

Understanding and Managing Landfill Fires: A Guide to Surface and Subsurface Hazards

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While essential for waste management, landfills can pose hazards when not properly managed. One of the more pressing challenges is the risk of landfill fires, categorized into two main types: surface and subsurface fires. Understanding their causes and appropriate management strategies is vital for maintaining safety, compliance, and can financially benefit the facility with early identification of potential situations.

Surface Fires

Surface fires are directly visible and can be caused by several factors, including hot loads (items in a post-combustion state that are smoldering or can be re-lit), lightning strikes, vehicle malfunctions, and chemical reactions within the newly placed waste. Dry and hot environmental conditions often exacerbate these fires. A surface fire is easily identifiable due to the readily visible smoke and flames, as seen in **Figure 1**.

In the event of a surface fire, the immediate response is critical. Personnel should call the fire department and then mobilize heavy landfill equipment to the area from a safe distance. A fire professional should lead a well-coordinated action plan. The mobilized equipment is vital in containing the fire and preventing its spread by removing flammable materials such as wood and fuel from the area and bringing in soil to smother the flames, thereby reducing the oxygen supply.

After extinguishing the fire, it is imperative to notify the appropriate regulatory agency. This notification



Figure 1 - Surface fire at a landfill.

should include details about the fire's cause, duration, damage, and the measures taken for remediation in line with the landfill's operating permits.

Subsurface Fires

Subsurface fires, or subsurface oxidation, are less apparent and can often go unnoticed until



Figure 2 - Subsurface fire due to compromised infrastructure.

visual signs like smoke or ground settlement are observed. These subsurface occurrences can arise from compromised infrastructure, over-extraction of gas from the landfill gas collection system (GCCS), the nature and composition of the waste itself, and the answer may remain unknown. A depiction of a subsurface fire due

to compromised infrastructure is in **Figure 2**. Other visual indicators of a subsurface fire include stressed or dead vegetation around a landfill gas well, ground settlement, or visible smoldering.

Monitoring gas data trends from wells is critical in preventing fires, as early detection can lead to effective prevention and proactive solutions. Data indicators of a potential subsurface fire include an increase in the well temperature, a methane (CH_4) to carbon dioxide (CO_2) ratio greater than one, and elevated carbon monoxide (CO) levels above approximately 100 ppm. When these gas data trends are present for a well, the well may no longer be in a methanogenic cycle and is shifting into an oxidation phase. An example of this shift is graphically depicted in **Figure 3**.

As these warning signs are detected, personnel should isolate the area by closing the air, force main, lateral piping, header valves, and closing wells within a 500-foot radius of the affected area. Further measures include placing two feet of soil to smother the area, extended by 10 feet in all directions. Monitor ground temperatures and CO levels continuously until the data reflects normal levels. Once data trends

indicate the subsurface fire has subsided, the isolated vacuum, air, and forcemain piping can be gradually reopened.

Preventative Measures

Preventative measures include diligently placing daily cover material atop the newly placed waste. Daily cover is not always required for every facility, but this can be an important factor in prevention. Additionally, the segregation of known reactive waste materials can prevent unexpected reactions within the active face of the landfill. Proactively identify waste streams to reduce the probability of an incident, reducing the facility's risk for fire.

Maintaining landfill gas infrastructure and ensuring its functionality is vital to preventing potential fires. A compromised vacuum or airline in the system can be enough to trigger a reaction and start a fire. In addition, proper shut-off valve placement can aid in extinguishing a fire when it is present.

Recently, lithium-ion batteries have become a source of ignition in landfill fires as they are hypersensitive to exploding in the presence of water.

These batteries are typically small, such as those in vape pens, making them especially hard for even the most trained landfill spotters to see. Therefore, educating citizens on disposal needs and drop-off locations is an important preventative measure. We recommend implementing immediate response plans for both types of fires to manage and mitigate risks effectively.

In summary, proactive measures such as segregating known reactive waste materials, monitoring gas data trends, maintaining infrastructure integrity, and educating citizens on proper waste disposal habits can significantly reduce the likelihood of fire incidents. By adhering to these practices, landfill operators and citizens can enhance safety, ensure compliance, and protect the environment and their community.

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Figures courtesy of SCS Engineers.



Figure 3 - Graphical depiction of oxidation phase in well data.