Reduce Electronic Waste Heat Without Breaking The Budget

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Thermal management has been one of the primary concerns for today's industrial facilities that must rely on maximum performance of sophisticated and highly advanced computers and components. Excess heat generated by electronics, if left unchecked, can damage the effectiveness of components and other intricate equipment inside panels and enclosures. The energy and heat they produce has to be substantially dissipated for the equipment to run with optimum efficiency over a long period. At the same time, companies have to be aware of the growing concern about incorporating environmentally-sound practices in all operations, and the impact on the company's finances. Can industry have both? The answer is yes, thanks to advancements in technology that can reduce heat within cabinets and panels efficiently without negatively impacting the bottom line.

No matter how sophisticated the technology, component reliability and its projected lifespan will inevitably decrease if temperatures rise to unacceptable levels. For that reason, manufacturers usually recommend an "optimum operating temperature" with an unsubtle caveat: do not exceed this level. If the heat is neither substantially reduced nor dissipated, components or equipment will be damaged and the manufacturer is likely to void the product warranty. Industries are quite aware of the susceptibility of components to heat-related damage, and have relied on one of several methods to control the heat that the circuitry produces. All of them work, but some are energy inefficient, which means that plants are using and paying for more energy than they actually need. Other cost issues detrimental to plant budgets are high maintenance and down time.

Methods of Electronic Heat Control

There are four commonly used approaches for controlling or removing waste heat from electronics. One of them, natural convection, relies on fans and filters and is inexpensive. Natural convection, however, comes with a caveat: it only works when the ambient air is cool and clean. That is not the case for most facilities, meaning that natural convection can only offer minimal protection from contaminants entering the cabinet.

The other three cooling methods are:

- Compressed air coolers: A small stream of air passes through the cooler and creates a vortex that will reduce the circuitry heat. The coolers, which have an average lifespan of five years, are relatively small devices with attached

lines for compressed air. They are capable of cooling below ambient temperatures, however it should be pointed out that with a few exceptions, panels and cabinets do not require that level of cooling to maintain efficiency and reliability. If there is a drawback to compressed air coolers, it is their operating costs and not their performance. Energy to produce compressed air and deliver it to the unit can be expensive. In addition, the coolers have been susceptible to problems in harsh environments, some of which are clogged lines and contaminants entering the cabinets. Another example is the occasional tendency of a small amount of oil mist in the air that enters the panel through the lines and possibly contaminates the circuitry.

- Air conditioning: This can be considered the old reliable method but it comes at the highest price of any of the major options. What makes it the most expensive to operate is the cost of energy, downtime, maintenance, and life expectancy. The latter is approximately two years, and possibly less, if the unit functions in a harsh environment. As any homeowner can attest, air conditioners require substantial energy use, a problem bound to impact a plant’s energy budget. Air conditioning in plants runs on 230 volts requiring a substantial and expensive amount of electricity. On the plus side, air conditioners can cool well below ambient temperatures, a benefit for such areas as the Southwestern United States, the Middle East, or an unusually hot factory environment or manufacturing floor. A closed loop air conditioner is another positive because it effectively prevents contaminants from entering a panel or cabinet. What can happen though, despite the closed loop, is internal condensation, which is moisture that can be damaging. Another negative is the refrigerant Freon in many air conditioners. The Environmental Protection Agency considers such refrigerants “ozone depleting substances” and has encouraged the use of alternatives. A number of air conditioning manufacturers are phasing out Freon for that reason.

- Heat Exchangers: Air to air heat exchangers employ heat pipe technology or plate surface technology for removal of waste heat from electrical components within a sealed enclosure. Air to water heat exchangers need only a small amount of water per minute to remove the heat inside cabinets. Like the closed loop air conditioners, heat exchangers do not allow harmful contaminants to enter the enclosure because there is no exchange of air from outside to inside. The air-to-air exchangers cool to slightly above ambient temperature, while the air-to-water exchangers can cool below ambient, depending on the waters temperature. Of the three cooling methods, the heat exchanger is the least expensive to operate because it has much lower energy and maintenance requirements and reduces down time in most cases. Rather than blanketing the cabinet components with cold air, the exchanger eliminates excess heat and “hot spots” by circulating air inside over the heat pipe core or plates, which is considerably more energy efficient and less costly.

Heat Exchangers and Green Technology

Heat exchangers and their heat pipe cores offer proof that green technology does not always have to be expensive. Research studies show that the pipe with its enhancement of thermal conductivity is ten times more efficient than other electronic heat cooling methods. Unlike the other devices, heat pipes do not require ongoing and expensive frequent charging, a fact of life for those facilities that rely on air conditioners around the clock for their electronics.

A company that can confirm the efficiency and reliability of heat exchangers is System Directions Ltd., Vancouver. The British Columbia firm designs and supplies complete electronic motor control systems, many with very high horsepower, to industries in the northwestern U.S. and Western Canada. Its customers are mining and saw mill industries, and both present challenges.

“Sawdust is everywhere and you have to keep the cabinets free of contamination,” says Scott Murdoch, sales technology director of System Directions. “That’s important because maintenance costs are considerable in Canada, and our customers can’t afford to have a system go down and idle at least 40 people.” Murdoch said his company used to drill holes and depend on fans and filters to cool electronics, but found heat exchangers to be a better choice.

“They are worth the investment because of the cooling, their efficiency and their ability to keep contaminants out,” Murdoch says. “They’re very low maintenance and our customers are pleased because they don’t have any work to do with the cabinets.

“The less you have to open the cabinet doors, the happier the customer is,” Murdoch says.

How Much Cooling is Enough?

Perhaps one of the best pieces of advice for any plant looking to control its energy costs, while still maintaining effective and efficient electronic heat control, is to begin with a change in mind set. The goal is to reduce the heat, not chill the entire cabinet. With the exception of severe or harsh external environments, such as in deserts or other high heat areas, there is no reason to chill below ambient temperatures. The technology has been designed to operate effectively for long periods of time to reduce heat at specific ambient temperatures. That is why effective control of hot spots is the preferred and energy efficient approach to keep the circuitry operating normally without any loss of output.

The energy cost of each heat control option has to be weighed along with other factors such as maintenance, servicing, efficiency, equipment lifespan and green technology. The fundamental goal in this decision-making process should always be the dissipation of waste heat from sensitive electronics without dissipating the plant’s energy budget.

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