

Review of Environmental and Health Effects of Management of Municipal Solid Waste

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1. INTRODUCTION

Enviro Consulting Ltd. with Birmingham University carried out an independent review of the health and environmental effects of managing municipal solid waste (MSW). The review was published by the UK Department for Environment, Food and Rural Affairs on 6 May 2004.

The study consists of a review of published literature with regard to:

- Emissions from waste management facilities
- The health effects of waste management facilities
- The environmental effects of waste management facilities

The study was designed to provide information in a form which could be used by waste management organisations, regulators and planners. The study also provided supporting information for use in setting policy with regard to waste management.

The following waste management options were studied:

- ♦ Materials Recovery Facilities
- ♦ Composting (in-vessel)
- ♦ Composting (windrow)
- ♦ Mechanical biological treatment (MBT)
- ♦ Anaerobic digestion with energy recovery
- ♦ Gasification/pyrolysis with energy recovery
- ♦ Unsegregated incineration with energy recovery
- ♦ Incineration of pre-sorted wastes with energy recovery, typically at small scale

- ♦ Landfill with landfill gas flaring and/or energy recovery
- ♦ Waste transportation excluding collection

The study found that there was considerably more information available on emissions to air than on emissions to other media.

The paper presented here focuses on the assessment of emissions to air and the assessment of health impacts arising from these emissions. The study also highlights other key conclusions of the report regarding evidence for health and environmental effects of managing MSW.

2. EMISSIONS TO AIR

Enviros Consulting Ltd was able to draw on a wide network of information sources in assembling a database of emissions to air. There was relatively little relevant information on emissions to air in the peer-reviewed scientific literature. In contrast, information provided by process operators, regulators and in Government-sponsored reports gave a substantial body of data.

This information was analysed to quantify emissions to air from waste management activities where possible, and to highlight areas where more information was needed. The main conclusions were:

- Incineration produces the greatest emissions of oxides of nitrogen, followed by pyrolysis/gasification and landfill (information of moderate quality). This is illustrated in Figure 1.

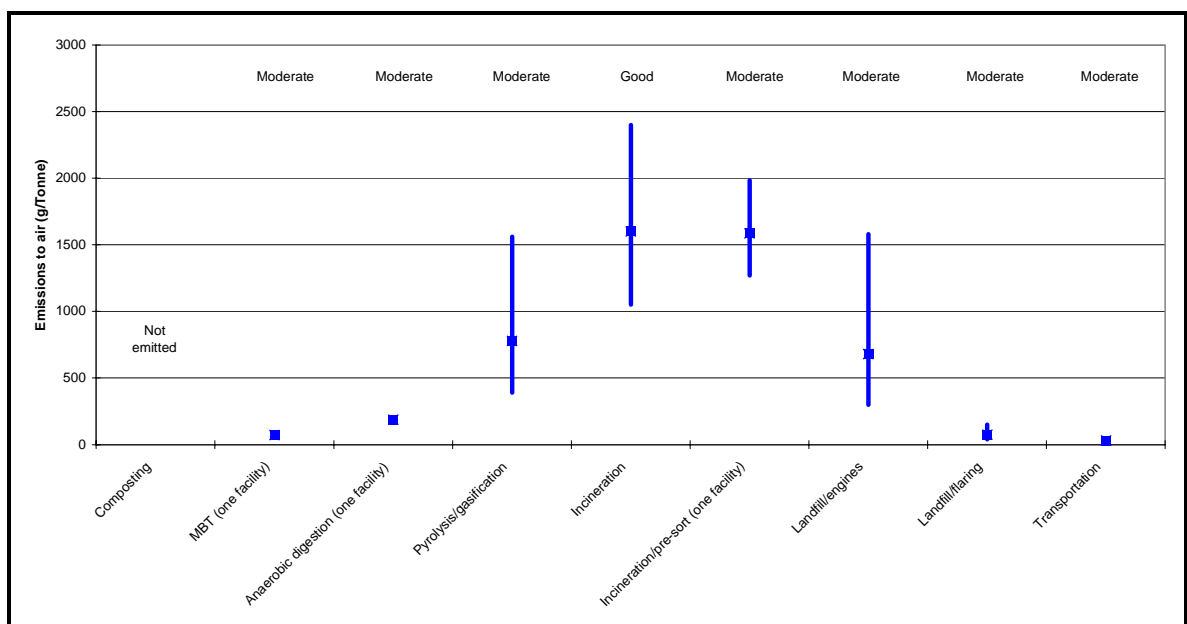


Figure 1 : emissions to air of oxides of nitrogen per tonne of waste processed

- Composting produces the highest emissions of particulates per tonne of municipal solid waste, although these data are of poor quality and would benefit from further research. Incineration is also an important source. Emissions from transport of waste are unlikely to be important.
- Sulphur dioxide emissions are similar for all processes which burn waste, or gases generated by decomposing waste (information of moderate quality). Transport of waste is unlikely to be important.
- Hydrogen chloride and hydrogen fluoride emissions are higher from processes where waste or waste gases are burnt, and incineration is the biggest source of hydrogen chloride (information of moderate quality).
- VOC emissions are likely to be greater from landfill, composting and MBT than from combustion processes. Methane emissions, which are important in global warming are highest from landfill (information of poor or moderate quality).
- Emissions of dioxins and furans per tonne of waste from incineration are higher than from other options, with other processes burning waste gases having lower emissions. Emissions from incineration in the UK have changed dramatically, with a 99.8% reduction in emissions since 1990. This was brought about following limits imposed in European commission directives. We gained a better understanding of the factors which result in dioxin and furan emissions, and developed improved ways of stopping them being formed, and removing them from flue gases.
- Landfill is the only significant source of emissions to sewer, surface water and groundwater.
- Other than landfill, all of the processes result in other outputs. These may be useful products (e.g. compost or the digested material from an anaerobic digestion facility). Some options produce electricity (anaerobic digestion, pyrolysis/gasification, incineration and utilisation of landfill gas), and we evaluated the benefit associated with reduced emissions from electricity generation using conventional fuels. Materials recycling facilities produce materials which are sent for reprocessing into useable products. This often has beneficial effects – for example, reducing the need to use raw materials.

However, dealing with MSW can also result in unwanted emissions – for example, if recycled materials need to be transported long distances for reprocessing. Some of the outputs can be re-used in other ways – for example, ash from waste incineration can be used in road building or to make “breeze blocks.” These re-uses have the potential for releasing unwanted substances to the environment, and re-use needs to be properly controlled. Some of the outputs need to be disposed of by landfill – for example,

composted material which is not of good enough quality to be used for land improvement, or air pollution control residues from waste incineration plant.

Figure 2 sets emissions to air from waste management in the UK in the context of other sources of emissions.

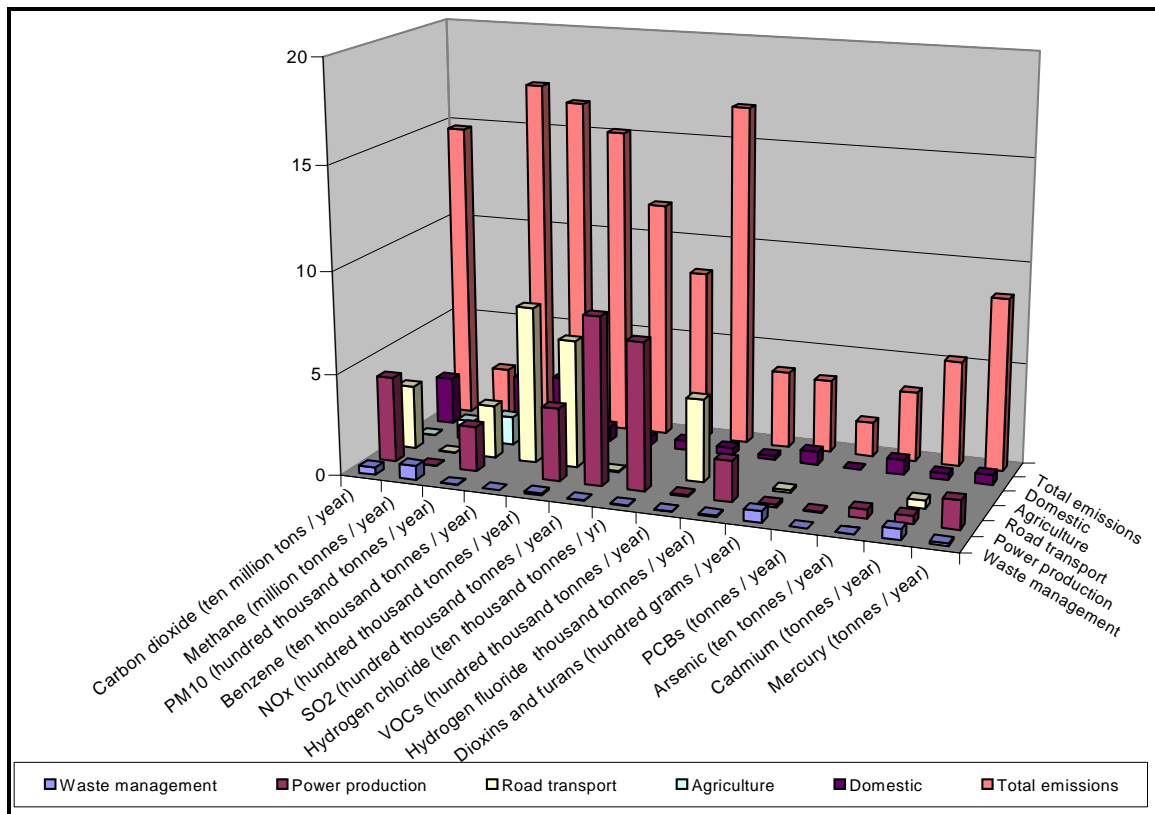


Figure 2 : Emissions to air in the UK from waste management and other sources

3. HEALTH EFFECTS

Health effects were studied in two ways. Firstly, a detailed literature review was carried out by Birmingham University to establish whether there is evidence for adverse health effects in populations living close to waste management facilities. Secondly, we used a dispersion modelling study to quantify where possible the health effects likely to be associated with the substances emitted to air. For most of the municipal solid waste facilities studied, the literature review found that health effects in people living near waste management facilities were either generally not apparent, or the evidence was not consistent or convincing. However, a few aspects of waste management have been linked to health effects in local people.

Possible health effects

A detailed study of landfill sites identified a possible link between living close to a landfill site, and the occurrence of some birth defects. The study also considered the occurrence of unusually low birth weight. This study was not able to say whether the associations are causal, or whether they might be reflect other factors which the study could not address fully. The observation is a small increase in the risk of a birth defect happening in babies born to families living near landfill sites. The increase is much smaller than other factors which influence the likelihood of birth defects, and the numerical results cannot at present be reliably used.

A recent study undertaken at residential areas in close proximity to a commercial open windrow composting plant looked at the incidence of bronchitis and minor ailments in people living in this area. The study provided some evidence that there might be a link between emissions from the facility and these health effects in residents living very close to the facility.

No significant health effects

The health effects of some waste management facilities have been investigated in detail, in response to public concerns.

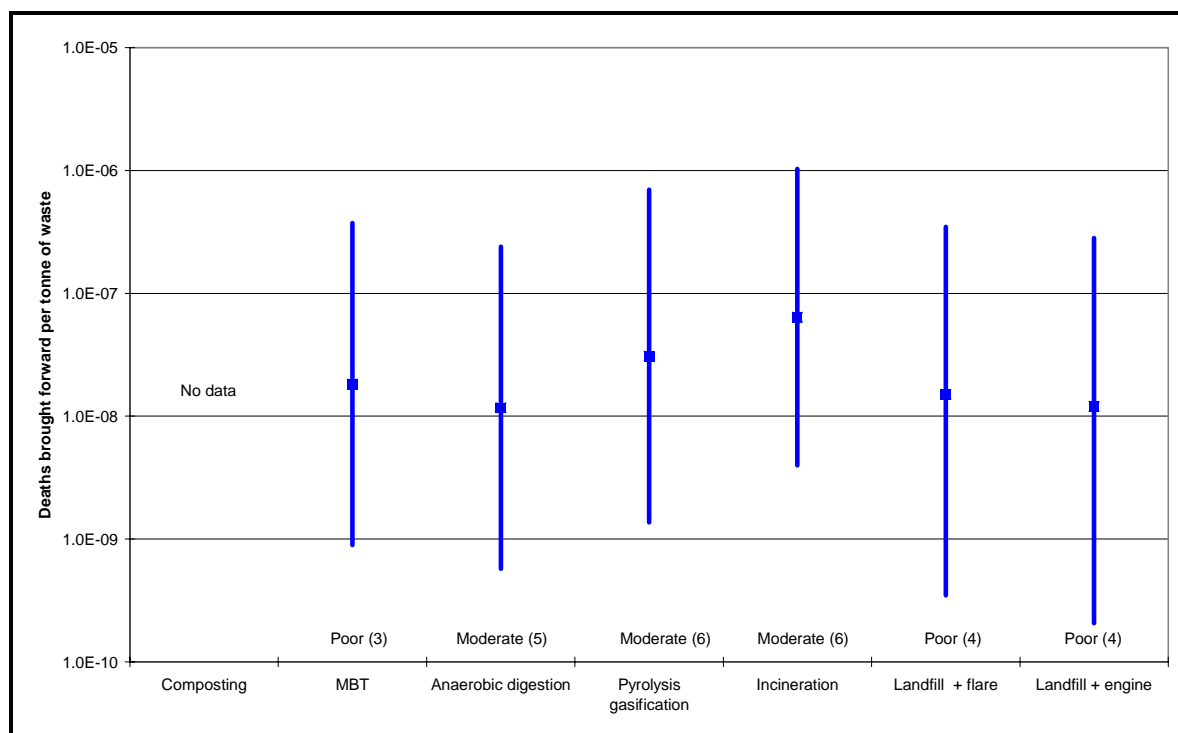
The review did not find a link between the current generation of municipal solid waste incinerators and health effects.

A detailed UK study was carried out to investigate whether there is any indication that living close to landfill sites results in an increase in the occurrence of cancer. This study did not detect an increase in the occurrence of cancer.

Studies have been carried out to investigate the existence of a link between emissions from composting facilities and the occurrence of cancers and asthma. No link has been identified.

Health effects of emissions to air

We were able to quantify some of the health effects associated with emissions to air from facilities managing MSW. This is shown in Figure 3.



Note: "1.0E-07" means 1×10^{-7} , or 0.0000001 deaths brought forward per tonne of waste managed: that is, 1 death brought forward for every ten million tonnes of waste managed

Figure 3 : Number of deaths brought forward per tonne of waste managed

Considering this on a national scale indicated that managing MSW in the UK could give rise to approximately five hospital admissions per year, and less than one death brought forward per year. The potential effects of emissions of carcinogens were less significant. These effects are much less than other commonly encountered risks to health, as set out in Table 1.

Health impact	Number per year in the UK due to			
	Handling municipal solid waste	Skin cancer (main UK causes are sunlight and sunbeds)	Lung cancer due to passive smoking ²	Health impacts due to air pollution ³
Deaths brought forward	0.55 (about one nationally per year)			11,600 (about one per small town per year)
Hospital admissions	4.9 (about five nationally per year)			14,000 (about one per small town per year)
Cancers	0.0014 (about one nationally every seven hundred years)	6,000 (about one per small town per year)	“several hundred” (about one per large town per year)	
Data Quality	Poor	Moderate	Poor	Poor

Table 1 : Comparison of quantifiable health risks associated with MSW in the UK with other commonly encountered risks to health

4 ENVIRONMENTAL EFFECTS

Relatively little evidence on the environmental effects of managing MSW was available in the published literature.

Two environmental issues stood out as being the most significant in the UK at present. Firstly, methane emissions from landfill account for approximately 27% of the UK total, resulting in a significant influence on global warming. Secondly, odours from landfill were found to account for 10 to 25% of odour complaints.

5. CONCLUSIONS

Most emissions to air can be quantified with at least a moderate level of confidence, although there are some exceptions. The main gaps were emissions from composting, mechanical biological treatment and anaerobic digestion.

The study investigated evidence for ill-health in people who might possibly be affected by emissions from MSW processes. For most of the municipal solid waste facilities studied, health effects were not apparent in people living near waste management facilities, or the evidence was not consistent or convincing. This is consistent with the relatively low level of effects identified in the study of the quantifiable health effects of emissions to air from waste management facilities.

However, a few aspects of waste management have been linked to health effects in local people. More research is needed to know whether or not these are real effects.