End-of-Life problems with fluorescent lighting

The use of electronic ballasts for bi-pin fluorescents has increased significantly since 1990. It has occurred not only in everyday applications but also in potentially explosive atmospheres. The benefits of increased performance levels i.e. higher light output, lower energy consumption and extended lifespan, has seen a steady decline of electromagnetic ballasts.

In 1994, a number of problems were reported in the USA and other countries, concerning the use of electronic ballasts in combination with T8, 26mm fluorescent lamps in 'cold start' mode. These T8 lamps using the 'cold start' method of operation are employed in potentially explosive atmospheres. The problems related to increased temperatures at the electrodes of the lamps which were at the end of their lifetime. This caused damage to the lamp holders (see photo). The problem is now known as the 'End-of-Life' phenomenon.

What is happening to a fluorescent tube at the end of its lifetime? To facilitate the lighting process, the electrodes of a fluorescent lamp are coated with an emitter material. This emitter becomes depleted during the lifetime of the lamp due to sputtering at ignition and gradual emitter loss during burning. A lamp reaches its end-of-life when all the emitter is consumed. A symptom of emitter loss can be visual as it causes end-blackening by attaching itself to the phosphor in the electrode area.

When all the emitter is gone, even the bare tungsten material starts to sputter off electrons, possibly causing severe end-blackening and the failure of the electrode. The lamp has now reached the end of its lifetime and should be replaced.

Without effective protection, the ballast will continue to drive the lamp or will try to ignite the lamp repeatedly. The temperature in the region of the electrode increases rapidly and causes overheating.

If the electrode breaks, at temperatures easily reaching 800ºC for a very short time, the wire can drop on the glass and even melt a hole in the tube. As soon as a leak occurs in the glass, the process of ignition will stop. Statistically, less than 1% of the lamps fail this way. If the wire breaks but does not fall on the glass, however, a discharge can result between the wire of the electrode and the glass for a period of 60-180 seconds. The resulting temperature can be as high as 300ºC. Subsequently the glass can weaken and the ring of the electrode sags towards the glass. This could result in a discharge and create high temperatures at the lamp-ends. If the ring comes in contact with the broken wire of the electrode, the arc discharge created could be maintained for hours and even days with an ever increasing temperature rise. The process will stop eventually when a leak in the lamp has developed.

Statistically, ALL fluorescent lamps can inherently have this problem. However, by manufacturing the lamps with a so-called 'weak spot' (Philips patent), the lamps will start leaking and the process will stop, but in a controlled manner.

It is clear that in potentially explosive atmospheres, this phenomenon can have disastrous results that cannot be ignored.

The solution to the problem is an effective stop circuit in the electronic ballast. This stop circuit prevents the lamp from igniting when it has reached the end of its lifetime. Philips, on their own initiative, have already fitted their industrial electronic ballasts with such circuits. In the meantime, the IEC standard for fluorescent lamps (IEC 61195) has introduced requirements so as to avoid the overheating of the lamp-ends by incorporating 'suitable measures in the electrical circuit'. It is, however, noticeable that only a handful of Ex manufacturers have incorporated such a circuit, despite the fact that this problem has been known for a long time. On the other hand, many users are totally oblivious to the problem because they have not been informed. The question is: Are the current fluorescent luminaires safe to use? The Notified Bodies have finally come up with a proposal to also include these stop circuits in fittings for potentially explosives atmospheres, and resolve the problem once and for all. New electronic ballasts have to comply with the latest EN60079-7 standard for Increased Safety equipment.

However, this question still remains. What to do with existing installations in flammable atmospheres, where the safety of personnel must come first?

After consultation, it appears that there are basically 4 options:

1. Regular inspections to identify and replace lamps which are failing or have failed. Symptoms to be identified are: o Low level light

o Flickering o Red burning

o Yellowish/reddish discharge near the electrode

o Severe end blackening

The frequent inspections increase the maintenance cost significantly without removing all the risks.

2. Group replacement with fluorescent lamps with a proven low standard deviation; in other words one which is less likely to fail e.g. Philips TL-D Xtra and Xtreme. The advantage of this option is the preventative character. Unfortunately, it does not remove all the risks and frequent inspections are still required.

3. Replace all ballasts of existing luminaires with a type including the new stop circuit as specified in draft standard EN 60079-7. Although effective, it is very expensive.

4. Replace the existing luminaires with a different technology not affected by ‘End-of-Life’. The IQL-range of ‘sealed for life’, maintenance free fittings are not affected by the problem because they use induction rather than electrodes to generate their light.

Conclusion:

1. Through proper risk assessments, the user will have to determine the corrective action required in order to safeguard its personnel and installations.

2. Users will need to be educated concerning the extent of the problem. The Health and Safety Executive, together with the manufacturers of fluorescent luminaires for potentially explosive atmospheres, will have to face their responsibilities in this matter

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