Infrared Thermography for Preventative Maintenance

Abstract

Infrared thermography is an electronic technique that is used to predict equipment failures. These results are used to plan corrective actions before costly shutdowns, equipment damage, and other P2E2 problems. This technique monitors temperatures and thermal patterns while the equipment is online and running under full load. Most equipment components have temperature limits that are used as guidelines to identify problems. This monitoring device is used to predict operating problems with pumps, motors, bearings, pulleys, fans, pipelines, vessels, electrical junctions, building structures, etc. Subsequent preventative maintenance reduces the consumption of energy and/or prevents leaks and pollution problems.

Simple IR inspections have identified problems or potential problems such as: bearing failures, insulation problems, overheated pumps and motors, misaligned belts and couplings, poor electrical junctions, faulty steam traps, blocked pipes and pumps, hot spots on insulated furnace and vessel walls, building leaks, etc. The controlled maintenance of impending failures prevents fires, equipment damage, energy losses, and also the cost of production.

In a 100 psig steam generating system with production costs of $8/1000 pounds, a ¼ inch leak costs $20,000 in one year. Insurance firms are encouraging their industrial policyholders to perform regular IR preventive maintenance inspections.

Process Description

P2E2 problems can sometimes be identified using Infrared Thermography (IRT) using vendors [1], or via purchasing equipment and training prior to in-house inspections [2-5]. The inspecting frequency is a function of the complexity of the equipment and facilities. The inspections are targeted to identify problems in the following areas:

1) **Electrical Problems**: poor contacts, overheating bearings or motors, inoperative capacitors, defective fuses, poor breaker connections, abnormal transformer temperatures, and overheated bushings.
2) **Mechanical Problems**: high bearing temperatures, defective valves, defective seals, and misaligned pulleys, belts and conveyors.
3) **Fluid Flow**: blocked lines or blocked valves.
4) **Insulation Deficiencies**: steam lines, HVAC systems, missing/damaged/misapplied insulation, and poorly insulated vessels.
5) **Leaks**: building structure, window seals, pipelines, storage tanks, pressured systems, and furnace exteriors.
6) **Heat Loss/Efficiency**: Building structures, roofs, radiators, heat exchangers, HVAC systems, and process equipment.
7) **Liquid Levels**: Storage tanks, condensers, and compressed gas spheres.
All mechanical systems generate thermal energy during normal operation, which allows IRT to evaluate their operating conditions. One of the biggest problems in mechanical systems is excessive temperature. This excessive heat can be generated by friction, cooling degradation, and material blockages. An excessive amount of friction is caused by wear, misalignment, and over or under lubrication. Infrared thermography can be used to identify these problems.

When inspecting electric motors and generators, operating temperatures and thermal patterns are used in a predictive maintenance program. All motors have a normal thermal pattern as well as a given maximum operating temperature. Conditions such as inadequate airflow, unbalanced voltage, bearing failure, insulation failure and degradation in the rotor or stator can be identified with an IRT monitoring program. Abnormal thermal patterns can also identify misalignment in couplings when these devices are used in conjunction with motors.

Steam traps, like any of the above-mentioned mechanical devices, eventually fail. Most are designed to fail in the open position to maintain the steam system operational. When they fail in the open position, they discharge live steam. Occasionally, steam traps also fail in the closed position. This causes condensate to back-up in the steam system with potentially disastrous results. Infrared thermography identifies problems of this nature. Since steam traps are often installed in hard to reach areas, the application of IRT is especially useful.

In a 100 psig steam generating system with production costs of $8/1000 pounds, a ¼ inch leak cost $20,000 in one year and ½ inch leak could waste $ 80,000 a year. More insurance firms are also seeing the advantages of having their industrial and commercial policyholders perform regular IRT predictive maintenance inspections. In many cases, the realized savings in insurance claims due to premature equipment failures have encouraged insurance companies to require their clients to perform regular IRT inspections. Although this may initially seem problematic to the companies, studies have shown that the financial and safety benefits outweigh the cost of conducting IRT inspections.

Companies
1. GlencoMetrics Inc., Richmond Hill, Ontario, 905-764-9297, info@glencometrics.com
2. Academy of Infrared Thermography, 360-676-1915, airt@infraredtraining.net
3. Ircon Inc., Niles, IL, 800-323-7660, info@ircon.com