

TOXIC GAS EMISSION AND DISPERSION WITHIN THE MEETHOTAMULLA MUNICIPAL SOLID WASTE DISPOSAL SITE

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Abstract

The most common method for municipal solid waste disposal in Sri Lanka is dumping in un-regulated landfills. Many landfill gases such as Methane (CH₄), Carbon Dioxide (CO₂), Hydrogen Sulphide (H₂S), Carbon Monoxide (CO) and other Organic and Inorganic gases are generated in these landfills due to biological degradation and decomposition of waste. The composition of major gases generated during decomposition are Methane (about 40 % – 50%) and Carbon Dioxide (about 50 % – 60%) and Carbon Monoxide (CO) is present at trace levels. Both CH₄ and CO₂ are colourless, odourless gases and nontoxic. However, at high concentrations, they reduce the oxygen percentage in air, causing health impacts on breathing, heart rate increase, clumsiness, emotional upsets and fatigue etc. Among the gases Methane is extremely flammable and can cause explosions at levels between 5% (lower explosive limit) to 15% (upper Explosive Limit) with an ignition source. CO, a trace gas, is identified as a toxic as well as an explosive gas with lower explosive limit of 12.5% v/v (125,000 ppm) and upper explosive limit of 74% v/v (740,000 ppm). In Sri Lanka, especially in dense urban areas large un-regulated dumps poses a threat of landfill fires, and explosions in rare instances risking neighboring populations and infrastructure.

At Meethotamulla municipal solid waste dump, a large scale un-regulated landfill site in the neighborhoods of Colombo, a catastrophic failure occurred in 14th April 2017. Following the incident, an environmental assessment was conducted to evaluate whether the cause of failure was an explosion of combustible gases or other. In a failure event of this nature there is a possibility that trapped combustible gases, mainly Methane and other toxic gases such as CO, Hydrogen Sulphide (H₂S), Volatile Organic Compounds (VOC) may release to the environment in large quantities. Such releases may ignite a fire in adjoining facility and also could pose health risk to neighboring communities. Therefore, possible risks to the nearby facilities and communities were also assessed. Concentrations of Oxygen (O₂), CO, CH₄, VOC, and H₂S at fourteen different locations of the Meethotamulla municipal solid waste disposal site were measured at the surface level, 1m above the surface level and 1 foot below the surface level using GasAlertMicro5 PID multi gas analyser. The measurements were repeated

for four sessions on 22nd April 2017, 29th April 2017, 3rd May 2017 and 14th June 2017 in order to evaluate the variations of gas concentrations over the time.

Concentrations of Carbon Monoxide (CO) and Methane (CH₄) gases have randomly varied from 1 ppm - 500 ppm and 0.05% - above 5% respectively over the four measurement sessions. Highest concentrations of the gases have been recorded at the level of 1 foot below the surface while showing comparatively low values at the surface level and 1m above the surface. The investigation revealed that the cause of failure is not due to a gas explosion but a subsurface failure along a weak soil layer. The measurement on Methane (CH₄) levels at 1 ft below the surface level at some locations fall within its explosive limits with a risk mainly a fire hazard under dry weather conditions. However, possibility of explosive hazard is low as the waste material is largely exposed after the failure. The Methane levels and other toxic gases (CO, H₂S, VOCs) at surrounding facilities and communities were lower than the prescribed danger limits hence respective potential risks are low.

Key words: Landfill Gases, Methane, Meethotamulla, Municipal Waste