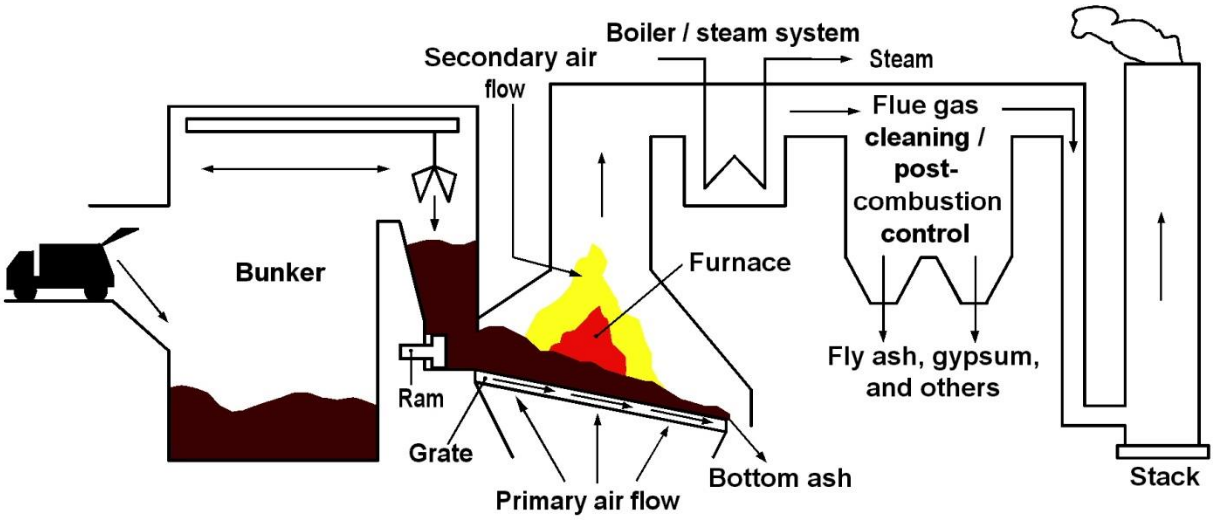
Waste Incinerator (Moving Grate)

Defining characteristics	Narrative
General	In small volumes generally composed of combustible materials, waste has been traditionally piled up, set alight and left to burn itself out. In recent decades, burn barrels have also emerged on the technological landscape of waste management, as a low-cost and safer form of waste incineration. However, neither burn piles nor burn barrels provide a long-term solution to the problems posed by increasing solid waste streams made up of mixed waste of diverse physical and chemical characteristics. The thrust of modern thermal treatment technologies therefore is to reduce health risks, recover valuable resources,[82] and reduce the volume of incineration residues, the latter mostly made up of inorganic waste constituents. Consistent with forces driving innovation, incinerators configured as waste-to- energy (WtE) plants are available in many designs from Asian, European and US constructors. Worldwide, the type of incinerator most widely used for processing municipal solid waste is the moving grate incinerator, to the effect that the incinerator is sometimes referred to as the municipal solid waste incinerator (MSWI).
Siting and land use	Ideally, the site chosen for installation of an incinerator plant should not should not cause environmental impacts including disruption of ecosystems on contiguous land in breach of established in legal statues or industry standards. Social costs and acceptability should also be considered and discussed with communities living in close proximity to potential incinerator sites. Alternative land uses forecast over the life span of the plant could be equally important. As a general rule, MSWIs should be located on land dedicated to medium-size and heavy industries.
Design (components) and Operation	An MSWI has the following key components: 1) waste bunker; 2) feeders, furnace; 4) flue gas cleansing system; and 5) ash pit. One or more waste bunkers constitute holding areas with capacity to store weekly volumes of waste delivered to incineration plant. In order o minimise floor area occupied by bunkers, these are often sunk below ground level. These are contraptions used to channelise waste into the incinerator's combustion chamber. In some designs, a screw feeder device is used, but more often than not, incinerators rely on a feeding mechanism comprising an overhead rail system (inside bunkers) equipped with grabs, hopper and a strategically positioned ram to poke waste into the combustion chamber of the furnace. The furnace, designed to withstand temperatures up to 1,400°C, incorporates a moving grate, air inlets, and bottom ash collector, flue gases outlet, and, in WtE plants, has an in-built boiler. A porous moving grate[83] sloping towards an ash collector represents a sort of conveyor on which solid waste is exposed to ignition temperatures and incinerated. Air inlets positioned above and below the moving grate provide the means of injecting calibrated levels of preheated air into the chamber to ensure complete oxidation of waste. The timing of waste introduction and control of burn conditions are important considerations for complete combustion and avoidance of plant shutdowns. High temperatures in particular are required for complete combustion of wastes (Byeong-Kyu et al., 2004; Nussbaumer, 200). If present, a boiler uses heat from burning waste to generate steam that is piped into a steam turbine to generate electricity. Flue gases from the combustion chamber are transported through a complex treatment system designed to remove particulate matter and hazardous chemicals. To this end, flue gas passes through wet scrubbers and sets of filters, arranged in series to ensure that plant emissions meet regulatory standards. Electrostatic precipitators and fabric filters installed downstream of the combustion chamber minimise the release of dioxins, furans, heavy metals, and other harmful chemicals (Mukerjee et al., 2016). Treated flue gases are released into the

[82] In thermal treatment technologies designed to break down organic wastes in absence of oxygen (i..e pyrolysis process), gases produced from heating organic wastes condense to biodiesel (synthetic fuel).
[83] The moving grate is made of corrosion-resistant alloys with large tolerance for high temperatures.

	atmosphere via a chimney stack of appropriate height. An ash pit collects end product of combustion coming off at the end of the moving grate. These are passed over with an electromagnet to extract useful metals. Ash is then removed through a water lock, and residues disposed of in landfills or reused as construction and road-building material after undergoing some form of treatment (Sakai and Hiraoka, 2000). Water used in all process is recycled.
Costs	According to (Ayalon et al., 2001), the investment cost of an incinerator with a processing capacity of 500ton/day is USD50 million; five-fold higher than the investment in an anaerobic plant of equal capacity. Depending on the nature and moisture content of waste, Byeong-Kyu et al (2004) report treatment costs in the range of 0.12 USD/kg (general waste) to 3.44USD/kg. In the same vein, Park and Jeong (2000) point out that treatment or disposal costs of infectious waste by incineration could be 10 to 20 times higher than corresponding costs for non-infectious wastes. Using specific assumptions about energy recovery from waste incineration, Rabl et al (2008) found the damage cost of incineration to be between 4 and EUR21/metric ton of waste, compared with EUR10 to EUR13 per metric ton of waste for landfilling options
Supporting infrastructure	Transport Electricity generation and transmission infrastructure (in case MSWI configure as part of WtE) District heating infrastructure (optional) Treatment and disposal plant/facility (for wastewater from scrubbers)
Advantages	Moving grate incinerators have several comparative advantages vis-à-vis other waste treatment technologies. In no particular order of importance, these incinerators can accommodate large quantities and variations in MSW composition. In addition, the technology is particularly suited for disposal of hazardous waste (biomedical), special waste (car tyres), and residues of other solid waste and wastewater management processes. Compared to other thermal treatment technologies, it has the highest processing capacity[84] and high reliability[85] , and does not require as much area as landfills (Rabl et al. 2008). Moving grate incinerators substantially reduce the weight (up to 75%) and volume (up to 90%) of solid waste, and are highly efficient in capturing generated energy.
Disadvantages /Challenges	Incinerators command high investment and operating costs. Although end of pipe treatment of flue gases should ensure plant emissions are below regulated standards, public perception of health risks is still a major factor in resistance to the technology (Rabl et a. 2008). The tendency not to segregate waste destined for incineration could also curtail alternative treatment and/or uses of organic wastes.
Abatement potential	Incineration of 1 ton of MSW produces approximately 1 ton of carbon dioxide (CO_2). If on the other hand, the same waste is was sent to a landfill, it would produce approximately 62 cubic metres of methane (CH_4) through anaerobic decomposition.[86] Within a time horizon of 20 and 100 years, the weight of 62 cubic meters of $CH_4$from landfill operations or fugitive emissions is approximately 2.93 and 0.98 tonnes of CO_2, respectively.
Level of penetration	The moving grate incinerator is a completely new technology

[84] Up to 4,000 tonnes of waste per day
[85] Capable of continuously for 8,000 hours per year[85] with only a month-long scheduled stop for inspection and maintenance
[86] Methane production actually depends on waste composition



Source: http://www.dcsc.tudelft.nl/Research/Old/project_ml_pvdh_ob.html

Further Reading

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