

FIRE RISK AND LITHIUM BATTERIES AT WASTE TRANSFER, RECYCLING AND RECOVERY OPERATIONS

This WISH information document provides practical advice on reducing the fire risk posed by rogue waste lithium batteries in general waste streams. The information in this document was originally produced by an ESA (Environmental Services Association) working group and is aimed at the operators of waste transfer, recycling and recovery facilities. It does not consider the recycling of lithium batteries themselves, which is a separate and technical area.

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Introduction

Technology advances, and waste streams change. Battery technology has advanced significantly over the past ten years, resulting in an increased use of lithium batteries in everyday items such as mobile telephones, toys, photographic equipment, laptops and similar, power tools and other equipment. Waste lithium batteries from such uses should be disposed of/recycled via suitable facilities. However, this is not always the case and increasingly 'rogue' lithium batteries are appearing in general waste streams at waste transfer, recycling and recovery facilities, where they can pose a significant fire risk.

Lithium batteries and fire risk

Waste management industry data indicates that the number of fires caused by rogue lithium batteries at waste sites has increased over recent years. Such rogue batteries may be from household waste streams, such as a householder who incorrectly puts a discarded power tool or other device battery in their bin bag or recycling container, or from commercial sources, such as lithium batteries from portable computing devices inappropriately disposed of into a general waste stream. In addition to separate batteries, lithium batteries may also be concealed in inappropriately disposed of waste electrical and electronic goods. The cost of these fires can run into the £ millions and they also pose a health and safety risk to waste site workers. Householders, commercial concerns and others should dispose of their waste lithium batteries correctly. However, as the use of lithium batteries in various devices and equipment increases, it seems inevitable that fires at waste management sites caused by rogue lithium batteries will continue to pose a significant risk.

There are various types of lithium battery in current use, and as technology advances other types may well be developed. Some types may pose a higher risk than others. For example, lithium (metal) batteries may pose a lower risk than lithium ion batteries. However, a waste operator is very unlikely to know in advance of a fire what type of battery may be the cause and, as a result, all should be viewed as a risk. In addition, it is not the intent of this document to be a technical discourse on lithium batteries, but rather to give practical advice.

Lithium battery fires

When a lithium battery is damaged it can project a shaft of flame for anything from a few seconds to several minutes, depending on the type and size. This may ignite surrounding combustible wastes. Several mechanisms may cause this (the mechanism may vary dependent on the type of battery, although the outcome is the same), such as:

- Physical damage causing a rupture of the battery casing, creating a short circuit and subsequent ignition



Left to right: Flame jets from a waste lithium battery from a portable computing device discovered at a waste recycling site, CCTV stills showing ignition of a lithium battery from a hand-held power drill in the picking cabin of a recycling plant

- Water ingress causing a short circuit or a reaction generating hydrogen and subsequent ignition of the hydrogen and/or vented electrolyte
- Exposing the batteries to excessive heat. (typically, >70 °C)

Fighting lithium fires requires specialist equipment and training and is outside of the scope of this document. In addition, as the waste operator is very unlikely to know in advance of a fire what type, size, how many etc lithium batteries may be present designing strategies specific to each possible scenario is unlikely to be of practical use. However, typically it is not the lithium battery fire itself which results directly in large-scale damage, although as illustrated by the photographs above if a lithium battery ignites in an occupied space such as a picking cabin there are obvious health and safety risks. Rather, it is more common that the lithium battery fire provides a high-energy ignition source which ignites surrounding general combustible wastes potentially resulting in a large and damaging waste fire.

Types of fire caused by lithium batteries

Whatever the mechanism by which they ignite, rogue lithium batteries at waste management sites tend to cause two different types of fire:

- Sudden fires, such as when a lithium battery is fed into a shredder or other aggressive type of recycling equipment, or when an item of heavy mobile plant such as a loading shovel runs-over a rogue battery in received wastes
- Delayed fires, such as when a damaged lithium battery concealed in a pile of waste 'smoulders' and then bursts into flame after a period of time. This may be hours or days after the pile of waste has been deposited at a waste management site

Reducing the risks of these two different types of fire often requires different approaches. Sudden fires may be best addressed through technical means, such as fixed fire systems, whereas delayed fires may be better addressed through management and awareness.

Reducing fire risk from lithium batteries

Lithium battery fires at waste management sites can occur in waste reception and storage, or during the processing of wastes such as at a recycling plant. In addition, the ignition of lithium batteries in picking cabins poses safety risks to workers.

Waste reception and storage

Prior to arrival at a waste site waste, lithium batteries may have already been subjected to compaction, damage and water ingress. In addition, batteries may be damaged by the action of heavy mobile plant such a loading shovel running-over a battery.

- All operatives working in waste reception areas, including mobile plant operators, should be inducted on and made aware of the risks from rogue lithium batteries and what to do if they see one
- Mobile plant operators in particular should be made aware of the risks associated with physical damage to lithium batteries caused by plant operations
- So far as is practical, deposited and stored loads should be checked prior to processing. This can be achieved visually, through sampling, or by utilising a thermographic camera. However, it should be noted that such checking, including the use of thermographic cameras, is unlikely to discover a lithium battery buried in a pile of waste and is a risk reduction rather than a risk elimination measure
- Ideally, all wastes in reception should be processed before the end of the working day. However, this is often not practical and at the least consideration should be given to fire spread, such as maintaining an adequate distance between stored and received wastes and high-value items such as recycling equipment, or the use of suitable bunkers to provide protection from fire spread
- Fire watches after working hours may be considered to detect any delayed fires, or the installation of fire detection systems in reception and storage areas aimed at discovering a delayed fire as soon as practical
- Dependent on plant and building value, consideration may also be given to the installation of fixed fire systems, such as deluges and oscillating water monitors

For more advice on fire risk in waste reception and storage and technical fixed fire systems, such as detectors and suppression systems, see WISH WASTE 28 “Reducing fire risk at waste management sites” (available as a free download from the WISH web site). In addition, when considering fire suppression and similar systems you should consult your insurer.

Waste processing

In recycling and recovery plants the mechanical processes involved may pose the risk of a sudden fire from lithium batteries. For example, more aggressive equipment such as shredders, trommel screens and balers damaging rogue lithium batteries resulting in a sudden flash fire. This can result in damage to the specific item of equipment involved and if the fire spreads also to other parts of the plant. In addition, any fire poses a life safety risk.

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- Lithium batteries should be considered as a fire risk in the equipment's specific risk assessment, both at design stage and the operator's assessment
- Workers should be inducted and made aware of the fire risk associated with lithium batteries in waste processing plant. This should include that if they spot a fire, they should activate an emergency stop immediately to reduce the risk of a fire being spread through the whole plant, such as by the action of moving conveyors or other mechanical handling systems
- Where appropriate, further mitigation may be considered to reduce the risk, such as blast shields for balers and the overall mechanical integrity of items such as baler access hatches and their hinges and fixings
- For higher-value plant consideration may also be given to the installation of fixed fire systems such as deluges at higher-risk items such as shredders, or in-conveyor deluges. If installed, such systems should generally be automatic and activated by fast-acting fire detection systems (slow and medium acting detectors are unlikely to be effective – by the time they have activated the fire will likely have already spread). In addition, such detectors should be tied-into the plant's operating system to stop the plant immediately a fire is detected to prevent fire spread by the action of conveyors and other mechanical systems

For more advice on fire risk in waste processing and technical fixed fire systems, such as detectors and suppression systems, see WISH WASTE 28 "Reducing fire risk at waste management sites" (available as a free download from the WISH web site). In addition, when considering fire suppression and similar systems you should consult your insurer.

Picking cabins, removing discovered rogue batteries and fires

In general, fires at waste management sites are more of a property risk issue than a life safety issue, although life safety and the provision of suitable escape and evacuation must be the top priority. However, the ignition of a lithium battery in an occupied space such as recycling plant picking cabin and the removal of discovered rogue lithium batteries from a picking belt or other part of a recycling plant may pose safety risks.

It is not the purpose of this information document to repeat what can be found in numerous items of advice and guidance on fire risk. The information below is aimed specifically at rogue lithium batteries and it is assumed that all other appropriate fire precautions are in place.

Lithium battery igniting on a picking line:

- Workers in picking cabins should be inducted and made aware of the risk of a lithium battery igniting in the picking cabin, including that if a lithium battery does ignite in a picking cabin, and if it is safe to do so, they should activate an emergency stop immediately to prevent any fire being spread by the movement of the conveyor
- Fighting lithium fires requires specialist equipment and training, which are unlikely to be available at a standard recycling plant. In addition, the appropriate fire-fighting strategy may depend on the type of lithium battery, which the waste operator is unlikely to know in advance. For some types, the use of a water extinguisher or hose may make the situation worse and standard powder, foam and carbon dioxide extinguishers may be ineffective because of the energy involved. Unless the required specialised equipment and training are in place, workers should be instructed not to attempt to fight a lithium fire. Once the lithium fire has stopped, any resultant waste fire ignited can be treated in the same way as any other waste fire, using water or other suitable fire-fighting medium
- However, there have been examples where further lithium batteries have been present in waste streams. For example, one lithium battery causes a fire, this battery itself burns-out quickly leaving a general waste fire, but further batteries are present in the waste which then ignite as a result of the general waste fire. Operatives should be made aware of this possibility and that if further lithium batteries start igniting while they are fighting a general waste fire they should retreat immediately – life-safety is our first priority. The same principle would apply when clearing wastes after a fire – if lithium batteries are observed during such work the task should stop and advice sought regards safe methods of clearing the waste

Small domestic lithium batteries, such as AA and AAA batteries, are unlikely to pose a significant risk. However, larger lithium batteries, such as those used in mobile telephones, laptops and other computing and similar devices, power tools and similar, may pose significant risks. On discovery of such a larger rogue lithium battery:

- The plant should be stopped as quickly as practical, either by use of an emergency stop or functional stop
- Appropriate PPE (personal protective equipment) should be worn. This is a matter for risk assessment, but is likely to include at the least eye and face protection, protective apron and protective gloves

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- The rogue battery should be visually assessed for any damage without picking it up. If the battery is damaged advice should be sought from a competent person – any damage may be hidden or internal to the battery and not visually obvious and all possible care should be taken
- Rogue lithium batteries should be removed without being touched, such as by using a plastic (non-conducting) shovel or similar. Fire is not the only risk here. Electric shock and exposure to hazardous substances from discovered and/or damaged lithium batteries are also potential hazards
- Removed rogue lithium batteries should be stored safely, ideally away from any buildings or equipment in a suitable container (water-tight and robust), such as a 'chemstore', robust container filled with sand or similar. Storage should be robust and away from any combustible or hazardous materials. The location of any such storage should be risk assessed and included in site emergency plans
- Rogue lithium batteries should not be allowed to accumulate in any quantity and should be removed from site for appropriate disposal/recycling as soon as practical. Operators should plan in advance and have identified a suitable disposal/recycling route, rather than having to search for one when a problem occurs
- All specific battery storage areas and storage areas which may contain lithium batteries should be periodically checked for hot spots
- If practical, discovered rogue lithium batteries should be tracked back their source/customer and the regulator informed, such as the EA (Environment Agency), SEPA (Scottish Environment Protection Agency) or NRW (Natural Resources Wales). However, it is understood that it is often extremely difficult to trace specific wastes back to customers and such action is likely often impractical

Note – the above covers lithium batteries discovered in picking cabins. However, batteries may be discovered anywhere in a waste, recycling or similar site, such as trapped in recycling machinery, on a transfer conveyor etc. The same principles as above apply, and all caution should be exercised.

Other types of battery

This information sheet concentrates on the risks posed by lithium batteries. However, other types of battery are known to have caused fires at waste management sites, such as automotive and similar batteries. In general, the controls noted in this sheet may also apply to such other types of battery and may form a starting point for your risk assessments in this respect. However, other additional risks may also be present, such as the release of corrosive material from lead-acid car batteries. You will need to take account of this type of difference in your risk assessments.

Disclaimer and WISH

This information document has been prepared by health and safety practitioners to assist health and safety improvements in the waste management industry. It is endorsed by the WISH (Waste Industry Safety and Health) Forum. This information document is not formal guidance and represents good practice, which typically may go beyond the strict requirements of health and safety law.

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The Waste Industry Safety and Health (WISH) Forum exists to communicate and consult with key stakeholders, including local and national government bodies, equipment manufacturers, trade associations, professional associations and trade unions. The aim of WISH is to identify, devise and promote activities to improve industry health and safety performance.

The information in this document was originally produced by an ESA (Environmental Services Association) working group. WISH thanks this ESA working group.

Further reading

- WISH WASTE 28 "Reducing fire risk at waste management sites" (available as a free download from the WISH web site)