Video fire detection
for waste management plants

Detect waste fires in time
and limit the impact

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Increasing fire risk at waste sites

Waste management facilities have an important role to play in society's journey towards a circular economy. Waste needs to be processed efficiently and in an environmentally friendly way. However, waste storage and management remains a dangerous activity. Many flammable materials are handled there, and the increase of batteries and electronics in the waste stream is creating unseen fire risks. Fires in waste bunkers are therefore a frequent problem. Typically, waste fires spread fast and are hard to contain, so they can result in extensive damage, financial loss, and negative impact on the environment.

Today, waste has become a valuable source for energy. That's why waste plant operators want to make sure they can reduce the likelihood and frequency of fires in waste management as much as possible. And when fires do occur, they want to be able to reduce the impact on their business continuity, their safety, and the environment.

Fortunately, there are ways to do this. In this eBook, we will discuss why a fire detection system based on **smart video analytics** offers waste facility operators a reliable way to protect their assets, safeguard business continuity, and limit environmental effects.
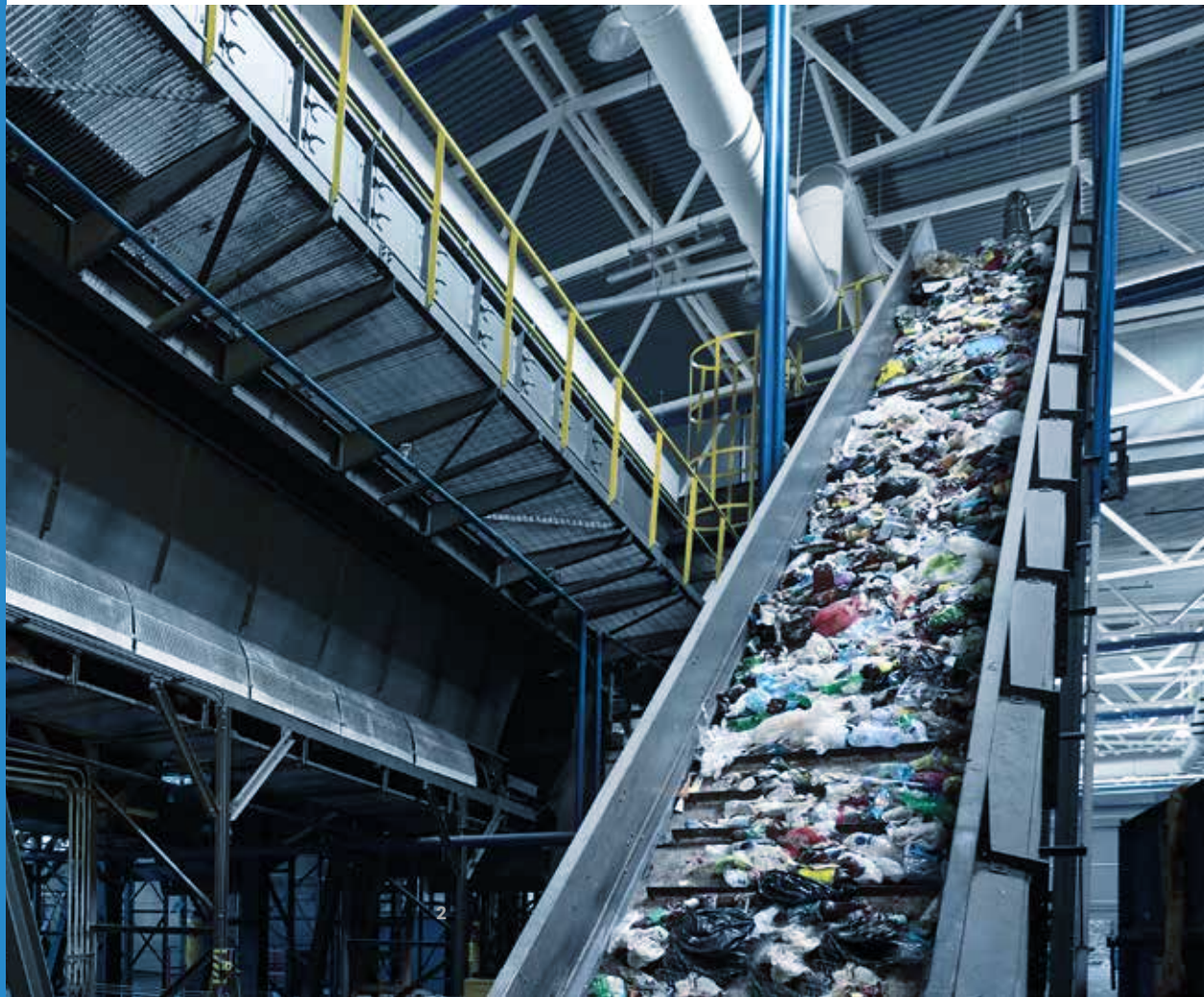
How serious is the problem?

The awareness of fire risks in waste management facilities may have increased in recent years, but the significant fire safety challenges remain. Although reliable, comprehensive data concerning the frequency of fires in waste storage facilities is not available for the entirety of Europe or the world, some European countries have been collecting data for many years.

In **Sweden** for example, studies point to an average of more than one fire per week in a waste facility that requires action by the fire and rescue service. Another study[1] says that approximately 60 to 70 waste fires occur in Sweden every year. However, these figures are probably underestimated, since many incidents in the waste recycling industry are handled without the help from fire and rescue services and therefore not reported.

According to the **UK**'s National Fire Chiefs Council (NFCC), fire and rescue services attend around 300 significant fires in waste sites each year.[2] Lithium-ion (Li-ion) batteries are responsible for around 48% of all waste fires occurring in the UK each year, costing the UK economy some £158 million annually.[3]

In the **United States** and **Canada**, at least 390 fire incidents at waste and recycling facilities were reported by the media in 2022, according to data from Fire Rover, a fire suppression system company.[4] The company also reported that waste and recycling facility fires caused 56 reported injuries and 2 reported deaths in that same year.

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[1] Fires in waste facilities: Challenges and solutions from a Scandinavian perspective, Mikalsen et al., 2021
[2] National Fire Chiefs Council (NFCC), 2022, https://www.ukfrs.com/guidance/fires-waste-sites
[3] NFCC, https://www.nationalfirechiefs.org.uk/News/lithium-ion-battery-waste-fires-costing-uk-over-100m-a-year
[4] Cutting Lithium-ion Battery Fires in the Waste Industry, 2021, Eunomia and the Environmental Services Association (ESA)
     https://www.wastedive.com/news/high-number-of-facility-fires-in-2022-prompts-renewed-look-at-battery-recyc/645682/

What is causing waste fires?

Spontaneous combustion

Spontaneous combustion occurs when materials self-ignite without an external ignition source due to heat generated by their own chemical reactions. Combustible materials are often brought into the waste stream. There, biological decomposition or chemical oxidation processes generate a rise in temperature. If the waste mass cannot dissipate the heat faster than it is generated, then spontaneous combustion can occur.

Organic waste, such as yard waste, food waste, and certain types of paper, can undergo decomposition processes that generate heat. Metal powders, particularly those with high surface areas, can oxidize and release heat, potentially leading to spontaneous combustion.

Spontaneous combustion may become even more problematic as we continue to face global warming. Most oxidation reactions accelerate at higher temperatures. A pile of waste material that would have been safe at a low ambient temperature may spontaneously combust more easily during hotter weather. As we are dealing with hotter summers and dryer winters, spontaneous combustion may become an even more important factor to reckon with.

Batteries & electronics

Lithium-Ion batteries are currently one of the most popular types of rechargeable battery for appliances and consumer electronics. Although this battery type is safe for consumers to use, it can start fires when discarded and damaged in residual and mixed recycling waste streams. Such damage occurs frequently during normal waste handling operations. In the UK, for example, the waste industry faces an estimated 201 waste fires caused by lithium-ion batteries (Li-ion) each year.[5]

Lithium-ion batteries contain highly flammable electrolytes and other reactive materials. They emit toxic and explosive gases when overheated, and they are prone to violent explosions. Damaged or faulty batteries can experience internal short circuits, which can lead to a rapid release of energy, heat generation, and potentially ignite flammable materials around them. Batteries can be damaged during transportation or handling, compromising their integrity and increasing the risk of fire. Storing batteries in a manner that allows them to come into contact with other conductive materials or in high-temperature environments can elevate the fire risk.

What's more, due to the conveyor belt systems used in the industry, fire hazards can spread easily throughout the waste management facility and lead to fast-growing fires.

[5] Cutting Lithium-ion Battery Fires in the Waste Industry, 2021

Chemicals and flammable materials

Waste management facilities handle various types of waste, including household, industrial, and hazardous waste. Improper waste segregation may result in chemicals, solvents, gases, fuels or other flammable materials getting erroneously mixed up in the waste and recycling stream. If there is enough of a substance, then it can easily become a source of ignition.

Some of these materials, such as oily rags or chemical-soaked materials, can undergo spontaneous combustion when exposed to air or other substances. Certain chemicals can react with each other or with environmental factors, like moisture, and produce heat, leading to fire hazards. Waste management facilities often have various potential ignition sources, such as electrical equipment, machinery, and welding activities. If these sources are not adequately controlled, they can easily trigger fires in the presence of flammable chemicals. Lack of proper ventilation can also have an impact on the buildup of flammable vapors.

The human factor

Human activity can also be a cause of ignition, both unintentional via for example hot works or intentional via arson. Human errors, negligence, and lack of awareness can lead to fire incidents with potentially severe consequences. Inadequately trained personnel may not be aware of the specific hazards associated with certain waste materials or may not know the proper procedures for handling them safely. Failure to follow established safety protocols and guidelines can result in unsafe practices, increasing the likelihood of fires. Negligent actions such as smoking near flammable waste, leaving ignition sources unattended, or improper use of equipment can lead to fire incidents.

Another important human risk factor is the tightened workforce. For example, it is estimated that the United States lost 10 million jobs during the height of the COVID pandemic. Recyclers and waste haulers were competing among themselves and other industries to hire candidates to fill open positions. The reduced available staff could easily disrupt the collection of waste and recyclables, and even result in fire safety issues. Removing hazardous materials from the waste stream needs human inspection. Every time a hazard such as a battery escapes the attention of the operator, there's another chance for a flammable material entering the waste stream.

The impact of fire in your waste facility

The impact of waste fires can be serious, both on a short and long term:

Environmental impact
Awareness of the fact that waste fires can cause dramatic and persistent adverse effects on the environment has risen in the past decades. Ecological impact can come from emissions to the environment or from pollution of the surface and ground water, among other things. Firewater run-off could also transport pollutants into drainage systems, rivers and lakes, groundwater and soil, threatening water supplies, public health and wildlife.

Economic impact
Waste fires result in loss of resources used for the provision of energy or heating, and damage to equipment and buildings. Waste facility operators also need to account for the cost of rehabilitation of resources and/or the environment, and the cost of fire prevention and response. A major fire could also temporarily put you out of business.

Reputation damage
Reputational costs can be substantial and may affect how the local community and others view you. You may also receive civil claims from the local community relating to nuisance or potential health effects. Ultimately the environmental permit can be withdrawn.

Human cost
There is the risk of death and/or serious injury and health damage from high thermal energy and smoke inhalation. Combustion products, even those from non-toxic materials, release airborne pollutants which can cause short, and long-term effects on human health.

Detecting fires, preventing worse

Although it may be hard to completely exclude fire incidents, there are ways to manage and reduce the risks. Educating the community on good sorting practices, frequent staff training, and investments in the right safety monitoring technology are all part of a comprehensive fire safety strategy.

One important investment that waste management operators need to make is an accurate and high-performance early warning system for fire incidents. Such a system can detect fire development in an early stage, and therefore prevent fire incidents from escalating.

Why traditional smoke detectors don't work

Detecting a fire in time in a waste management facility environment is not that simple. Traditional smoke detection systems that are used in residential or office environments (for example, point, beam or aspiration-based detectors) typically do not perform well in waste bunker environments, for at least two reasons:

1. Harsh environment triggers false alarms

Waste plants typically generate substances that can unintentionally activate conventional smoke detection systems. Chemicals, dust or waste flying around caused by loaders moving the waste heaps, exhaust gases or vapor will therefore cause these detectors to generate a high volume of unwanted alarms. A conventional smoke detector will respond to dust in the same way as to smoke particles. Dust is also one of the reasons why a conventional smoke detector will degrade very fast, which has an impact on its smoke detecting performance.

Smoke detection systems that generate too many unwanted alarms are not only very annoying, but they are also quite costly. A fire outbreak will require all activities to be stopped, but unfortunately business interruption losses are also not always covered by insurance policies. Unwanted alarms also lead to the unavailability of emergency services in the event of real fires. In some cases, users of these detection systems might decide to deactivate the detectors altogether, just to avoid the annoyance.

2. Ceiling-mounted detectors react too slowly

Conventional smoke detection systems, like point, beam or aspiration-based smoke detectors, need to make physical contact with the smoke before they can generate an actual alarm. Unfortunately, a waste bunker is typically a high building where smoke from an initiating fire will reach the smoke detector very slowly, too late or not all, because of a process called stratification, which stops the upward movement of smoke.

Since traditional fire and smoke detection systems will not work effectively in waste plants, waste management professionals are increasingly looking for an alternative that is more tailored to the industry.

That alternative is **Video Fire Detection**.

Video Fire Detection: the visual alternative

Conventional smoke detection systems have proven their value for many years in residential and office environments. But in the challenging conditions of the waste bunker, they are inefficient, either because they are activated too late, or they generate a high number of unwanted alarms. That is why waste management professionals today are looking into more intelligent systems that can take into account the challenging conditions of waste facilities. One of the most effective systems in place today is **Video Fire Detection**.

What is Video Fire Detection?

A Video Fire Detection system uses a networked security **camera** in combination with carefully developed video **analytics software** to scan the environment in real time and to precisely locate smoke or flame at its source. When a fire is detected, the Video Fire Detection system will send an alarm output over to the fire control panel to generate an early warning.

The benefits of Video Fire Detection

Lower false alarm rate
Video Fire Detection is very accurate and therefore the unwanted alarm rate will be extremely low. Video Fire Detection systems will efficiently analyze the camera image to make a distinction between starting smoke and other irregularities, such as dust, damp, people walking in the field of view, animals, vehicles or objects. That is why video-based fire detection is an ideal technology for harsh environments, like waste recycling plants.

Detect smoke and flames
Video Fire Detection systems can detect both smoke and flames. This offers a significant advantage due to the varying behaviors exhibited by different types of fires. Smoke detection is crucial as it helps identify smoldering fires that may not produce visible flames initially. On the other hand, flame detection plays a vital role in swiftly identifying fast-spreading fires that generate visible flames. By combining both smoke and flame detection, Video Fire Detection systems offer enhanced accuracy and reliability in identifying and responding to fires, ensuring the safety of individuals and minimizing property damage.
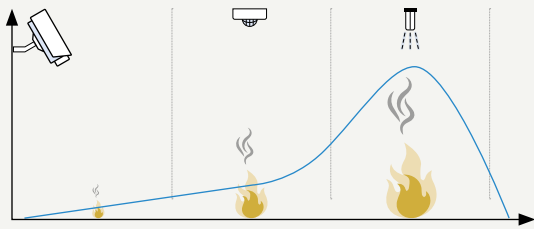
Fast detection

In fire safety, speed is crucial. Video fire detection systems will see initiating fire much faster than conventional systems. Waste storage bunkers usually have tall ceilings. Therefore, linear heat detectors, sprinklers, or conventional point or beam type detectors installed at the ceiling are inefficient, because it would take way too long for the smoke to reach them.

Video Fire Detection on the other hand makes efficient use of CCTV, so it is able to see dangers from a large distance, without the need to make physical contact with the smoke. It immediately sees the danger when and where it originates.

By detecting the fire early, intervention can start promptly - before the fire has developed beyond control. Early intervention can also limit equipment and infrastructure damage, reducing downtime in processes that rely on that infrastructure.

Instant verification

Control room operators can monitor the video images coming from the fire detection cameras in real time. This allows them to assess the nature and severity of the fire as well as the stage it is in.

Based on pre-incident recording, they can see whether people are present at the place of the incident and they can better assess the overall situation. This way, they can also make better use of their emergency resources. After the incident, the video footage can be used for risk analysis and prevention of future incidents.

Ideal for (semi-)outdoor environments

Waste storage is often located in semi-outdoor spaces or in sheltered spaces that are exposed to outdoor elements. Detecting fires in such an environment can be challenging for conventional fire detection methods. Airflow can easily disperse heat and smoke, and harsh weather conditions may render traditional detectors ineffective.

Video Fire Detection technology uses high-quality cameras that allow for early-stage fire detection despite varying lighting conditions. Moreover, a fire detection camera can be protected by weather shields and sunshields to provide additional protection against heavy rainfall and sunlight.

Video Fire Detection: enabling better decisions

Fire incidents that cause business interruptions can have significant economic and environmental consequences. It is therefore crucial to be able detect a fire outbreak as early as possible to control, isolate, and extinguish it before it causes significant damage.

Video Fire Detection is a perfect fit for the waste management professional. Because of its visual nature, it can accurately detect initiating fires directly at source. This is a huge speed advantage compared to smoke detection technologies that need to make physical contact with the smoke. And it effectively filters out unwanted events that are so typical of waste bunker environments. This avoids situations where a detection system generates so many unwanted alarms that operators choose to ignore it altogether.

Video Fire Detection gives the human safety operator room for interpretation. Seeing the camera images of a fire incident early on gives the operator the time to make better, well-founded decisions. That decision could be calling the emergency services to avoid further damage, it could also be isolating the fire event to prevent the entire operation from shutting down and running into costs. The operator can even choose to ignore the alarm when that is suitable.

FireCatcher
Video Fire Detection
for critical environments

FireCatcher from video analytics specialist Araani is a patented reliable early warning system for fire detection in critical environments, such as waste management facilities. By adding Araani's proven and tested video analytics to visual security cameras, FireCatcher offers superfast smoke and flame detection in places where traditional smoke detection systems fail due to slow detection or too many false alarms. The FireCatcher Camera, in its fully integrated product version, has successfully met the requirements set by international standards and holds the esteemed qualifications of being approved by BOSEC and CNPP as a primary fire detector.

FireCatcher offers all the above-mentioned benefits of Video Fire Detection. But there's more that waste management operators will value about this solution.

Seamless integration with your fire control panel
FireCatcher fully integrates with your existing devices and systems, including LAN, VMS or Fire Alarm Control Panel. FireCatcher creates a visual bounding box overlay and metadata for alarm visualization and features configurable detection zones to match any environment.

Automated activity monitoring
FireCatcher allows you to deactivate the smoke alarm automatically and temporarily, while still retaining the flame detection capability. This way, you can avoid unwanted alarms during typical human activities that create a lot of dust, such as the start-up of the waste management process or the cleaning of the waste shredder. FireCatcher can do this autonomously, based on the detected activity in the waste storage area.

Image quality monitoring
A clear and high-quality video image is a basic condition for reliable fire detection. Araani's FireCatcher cameras come with a sophisticated image quality control algorithm that can detect issues such as insufficient brightness or contrast, a dirty or obstructed lens, changes in the field of view due to external factors, and more. Whenever an issue is detected, an alert is sent to the fire control panel and operators can promptly initiate the required maintenance intervention.

Camera housing
The FireCatcher Camera is mounted in an appropriate housing, so it can operate in environments with dust, damp, humidity or other atmospheric disturbances, without any problems.

Key points

▸ Fires in waste processing are a frequent problem. Waste fires are hard to contain and spread fast.

▸ Spontaneous combustion and e-waste are some of the most important causes of waste storage fires.

▸ The economic and environmental impact of waste fires can be enormous.

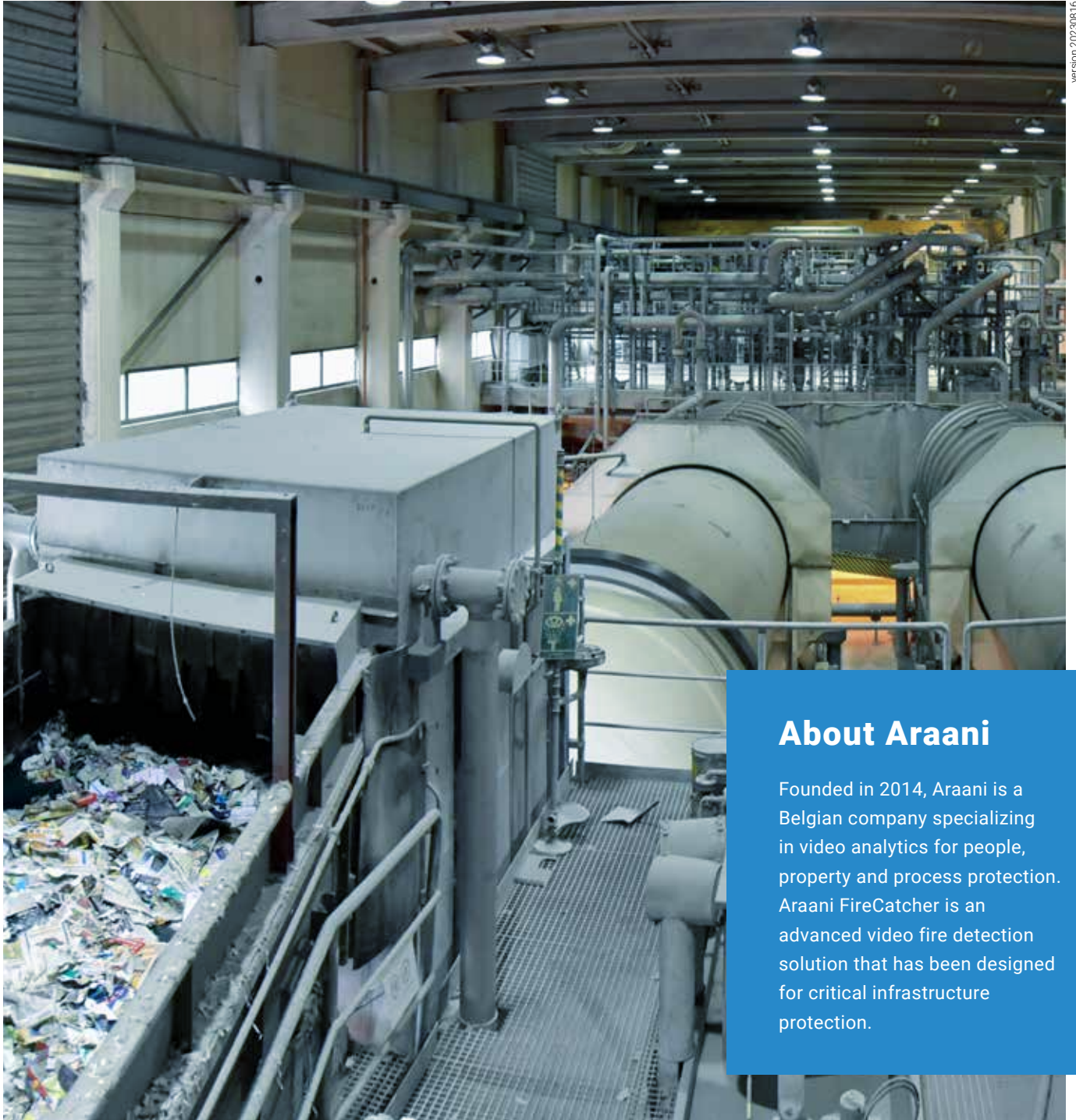▸ Conventional fire detectors are not suited for use in the harsh conditions of waste management facilities.

▸ Video Fire Detection can detect fires at the source in an early stage.

▸ Video Fire Detection reduces the unwanted alarm rate, because it can make a distinction between fly-away dust/waste and real fires.

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About Araani

Founded in 2014, Araani is a Belgian company specializing in video analytics for people, property and process protection. Araani FireCatcher is an advanced video fire detection solution that has been designed for critical infrastructure protection.

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