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Advanced Machine Reliability Resources, Inc.

A Vision for Precision Machinery Lubrication

Question: What is the value of precise, efficient lubrication practices?

Answer: Dependable plant capacity without additional capital expense.

The Indirect Impact: The biggest reason to focus on improvements in this foundational plant practice is to improve plant capacity. Maintenance repair cost reductions may inspire the initiative, and may well justify the costs typically required to achieve substantial improvement. However, regardless of how substantial these benefits may be, they pale in comparison to the value accrued to the organization through dependable, repeatable capacity.

Dependable, repeatable capacity enables progress in multiple aspects of enterprise management: reduced COGS, improved or sustained quality, improved safety performance, improved customer satisfaction, improved financial performance, and improved value for stock holders, and improved job security for the persons involved in the enterprise.

The Direct Impact: Precision Machine lubrication also enhances the direct financial performance of the maintenance practice. Consider this: for every dollar spent on lubricant purchases, a capital intensive manufacturing plant will also spend between $10 and $20 dollars on repairs of lubricated, and their tangent, components. The site will also spend $3 to $5 dollars on labor for each dollar in lubricant purchases. Analyze your own budget and you will find this relationship to exist.

Budget Line Item	Amount
Lubricant Purchases	$100,000
Labor Purchases	$300,000 – $500,000
Component Purchases	$1,000,000 – $2,000,000
Total To Sustain Lubricated Components	$1,400,000 - $2,600,000

To put this another context, for each dollar that the site spends on lubricants, it will spend on average another $20 dollars to sustain the operation of lubricated components, producing a 20:1 expense to expense ratio. In practical terms, if the site lubricant expense is $100,000 dollars, then a reasonable estimate of the additional labor and mechanical repair expense is $2.0 million dollars.

Two changes must occur to improve this expenses ratio.

- First, make the dynamic oil film between the components thicker.
- Second, make the oil film between the components cleaner.

That's it. Accomplish these two changes and the ratio *will* decline. Theoretically, it must decline. Accomplishing these two changes is not easy or free, but it is certainly possible.

The Benefit of Wider, Cleaner Dynamic Oil Film Clearances

The impact from improvements in the selection, application and maintenance of the lubricant to accomplish the two results (thicker, cleaner) can be immediately recognized through reduced costs in lubricant use, labor use and parts replacement.

Each program assessment to date has uncovered overwhelming cash flow and five year return potential when the following program parameters are analyzed:

- Product consolidation and inventory reduction
- Product (lubricant) lifecycle extensions
- Product cleanliness management
- Lubricant application and replenishment rates
- Oil Analysis improvements – sample collection
- Oil Analysis improvements – test selection and alarm setting development
- Component rebuild reductions

The most significant financial impact, limiting production losses, is generally not included for a variety of good reasons.

The Economic Driver – Reduced Cost of Operations

Because it is a 'maintenance' function, and because maintenance is generally responsible for managing the cost of existing capacity rather than expanding capacity at a reduced unit cost, the likely driver will be reduced ongoing cost of machine care.

Fortunately, the long term improvement in cash flow from combined reductions in labor consumption, material consumption, machine parts consumption (machine repair), and lost production (due to scheduled and unscheduled downtime) represents a tremendous dividend for an arguably miniscule investment.

The AMRRI Mission

Advanced Machine Reliability Resources **(AMRRI)** was formed to assist companies in their efforts to improve productivity (reliability and repeatability) and reduce cost through changes in machine lubrication practices.

AMMRI provides services configured along one or more of these five avenues:

1. Turnkey Contract Lubrication Management (2010) – AMRRI will define and execute planned lubrication practices on five-year agreements, with specifically identified objectives for cost reduction and machine performance improvement.
2. Lubrication Management Support – AMRRI provides in-plant direction and management support to site personnel, including the identification of specific improvement targets and timetable.
3. Technical Evaluation and Strategic Planning – AMRRI provides companies with analysis of their current program's strengths, weaknesses and opportunities for improvement. AMRRI then works with site management to define a strategic plan for improvement.
4. Technical Analysis and Problem Solving – AMRRI contracts with the site to address specific technical issues and present solutions to those issues only.
5. Education and Personnel Development – AMRRI provides onsite or off-site technical education and training to support the site's existing developmental program.

The following sequence of events represents the orderly process that AMRRI observes for the development of Machine Lubrication Practices

Step 1. Benchmarking and Gap Analysis – AMRRI uses a gap analysis tool that was initially used to conduct measurements of the state of lubrication practices at EPRI (Electric Power Research Institute) member power generation plants. The survey and analysis tool has been modified several times in the last seven years to fit other production environments, including: petroleum exploration and refining, minerals and cement processing, paper manufacturing, and food processing. The well-developed survey process and gap analysis is designed to identify the right components for an improvement strategy.

The survey and gap analysis follows this general profile:

a) Meet with maintenance and production management to discuss benchmark and gap analysis objectives and expectations (.5 to 1.0 hours +/-).
b) Tour the site and review the state of conditions pertaining to:
   1.) Lubricant inventory complexity and redundancy
   2.) Lubricant 'depot level' storage, 'open' storage and lubricant handling methods
   3.) Existing scheduled (PM) practices

4.) Lubricant selection and application (type, frequency, quantity, etc.)
5.) Oil sampling and Analysis practices
6.) Lubricant contamination control practices
7.) Lubrication Program Definition and Control (SOP's, PM details, PM intervals..)
8.) Lubricant scheduling and tracking methods
9.) Lubrication Management (goals and objectives, personnel selection, training and certification, inter-company communication, etc...)

c) Interview Maintenance Management, Maintenance Department Managers (mechanical, electrical), and maintenance planners to discuss and evaluate goals, objectives, and planning method for the use of the lubrication program to support machine health.
d) Interview persons currently conducting lubrication activities if possible while touring the site. Ask questions that produce responses that indicate what they know about this particular aspect of maintenance.
e) Take photographs to include in the report to apply emphasis to specific areas and items for improvement.
f) Prepare a report that includes: an assessment of strengths, weaknesses, opportunities and threats, identifies opportunities for positive cash flow (short term) improvements, identifies project opportunities for long term improvements, and supporting details on other items identified for improvement (as time allows).

The survey and gap analysis is the best way to clearly identify the things a site is doing well and the things that need attention. Once the survey and report are complete, site managers will have a list of improvement opportunities that conform to the challenges of the production environment(s), and conform to the specific site reliability objectives.

2. Education – through a variety of delivery methods.

a) Private content development and delivery - AMRRI can provide any length of presentation on the topic, from a simple half or one-day 'introduction' level course for machinery operators and mechanics, to an extensive treatment divided into several weeks. Private training sessions ranging from one to four day (eight to 32 hours, 8 hours per day), and delivered according to the site-specific schedule are common.

b) Education via Community College centered credit courses – AMRRI has developed a 3-credit hour Introduction to Machinery Lubrication course that any supporting community college can adopt to fulfill local site training requirements. If there are no community colleges supporting the site/region/division then AMRRI can provide an equivalent of the course without credit at a time and place of the client's selection. The course syllabus and a sample of presentation content is available upon request.

c) Vigorous testing and verification of learning-gain – most training departments want more than a certificate of attendance these days. AMRRI can provide testing in a variety of ways, including pre-course exam, per-section exam, and/or final exams.

This specific test, or set tests, does not represent a certification. However, if a given student can pass a 100 question multiple-choice exam based on a random draw from the 500 questions in the library, then that student certainly should be able to pass the ICML MLT Level 1 test. A sample of test questions is available upon request.

3. Practices and Methods development – Companies can enhance their productivity by establishing, implementing and maintaining standardized practices for production and maintenance routine activities. Effective or 'Best Practices' are those practices that conform to the immediate production and business requirements. The process for creating standardized work practices is time consuming initially, but becomes useful when personnel changes occur, and/or when personal assignments change frequently.

In operating environments where lubrication technicians are not fully knowledgeable on effective machine lubrication practices (including some understanding of the scientific principals involved), the standing practices morph to reflect the opinion and judgment of the personnel involved. This creates significant, and often damaging, variability.

AMRRI can participate in refining existing SOP's and/or can provide detailed 'precision lubrication' work practices that can be incorporated into existing work plans. Documents can be provided in either excel, word, or PDF format for integration into existing CMMS systems. Alternately, AMRRI can populate a stand-alone scheduling system to complete management of operating and outage based lubrication activities.

4. Contract Management and Contract Lubrication Services – (2010**)** AMRRI can provide contract lubrication management support aimed at helping existing company personnel improve the effectiveness of site practices. (2008) Additionally, AMRRI is willing to place management contract personnel for fulfillment of the entire lubrication program, including: lubricant supply, delivery, application, removal, analysis for condition monitoring, machine inspection, and specialized services as required.

5. General Consulting – AMRRI has either recently supported, or is currently involved with, activities for each of the following organizations, in alphabetical order:

- Buzzi Cement (multiple sites –benchmarking, gap analysis, strategic planning, training)
- Chevron (benchmarking and education)

- Electric Energy, Inc. (problem diagnosis and resolution, retainer based consultation activities)
- General Mills (benchmarking, gap analysis, lubricant analysis)
- Michelin (problem diagnosis and resolution, retainer based consulting activities)
- Mosaic, Incorporated (lubricant analysis)
- Rayonier, Incorporated (education).
- Red Rocks Community College (course content development)
- SKF Reliability Group (benchmarking, gap analysis, lubricant analysis)
- STLE (technical content development)
- Trico (training education)
- Valero Energy (benchmarking, gap analysis, lubricant analysis)

AMRRI welcomes your interest in the development and implementation of the critical, foundational component of optimized process and machine reliability. Please call 615.771.6030, or email us at info@amrri.com.