrective activities to address non-normal equipment conditions. This role is critical to the weekly downturn planning/scheduling activities, which now incorporate much more proactive work.
- Planner (two positions) – Responsible for the detailed planning of inspection and corrective maintenance jobs within the Tabware CMMS. This includes the identification of all parts, materials, manpower, procedures, safety information, permits, tools, and so on, required to perform corrective maintenance work efficiently, effectively, and safely.
- Operator (one position) – Responsible for performing operator inspections of equipment and providing operator input to the work identification analyses.

Asset Risk Prioritization

To determine the order in which production equipment would undergo work identification, an asset prioritization analysis was conducted using AssetWise Performance Management on the finishing mill systems within the HSM. The output of this analysis is a relative risk number assigned to each system identified. The relative risk number is the sum of the magnitude of consequences of failure of the system in terms of a number of criteria (including safety, environment, quality, throughput, cost, and customer service) multiplied by the likelihood of failure of the system. The relative risk list, sorted in descending order in AssetWise Performance Management, was used as a starting point for the WCER team to develop their work identification plan for the HSM. However, relative risk was not the only parameter considered in the development of the work identification analysis plan.

Efficiencies Using AssetWise Performance Management Smart Copy

Another key factor used in determining the sequence of analyses was the potential that an analysis had to be applied to multiple assets. The team identified those systems that were similar to others within the HSM, as these offered the opportunity to fast track both the analyses and their implementation through the use of templates and the Smart Copy capability within AssetWise Performance Management. In this manner, failure modes and the associated action plans developed through formal work identification analysis for one asset are copied to another asset, taking along all the detail of the indicators built to inspect for asset condition and the corrective task required when the indicator condition is found to be non-normal. A validation of these failure modes, condition indicators, and tasks is performed with equipment operators and maintainers prior to making



them active to ensure that they do in fact apply in the operating context of the new asset. The use of this software functionality allowed for rapid implementation and deployment of technically based maintenance programs for the like type systems within the finishing mill. Their strategy to employ templates and analysis copying enabled the HSM WCER team to rapidly implement 11,236 indicators within 12 months.

Work Identification

ArcelorMittal USA WCER leadership identified four options to be used for formal work identification, including Aladon Reliability-centered Maintenance (RCM2), Aladon Maintenance Task Analysis (MTA2), Current Inspection Implementation (CII), and Root Cause Failure Analysis (RCA). These approaches vary in their level of rigor from the very detailed analysis of RCM2 to the less rigorous approach of CII. The approach selected depends on a number of factors including the complexity and criticality of the equipment, availability of knowledgeable resources, current and targeted performance of the equipment and the current level of knowledge of the equipment operation and its performance. The Burns Harbor HSM leadership chose to employ only MTA2 and RCM2 for all of their analyses. Key reasons for this decision included:

1. Thorough program documentation was identified as a requirement of the effort.
2. Sufficient resources available to support all elements of work identification performance and implementation.
3. They are strong supporters of technically valid work identification techniques.
4. MTA2 specifically offered the potential for rapid program implementation within AssetWise Performance Management and therefore rapid deployment of the improved proactive inspection activities.

Work identification analyses were conducted with the participation of trades and operating personnel from the finishing mill area. Once analyses were completed, the results were compiled into summary reports for review and approval by the area management team.

Implementing Maintenance Action Plans

Following approval, equipment specialists implemented the action plans through the creation of indicators within AssetWise Performance Management. An indicator is defined as a point of inspection for an asset that highlights whether or not a specific failure mode is developing, which could potentially lead to a subsequent asset failure. The indicators were organized into logical groupings called routes, which are all of the indicators to be inspected by a specific role at a specific frequency for a given asset operating condition. New routes are validated by the implementer working with an inspector to complete the route to identify any changes to indicators or their sequencing, which would improve inspection quality and effectiveness. Once validated, the routes are activated and data collection and analysis commences.

The 11,236 indicators implemented in the first year have been organized into 386 separate inspection routes for operating and maintenance personnel. Of these routes, 45 percent are performed while the equipment is running, while the balance must be done during a shutdown.

With use of the AssetWise Performance Management Asset Health Indicator Panel, the team was enabled to manage equipment problems by exception since the software consolidated all sources of condition data, analyzed the data based on rules, and calculations and provided one central view of the health of assets. Those responsible for an area are alerted when a problem arises, based on the condition data input from various sources.

Use of Predictive Technologies

The HSM WCER team aimed to maximize the effectiveness of its reliability program through the use of predictive technologies for asset inspection wherever possible and practical. This has resulted in the extensive use of vibration, thermographic, ultrasonic, and oil analysis techniques throughout the program. Predictive technologies have already proven highly successful in identifying non-normal asset conditions for follow up.

In order to monitor how effectively the WCER business process is executed, the HSM WCER team built Key Performance Indicator (KPI) dashboards within AssetWise Performance Management to track and report on all aspects of WCER, including strategy development, program implementation, performance management, and work management. This information provides personnel involved in WCER the means to quickly see how well they are executing their business process activities and highlights any issues well before they negatively impact equipment performance.

Results:

Over a 12-month period after the launch of the WCER program in the Burns Harbor HSM, a total savings of USD 2.1 million was realized. This savings came from several areas including:

- Avoidance of unplanned downtime of production assets through equipment inspections aimed at identifying potential failure conditions and through the modification of production equipment to eliminate specific failure modes. The non-normal conditions were addressed with appropriate corrective action prior to failure. These improvements resulted in a savings of USD 1,282,500 due to avoided equipment failure.
- Improved efficiency of corrective work performed during scheduled plant shutdowns due to information provided from equipment inspections coupled with improved planning and scheduling practices. Schedule compliance for shutdowns has increased from 65 to 80 percent resulting in a manpower savings of USD 394,400 on an annual basis.
- An improvement in HSM work ratio due to reduced asset downtime that translates to a savings in energy (gas/electric) consumption of USD 400,000.

Significant Costs Avoided – Some Examples:

Some specific examples of unplanned downtime of production equipment that was avoided through the identification and correction of non-normal equipment conditions or redesign of the equipment are:

Single Modification Saves USD 200,000 Per Year by Avoiding Unnecessary Bearing Failures

During the analysis of the finishing mill stand No. 1 (F1), it was identified that bearings failed on average twice per year at a cost of USD 100,000 per bearing. These failures were determined to be caused by problems with the lubrication hoses. The analysis team

Over a 12-month period after the launch of the WCER program in the Burns Harbor hot strip mill, a total savings of USD 2.1 million has been realized.

recommended that the hoses be redesigned in a manner that eliminated this cause of bearing failure. This redesign has been completed and no bearing failures have occurred since the change. This single modification saves USD 200,000 per year by avoiding unnecessary bearing failures.

Vibration Inspection of Finishing Mill No. 6
A vibration inspection of finishing mill No. 6 main gearbox was identified through formal analysis and implemented on this equipment. Routine performance of the inspection highlighted a high vibration condition of the gearbox.

Further investigation triggered by this non-normal vibration reading identified the likely cause to be a lack of coupling lubrication. The coupling was properly lubricated and another vibration reading taken, which was found to be normal.

If the coupling had failed, the corrective action would be to change the set of main drive reduction gears on which the coupling is press fit. The cost to recondition the gear set and coupling is USD 385,000, which is the cost avoided due to taking corrective action when this non-normal condition was detected.

Infrared Thermographic Inspection
An infrared thermographic inspection of the main drive spindles on the finishing mills showed the temperature of four of the spindles to be excessively high. Investigation revealed that grease fittings on these spindles had failed and, as a result, proper lubrication was not being supplied. On the next shutdown, the grease fittings were changed and the spindles greased. Subsequent infrared inspection showed the spindles to be running at normal operating temperatures. Each unexpected spindle failure would have cost USD 120,000 and therefore detecting and correcting this non-normal temperature on four units represents an avoided cost of USD 480,000.

A lubrication oil analysis task was identified for the ram gearbox on each finishing stand. On the first inspection, three of the seven gear boxes were found to have extremely low oil levels, triggering critical alarms in AssetWise Performance Management. The gearboxes were drained and refilled with lubricating oil. A failure of any one of these gearboxes would cost USD 38,000 and therefore this inspection finding represents an avoided cost of USD 114,000.

Effective Use of Manpower During Weekly Scheduled Shutdowns
The HSM WCER effort has also driven a significant improvement in effective use of manpower during weekly scheduled shutdowns. In the past, shutdown work schedule compliance averaged only 65 percent due to the large amount of work identified during the shutdown. Much of this work was found to be critical enough that it had to be addressed before returning the mill to operation. This meant that some of the planned and scheduled work was delayed to a later time. The manpower applied to the newly found work was not efficiently used because the work they were performing was not planned in advance. Much of their time was spent searching out parts and tools to complete the jobs.

Equipment inspections developed and implemented through WCER have ensured that more of the critical corrective work is identified in advance, allowing the jobs to be fully planned and scheduled prior to the shutdown. The manpower available on shutdowns is now more efficiently utilized on planned activities and the work schedule compliance for shutdowns is now 80 percent every week. This increase in the efficiency of shutdown manpower utilization translates to a savings of USD 11,600 per shutdown or USD 394,400 on an annual basis.

The average production equipment delay rate in the HSM before implementation was over 20 percent, averaging 22 percent delay rate or 78 percent working ratio. Since starting the WCER in the HSM, the average delay rate dropped to 18 percent, which is a working ratio of 82 percent. Though this improvement did not translate into additional profit at the time due to economic conditions, it resulted in significant energy savings (gas/electric only) in the amount of USD 400,000 year to date. Once economic conditions improve and markets return, the increased working ratio will deliver a significantly higher profit to the organization through increased production capability.

Additional Benefits

Additional benefits of the Burns Harbor HSM WCER effort, which cannot be quantified in terms of cost savings, include:

- Increased focus on effective planning of shutdown corrective work, resulting in improved safety for work crews.
- In order to perform more effective inspections, the WCER team has focused on cleaning up the entire finishing mill area. This has improved working conditions for area personnel and, in turn, has improved worker safety.
- With the exception of one position that was filled from outside, the entire WCER team was formed from existing HSM personnel without increasing the labor budget. Therefore, this improvement effort came at little additional cost to the business unit and yet has already delivered significant savings.

Future Direction

As a result of the improvements made in the finishing mill area of the HSM, the WCER team has now been mandated to implement a proactive maintenance program for the run out table and coiler area. Additional resources will be needed for this work and they will be drawn from the existing HSM workforce. With this increased scope of work, the WCER team is now responsible for the reliability program for 50 percent of all of the HSM assets. The team will continue their work in the same manner until all HSM assets have been addressed. It is clear that by taking a very focused approach to reliability improvement, providing team members with the essential skills, tools and information to be effective, and looking for opportunities to fully leverage all of the work done, the WCER team at the Burns Harbor hot strip mill have achieved very dramatic results in a one-year period.

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