Nota del Comitato NO-TAV Torino

Il presente documento, in lingua inglese, è estratto dal rapporto "*Popolazione, salute e gestione dei rifiuti: dati scientifici e scelte di indirizzo*" scaturito da un convegno dell'**Organizzazione Mondiale della Sanità** (Sigla inglese WHO, World Health Organization) svolto a Roma nel Marzo 2007.

Le quattro pagine di testo seguenti contengono il capitolo dedicato agli inceneritori, alle loro emissioni ed al relativo impatto su territorio e salute .

- Nel paragrafo 3.1, "**Emissioni ed esposizione**" si può leggere la lista delle principali sostanze prodotte dalla combustione di rifiuti; la relativa tabella 3 riporta i limiti di emissione previsti dalla direttiva europea per gli impianti di incenerimento. Vengono poi elencate le varie vie di esposizione della popolazione residente nei pressi di un inceneritore.
- Nel paragrafo 3.2, "**Evidenza scientifica**" si citano studi epidemiologici sulla maggior incidenza di alcune malattie tra la popolazione esposta alle emisssioni, per residenza o attività lavorativa; si notano discrepanze tra i diversi studi e si evidenzia l'esigenza di nuove ricerche (specie per le polveri sottili e sottilissime, i cui effetti sulla salute sono ancora così poco noti da suggerire ldi adottare il principio di precauzione).
- Il paragrafo 3.3, "**Studi di casi critici**" descrive 3 ricerche (condotte in Spagna, Francia e Portogallo): due sembrano indicare scarsa incidenza degli inceneritori sulla salute, una (la francese) è invece più pessimista.

WORLD HEALTH ORGANIZATION
EUROPE

Population health and waste management: scientific data and policy options

Report of a WHO workshop
Rome, Italy, 29–30 March 2007

3. Incinerators

Solid urban waste incineration started at the end of nineteenth century. The first incinerator, called “Destructor”, was built in 1876 in Manchester, by Alfred Fryer (Maxwell, 1967) and was originally introduced for reasons of hygiene and volume/weight reduction. In 1893 an incinerator producing steam existed in Hamburg and between 1903 and 1905 there were two plants for district heating and cogeneration in the United States. But only at the end of the 1960s, to decrease the pollutant emissions in the atmosphere, were incinerators more frequently equipped with energy recovery systems (Beltz, 1979).

Nowadays, incineration represents only a part of a complex waste management system that should include reduction of production, differentiated collection and re-use of waste, recovery (of materials and energy) and final disposal. The goal of current waste incineration technology is to treat waste so as to reduce its volume and hazard, to capture, concentrate and destroy potentially harmful substances and to recover energy from combustion.

3.1 Emissions and exposure

Waste fuel for incinerators are crude MSW, residual from differentiated waste collection and treated MSW or refuse derived fuel. Inorganic emissions include water (vapour), carbon oxide (CO), carbon dioxide (CO_2), sulphur oxides (SO_X), nitrogen oxides (NO_X), and products of incomplete combustion such as silicates, inorganic ash, soot, metal elements and their oxides and salts (for example, mercury and other metals with high vapour pressure). Organic emissions include VOC, hydrocarbons (HC), dioxins (polychlorinated dibenzo-p-dioxin (PCDDs) and polychlorinated dibenzofuran (PCDFs)), polychlorinated biphenyls (PCBs), polycyclic aromatic hydrocarbons (PAHs). Particles (particulate matter with an aerodynamic diameter smaller than 10 (PM_{10}), 5 (PM_5), 2.5 ($PM_{2.5}$) microns and ultrafine particles) are emitted too. Further emissions, not related to the stack, can be summarized by ash, bottom ash, fly ash, noise, odour, pests, transport–related emissions, dusts and spores.

Incineration plants emission limits given by European Directives are described in Table 3.

Table 3. Incineration plants emission limits: the European Directive

POLLUTANT	LIMIT (mg/Nm^3 s)	POLLUTANT	LIMIT (mg/Nm^3 s)
Total dust	10–30	TOC[1]	10–20
HCl[2]	10–60	Cd[3], Tl[4], Hg[5]	0.05*
HF[6]	1–4	Sb[7], As[8], Pb[9], Cr[10], Co[11], Cu[12], Mn[13], Ni[14], V[15]	0.5
SO_2	50–200	PAH	-
NO_2[16]	200–400	PCDD + PCDF (ng/Nm^3)	0.1**
CO	50–100		

Note: the double limit value is: daily average and maximum (hourly or 30 minutes average).
[1]Total organic compound; [2]Hydrogen chloride; [3]Cadmium; [4]Thallium; [5]Mercury; [6]Hafnium; [7]Antimony; [8]Arsenic; [9]Lead; [10]Chromium; [11]Cobalt; [12]Copper; [13]Manganese; [14]Nickel; [15]Vanadium; [16]Nitrogen dioxide.
*Limit for (Cd+Tl) and Hg separated.
**Calculated using the concept of toxic equivalence factors referred to 2,3,7,8 T_4CDD.

The stack height is never less than 70 metres but in modern large plants can be higher (up to 120 metres). The stack effective height (geometric plus enthalpic thrust), local atmospheric conditions and topography situation determine the dilution of emissions.

Incinerators have been operating in many European countries since 1960s–70s and their technology has evolved over time, with general reduction of emissions affecting neighbourhood communities. New generation incinerators built with the “best available technologies” (BAT) are characterized by a flue–gas multistage cleaning treatment and guarantee emissions within the limits specified by the European Directive. These plants do emit pollutants into the environment but it is unlikely that they would make a significant contribution to the overall background level of air pollution in a particular area if properly run and maintained and if adequate waste is processed.

Populations living near incinerators are potentially exposed to chemicals by way of inhalation of contaminated air, consumption of contaminated foods, water or dermal contact with contaminated soil (Franchini et al., 2004). However, the presence of hazardous agents in the vicinity of an incinerator cannot easily be translated into useful exposure information. In fact, it is difficult to assess if human exposure has occurred at all, let alone quantify it, although for few substances it is possible to use biomonitoring to identify exposure. Surrogate measures of exposure such as the distance of residence from the plant are thus often used in epidemiological investigations; these proxies have many limitations, for example they can be inadequate if other factors (stack height, prevailing wind direction, fall out area) are not considered.

The location of the plant is a critical factor. Most incinerators are located in areas where many other sources of exposure are present: caution is therefore needed in the interpretation of occurrence of high disease risks, which may be due to risk factors other than the incinerator emissions.

Occupational exposure is of higher intensity and duration but results of these studies are difficult to extrapolate to the general population because of a set of confounders (sex, age, lifestyle) and of the healthy worker effect.

3.2 Scientific evidence

Compared to landfills, a limited number of epidemiological reviews were carried out to assess the health effects of incinerators on the population occupationally exposed or living in the surroundings.

In four out of six studies reviewed by Rushton (2003) excesses were reported for specific cancer causes (cancer of the digestive system, of the liver, kidneys, pancreas and NHL); some excesses for skin, stomach and respiratory cancer were reported in occupational studies together with a plausible strong association for low birth weight. Exposure data were found to be inadequate for drawing reliable conclusions on these associations.

Franchini et al. (2004) reviewed articles published between 1987 and 2003. A total of 45 articles were selected: 32 concerning health effects on population living near the plants, 11 on occupational exposure and 2 on both environmental and occupational exposures. In most of the studies exposure was poorly characterized because of the lack of information on emission, nature of waste feed and off-site migration routes from the incineration sites. The majority of the studies concerned first generation incinerators, characterized by limited abatement technology and low combustion temperatures, resulting in high emissions. The emissions of more modern incinerators investigated in studies included in the review are more limited and of different kind. For this reason the results of all the studies cannot be easily compared, and consistency across studies is not expected. However suggestive evidence was provided by two thirds of those studies focusing on cancer. In these studies, significant positive results were found for some specific cancers (NHL, STS, lung cancer and childhood cancer); results on cancer of larynx and liver were not consistent. Results on non-cancer end-points, such as chronic or acute respiratory effects in children or adults, were inconclusive. Occupational studies provided some evidence on lung cancer, esophageal cancer, blood PCDD/F level; an increased risk of producing urinary mutagens in exposed workers was reported. Biomonitoring studies did not provide conclusive evidence: in some studies exposure to PCB and heavy metals were associated with reduction of thyroid hormones. The authors suggested the need of carrying out further research based on the development of specific biomarkers and through the implementation of systematic environmental measurements to better characterize the exposure.

In the review carried out by DEFRA (Enviros Consulting Ltd et al., 2004), already mentioned above, it is concluded that there is no convincing evidence of association between incinerators and cancer while there is a little evidence on respiratory problems. It is however stressed that in most cases the incinerator emissions make a small contribution to local levels of air pollution.

A recent publication in Italian reviewed papers included in the Medline literature database, published between 2003 and March 2006, identifying 32 publications (Bianchi, Franchini & Linzalone, 2006). Most of the studies assessed the individual exposure using biomarkers, while “traditional” epidemiological studies, based on surrogate exposure metrics, decreased in number. Occupational studies consistently identified job categories at higher risk for exposure to fly ash, particles, metals, organic compounds, dioxins and positive association with length of employment. Results from studies on the general population were less consistent: some associations for NHL and STS were reported but the number of studies was limited and exposure was poorly characterized.

Other European studies were analyzed in a recent review (Linzalone & Bianchi, 2007). The authors focused on fine and ultrafine emissions coming from incinerators and stressed the necessity to adopt a precautionary approach, because of the limited number of studies and the weakness of the present knowledge on the health effects. They described two French studies (Institut de Veille Sanitaire, 2006a, b), dealing with the relation between dioxin levels in blood of population living near incinerators and cancer incidence, that did not give consistent results and an Italian metanalysis (Bianchi & Minichilli, 2006) that found an excess of male mortality for NHL in the population of 25 small municipalities with municipal solid waste incinerator (MSWI). A significant association between modelled dioxin exposure and sarcoma risk was detected in the Province of Venice (Zambon et al., 2007).

More recent Portuguese and French studies are described in the case studies section (see paragraph 3.3).

3.3 Critical case studies

Three case studies, described in detail in section 6, were presented to facilitate the general discussion on health effects of incinerators.

The first case study, carried out in Barcelona, Spain (see Annex A15), considered the MSWI of Mataró (Gonzales et al., 2000, Gonzales et al., 2001). Nineteen per cent of waste produced in Catalunya is burned in this plant, with a satisfactory energy recovery, emissions largely within legal limits, but with an insufficient capacity. A biomonitoring study was initiated because of local community concerns over the effects of dioxins. Study subjects were recruited among volunteers and classified as potentially exposed or unexposed according to the distance of their residence from the plant. A control group from another city without an incinerator was also included in the study. Dioxin, furan and PCB levels in the blood were repeatedly measured and a questionnaire on sociodemographic factors, occupation, dietary habits (consumption of locally grown foods), reproductive history and respiratory symptoms was distributed. Average dioxin levels were found, unexpectedly, to grow in all study subjects over time (40% in 4 years); high concentrations were not limited to people living near the incinerator, affected both sexes and were independent of age. The authors concluded that the increases in dioxin levels could not be attributed to incinerator emissions but probably reflected an increase in exposure to and intake of dioxins from food or other unknown sources.

In the second case study, several epidemiological studies (Floret et al., 2003, Floret et al., 2004, Floret et al., 2006, Viel et al., 2000) carried out around the municipal waste incinerator in Besançon, France (see Annex A16), were described using a sequential approach starting from crude investigations, gradually refining towards specific, aimed studies, following what the author referred to as a “funnel” type approach. Such sequence included, in order, a macro–spatial step, a micro–spatial step, the validation of a diffusion model, the dioxin measurements in locally produced food and a case–control study with dioxin blood levels. With the macro–spatial step (Viel et al., 2000) clusters of NHL and STS were first found near the incinerator. In the micro–spatial step (Floret et al., 2003, Floret et al., 2004) analyses used a case–control study design applied at block level (a block has 161 inhabitants on average), including measures of socioeconomic status; increased risk was found for highest dioxin levels, derived from a validated atmospheric diffusion model (Floret et al., 2006). The next study in the sequence, based on measured levels of dioxin and heavy metal in locally produced eggs and vegetables, also evaluated in a case–control design in connection with dioxin and pesticide blood levels, is underway; results are due in one year.

In the third case study (see Annex A17), carried out on the population living near two Portuguese incinerators (one in Lisbon and one in Madeira Island), a large monitoring project was described (Reis et al., 2007a, Reis et al., 2004a, Reis et al., 2007b, Reis et al., 2007c, Reis et al., 2007d, Reis et al., 2007e, Reis et al., 2004b). These HBM studies set out to investigate the local exposure to the most critical incineration–related pollutants: dioxin and heavy metals levels were measured in the blood of the general population, lead and mercury levels in the blood and pubic hair of mother–child pairs and in children under six years of age, and dioxins levels in the milk of breastfeeding women. Analyses and surveys of possible adverse health effects were conducted on asthma prevalence, cancer mortality and incidence, mental health status, self–perception of health status and frequency of reproductive disorders such as low birth weight, preterm delivery, spontaneous abortion, foetal malformations and infant and perinatal mortality. The biomonitoring campaigns were based on a series of cross-sectional studies, repeated every two years and, in order to control the confounding, on questionnaires on anthropometric and sociodemographic factors, lifestyle and behavioural variables. Epidemiological studies were carried out through periodic analyses of health registries (cancer mortality, infant and perinatal mortality, low-birth-weight and foetal malformations data) and on self–administered questionnaires dealing with asthma and tobacco consumption, mental health and self–perception of health status. Results from the surveillance programs showed no statistically significant differences for blood level of dioxins and for health outcomes in exposed and not exposed population (defined according to the distance from the plants) suggesting the presence of effective source control measures and abatement technology in both plants. Results from exposure determination showed a significant declining trend for almost all the pollutants (dioxins and metals) under study.