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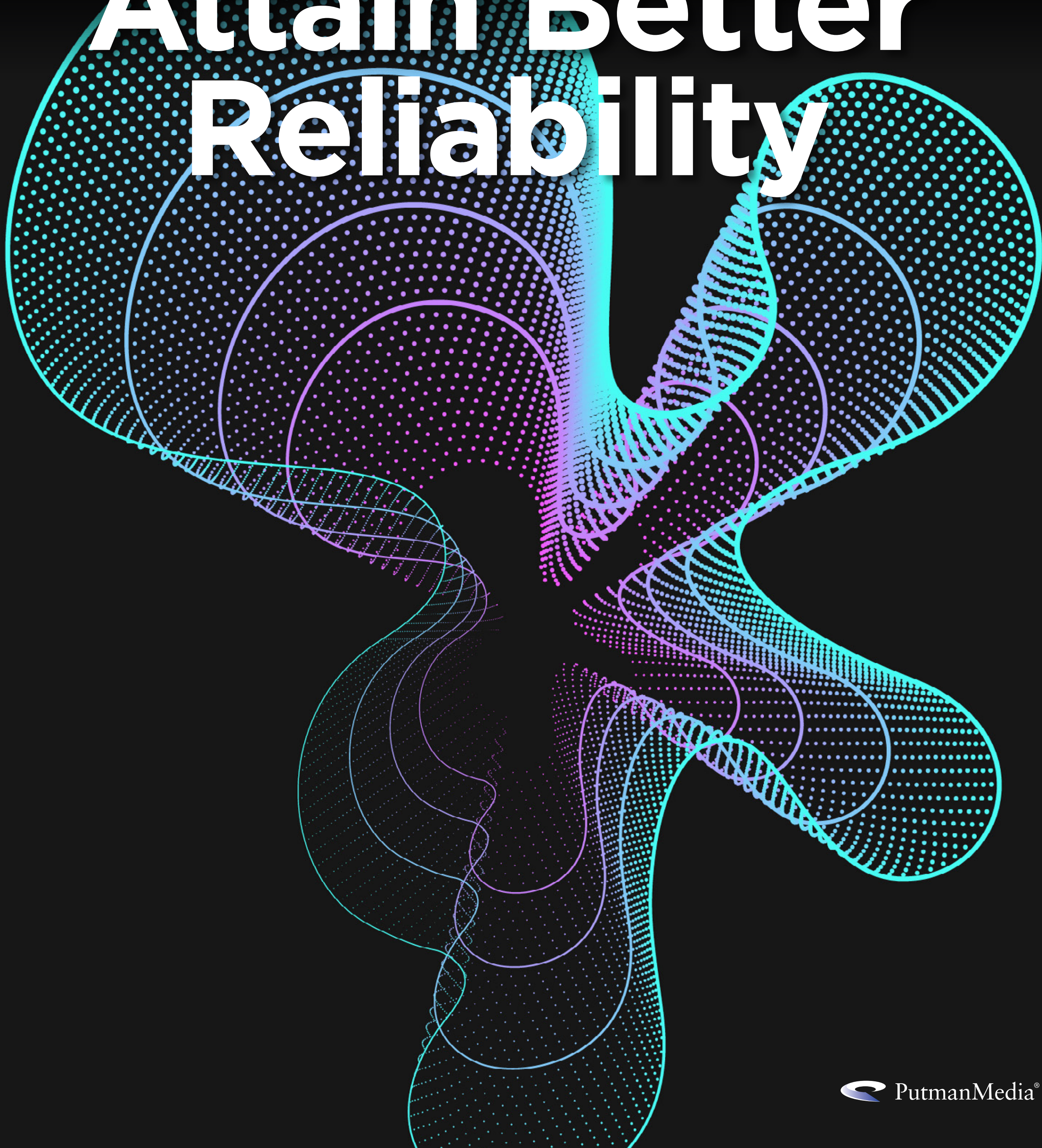
Attain Better Reliability



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When Your Assets
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Chesterton's total system solutions for pump and valve asset management can improve reliability, reduce life cycle cost, and enhance overall operating efficiency and availability.
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Successfully Implement a Reliability Program

Avoid eight common pitfalls that can lead to failure

By Adam Grahn, Deloitte Canada

The purpose of a reliability program is to ensure that a plant's physical assets can meet production goals at the lowest possible unit cost while mitigating safety and environmental risks. Such a program requires ongoing assessment, testing and performance reporting. It should become embedded into the culture of the plant as just "part of the way work is done."

Any information and measures must be used to assess the financial, environmental and operational impact of the plant's assets, and consequently to bolster the bottom line of the organization in a cycle of continuous improvement.

A reliability program will ensure the "hidden capacity" of a plant is uncovered and exploited for maximum operating effectiveness at the lowest marginal cost. This is especially true as the age of a facility begins to take a toll and equipment approaches (or exceeds) its expected useful life, as is so often the case in the chemical industry.

Unfortunately, implementation of a reliability program isn't without pitfalls. Missteps can seriously derail successfully implementing the program and sour plant leadership and frontline staff on any future attempts. So, it's critical that a reliability program is implemented correctly the first time.

WHY DOES RELIABILITY MATTER?

Put simply, from a cost/benefit perspective a business-focused and technically based reliability program arguably is the most economically feasible and successful method for delivering a strong return on assets.

A well-functioning reliability program ensures a plant is positioned to take advantage of market changes that can make a particular chemical more (or less) profitable almost overnight.

Reliability is the grease that lubricates a plant's ability to "do more with less," which is the economic reality that many chemical processing facilities face.

A well-functioning reliability program ensures a plant is positioned to take advantage of market changes that can make a particular chemical more (or less) profitable almost overnight. Moreover, as a plant's asset base begins to degrade and long-range capital budgets are slashed, applying reliability principles aimed at getting the most out of the existing assets and extending their life while simultaneously managing new capital assets properly is imperative.

At its root, a well-designed maintenance and reliability program will:

- identify and quantify high-risk assets to allow for prioritization of maintenance, operations and new capital efforts;
- pinpoint and mitigate known causes of failure so equipment functions to its intended design requirements;
- reduce susceptibility to catastrophic events;
- optimize maintenance and operating costs;
- ensure spare parts are on hand when needed... and aren't when they're not;
- defer capital and extend asset life;
- make certain new assets are adequately cared for and available to operate for their entire expected life; and
- promote building a culture of asset care and continuous improvement into the workforce.

CAUSES OF FAILURE

Unfortunately, despite the strong business case and clear benefits of implementing business-focused technically based maintenance and reliability programs, such programs often fail to deliver on their promise at a chemical plant. Let's look at eight typical reasons for this:

1. *Lack of leadership support*. An informal survey pointed to this as the most common cause of failure. In essence, it usually stems from:
   - absence of a well-defined business case to identify the benefits of implementing the program;
   - poor communication of the scale and

One of the first steps to building a reliability program is to identify a plant's assets and evaluate their criticality and risk in a structured way.

impact of implementing a reliability program on the rest of the organization; and
- senior management viewing maintenance and reliability as a cost center.

What to do: Engage leadership early and build a business case that clearly outlines the benefits to your organization based on your specific chemical and plant configuration. Ensure the business case is presented in the language of your senior management and is aligned with its vision. Don't shy away from critical issues of cost and risk — and build out a clear roadmap that indicates when financial benefits should be expected and how they will be measured.

2. *Poor application of risk-based thinking.* One of the first steps to building a reliability program is to identify a plant's assets and evaluate their criticality and risk in a structured way. Too often, chemical manufacturers neglect to undertake this important activity or misapply the logic, leading to devoting significant effort to assets that present low risk to the organization's goals or, conversely, contribute little to its profitability.

   What to do: Make certain a clear and consistent risk matrix is used across the production asset base. Ensure the organization correctly applies the outcomes of the risk evaluation to scheduling maintenance work, evaluating capital projects, performing reliability-centered-maintenance-type analyses, and everything in between.

3. *Failing to treat the effort as a program.* Too many chemical manufacturers regard a reliability improvement initiative as a one-time project rather than as an ongoing program. This inevitably undermines sustainment of the effort and leads to poor implementation of the outcomes of the development work.

   What to do: Build a sustainment plan from the outset. Ensure the key performance indicators selected to monitor the program are both project-based (schedule, budget, etc.) as well as

Put dedicated resources and budget to tackle the change and cultural development aspects of the program.

performance-based (availability, cost per unit produced, etc.). Also, make sure there's a clear mandate for change management and sustainment support and appropriate budget allocated to that effort.

4. *Wrong choice of people.* Many organizations tend to view reliability as "extra work." So, they assign people to the program based on convenience as opposed to skills — often picking people on "light duty" to support a program at its launch.

   What to do: Get the key technical and leadership people "into the tent" from the beginning of the project. Don't settle for "Special Project Bob."

5. *Infatuation with software.* In many cases, people become transfixed by the software tools and the tools quickly turn into the focal point for the initiative. While software tools are important, my experience clearly shows that process, practice and people are the most crucial elements for success.

   What to do: Build and implement business processes and drive tool selection based on the process that will work for your organization. Effectively put the horse before the cart.

6. *No short-term wins.* People often begin a reliability program implementation with the best of intent. However, they quickly become overwhelmed by the size and scale of the activity.

   This often can be seen when there's a short-term high level of investment but support for the project quickly evaporates when meaningful improvements to equipment performance and cost measures don't appear in the first few months of the program.

   What to do: It is critical that early efforts show tangible and meaningful wins that can be (and are) communicated throughout the organization.

7. *Inattention to change and integration.* Many chemical makers will devote significant technical resources to a reliabil-

ity initiative — but with little regard to the impact of the program on the "day to day" lives of their people. This causes fear and distrust of the program and often a passive-aggressive attitude that inevitably will cause the program to fail.

What to do: Put dedicated resources and budget to tackle the change and cultural development aspects of the program. Ensure these resources aren't just about holding hands and singing "Kumbaya" but have a well-defined and structured approach to leading the change elements.

8. *Death by training.* Armed with the best of intentions, many organizations will look at the reliability program particularly as a means for addressing a lack of knowledge within their technical group. In such cases, the companies will engage industry experts to train a specific subset of their people. They do this with little regard for the organization at large and a lack of appreciation of the substantial effort required for developing and implementing a reliability program. This leaves the organization susceptible to employee attrition. It also leads to significant effort and budget spent on formal training — with little attention to coaching, auditing, implementation, etc., that will ensure the training is put to good use.

   What to do: Look at training (especially formal classroom training) as a supplemental method for ensuring knowledge transfer. However, make sure the expectations are reasonable, and the trainees are capable of delivering the outcomes expected of them.

ACHIEVE SUCCESS

While the business case that supports implementing a reliability program is strong from a profit, safety and environmental stewardship perspective, many factors can cause failure of the program. Despite these challenges, if an organization develops a practical and robust strategy, trains its employees to embrace a proactive culture toward reliability, and gets real commitment from its leadership team, then it's likely to achieve impressive business results from its reliability program. ■

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Make Your Improvement Program Endure

Decline is inevitable unless you address plant culture issues

By Bernie Price, Polaris Veritas

It's almost impossible to work in the chemical industry for any length of time without being involved in some improvement or cost-reduction initiative. These efforts range from the random local and piecemeal to comprehensive multiyear corporate-wide programs. Many succeed, initially. However, their impact usually deteriorates over time because of the lack of discipline and personnel changes that rob the site of key knowledge underpinning success. The task, therefore, isn't just to come up with a better mouse trap but to come up with one that still will be working well in 20 years. So, you need to design not just effective but "durable" process improvement programs.

Consider a simple analogy: It might take five or more years of very hard work to cultivate a garden from raw land. However, that land, if then left unattended by trained gardeners, will return to virtual wilderness in three years or less. This illustrates that how we engineer durability into the new systems is every bit as important as the systems themselves.

The knowledge gained during the transition from an inefficient reactive operating status to "world class" performance doesn't just relate to technical improvements but also has a very large "cultural" component. A site must nail down both the technical and human interaction elements at the start.

Most manufacturing plants, particularly older ones, aren't designed, constructed or operated with the expectation they would perform at what today is considered a world-class level of performance, i.e., an overall equipment effectiveness or OEE of ≥90%. While we to some extent can build in reliability by specifying high quality equipment such as API-610 process pumps instead of ASME standard chemical pumps, it's much more difficult to anchor the systems and permanently change the cultural/operating mindset.

TRANSITIONAL CULTURAL CHANGE

The primary challenge, therefore, is getting employees to work in teams to resolve issues and solve problems around achieving "world class manufacturing efficiency."

A company faced with poorly performing assets typically commissions a "benchmarking" exercise to find just how good or bad the situation is. Not enjoying the news it usually receives, the firm then searches for a solution that hopefully will simultaneously reduce costs and improve efficiency while being both quick and painless.

Typically, the company clings to the concepts of "lean" and "cost reduction" and hopes that by sending a few employees to short training courses and conferences, the knowledge will spread by osmosis throughout the organization. This simply doesn't work. Instead, the firm should be looking for an integrated system of "enduring efficiency improvement" and "better documented methods" rather than simple cost reduction. It's not just misfocused corporate emphasis, though. Being engineers by training themselves, plant managers often undermine success by believing that simply getting more/better engineers will solve any problem. This is a common refrain I've heard from plant managers in the U.S., Japan and Europe. Sadly, having "x" more engineers isn't the answer.

TYPICAL IMPROVEMENT PROCESS MECHANICS

In basic terms, you can divide activities within a plant into four principle areas that are focused around 1) safety, 2) reliability, 3) operating accuracy and 4) quality.

Excluding the safety element for simplicity in this article, as management consultants we typically set up cross-functional element teams under the headings:

1. Work planning and scheduling;
2. Operator asset care (total productive maintenance — TPM);
3. Reliability centered maintenance (RCM);
4. Equipment condition monitoring; and
5. Multilevel problem-solving, e.g., six sigma, root cause analysis (RCA), Kaizan, etc.

Operational accuracy (excellence) improvement, i.e., error proofing, success in all these can be defined as having a fully engaged group operating in a team environment implementing industry best practices and performing each sub-activity at "world class standard."

A broader multiple-improvement initiation is harder to implement but is more durable if accompanied by a plant-wide culture change.

Just as fundamental is having a team-based culture with a methodology centered on plant-wide forms of problem-solving. The particular problem-solving techniques used must function routinely at all levels.

These multi-level problem-solving and defect-elimination processes share a step-wise approach: identification of the initial problem/issue/defect; classification by size; prioritization; and, finally, allocation of resources to eliminate it as a loss.

Often constrained by budgets, a company will recognize the need for improvement in one particular area and mount an initiative aimed at just that narrow area. Initially, that achieves impressive results but the impact quickly dwindles because the rest of the organization (having no ownership) doesn't support the efforts. A broader multiple-improvement initiation is harder to implement but is more durable if accompanied by a plant-wide culture change.

I've personally been involved for over 50 years in changing organizations from the reactive to the world class state. At first, I often became so focused on the improvement process itself that I largely overlooked the threat posed by the loss of knowledge and skills over time. I naively thought: "What people in their right mind would ever discard all the knowledge and efficiency gained during the implementation program that was producing major profit for the owner, bonuses for employees, reduced stress and job security?" Unfortunately, I discovered that all of them would to some extent.

PROMOTING DURABILITY

I've used four separate basic approaches, either singly or in combination, for different plant situations. So, let's discuss some of the pitfalls and failures I encountered.

- As an improvement project implementation reaches a conclusion, it's normal to extend the time between the periodic presentations of progress by the team leaders from monthly to quarterly and then semiannually. As a minimum, I recommend a high-level annual review with senior managers and team leaders with a written report back to a senior manager.
- Knowing that the plant's systems need constant reinforcement, a second approach is to have the owner select a talented department manager to be trained by the consultant to be part of the implementation team as the manager of the change process. Then ultimately, that person becomes the "main man" in

sustaining the systems. This approach is designed not just to achieve enduring success at one plant but also ultimately to give the company an internal consultant for efforts at other sites. I've found this approach moderately successful but it hinges on whether and how long the chosen individual remains at the company. With the knowledge gained in the improvement implementation, such people often get "poached" by competitors.

- Another strategy is to divide the responsibility for "system durability" among multiple leaders. This way, the loss of one person isn't necessarily catastrophic.
- Here, a company selects six to ten of the most-respected implementation team leaders and makes them responsible for maintaining the supporting management system.
- Even here, best-laid plans sometimes can go astray. For instance, following a very successful implementation at one plant in the Chicago area, the owner purchased two additional plants and then transferred 90% of the key individuals (improvement team leaders) from the first plant to the other plants, leaving the original plant to sink backward.
- In every case, however, a pillar of durability is a documented "operating management system" that includes industry best practices and detailed "performance standards" around the key technologies. This requires periodic auditing. Such auditing can pose many long-term issues — not only about getting the audits done but also about getting money and resources to train newcomers in the skills to keep the culture and system operating.

Consider what happened at a plant in Louisiana: The company gave an individual many months of training and spent hundreds of thousands of dollars for equipment to enable that person to set up an advanced equipment-condition-monitoring program. The program achieved four years of outstanding success. Then, a new plant manager (not understanding the criticality of condition monitoring to mechanical integrity) allowed the person to take a new job in the same plant at a half pay grade higher to do a clerical job in the safely department but didn't provide a qualified replacement. This demoralized the remaining condition monitoring team and led to collapse of the system.

OTHER KEY ISSUES

Strive to make the organization believe the success belongs to them, i.e., the organization itself is responsible for the achievement. This hopefully will foster "ownership" of the system along with the new culture it embodies. As a consultant, I find ultimate satisfaction when someone at a site says: "I can't understand why we paid all that money to someone from outside to teach us something we already knew."

Strive to make the organization believe the success belongs to them...This hopefully will foster "ownership" of the system along with the new culture it embodies.

If possible, let the lowest-level capable employee head up some element of the program. It's a learning/growing experience for the individual — and that person is less likely to leave the company.

From day one, emphasize the concept that the improvements must endure — that they should last forever and be embedded in all implementation team communication. Keep using the word "durable."

Also, concentrate heavily on the senior management team. (Maybe this should be strategy No. 1!). Give them the "big picture view" of the organization and the sustaining culture you're trying to create so they can fully support it. Senior executives operating in large organizations often expect an "individual" to drive change and success; they tend to see the world in terms of a good quarterback equals a good team.

A final but vital factor in the life of any program is realizing the most important person in the organization is the plant manager. Here, the issue is that over a 5-yr implementation, that person probably has a 70% chance of being replaced by an individual who has no understanding of the program and little or no ownership. So, do all you can to talk up the value of the improvement process and get the new plant manager invested in its success.

If that doesn't work, the only person who can help in this situation is the plant manager's boss. If you can get that executive to show a distinct interest in the progress of the program from day one rather than just in the bottom-line financial results once a quarter, you're halfway there. ■

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Establish Equipment Wellness

Achieve longevity and reduced costs with an asset management plan for fluid sealing systems

By Steven Bullen, A.W. Chesterton Company

The term "Asset Management" is often perceived as another management buzzword with little value to the business of fluid sealing. But the reality is that proper installation and management of fluid sealing systems can have an enormous role on the long-term "wellness" of pumps, mixers, valves, and other important industrial equipment.

Two different chemical processing facilities can use the same brand of pump in the same application, yet have radically different maintenance costs. That means one of these facilities is leaving a lot of money on the table when it comes to managing assets! It is estimated that approximately 80% of the cost of fluid handling systems comes from the operation and maintenance.

The healthiness of each piece of equipment has significant impact on each asset's life cycle, energy and maintenance costs and, ultimately, the reliability and profitability of the operation. There is clearly opportunity for significant savings if equipment wellness is established from the start.

ASSET MANAGEMENT PLAN

Asset management is an organizational activity and practice designed to manage assets (including pumps, mixers, agitators) as well as their performance, risks, and costs over the asset lifecycle to achieve the organization's strategic plan. These activities are formalized in an asset management plan (AMP), which takes a systematic approach.

The AMP clearly outlines:

- a specific timeframe,

- intent,
- outcome, and
- upgrade costs.

As an example, an AMP may stipulate: “The plan is intended to upgrade the XYZ Corp. polymerization unit #1 to produce 170 tons per hour with 95% purity at a cost of $800 per ton. We aim to accomplish this by investing $20 million over the next 5 years to upgrade the current fluid handling system while developing and adopting the best operating and maintenance practices.”

A plan such as this clearly indicates the commitment the company is making to this unit and its strategic importance to the overall business. Starting with this kind of a plan will help justify costs incurred in equipment upgrades or the cost of technology when the return on investment is considered.

SETTING GOALS

An asset management partner can help your plant assess the equipment and related fluid sealing and make recommendations to improve long-term system efficiency and meet your established goals.

A partner will aim to:

- reduce purchasing activity,
- lower reactive maintenance,
- increase safety,
- raise production efficiency and quality,
- lower inventory and increase asset utilization, and
- cut the unit cost of production.

For the purposes of this article, we’ll focus on two key areas for an AMP for fluid sealing of pumps:

1. Identifying and assessing the state of the current equipment, and
2. Identifying upgrades and new maintenance practices to extend equipment life.

FLUID SEALING: EQUIPMENT SURVEY/ANALYSIS

The initial step starts with a full accounting of all equipment, its operating record and conditions (Figure 1).

- Identify as much of the

RECORD KEEPING

Figure 1. Systematically recording pump conditions and failure analysis can greatly extend the life of plant equipment assets.

appropriate equipment, hydraulic, process, and sealing device information as possible.

- Identify baseline reliability and costs.
    - Survey equipment, application, resources.
    - Collect maintenance work order data, and maintenance and operating costs.
    - Determine baseline mean time between failure (MTBF) by either single piece of equipment, unit or plant.
    - Evaluate pumps, suction and discharge piping conditions and baseplate conditions.
- Identify bad actors
    - Establish plant criteria for "bad actors" — equipment that demonstrates poor performance in MTBF or by spend.
    - Identify pumps with operating points deviating from the manufacturer's pump curve and determine the energy saving opportunities.
    - Identify misapplied pumps for the system requirements.
    - Calculate baseline cost analysis
- Review system controls and operational set points.
- Create condition assessments on system equipment.

On the fluid sealing front, goals typically include monitoring pump efficiency against the manufacturer's pump performance curve, for example, and increasing the average mean time between repair (MTBR).

This practice may involve use of software or new record-keeping procedures to monitor the performance of specific pieces of equipment in a facility.

FAILURE ANALYSIS

Component failure analysis is critical. Mechanical seals and bearings represent greater than 75% of centrifugal pump failures. The cause of these component failures needs to be identified and then the root cause pursued. An understanding of why failures occur and how to eliminate them is one of the most crucial elements in establishing a longer, reliable life-cycle. This also makes it easier to identify trends.

Here are just a few of the detail steps

EVALUATION PROCESS

Figure 2. Evaluating conditions at the pump location is the beginning of the root cause failure analysis process.

involved in re-assessing the "wellness" of pumps, mixers, and agitators, as well as recommended procedures.

AS FOUND CONDITION (FIELD ASSESSMENT)

The "as found" condition needs to be addressed at the pump location and on the bench. This is the beginning of the root cause failure analysis process (Figure 2).

- Information at the pump location should indicate observations such as leakage location, barrier fluid tank pressure and level, vibration levels or traces, baseplate condition, casing condition, etc.
- Note areas of corrosion, erosion, cracks, surface damage.
- Identify location of rub marks by the impeller on the casing.
- Note any wear or cavitation damage and their location (such as the casing cut water).
- If pipe strain is suspected, the suction and discharge pipe should be loosened to determine its total movement. A standard form should be created to identify each of these areas.

"AS FOUND" CONDITION (BENCH ASSESSMENT)

Pump tear down should consist of appropriate dial indicator checks as noted in tear down sheets.

- Tools and indicators necessary for analyzing as found condition should be identified and placed in an accessible location.
- Conduct appropriate training for all personnel on proper measurement techniques.
- Indicator checks of the as found assembly should be completed and recorded on the shaft, shaft sleeve, seal chamber face, impeller OD and face, and axial shaft endplay.
- Check rub marks at all close running clearance locations such as the back cover throat area and seal diameters.

MECHANICAL SEAL ANALYSIS

When analyzing seals for mechanical, thermal or chemical damage, examine the metal components, o-rings, seal rings, and seal ring wear track (Figure 3). Maintain a seal failure analysis database to record failure modes and analyze recurring problems on the same equipment or process fluid.

ANALYSIS

Figure 3. Seals should be analyzed following pump failures to resolve failure causes or pinpoint recurring issues.

More than half of all bearing failures are due to contamination.

BEARING ANALYSIS

Bearing failure analysis should be performed either in-house by trained personnel or outside, using vendor expertise. More than half of all bearing failures are due to contamination. Contamination can be from the outside environment passing through lip seals or poor performing labyrinth seals and contaminating the oil in the bearing housing.

- Guidelines for bearing replacement should be developed that include replacing bearings on each failure.
- You can also use the vibration trace prior to removal to determine bearing condition.
- Any rub marks on close running stationary and rotary parts indicate significant shaft movement that may indicate poor bearing condition. High axial endplay also is a key indicator.

EXTENDING EQUIPMENT LIFE

Unless equipment, procedures and processes change, there will be no change in performance or lifecycles. Some changes involve minimal investment or are simply a better procedure. For example, the firm might recommend using variable-frequency drives (VFDs), trimming impellers, and eliminating unnecessary fittings as ways to achieve a more reliable and efficient fluid handling system. Other changes may include pump upgrades, cylinder upgrades, sealing upgrades, and more.

SEALING-RELATED UPGRADES

Below are some ways to extend the life of equipment that seals fluids:

Mechanical Seal Upgrades. Mechanical seal designs are available that use newly developed techniques to maintain face flatness during operation, optimize seal ring responsiveness, increase dual seal cooling, etc. These features all greatly assist in increasing reliability. Seal selection and materials should also be optimized to promote standardization where possible.

In safety or emissions-sensitive applications, non-contacting gas seals can be used. New cartridge gas seals now fit in standard pump envelopes, actively adjust to changes in stuffing box pressure, and have process pressure on their outside diameter for easier use and greater reliability. As these seals are non-contacting, their life may exceed contacting seals.

Unless equipment, procedures and processes change, there will be no change in performance or lifecycles.

Environmental Controls. Processes that contain particulate can clog or score seal faces they typically benefit from the use of a centrifugal force device to continuously clean the seal chamber. For example, Enviroseal's SpiralTrac device uses the natural centrifugal force of the seal chamber environment to collect, concentrate particulate, and expel it from the seal chamber. It can also be used to reduce Plan 32 flush flow rates to minimize dilution.

Seal Piping and Barrier Fluid Tanks. Piping for dual seals should be standardized. Piping size, material, slopes, valve type and valve locations should be standardized for barrier fluids.

- Stainless steel barrier fluid tanks should be used.
- Barrier fluid tanks using pressurized barrier fluid (Plan 53) should be set to 15 – 30 psig above maximum stuffing box pressure.
- Pressure gauges should be in working condition and pressure requirements stated.
- Barrier fluid level and pressure should be monitored at periodic intervals and necessary corrective actions taken.
- Contamination of barrier fluid should be avoided from containers and supply when adding barrier fluid to renew liquid levels.
- The barrier fluid tank should be located as close to the mechanical seal as possible to reduce pipe friction losses and promote maximum barrier fluid flow.
- Barrier fluids should be compatible with the process fluid and provide adequate lubrication, be clean, not degrade and be compatible with mechanical seal components.
- Other piping plans such as Plan 11, 54, 13 etc. should be evaluated for their application and set-up in a similar fashion.

Bearing Protection. This is essential to avoid mechanical seal failure. Bearing damage results in more axial movement and shaft deflection that ultimately results in seal failure and equipment damage.

Studies have shown that most bearing failures are caused by insufficient or improper lubrication. Reviewing the lubrication technology being used and the application and frequency can make a great difference.

Rubber lip seals protect most centrifugal

If the equipment, procedures, and processes don’t change, one thing can be guaranteed: There will be no change in performance.

pump bearings. Many pump standards such as API 610 standard for refinery and petrochemical pumps and the ASTM F998 standard for marine pumps discontinue the use of lip seals for bearing protection. Studies have shown these seals have much shorter life than the bearings they are protecting.

Other seals to consider:

- Non-contacting labyrinth seals offer increased protection from contamination.
- Positive face seals isolate the bearing housing and provide maximum bearing protection on pumps in atmospheres with high particulate and moisture.

OTHER UPGRADES

Pump Upgrades. If the equipment, procedures, and processes don’t change, one thing can be guaranteed: There will be no change in performance. Centrifugal pumps upgrades can easily be addressed and standardized as part of a pump repair.

Upgrades may include:

- Reconditioning the pump surfaces and applying protective coating to improve energy efficiency by 5–20%
- Minimizing shaft vibration and deflection to keep pump operating at its best efficiency point (BEP).
- Checking shaft deflection using the shaft slenderness ratio and upgrade with new power ends/solid shafts.

Seal Chamber Upgrades. Seal chambers have been designed to enhance the environment for the mechanical seal. Enlarging the diameter around the mechanical seal to 5/8 in. or 1 in. around the shaft results in greater cooling, lubrication, and less clogging of the mechanical seals.

C-Frame Adapters. Motor adapters are available for many pumps. The adapters automatically align the motor to the pump. C-frame adapter motors can be bought or the end bell retrofitted to use with the adapter. Coupling alignment is automatic. Misalignment due to thermal growth, pipe strain and vibration is minimized.

Pump Build-Up. The pump assembly process should also be monitored carefully. Indicator checks of the completed assembly should be performed and recorded. Seal and bearing installation training assists in minimizing start-up failure. Impeller adjust-

Proper equipment training and time to perform the procedure is critical.

ments should be set correctly for shaft thermal growth in hot processes.

Coupling Alignment. This is critical to minimizing the vibration that will cause premature bearing and seal failure. Proper equipment training and time to perform the procedure is critical. Soft foot should always be checked. Proper techniques for aligning of equipment at elevated temperatures should be used. The use of c-frame adapters to align and ensure motors are aligned to the pump should be investigated. Tolerances for soft foot and alignment should be established for equipment types and speed. Both as found and as left misalignment should be recorded.

Pipe Fitting. Piping to pumps should be viewed from both a mechanical and hydraulic perspective. Mechanically, it is important to ensure that the pump is not subjected to stresses from the piping. Pipe hangers should be positioned correctly. Axial, radial and angular pipe tolerances should be established for suction and discharge connections. Establish procedures for checking and retrofitting existing installations. New installations should be governed by engineering standards.

Improper set-up of piping from a hydraulic standpoint will result in increased hydraulic turbulence and possible localized cavitation leading to shaft vibration. A minimum of ten diameters of straight run pipe is needed in front of suction piping and a minimum of five diameters after the discharge. Eccentric reducers on the suction side of the pipe should be mounted in the correct orientation.

Preventative Maintenance – Lubrication. Oil viscosity and type should be selected for a range of process temperatures. Higher temperature applications may need higher viscosity.

Some best practices include:

- Always check the oil level setting when rebuilding pumps.
- Use non-leaking seals such as labyrinth or face seals.
- Consider oil analysis to detect lubrication problems with both the general population and specific problem equipment.

Preventative Maintenance - Vibration Analysis. General vibration on equipment should be performed on a periodic basis. In some cases, vibration traces can be recorded in the as found and as left conditions to assist in root cause analysis and its solution. High acceleration frequencies can be monitored

Vibration analysis can also assist in identifying failure modes and their solution.

for bearing condition and low velocity frequencies can be measured for general equipment condition. Vibration analysis can also assist in identifying failure modes and their solution.

NEW TECHNOLOGIES

On the sealing front, recommendations may include upgrading to improved technologies such as:

- Split seal technology to reduce leakage and its resulting impact on equipment, in preference to pump packing;
- Dual seal technology in applications which require absolute zero leakage or backup seal coverage;
- New material technologies in mechanical, rotary, hydraulic seals and packing that extend shaft life and withstand demanding conditions;
- Environmental controls that prevent contaminants from invading the seal faces to reduce or eliminate the need for a flush; and,
- Higher-grade lubricant technology to decrease friction.

ROUTINE WELLNESS CHECKS

These are just some of the upgrades and best available techniques to increase the "healthiness" of fluid sealing systems.

Using an AMP with a systemized approach across teams, monitoring equipment health becomes routine. Employing this methodology, monitoring the right areas, and educating staff on best practices, your organization will make considerable progress in capturing the long-term savings and extend the life of older equipment. ■

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Tap into expert knowledge. Chemical Processing editors and industry experts delve into hot topics challenging the chemical processing industry today while providing insights and practical guidance. Each of these free webinars feature a live Q&A session and lasts 60 minutes.

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Have a question on a technical issue that needs to be addressed? Visit our Ask the Experts forum. Covering topics from combustion to steam systems, our roster of leading subject matter experts, as well as other forum members, can help you tackle plant issues.

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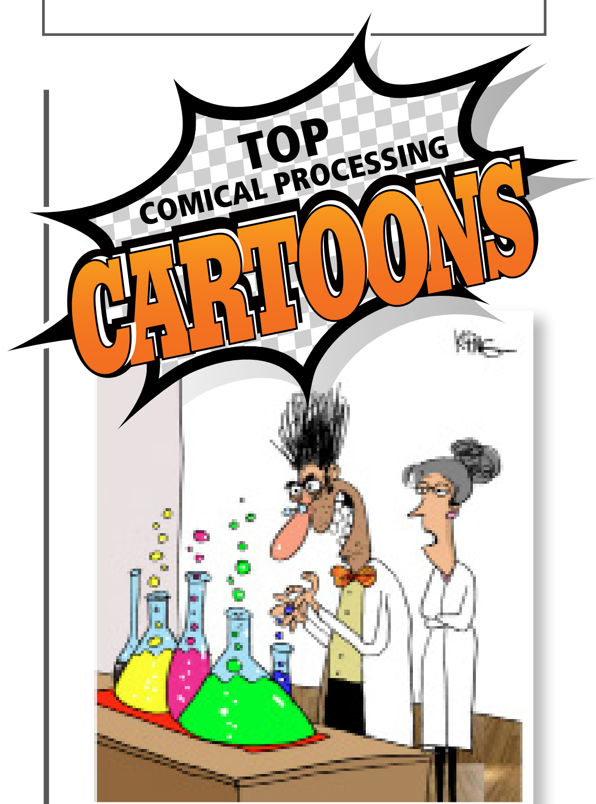

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