Industrial Applications of Infrared Thermography

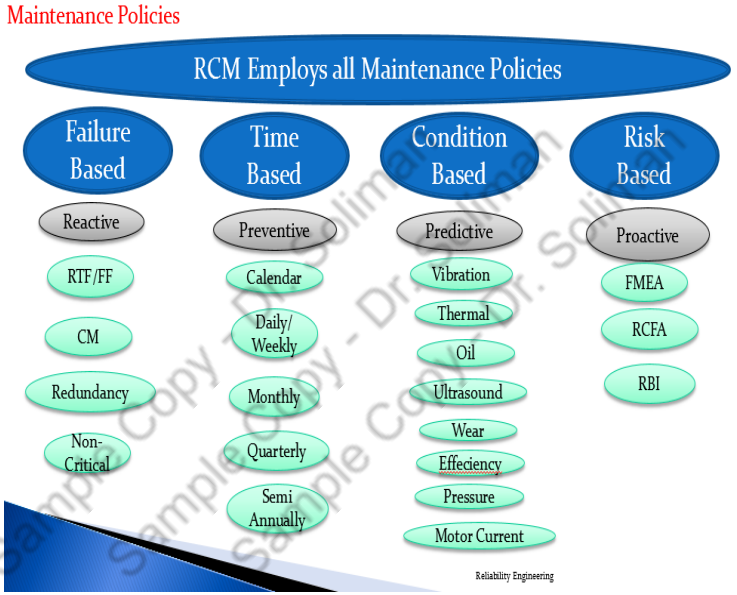
How Infrared Analysis Can be Used to Improve Equipment Inspection

By Mohammed Hamed Ahmed Soliman

Contents

Overview on Condition Monitoring

Maintenance Policies and Strategies

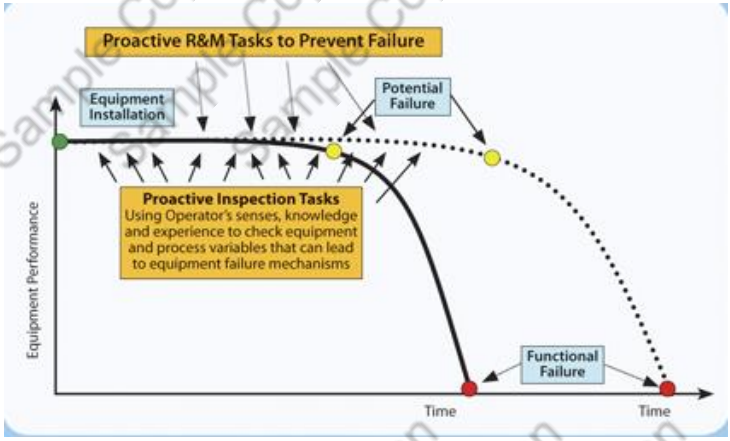


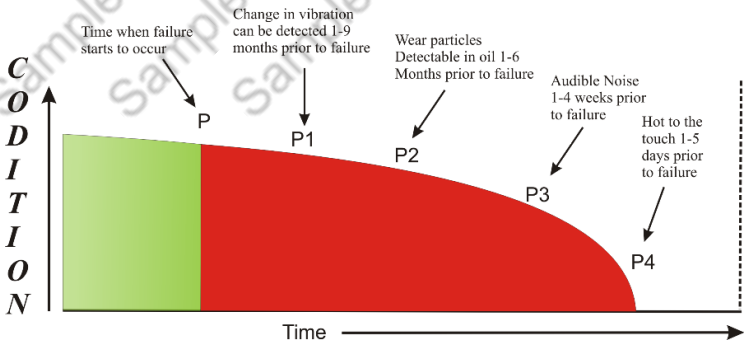
Reliability centered maintenance promotes the use of Predictive and Risk Maintenance policies for identified critical equipment

Predictive Maintenance Techniques

Predictive Maintenance Embraced by Plant Maintenance

Technique / Application	Pumps	Electric Motors	Diesel Generators	Condensers	Heavy Equipment / Crane	Circuit Breakers	Valves	Heat Exchangers	Electrical Systems	Transformers	Tank Piping
VIB Analysis	•	•	•		•						
Oil Analysis	•	•	•		•					•	
Wear Analysis	•	•	•		•						
IR Analysis	•	•	•	•	•	•	•	•	•	•	
Ultrasound	•	•	•	•		•	•	•	•	•	
Non-Destructive testing (Thickness)				•			•			•	
Visual Inspection	•	•	•	•	•	•	•	•	•	•	•
Motor Current Analysis		•									





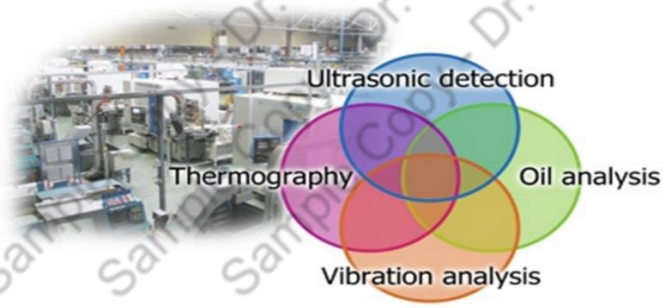
Reliability KPIs

KPI	Description
MTBF	Mean Time Between Failure
No of failures addressed by root cause analysis	>75%
Ratio of PM work orders to CM work orders generated by PdM inspection	
OEE (Overall Equipment Effectiveness)	Availability x Reliability x Quality (85%)
Percent of Faults Found in Predictive maintenance Survey (Vib, IR, UT, OA)	No of faults found/ No of devices checked (target <3%
Percent of equipment covered by condition monitoring	Target= 100%
Reliability of critical equipment	99%
Facility Availability	>98%
Availability of critical equipment	>98%
Percent emergency maintenance	<5%
Percent planned maintenance	90%

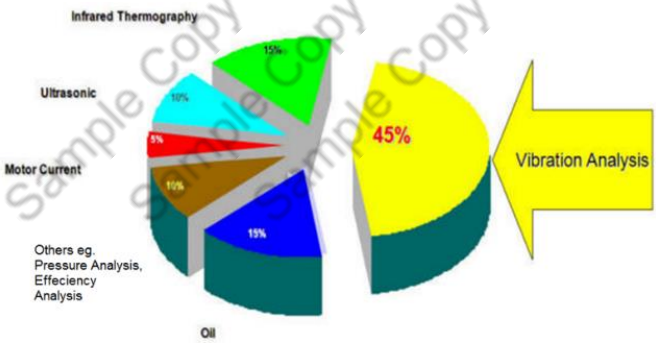
Why using Condition Monitoring programs (predictive maintenance)?

Benefits of setting up a Predictive Maintenance (PdM) program:

1. To detect what is out of the human sense.
2. To discover hidden failures.
3. To Detect early failures & monitor the machine health condition.
4. To reduce Maintenance Costs.
5. As a useful tool to improve the machine reliability.



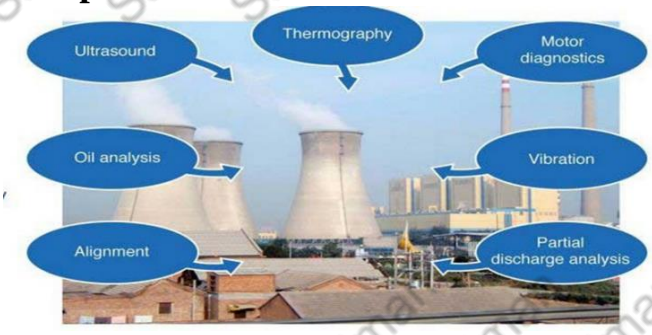
Four tools make up 85% of any PdM program



Vibration present 45% of PdM programs, infrared present 15% but it's the fastest way to inspect equipment and analysis failures

Equipment that fails in service can cost up to 10 times more to repair than the equipment repaired when predicted by condition monitoring.

Other PdM Techniques and Brief Comparison



Notes:

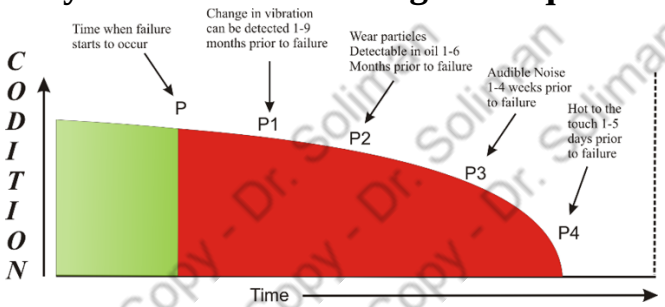
Motor diagnosis = motor current analysis, and it's a technique involve intensive diagnosis of motor currents.

Oil Analysis involve Wear Particles Analysis for more intensive diagnosis about the sources of failure. For more information about the technique read the book: Machinery Oil Analysis and Condition Monitoring.

Thermography: involve thermal analysis using infrared camera. For more information about the technique, read the book: Industrial Applications of Infrared Thermography.

Ultrasound Analysis: is an acoustic method based on high frequencies measurement. For more information, read the book: Ultrasound Analysis for Condition Monitoring.

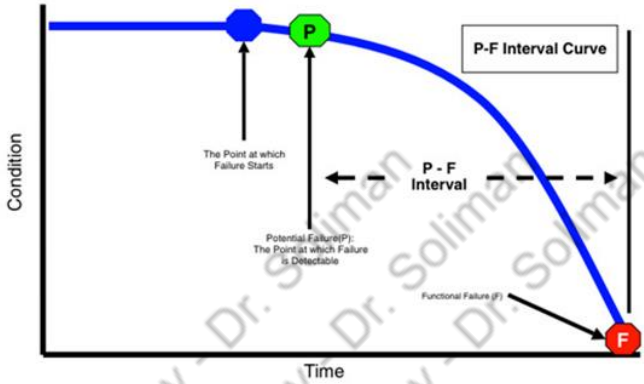
Why condition monitoring techniques?



Vibration VS Thermography VS Oil Analysis

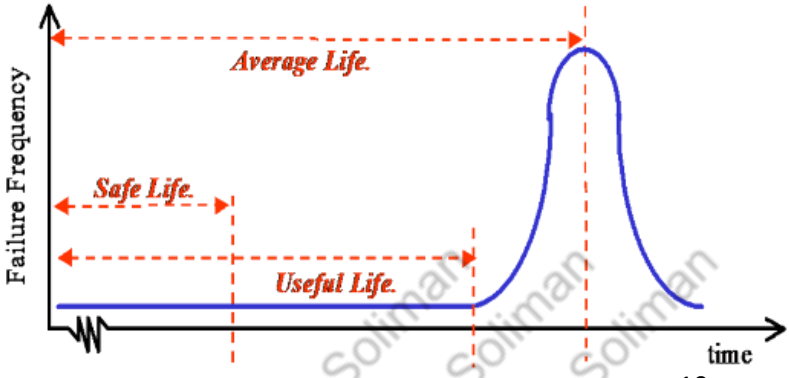
Type of fault	Vibration	Temp	Oil
Out of balance	xxx	----	----
Misalignment	xxx	x	----
Damage of bearing	xxx	xx	x
Damage of gear box	xxx	x	xx
Belt problems	xx	----	----
Motor problems	xx	x	----
Mechanical looseness	xxx	x	x
Resonance	xxx	----	----

While temp analysis can't detect various faults like vibration, but it's a less expensive technique, and doesn't require intensive training and practice like vibration.



One of the most benefits of a condition monitoring program is to detect potential failures at early state

Determine the PM Interval Using Reliability Data from PdM Programs



Introduction about Thermography Technique

The Technique

Infrared monitoring and analysis has the widest range of application (from high- to low-speed equipment), and it can be effective for spotting both mechanical and electrical failures. It also requires minimum skills for analysis.

What is infrared radiation?

Everything on this planet contains thermal energy and therefore has a specific temperature. This thermal energy is emitted from the surface of the material. This energy is called is infrared (IR) radiation. The amount of IR radiation emitted at a certain wavelength, from the surface of an object, is a function of the object's temperature. This is a very important concept, since it implies that one can calculate the temperature of an object by measuring the infrared radiation emitted from it.