# 8 Hidden Risks at Your Waste Plant

Managing Risks Associated with Waste Management Facilities



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### Introduction

The variety of materials processed by waste plants, along with specific equipment and methods of processing all contribute to significant risks for waste management plants. Management of these risks has strong bearing on insurance issues and overall site viability.

Risk management starts with basic compliance with relevant regulation authorities and the plant approval, however the advice of the insurer, local fire brigade and relevant professionals will be important aspects of assessing risk and response.

When investing in risk minimisation and protection systems, it is important to consider not just the impact on reduced insurance premiums but also the impact of a major incident on upstream and downstream businesses, the disruption of a prolonged period of business closure or reduced capacity, the impact on licences, etc. that the business relies on to operate, and the impact on the business brand.

A method of evaluating the risk is to calculate the Maximum Foreseeable Loss (MFL), Probable Maximum Loss (PML) and Normal Loss Expectancy (NLE) scenarios; with significant differences between the NLE and MFL or PML indicating high effectiveness of protection measures, which may be factored into insurance premiums.

Following is an examination of eight key areas of risk associated with waste management facilities.



### Fire

For general fire safety active fire protection measures, such as automatic fire alarms, automatic sprinkler protection and special extinguishing systems are essential. A double-pronged approach using a thermal detection system has the potential to detect a potential problem before it becomes a fire, further reducing risk.

#### **Stockpiles**

Spontaneous combustion in stockpiles is a common hazard. By nature it is difficult to detect as it commences within a stockpile and, by the time that there are external signs, it is well established and difficult to control.

Thermal imaging cameras mounted in a suitably robust housing are a proven means of addressing this; and can detect heat build-up long before there are external signs of a problem.

Such cameras can be fitted with communication interfaces. They have been integrated into remote location monitoring systems capable of triggering an alarm when a threshold is reached, to alert personnel. False alarms from other sources of heat (e.g. a forklift) can be avoided by linking the IR output to a clock, so that the elevated threshold is maintained for a nominated period before an alarm is sounded. In addition to an alarm, an infrared monitoring system can also trigger a fire suppression response from either a fire suppression system or an internal firefighting crew.

The system can be set up with a failsafe capability whereby the camera's digital I/O output goes low (typically zero volts) after an appropriate time delay, causing the PLC to go into its alarm state. The alarm alerts personnel that either the monitoring function has been lost or there is a temperature rise.

A central control room can receive output from a number of IR cameras set up around a waste plant, with the operator able to identify which camera gave rise to the alarm, and view the image from that camera.

Cameras can be set up to automatically send temperature data and images for data logging of alarm incidents and subsequent analysis.

A further advantage of an IR system is that it can double as a means of detecting intruders at the waste plant.





# Dust, Ingnition and Explosions

By the nature and volume of the materials handled (and the dust generated when processing and sizing waste material) waste facilities have a high inherent risk of fire and explosion.

There are many potential sources of ignition for a fire or explosion – heat generated by failing bearings on various plant items, electrical infrastructure, the heat of the sun on metal, hot exhausts on mobile plant, friction from equipment used for sizing waste, etc.

The most devastating explosions are actually secondary explosions: the primary explosion is caused by ignition of a cloud of dislodged dust, but this explosion dislodges a far greater cloud of dust that is the source of the secondary explosion.

A routine commitment to site cleanliness is a means of minimising the volume of dust that can be ignited, but using an inappropriate method of doing this can actually magnify the problem. The use of sweeping and air blowers has been linked to explosions in the past - sometimes resulting in death or serious injury.

Wet/dry industrial vacuums are the preferred method of picking up small volumes of dust, debris, spills and liquids. Where explosions are a risk, air-powered vacuums are preferred to electric units.

However, for a large industrial facility generating high levels of dust, an extraction system and baghouse is appropriate. These can be potentially hazardous, and may require spark detection/ suppression and/or a pressure release system (e.g. blast panel)

One form of spark suppression is a modification to the ductwork to induce turbulent flow for a short distance, to strip air from around an ember and cool the spark below ignition temperature. The alternative is a spark detection and extinguishing system that uses sensors to detect a spark, sending a signal to trigger an extinguisher and eliminate the spark.

A pressure release system (blast panel/explosion vent) can be used on the dust collection baghouse. This acts like a fuse, minimising or eliminating damage to surrounding structure. An alternative is an inerting system that introduces an inert gas to reduce the oxygen concentration to a level where it does not support combustion.

The explosion vents must be directed either outdoors or to an area where an explosion can be safely dissipated. Flameless explosion vents using mesh to absorb the flame are a variation of the traditional explosion vent.



### **Other Stockpile Issues**

Monitoring instrumentation can perform other functions at organic waste composting facilities. Inpile oxygen and temperature probes can be set up to communicate with a central control system to optimise the decomposition process through optimal bacterial, temperature and oxygen conditions. This can accelerate the composting process; as well as guard against excessive temperature build-up that can give rise to spontaneous combustion.

Administrative controls also play a role in managing this risk. Risk of combustion is heightened with reduced particle size and the time spent in a stockpile.

To control the former, it is recommended that the waste processing occurs close to the time that the processed stock is due to be drawn on for downstream processing, to minimise the stockpile time for the sized waste.

To minimise the second risk, it is recommended that stock is turned over at least one a month. To manage this, good systems recording the age of each stockpile are necessary. In addition, it is suggested that two smaller freestanding stockpiles or two smaller bunkers are used in preference to a single larger stockpile or bunker. This allows one to be completely drawn down at the same time as the other is being built.

There are guidelines for maximum stockpile sizes and spacing between stockpiles. These cover both internal (inside a building) and external stockpiles; and both bunkers (walls on three sides) and free standing stockpiles. There are also separate provisions for loose and baled waste.

While there are pros and cons for each form of storage, as a general rule bunker storage with properly constructed fire wall (no gaps, built from a material that is not combustible and has low heat transfer) allows fire to be contained and makes good use of space. Stockpile collapse is also less of an issue with a bunker than with a free standing stockpile.

Internal storage has an advantage over external storage in making it easier to install fire detection and suppression systems, and also avoids wind issues that can fan flames or spread waste. However, external storage is less costly and may provide greater visibility and easier access for firefighting.

For the apparent advantages of bunker storage to be realised, the bunkers need to be used correctly i.e. no waste is above the height of the bunker walls, and no waste spills outside the side walls to provide a path for a fire to travel to an adjoining bunker.

Separation distances between stockpiles/banks of bunkers can vary depending on the level of risk posed by the waste. Another factor is that some waste (e.g. crumb rubber, shredded plastic) can become liquid when ignited, and spread further than if it remained solid.

Separation distances for external stockpiles also apply to the distance from buildings, and may apply to separation from the boundary if there is a significant external risk of fire entering the property e.g. from an adjoining business, bushland, etc., or if arson is considered a risk. Alternately, non-combustible waste might be stored near the boundary.

Some wastes with a high risk of spontaneous combustion may be best stored in a silo with an appropriate fire detection and suppression system fitted.

Another consideration in the location and spacing of external stockpiles is that adequate access is allowed for fire service vehicles to access fire hydrants and fire risks.



# Equipment

There are a number of risks associated with typical waste processing equipment. Shredders, bag openers and similar equipment can pose an ignition risk through friction.

While trommels, other screens and air separators do not pose a high risk in themselves, their general proximity to shredders and other potential fire sources means that the oxygenation in the screen can convert a smoulder into full ignition.

Electrical plant rooms are a common source of fires, and appropriate automatic detection and suppression systems should be located in these rooms. Sealing penetrations (conduits) into these rooms, as well as having clear panels on doors so that people can check the room for fire before entering, are further safeguards.

Good inspection and maintenance practices are crucial in managing risks relating to equipment, particularly considering the severity of the potential consequences of substandard practices.

Thermal imaging is a way of identifying maintenance issues in electrical equipment, as well as in conveyors and other plant, sufficiently early that timely attention to maintenance can greatly reduce the risk of fire.

Plant design can also be used to manage risk, with the aim of having a problem contained to the area where it originated rather than spreading to other parts of the plant.

The three key areas are the receiving area, the processing area and the storage area. One approach may be for the reception area to be physically separated from the processing area by a wall to compartmentalise each area, and having some distance between the storage area and the processing area.

However complete compartmentalisation is not practical as waste needs to be conveyed from the receiving area to the processing area, requiring a penetration in the wall. This could be addressed by a drench system to protect the wall, combined with a suppression system above the conveyor.

A further design issue is to ensure that there are clearly marked paths to emergency exits to ensure safe evacuation in the event of a fire. Inductions, training and regular drills are important to reinforce this.

A potential problem with fighting fires in internal storage areas is the smoke, which can make it difficult for firefighters to direct water to the seat of the fire. This can be addressed with passive or automatic smoke vents in the roof over internal storage areas, but can delay activation with some fire detection and suppression systems.



# Conveyors

However, there are a number of issues that must be managed to ensure safe, reliable operation of the conveyors. Some of the issues are:

- Fire risk from the friction of belt slip
- Fire risk as a result of heat from failing or failed pulley and idler bearings, etc.
- Rapid transfer of fire from one part of a facility to another via the conveyor
- Spillage from the conveyor, creating a potential fire hazard if it is not cleaned up promptly
- Belt failure, causing extended downtime with clean-up and belt unloading, in addition to belt replacement time.
- Belt slip

#### Causes of belt slip include:

- Build-up of material on the pulleys or belt (belt scrapers can address this)
- Insufficient traction between the belt and drive pulley (replacing the lagging can address this)
- Insufficient belt tension (this can be adjusted)
- Failing idlers (repair or replacement thermal monitoring can detect a problem in sufficient time to allow scheduled maintenance, avoiding failure; while attention to lubrication, cleaning and alignment can minimise the problem.
- Belt Misalignment

#### Causes of belt misalignment include:

- Misaligned conveyor structure (on the centreline or side-to-side)
- Incorrect splicing of the belt (e.g. not square)
- Uneven loading of the belt
- Incorrect idler installation.

While correction of the underlying problem will generally overcome this issue, there are a number of aftermarket belt tracking devices that offer a solution for difficult tracking problems.

#### **Detection of problems**

Thermal imaging can detect abnormal heat patterns that are an early indicator of bearing problems. This is done with the equipment in operation, and generally allows maintenance to be undertaken during scheduled downtime, without disrupting production.

Vibration analysis is another technology that can be applied while the conveyor is operating, and can give an early warning of problems in rotating equipment e.g. shafts. Splice X-rays can identify problems with belt splices and ultrasonic systems are available to detect rips in belts, and can be linked to a conveyor shutdown if required.

#### Fire spread by conveyor

A significant risk at a waste plant is that alight waste on a conveyor belt can quickly spread the fire. A way of managing this risk is for fire sensors to trigger an automatic shutdown of a conveyor. Depending on the level of risk, water deluge or sprinkler systems could be considered as an extension of this solution.

Conveyor transfer points are an area where dust is generated, and fire suppression systems should be prioritised for these locations.



# Managing Hot Loads

Hot loads are loads arriving in the receiving area where the load may be smouldering or risks such as gas bottles, batteries, etc. may be hidden in the load.

A procedure for handling hot or suspect loads could be to discharge them at a set-down area sufficiently distant from storage and buildings to minimise risk, but having its own firefighting facilities. Any smoulder issues can be resolved there, or a load can be sorted through to locate any problem items.

Thermal imaging has been used on waste collection vehicles to examine the contents of a bin pickup, and provides a means of taking personal judgment out of the picture when determining hot or suspect loads.

Consideration should also be given to using thermal imaging to monitor the receiving area, possibly linked to a fire suppression system.

Where a waste facility has set hours of operation, consideration should be given to having a set period (e.g. an hour) for monitoring the site to see whether any issues arise that were not apparent at shutdown.

This watch period should also apply to hot work (e.g. welding) to ensure that problems do not arise after work is completed.

With thermal imaging set up around a plant, linked to a central control room, the watch period need not require a site presence, and could operate around the clock, including monitoring to detect intruders as well as combustion and gas issues. This could be linked to a fire suppression system.





## Methane Emissions

Traditionally, compacted clay caps have been used as a barrier layer to isolate filled landfill cells from rain water infiltration through and an impermeable (compacted) clay layer, combined with landfill geometry that facilitates run-off. Geocomposite (geofabric and bentonite) barriers have been a modern development of this.

Regulatory requirements for caps have been prescriptive, with the assumption that building the cap in the specified manner will provide an impermeable barrier, while also guarding against leachates entering soil and groundwater surrounding the landfill.

Microbial degradation of biodegradable waste in anaerobic conditions gives rise to landfill gases, which vary in type and volume depending on the time phase.

Perimeter wells are required to monitor landfill gases, and flaring is an accepted method of managing methane emissions. Where the volume is sufficient, landfill gases can be harvested as a fuel for energy production.

Periodic inspections with infrared cameras such as the FLIR Systems ThermoVision GasFindIR can be identify a range of Volatile Organic Compound gases, including methane. Where gases are captured for energy production, these cameras can also be used for detecting leaks in pipework.

While clay and geocomposite (geotextile and bentonite) barriers have been a traditional solution to leachate issues, they have limitations in performance. Over time, the impermeability of clay deteriorates – sometimes in as little as a year. Ion exchange with surrounding soil can also compromise the impermeability of geocomposite barriers.

This was recognised in the United States, where phytocaps were evaluated under the US Alternative Cover Assessment Program (ACAP), and are now accepted.

These are vegetated soil landfill covers designed primarily to reduce the drainage of rain water into the waste using water balance mechanisms rather than traditional barriers. They also perform a secondary - but important - role in oxidising methane through the root system of the vegetation, to the extent that a methodology has been developed for calculating carbon credits.

In Australia, Pacific Environment Ltd has been instrumental in gaining acceptance of phytocaps as an alternative cover, and there are now guidelines for their use in Queensland, New South Wales and Victoria. In addition, the Waste Management Association of Australia produced Guidelines for the Assessment, Design, Construction and Maintenance of Phytocaps as Final Covers for Landfills in 2011. There have been a number of trials, and the first commercial application in Australia was completed in 2011.

With phytocaps relying on a layer of lightly compacted soil and the vegetation that it supports, they are comparatively simple and cost-effective in terms of both establishment and ongoing maintenance, compared to traditional clay caps. There is a scientific basis for calculating the depth of the layer for sustainability across a range of climatic and seasonal conditions, and sufficient history in the US to prove their effectiveness.

With the establishment and health of the vegetation being a critical factor in the success of a phytocap, hyperspectral imaging (also known as imaging spectroscopy) would be an appropriate means of monitoring vegetation health. It has been used for this purpose in other applications; and can be used with a drone, vehicle or fixed location, depending on what is most appropriate for the site.

This technology is equally applicable for other monitoring other plant-based waste treatments, such as wetlands treatments of stormwater, sewage and waste water. As conventional closed caps require regular inspection for dead or stressed vegetation, this technology could also have application in convention caps.



## Waste To Energy Issues

While there are a number of technologies advanced for converting waste to energy, some are regarded as largely unproven over the longer term.

Waste-to-energy gasification/pyrolysis plants exist in relatively small numbers. However, an EPA report on a proposed waste to energy plant that uses combustion grate technology indicated that modern waste to energy plants, when well-designed and operated using best practice technologies and processes, can operate within strict emissions standards that have acceptable environmental and health impacts to the community.

Combustion grate technology is the most widely used waste to energy technology around the world. It is possible that other technologies will evolve and over time achieve similar acceptance.

From an economic point of view, robust technology proven over many installations, and having the capacity to handle a range of municipal solid wastes, provides the confidence to invest.

The Syncom process used by Martin GmbH, a long-established German leader in waste to energy technology, actually uses thermal imaging to optimise the combustion process. This results in significantly reduced Carbon Monoxide content in the flue gas, a significantly higher combustion temperature in the fuel bed, and partial sintering of the bottom ash. The first plant has been in operation since 2004.

A further, symbiotic extension of this in Europe is the use of energy from the municipal solid waste plant to power a dry digestion plant to process organic and garden waste and produce municipal biogas, high-grade compost and liquid fertiliser.

The hazards of biomass feed stock (fire, dust explosion) are similar to those outlined for waste plants, and can be managed in the same way e.g. thermal imaging. This could also be used for detecting leaks of the biomethane produced in the digestion plant.



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