Innovative thermography and energy efficiency opportunities in textile SMEs

Most energy efficiency programs do not focus on innovation, but analyze existing practices looking for marginal improvements. Both these approaches are inadequate. The reality is that innovation and major energy efficiency improvements are inextricably interwoven. Especially in times of high energy price volatility, improving energy efficiency should be a primary concern for industries, especially textile plants. There are various energy efficiency opportunities that exist in every textile plant, many of which are cost-effective. However, even cost-effective options often are not implemented in textile plants, mostly because of limited information on how to implement energy efficiency measures.

The analysis of energy efficiency improvement opportunities in the textile industry includes both opportunities for retrofitting/process optimization as well as the complete replacement of the current machinery with state-of-the-art innovative technology. However, special attention is paid to retrofitting since new technologies have high upfront capital costs, and therefore the energy savings resulting from the replacement of current equipment alone in many cases may not justify the cost. However, if all the benefits received from the installation of the new technologies, such as water saving, material saving, less waste, less wastewater, less redoing, higher product quality, etc. are taken into account, the new technologies are more justifiable economically.

Thermal imaging for energy analysis

The requirement for an energy audit such as identification and quantification of energy necessitates measurements; these measurements require the use of instruments. The instruments must be portable, durable, easy to operate, and relatively inexpensive. Monitoring equipment can be useful to measure the actual operating parameters of different energy equipment and compare them with the design parameters to determine whether energy efficiency could be improved. The operating instructions for all instruments must be understood, and staff should familiarize themselves with the instruments and their operation prior to actual audit use. Instruments like thermal imagers (Figure 1) and ultrasonic fluid flow meters are still considered to be innovative in most developing countries because of their initial high capital cost.

Figure 1. A typical IR thermograph available on the market.

Innovative techniques like thermography have provided breakthroughs in our ability to determine energy losses through heat. Thermal imaging, also known as thermography, uses an infrared (IR) camera to show a temperature map of an object differentiated by color. Because heat radiation, and therefore energy consumption, is directly related to temperature, it is possible to determine the points of high energy loss in objects or buildings.

Unfortunately, IR thermal imaging cameras are too expensive to be owned domestically. Although prices have fallen substantially over recent years, the price is still measured in thousands of dollars rather than hundreds. Thermal imaging devices are widely used by professionals in a variety of industries for both energy and safety monitoring. The ability to detect hot spots in, for example, rotating machines enables faults to be detected and future failures predicted. By knowing the dimensions and apparent temperatures of the areas causing a loss and taking into consideration the environmental factors affecting those areas, the approximate heat loss through the system can be quantified. The savings in energy which can be achieved by preventing such losses can be considerable.

While conducting energy audits, especially in the textile sector, thermal imaging helps significantly in easily identifying losses in electrical as well as thermal utilities. One should have the knowledge of emissivity settings of the imager being used to obtain accurate surface temperature readings. Three of the most common applications of IR thermography are electrical, mechanical, and refractory/insulation.

Electrical terminal points of components such as fuse blocks, control circuits, circuit breakers, transformer bushings, and main disconnects can all develop faulty connections. IR thermography allows a technician to test and detect faulty connections in the early stages, so that repairs may prevent possible future breakdowns that would be very costly. A list of possible connection problems in transformers and their results are given in Table 1; Figure 2 is an illustration.

Figure 2. IR thermographic identification of a loose transformer connection. The inset is a view of the entire device.

Table 1. Potential effects of loose electrical connections in transformers.

Key equipment	Conditions	Potential impact
Transformers	Loose connections, overheated bushings, poor contacts, overloading, blocked/restricted cooling passages	Arcing, turn-to-turn faults, fire. Repair or rewind (5,000 kVA) = US$40,000–60,000. Replacement= US$60,000–80,000. Time lost = several months.

Mechanical equipment can face an inherent problem with excessive friction if not lubricated properly. As one example, a motor spinning at nearly 3,600 rpm and its rotor are in close contact with a bearing surface, and there is only a thin film of lubricant separating the two surfaces. But if the lubrication breaks down, or misalignment occurs, or excessive loads are applied, there will be elevations in the amount of heat generated. IR thermography can be used to help detect these conditions. Thermography is not limited to just motor bearings, however. It can also detect problems in gears, couplings, pulleys, conveyors, and chain drive systems.

Refractory/insulation is an application that is considered as a cost savings. It addresses a problem that is often hidden from the daily view of predictive and preventive maintenance, although it can result in an expensive drain on plant performance. The refractory and/or insulation of boilers, heat treatment ovens, refrigerated spaces, driers, ovens, and buildings all represent places where the slow and undetected loss of a desired control to the atmosphere can increase operational costs.

Examples of IR thermography use

Steam trap analysis

Steam systems virtually all rely on steam traps for their control and, when working properly, efficient operation. Steam trap failure can be hard to spot, but often leads to significant energy wastage and operational problems. A single steam trap passing steam can waste hundreds or even thousands of dollars each year. Thermal imaging is an excellent tool for determining the condition of steam traps (Figure 3), and an extremely useful part of an effective maintenance program.

Figure 3. IR thermographic image of an operating steam trap.

End panel insulation in cylinder dryers

The insulation of end sections can reduce heat waste, thereby saving fuel and money. Figure 4a and b shows examples of an insulated and uninsulated cylinder dryer, respectively.

(a) (b)

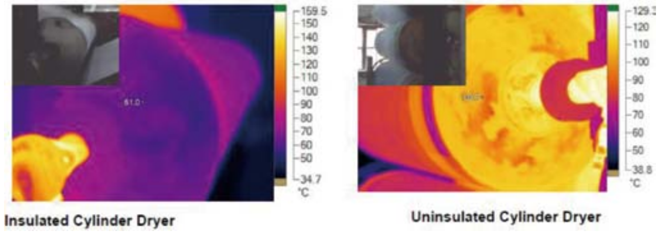

Figure 4. IR thermographic image of an insulated (a) and uninsulated (b) cylinder dryer. The heat loss is apparent in (b).

As Pakistan's first APO-certified trainer on GP and energy efficiency, Asad Mahmood has vast experience in the field of energy, along with excellent analytical, communication, and presentation skills. He is also knowledgeable on renewable energy technologies. Mahmood is currently working with ENERCON and is a member of the Technical Committee of the World Energy Council. He has conducted more than 200 energy audits and initial energy assessments in various sectors. His energy efficiency activities resulted in reductions of about 10–15 MW of connected load.