FIRE DETECTION

Fire Detection in Buildings with High Ceilings

How to Detect Smoke at an Early Stage in Premises with High Ceiling Heights

Many industries today rely heavily on the detection system to be fast enough and give such early warning that the rescue service arrives in time to extinguish the fire before the damage is severe. In some cases they also trust that the detection system gives such early warning that the smoke does not cause any damage like smell and corrosion on the goods stored. However, it is not easy to detect smoke at an early stage in premises with high ceiling heights, as the smoke from a small fire is insufficiently thermally buoyant to reach right up into the ceiling zone.

It is not certain that the smoke from a small fire will reach all the way up to the ceiling in a high building.

Ineffective for Small Fires

Tests carried out on small fires, such as of PUR foam or pieces of wood on a cooker hotplate, have shown that the smoke sometimes does not reach up to more than about 5 m above floor level. What is this due to? The answer is that with such a small fire, the smoke movement is affected by the existing air currents and temperature gradients in the room before the fire starts. There may be a layer of warm air close to the ceiling, but as the rising smoke plume cools and its velocity drops, it is unable to penetrate through the layer of warm air as its temperature by the time that it reaches it is less than that of the air. As the velocity of the plume decreases, it will become increasingly influenced by other air currents, such as from the ventilation system, from the warmth from machinery etc. These conditions vary with the time of year and time of day, depending on factors such as which machines are in operation, whether doors are open, whether the plant is running, ambient climatic conditions etc.

Tests and simulations in a recent Swedish Fire Research Board project show that it is very difficult to find optimum positions for smoke detectors. This is due to the fact that the detectors must operate correctly for a wide range of types of fires and micro-climates. Smoke from a larger fire will reach further up towards the ceiling, while that from a smaller fire will level off further down. The local micro-climate depends on the weather, on which machines that are in operation, ventilation etc. A possible solution might be to position sensitive detectors at several different levels. Using such sensitive detectors requires an intelligent system to minimize false alarms.

What Size of Fire Must be Detected?

It must be possible to detect a fire at a sufficiently early stage to enable it to be tackled before it causes unacceptable damage. This means that it is also necessary to consider the fact that there will be a certain time lapse before the fire and rescue services can arrive. It is therefore necessary to accept that a fire will grow in some particular manner between the time of its detection until measures can be set in against it. Working backwards from this, it is possible to decide what size of fire, or thermal output from the fire, must be detectable. If a fire is likely to grow very quickly, it will therefore be necessary to detect it at a very early stage if it is not to have got out of hand before fire-fighting starts. In such cases, it may for example be necessary to install detectors at several heights in order to ensure sufficiently early detection. The same applies for cases where only limited damage can be accepted. There are no simple design rules today to indicate the size of fire that can be detected in some particular given premises.

One way of tackling this problem is, for example, to carry out in-situ tests, using a burner and controlling its output until the output is found at which the smoke just reaches the ceiling or to wherever the detectors are positioned. Tests of this type have to be carried out on a number of occasions, as the interior climate varies depending on the time of year and time of day.

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