

Landfill Fires

Construction waste landfills are not always carefully designed, resulting in fires ignited by spontaneous combustion that are difficult to put out.

In attempting to reduce the volume of solid waste going into municipal landfills, many jurisdictions require that construction and demolition waste be separated from the municipal solid waste stream and be landfilled separately. What these policies did not anticipate, however, was the resulting increase in the number of landfill fires. In fact, 90 per cent of landfill fires occur in demolition, landfill and construction (DLC) waste sites.

During the early 1990s it was widely perceived in the U.S. and Canada that industrial landfills should contain only non-putrescible solid waste materials. Because the DLC landfills don't have organic waste and hazardous leachates, it was thought that sophisticated leachate collection and landfill gas control systems generally were not necessary. As a result, these landfills are not monitored as carefully as perhaps they should be.*

Any expanding city generates a large amount of demolition and construction waste, and because DLC landfills need less capital investment, and since it's easier to obtain operating permits, their numbers have increased. Their operators want to minimize the use of soil cover because it takes up valuable capacity, which is unfortunate because the soil cover acts like a firebreak. With the increase in the number of construction and demolition landfills there has been an increase in the number of landfill fires.



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Sperling Hansen Associates of North Vancouver teamed up with Key Safety Services of Calgary to form Landfillfire.com in 2000, combining their expertise in preventing and extinguishing landfill fires. They first joined forces to extinguish the high profile 300,000 m³ fire at the Delta Shake and Shingle landfill in 1999 (See CCE May 2001). Since then the team has worked on several others, including a 10,000 m³ landfill fire in Colchester County, Nova Scotia, a 60,000 m³ landfill fire in Duncan B.C., and large underground fires in Minnesota and Fresno, California.

"These fires are extremely difficult to fight," explains Jarvis Jackson, president of Key Safety Services.

"Most people don't understand what they are facing with an underground fire. An underground fire is a slow smouldering fire with a wide range of temperatures. As it burns in the sub-surface it creates a cavity which encourages air movement. Not only does it become a self feeding fire, but it also becomes dangerous, because there is the risk that the heavy equipment we use to fight the fire can fall into one of these cavities." Jackson knows a thing or two about fighting challenging fires; his company extinguished 186 fires in 200 days in Kuwait after the first U.S.-Iraq war. Key Safety put out more fires in Kuwait than any other of the 16 international teams that were brought in.

Dr. Tony Sperling, P. Eng, president of Sperling Hansen, sort of fell into this unusual area of expertise for a geotechnical engineer. His "big break" came in 1998 when the regional district of the Okanagan Similkameen hired the firm to develop an extinguishment plan for a landfill fire. "It was only about a 30,000 cubic metre fire, but I found it to be a really interesting environmental topic that was not well understood, so I did a lot of research on landfill fires and spontaneous combustion," he says. Most of Sperling's training has been on-the-job. Towards the end of 1999 he got a call about the huge out of control fire in Delta, and from then on there was no turning back.

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* British Columbia issued "Landfill Criteria for Municipal Solid Waste" in June 1993 as a guideline for operating landfills, but not for specifically reducing fire risk. There are no federal guidelines. Landfills with a gas collection system are also an ignition source if they are poorly operated; if the vacuum system is set too high it pulls too much oxygen into the landfill, fuelling a fire.

Landfill fires are categorized into four levels based on how quickly they can be extinguished. Level I is a small easily extinguished garbage fire. Level II is a small fire on the active face, or the face of the operating slope where the garbage is being dumped. Level III is a little more serious and can take up to a week to extinguish, and Level IV, is a fire of 10,000 or more cubic metres, (about one hectare) that takes longer than a week to extinguish.

These fires pose a number of threats. There is the obvious risk that the fire will "surface." There is the odour. But the most immediate threat to public health is the problem of smoke and the fine particulates, or PM10's (particles of minus 10 microns), that result from these fires. Additionally dioxins and furans are released into the air when plastics are combusted at low temperatures in the presence of chlorine even at low concentrations. These nasty airborne carcinogens bioaccumulate and are related to birth defects.

Spontaneous combustion occurs in the landfill when the biological activity from decomposing wood waste starts to raise the temperature. At about 80°C the bacteria will start to die. In some instances heat build-up will then continue. Through a process called pyrolysis, temperatures rise to the point where the reactions change from biological to chemical and become exothermic, producing excess heat. In a properly capped municipal solid waste landfill that is built in distinct and separate cells, the heat is trapped and the reaction may go no farther. Once the oxygen is consumed by the aerobic bacteria they die off and the reaction is complete. However, in a DLC landfill, where there may be little or no capping, and the coarse material is very pervious to gas migration, the reaction can go a lot further. It can cause large underground fires that can spread at an unpredictable rate in unpredictable directions.

There is still speculation as to what mechanism elevates the temperature from 80°C to 150°C, but what is known, is that from 150°C the temperatures start to rise quickly and these fires become difficult to fight.

With time pressing as the fire burns, the engineers have to evaluate the fire before formulating an extinguishment plan. The size and extent has to be determined, which means accessing the subsurface to collect gas and temperature data using geotechnical boreholes. The process can take one to two days depending on the services available. Sometimes the crews will have to wait for drill rigs

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and operators. If the fire breaks to the surface, there are more aspects to consider: the speed of the fire, increased airborne contaminants, hazards to workers, and different rates of combustion that result in different by-products.

A number of different strategies are used to extinguish the fires depending on the size of the fire and the availability of material. It may be possible to extinguish a fire just by smothering it or preventing it from spreading and letting it burn itself out. On a larger fire an overhaul strategy might be used where the crews go in and dig up the fire, sorting the unburned material and extinguishing the burning material. This method is labour intensive and requires large laydown areas. The crews may also inject the subsurface with firefighting agents such as F-500 and "Pyrocool."



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These products work like a class A foam in that they have a "surfactant." However, they also have a "mycelle" that prevents and retards combustion essentially by encapsulating the oxygen. Usually a mix of these processes is used, starting with an overhaul and injecting the subsurface with fire retardants near the end.

Randy Wolsey, current Fire Chief for the city of Edmonton, former Fire Chief of the city of Delta, and also a part of the Landfillfire team, offers some practical advice in preventing these types of fires: "A landfill, even a DLC landfill, should be designed like a building where firewalls and separation techniques are used. . . . When we are building these landfills we need to compact the landfill to reduce the amount of air. Anything above about 15% oxygen will increase the risk of fire."

Sperling explains that proper construction involves intermediate covers around 300 mm deep, usually consisting of soil, and sometimes with geomembranes. The permanent cap is 1-2 metres thick and designed in multi layers including top soil, a coarse drainage layer and a barrier layer, which is typically clay.

Landfill fires are dangerous, a threat to public health and difficult to extinguish. However, with a little planning and enforcement their occurrence can be reduced. **CCE**

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