Automatic extinguishing solutions in recycling facilities and incineration plants utilizing heat detection

Figure 1: Remote controlled FireDos M2 fire monitor with manual backup on standby in recycling facility.

With a growing awareness towards the environment and resources, the amount of recycling and incineration facilities worldwide has increased significantly. The risk of fires in these industries is a rising concern. Solutions to extinguish these fires in the early stages of development are imperative, especially considering that the materials being processed are unpredictable.

There is certainly no simple answer to this challenge, but it is an issue that needs addressing. In this article, suitable fire-protection systems are discussed, with a focus on automatic extinguishing solutions utilizing heat detection and remote-controlled fire monitors.

Development of the fire hazard situation

Over the last few years, the trend towards recycling materials has grown in many parts of the world. This has led to the division of organic wastes and recyclables and the installation of waste management companies operating incineration plants, composting plants and recycling facilities instead of landfills. Vast amounts of materials are now temporarily stored. The fire hazards associated with this are growing as relatively dry materials with high energy contents are stored together with potential ignition sources such as lithium-ion batteries, household aerosol bottles, paint cans and propane tanks. In composting facilities, decomposition can lead to temperatures high enough to cause auto-ignition of the stored material. These types of fire can be difficult to detect and often demand great effort to extinguish when detected too late. This can have serious effects on the environment and public health and jeopardize the safety of firefighters and local communities.

Potential for fire hazards

Recycling facilities are generally set up in three sections:

- Delivery and primary storage area of unsorted recycling goods (tipping floor)
- Sorting and separation facility
- Storage of separated goods such as plastic, paper, metal, glass and compost

This article will focus on the first section of delivery and primary storage, the tipping floor. Here the complete variety of mixed waste, as it comes from our households, is tipped from collection trucks onto concrete floors or into waste bunkers. In this conglomerate of waste, both ignition sources and combustible materials are present. Damaged batteries that have developed heat are exposed to oxygen and sparks can ignite gases and vapours leaked from household aerosol bottles, paint cans and propane tanks, or formed due to decomposition of waste. Before being transported into the recycling facility via conveyor belts, workers or machines sort out as much problematic garbage as possible. Unfortunately, these components often end up inside the facilities where they may ignite and start a fire. Fortunately, most of the waste is in constant movement. Hotspots or a fire can be monitored and quickly dealt with if the proper detection and extinguishing equipment is installed.

In incineration plants, the untreated waste is often delivered and burnt without any separation, apart from the removal of metal. The material is stored in bunkers, partially several metres high, where it may be stored for longer periods of time before being transferred to the incinerator. Here a fire may smoulder below the surface without being detected and break out over a wider area.

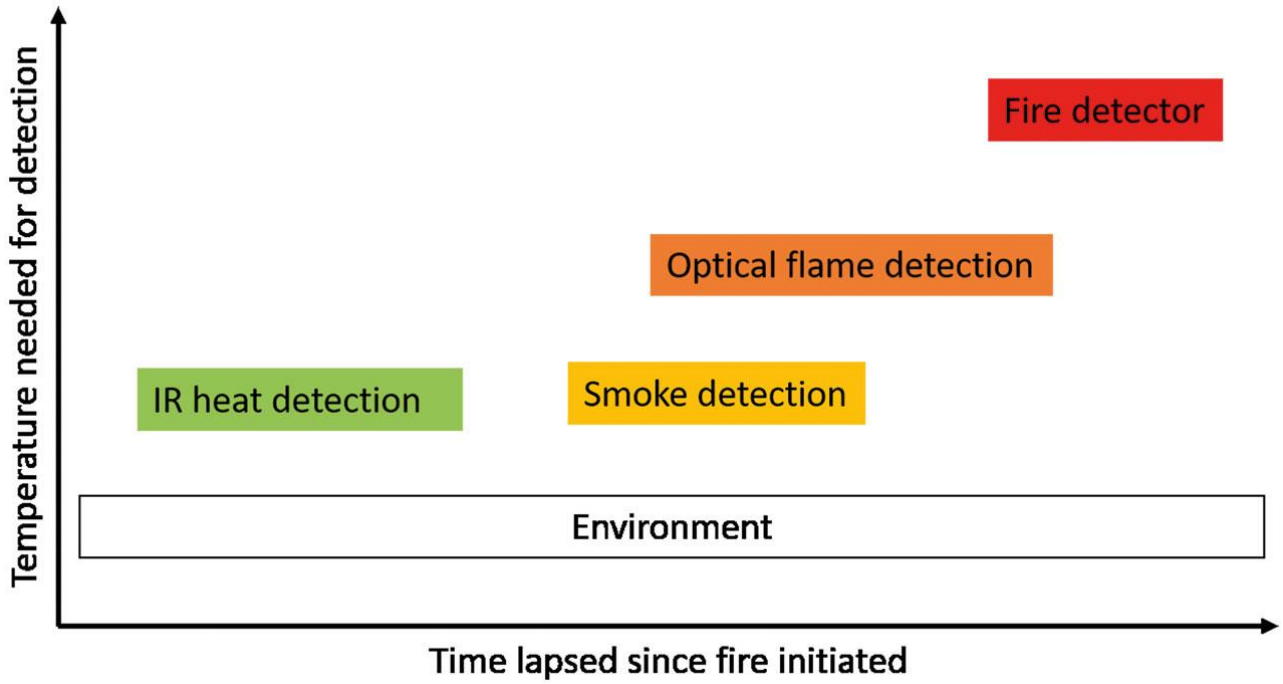


Figure 2: Sensitivity of fire detection systems.

Fire-protection systems

The main extinguishing systems used in recycling and incineration plants are sprinkler or deluge systems and firefighting monitors. Dependent on the goods that must be extinguished, water or foam can be used as an extinguishing agent.

Sprinkler systems are mainly used indoors and are generally water-filled. A fire's heat will activate individual sprinkler heads that will release extinguishing water onto the area below it. If the fire spreads, additional sprinkler heads are activated to extend the extinguishing capability. Each sprinkler head is designed to protect an area of several square metres. Large areas are exposed to the extinguishing water when several sprinkler heads are activated, and the system usually must be manually deactivated. Depending on the distance between the fire and the sprinkler heads, they may be triggered too late to successfully extinguish the fire. They are mainly used in areas with low ceilings.

Sprinkler systems can alternatively be filled with a foam premix that generates extinguishing foam once released. The premix is made using specially designed proportioning systems, such as the GEN III water-motor-driven proportioning pumps made by FireDos.

Deluge systems are sprinkler systems with open nozzles. They can be manually operated or may be equipped with remote-controlled valves that are triggered by heat-detection systems. On activation extinguishing will occur in the complete section of a larger area.

Firefighting monitors, like the distinctive octagonal 'Oval Flat Design' from FireDos, are designed for indoor or outdoor use. When a fire is detected, they are either manually operated or can be remotely controlled. Fire monitors allow precise positioning of fire-extinguishing media from a safe distance. See the following link for a FireDos M2 in action in a recycling plant: https://www.linkedin.com/feed/update/urn:li:activity:6709360327227654144

Dependent on the fire-extinguishing system setup, it is possible to switch between water and foam. Firefighting monitors are optimally suited to be combined with detection systems to form an automatic fire-extinguishing system.

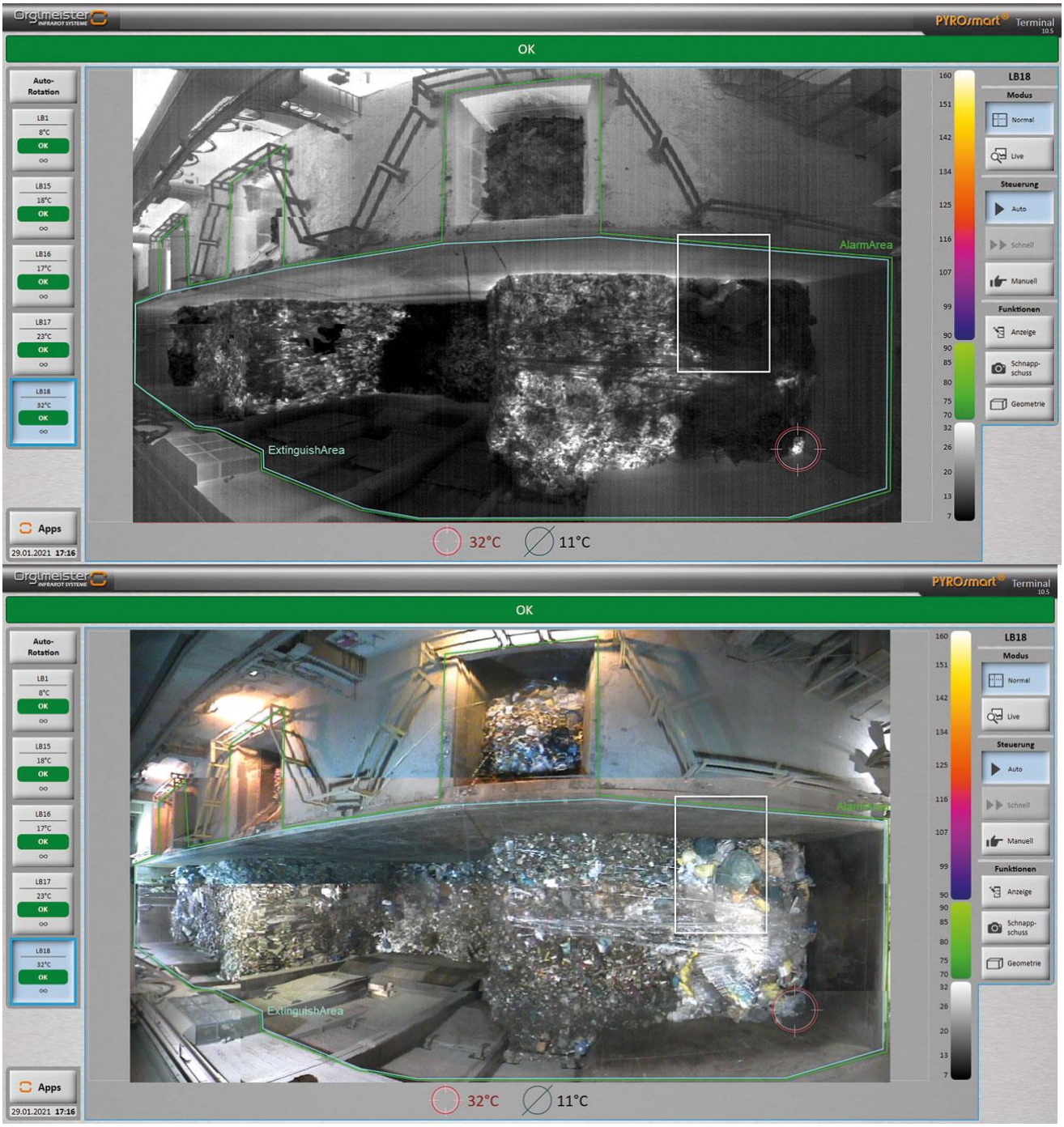


Figure 3: Video and high-resolution radiometric panorama from a PYROsmart heat detection system.

Fire-detection systems

We can differentiate between three common detection scenarios:

- Smoke detection
- Fire detection
- Heat detection

Smoke detectors are mainly installed under the ceiling to monitor complete halls or sections of a big area. They generally require a large amount of smoke to trigger an alarm. They are mainly used together with manual firefighting equipment utilizing hoses or firefighting monitors as the exact location of a fire must be visually confirmed. They are not well suited as components for modern automatic firefighting solutions.

Another possibility for smoke detection is the use of video smoke detection. It is recommended to use these systems only if combined with another type of detection to avoid false alarms triggered by steam, exhaust fumes or fog. These systems also require ideal lighting conditions and only work in areas with low levels of dust.

Sprinkler systems are classic fire detectors. They are not suited as components for modern automatic firefighting solutions.

Linear heat or fire detectors are sensor cables. They are mainly used to monitor tunnels or garages but may also be installed in big halls. They are generally not suited for use in incineration plants and recycling facilities but may be a suitable option for monitoring covered conveyor belts.

Most common heat detection is achieved through thermal imaging by using infrared (IR) detection technology. In contrast to detecting smoke or a fire, the environment is monitored for radiated heat. By continuously monitoring a specific point or area and measuring the actual radiated heat, or analysing the increase in temperature, fires can be detected, even if they have not yet reached the surface of a pile. The rise of hot gases may be sufficient to detect a sub-surface fire. Usually, temperatures of 80°C are considered strong indicators of a fire. Heat monitoring of an object with an infrared early fire-detection system means a fire is identified in its formation phase.

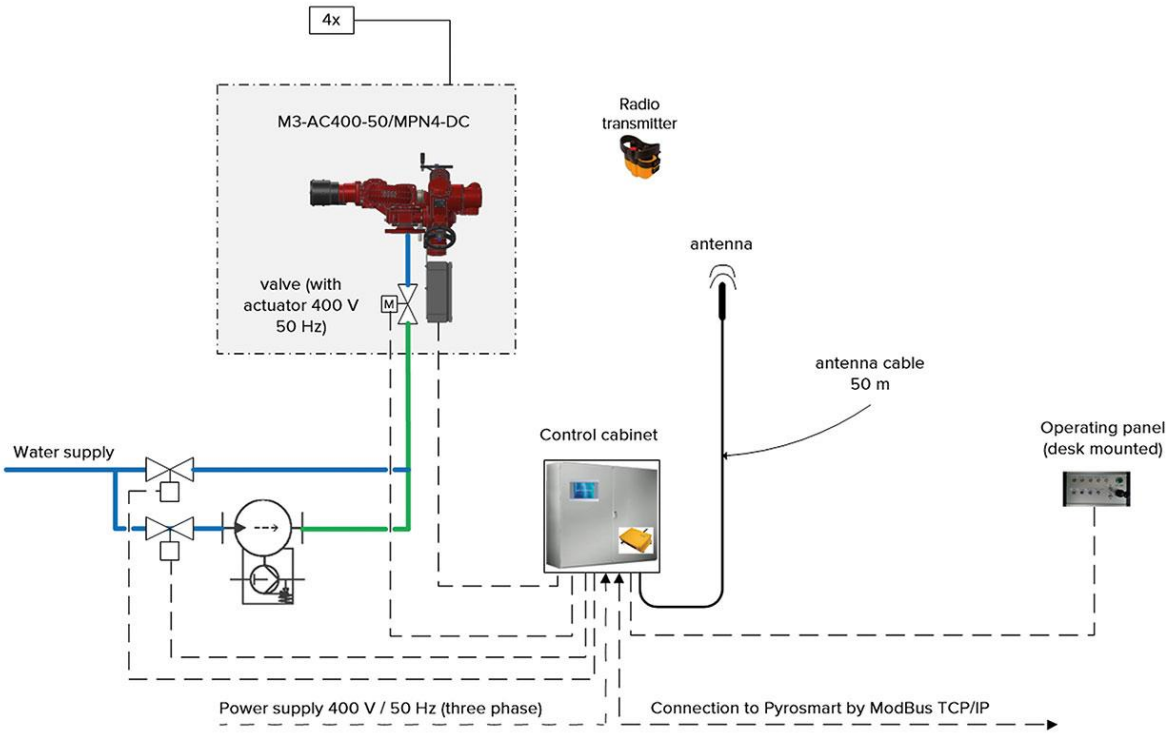
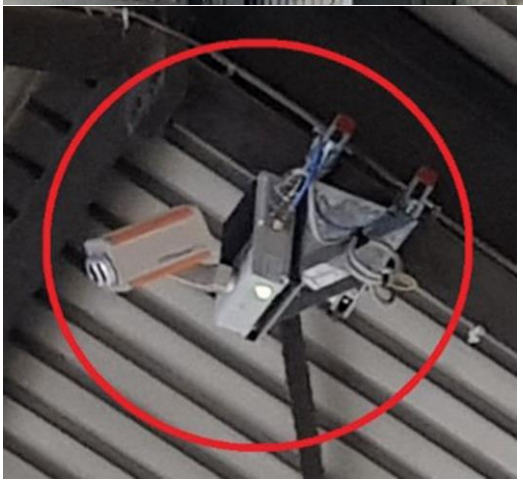


Figure 4: Schematic of remote-controlled monitors with optional water or foam output and connection to a heat detection system.

For fire detection, continuous monitoring of the hazardous area is mandatory to detect any changes in the environment. Intentional and known heat sources such as motors from belt drives or vehicles, exhaust pipes, sun and reflections should be automatically identified and ruled out as potential fires to reduce false alarms to a minimum.

One stationary, relatively inexpensive camera can cover a large area when using a lower resolution, but this will prevent the early detection of fires while they are still small. With more sophisticated technology, such as the Orglmeister PYROsmart system, areas can alternatively be surveyed using a single pan/tilt head camera. It continuously scans a large area and builds a high-resolution radiometric panorama image. Combined with intelligent analysis software, detection and exact locating of a hotspot allows positioning of water or foam using a precise, remote-controlled monitor such as the FireDos M2 or M3. On-demand, a combination of IR and live video pictures will provide an effective analysis of the situation, especially when the resolution is high enough to allow the user to zoom into the video image.

Through self-learning and artificial intelligence (AI), the software analyses the environment and differentiates between hot motors, exhaust pipes and hot spots that indicate potential or actual fires.



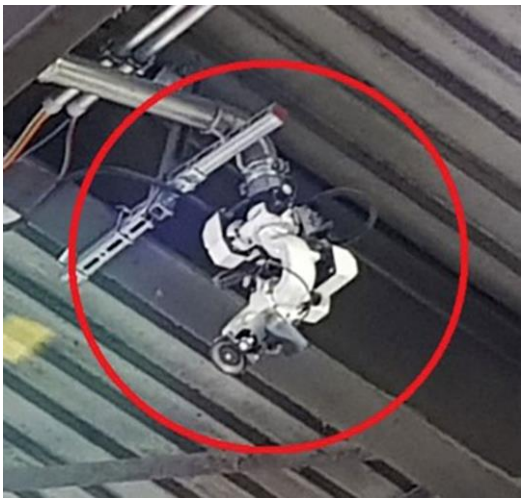


Figure 5: PYROsmart heat detection system and remote-controlled monitor in recycling plant.

Automatic extinguishing solutions

When planning a fire-extinguishing system, the most effective firefighting strategy to extinguish the wide range of possible fires must be found.

One of the steps is the decision to use water, foam or have the alternative to use either.

Assuming a plan to use a detection system, it must be decided between manual or automatic intervention. Considering that incineration plants may be operational 24/7, recycling facilities often only run one or two shifts a day, making around-the-clock monitoring and firefighting by staff members difficult.

In the case of manual intervention, the detection system will raise the alarm. Dependent on the system used, this may be a critical hotspot, a flame or smoke. In each case, visual confirmation of the fire threat and manual intervention of the extinguishing process is required by, for example, activating a deluge system or utilizing a manual or remote-controlled fire monitor.

If the fire-extinguishing system is automated, triggered by smoke or fire detection, a deluge system may be activated, flooding the complete area. Alternatively, a fire monitor could automatically direct the extinguishing agent using a pre-programmed spray pattern in a pre-defined area. Deactivation of the extinguishing system is mainly done manually.

Suppose the fire-detection system uses IR heat detection. In that case, a remote-controlled monitor is activated to accurately direct water or foam to the exact location of the hotspot or fire. A pre-programmed spray pattern may be used. Deactivation may be manual, or the fire monitor can be automatically turned off after a defined extinguishing time. IR heat detection will continue and restart the extinguishing process when and where necessary.

An automatically controlled process with a multi-stage approach is also efficient when a hotspot has been detected:

1. Precise delivery of a limited volume of water to an identified area.
2. Monitoring and the additional delivery of water if the temperature has not decreased to a non-hazardous level.

3. Monitoring and the delivery of foam may be activated automatically if water does not give the required result after one or two extinguishing attempts – or the extinguishing area is enlarged.

With automatic detection and extinguishing systems, the firefighting approach can be customized to the facility, the goods to be extinguished and the threat a fire may pose to the environment. A first step, and a significant part of the process, is to determine the best approach for firefighting with an analysis of the premises to assess detectors and fire monitors' best positioning. Optimum placement of these devices minimizes the quantity and the cost of a system.

Conclusions

When it comes to firefighting, the three steps for any facility are:

- Prevention – Internal Response – Professional Response
- In the event of a fire, integrated processes, and systems, consisting of state-of-the-art heat detection and automated extinguishing solutions, are essential to assure that a fire has been extinguished before a professional response is necessary.
- Advanced, state of the art fire-hazard detection and automatic suppression systems provide great potential to reduce damage and property loss. Although the initial investment cost is higher than for traditional methods, by focusing on early detection and smart, precise extinguishing, rather than extended firefighting, plant owners and operators can reduce reoccurring costs, and facility shutdowns can be reduced and the total cost of operation optimized.

For more information go to www.firedos.com

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