Incineration and Links to Cancer

Introduction

According to recent Canadian cancer statistics, almost 40% of Canadian females and nearly half of Canadian males will develop cancer in their lifetime. Commonly called a disease of older people, the 2008 Canadian Cancer Statistics predict that of the 166,400 new cases of cancer expected in Canada this year, well over half will occur in Canadians under age 70. About 30% of new cancer cases and 18% of cancer deaths will occur in young and middle-aged adults ranging in age from 20-59.[1]

A comprehensive cancer prevention strategy means reducing exposure to carcinogenic substances at every opportunity. Inherited genetic factors make a minor contribution to most types of tumours.[2] The environment has the principal role in causing cancer, accounting for an estimated 75-80% of cancer cases and deaths in the U.S.[3] For a clearer understanding of the risks, studies that link cancer to waste incineration should be viewed together with studies that link individual pollutants to cancer.[4] While a number of health impacts have been linked to waste incineration, this fact sheet focuses on the links to cancer.

Studies in the United Kingdom found an increased risk of childhood cancer, childhood leukemia and solid tumours of all kinds among children living near incinerators. Studies from France, Japan, Italy, United Kingdom and Sweden found that populations living near incinerators had a cluster of soft-tissue sarcoma and non-Hodgkin's lymphoma; a two-fold cancer-risk; increases in laryngeal cancer; increases in lung cancer or lung cancer mortality and generally higher risks of all cancers but specifically of stomach, colorectal, liver and lung cancer. Incinerator workers in Italy, the U.S. and Sweden had significantly higher gastric cancer mortality; a high prevalence of hypertension and excessive deaths from lung cancer and heart disease.[5]

Incinerator Technologies

Though burning garbage is known to be a significant source of exposure to carcinogens and other pollutants, increasingly there are plans by municipalities to expand this type of waste disposal across Canada. Incineration does not eliminate or reduce the waste. Rather, it destroys resources and converts waste into different chemical compounds, some of which are the harmful components described in this fact sheet.

Mass burn incinerators are "excess air" combustion units (waste is burned in the presence of more air than is necessary to oxidize or burn the materials in the firebox) and have been around for decades. Sellers of this technology claim that modern "state-of-the-art" incinerators are safer than past versions. Gasification, pyrolysis (starved air) and plasma arc technologies – so-called "incinerators in disguise" – heat or convert waste materials at

high temperatures to create gas (syngas), liquids and solid residues of ash (char) or slag. However, the waste gases are then burned, releasing hazardous pollutants.

Health Canada states that the biggest source of dioxins and furans is the large-scale burning of municipal and medical waste.[6] Plasma arc gasification vendors often claim their technology achieves zero emissions and are not, in fact, incinerators. However, the Canadian Council of Ministers of the Environment (CCME) definition for "waste incinerator".[7] is any system that thermally treats waste. It confirms that plasma arc units are already subject to its standards.[8] A 2007 review states that any new thermal destruction technology only be approved by the jurisdiction having authority if the applicant can demonstrate that the system will meet the emission standard. However, these technologies emit dioxins and other harmful pollutants and are defined as incineration by the U.S. Environmental Protection Agency.[9] An analysis of incineration and gasification units using EPA emissions data showed that both emit the same pollutants albeit in different quantities.[10] These newer technologies are also considered incineration by the European Union.[11]

Toxic Air Emissions

Both the amount of waste and its potential toxicity are increasing. Incinerator emissions are a major source of fine and ultrafine particles, toxic metals and more than 200 organic chemicals, including those known to cause cancer, genetic mutations and disruption to normal hormone function.[4] Even the most modern Municipal Solid Waste (MSW) incinerators do not have the technology that prevents the release of ultrafine particles.[12]

Approximately 70% of garbage burned is emitted to air. The exact composition of emissions from incinerators will vary with the waste that is being burned at any given time and depends on the efficiency of the facility and the pollution control measures in place. Emissions also contain other unidentified compounds whose potential for harm is as yet unknown. With the make-up of garbage continually changing, so too does the chemical nature of incinerator emissions and therefore the potential for adverse health effects.[4]

A 2007 Generic Human Health and Ecological Risk Assessment commissioned by Durham and York Regions in southern Ontario confirmed that chemicals of potential concern (CoPC) may interact to produce toxic effects, however, more detailed studies are required into this area to determine synergistic effects.[13]

<u>Organic Compounds</u>

Dioxins are a group of chemicals with over 200 individual members. Dioxins are produced as unintentional by-products of manufacture and use of elemental chlorine, and the burning of materials that contain any form of chlorine. All incinerators produce dioxins. Incinerators generate and emit brominated and mixed chloro-bromo substituted

dioxins in appreciable quantities. Research has shown that while dioxins can be destroyed in the combustion zone of mass burn incinerators, they can be regenerated, depending on the incinerator's temperature profile, and formed from precursors that are either constituents of the waste or by chemical recombination of materials in the waste.[12]

Dioxins are a Class 1 IARC carcinogen (cancer causing agent), are persistent (take a long time to break down), toxic and accumulate in the tissues of humans and animals.[12] Dioxins enter the human body through the food we eat, the air we breathe and skin. The most important route for human exposure is through food, amounting to more than 90% of total exposure. Fish and animal products, such as meat, dairy and eggs, account for approximately 80%.[14] Dioxins can induce cancer, interfere with our immune systems and male and female reproduction, impact child development and interfere with normal hormone function and growth factors. It is toxic to our organs (liver, spleen, thymus, skin).[12] Cancers linked to dioxins include lymphomas and cancers of the lung, liver, skin, soft tissue, oral and nasal cavities.[4] Organic toxicants including polychlorinated biphenyls (PCBs), polyaromatic hydrocarbons (PAHs), dioxins, and furans have also been linked with breast and testicular cancer.[4]

Infants and children exposed to dioxins before or just after birth can suffer from a range of health effects to the central nervous and immune systems, as well as on growth, sexual development, thyroid function and reproductive health.[12] PCBs are a mixture of compounds and may have a "dioxin-like" effect. Both PCBs and dioxins are toxic to the developing brains of babies both before and after birth. The toxic significance of many volatile organic compounds is unknown.[15]

With improved pollution control on mass burn incinerators, air emissions of dioxins can be reduced, but not eliminated. Rather, increased air emissions controls have shifted more of the dioxins and other toxic substances generated to the ash residues, thereby creating new disposal and pollution problems.[12]

Gasification, considered by some to be more "high tech" than mass burn incinerators also creates pollution. According to EPA test data, compared to mass burn incinerators gasification units emitted more nitrogen oxides, which contribute to smog, and ground level ozone, and can emit more dioxins and furans.[10]

Heavy Metals

Emissions and ash from incinerators can contain over 35 metals and many are known to be toxic at low concentrations. Toxic metals accumulate in the body and can remain there for years. Inhaling heavy metals such as nickel, beryllium, chromium, cadmium and arsenic increases the risk of lung cancer.[16]

In the waste stream, mercury is present in batteries, fluorescent light bulbs and paints. Cadmium is present in paints, PVC plastic bottles and pigments used to colour plastics.

Lead is present in batteries, plastics and pigments. Antimony is present in flame-retardants and in plastics. The incineration process leads to metals being concentrated in the ashes by up to ten times as the volume of waste is reduced. Mercury is an exception with a greater proportion vented into the air via the flue stack.[12]

Like dioxin, mercury is a persistent and bioaccumulative toxin that can be transported far from where it is emitted into the environment. A potent neurotoxin, it attacks the body's central nervous system. It is particularly hazardous to developing fetuses and transfers from women to fetuses across the placenta and to infants through breastfeeding, resulting in exposure at critical stages of the baby's development.[17]

Particulates

Various studies have confirmed that the smaller the particles, the more dangerous their health affects. The body does not have an efficient way for clearing the deeper part of the lung, as only a tiny fraction of natural particles are of such a small size. Smaller particles are not filtered out by the nose and bronchioles and their miniscule size allows them to penetrate deeply into the lungs and be directly absorbed by the bloodstream, travel through cell walls into the cell nucleus, affecting the cell's DNA. The smallest particulates (minute particles), particularly ultrafine particulates (PM. 0.1) are highly chemically reactive.[4]

Incinerators are particulate generators. Heavy metals, dioxins and other chemicals can adhere to particulate surfaces increasing their toxicity. Fine particulates have been associated with respiratory and cardiovascular disease and with lung cancer.[4]

Ash and Slag

For mass burn incinerators, approximately 26-40% of combusted waste will remain as solid residues. Both the bottom and fly ashes can contain high concentrations of heavy metals. Improved pollution control technology in modern incinerators can transfer the toxic load of dioxins and some heavy metals from airborne emissions to the fly ash.[14] The ash residues are generally put into landfill sites, which raise concerns about these contaminants leaching.

There is considerable uncertainty about the quality of the "slag" produced by plasma arc technology. While vendors claim the contaminants are encapsulated in the slag, which could be used for various building materials, there are concerns about carcinogens such as arsenic and cadmium leaching and how this might impact any "beneficial use" of the material.[9]

Liquid wastes

Wastewater from wet exhaust gas cleaning contains heavy metals. The most significant in terms of toxicity and quantity are lead, cadmium, copper, mercury, zinc and antimony. Published scientific data on these is very limited.[12] The concerns would be around possible soil and water (ground or surface) contamination.

Regulation, Monitoring and Enforcement

Only a small fraction of the hundreds of incinerator pollutants are controlled. In addition, real-time and continuous monitoring technology is not available for all pollutants including some of the most dangerous, such as dioxins. Incinerator proponents often base their claims of "safe" operation upon stack gas emissions tests for dioxins. However, dioxin emissions are not constant and these tests rarely sample during start ups, shut downs and upset conditions when "spikes" of dioxin emissions can occur, resulting in periods of high dioxin production being excluded from test results.[17]

Environmental standards and regulatory emissions' limits vary and are often based on what is technologically achievable e.g. Best Available Technology Not Exceeding Excessive Cost (BATNEEC) or Maximum Achievable Control Technology (MACT). In Ontario, pilot facilities for newer waste technologies such as plasma arc gasification do not have to undergo an Environmental Assessment, providing they are small and meet the Ministry of Environment's air emission standards. This is permitted, even though plasma arc technology is considered to be unproven for the processing of mixed municipal solid waste. In Ontario, CCME Canada-wide Standards for dioxins and furans are included in guidelines for incinerators.[18]

The 2007 CCME Review noted that there is a lack of data on the concentrations of dioxins and furans in residues such as ash and the quantity of residues generated.[8] In Ontario, Durham and York Regions are on record as saying they consider the bottom ash as suitable to go to landfill for use as daily cover. The two Regions intend to conduct research into using the material as a component of asphalt aggregate or concrete.[19] However, there are well-documented concerns about the health risks of using incinerator ash for such purposes as the ash contains heavy metals and other chemical pollutants.[17]

Conclusion

All incinerators generate toxic emissions, including carcinogens, and are a leading source of dioxins globally.[20] Since there are safer, more economical and flexible options, we should adopt the precautionary principle and move away from waste management options that pose a serious risk to human health and further degrade our environment.

Furthermore, the burning of waste destroys resources and locks communities into very expensive contracts, which require large and predictable volumes of garbage over long periods of time to recoup the large capital costs.

Far more energy would be saved and fewer health and environmental impacts – including cancer – would result from reusing, recycling and composting materials. In a world of depleting resources it makes no sense to incinerate materials when safer options exist.[21] Canada's waste management approach must take a healthier and more economically viable course. Any risk to our health that is avoidable, is unacceptable.

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