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OBJECTION TO ORICA AUSTRALIA'S APPLICATION TO EXPORT THE POPS WASTE, HEXACHLOROBENZENE TO FINLAND FOR INCINERATION

National Toxics Network (NTN) is a NGO (non-government organisation) network working for pollution reduction, protection of environmental health and environmental justice. NTN is the Australian focal point for the International POPs Elimination Network (IPEN) and strives to achieve the full implementation of the *Stockholm Convention on Persistent Organic Pollutants* (POPs) 2001 and other relevant international and regional chemical treaties. We are committed to a toxics free future. NTN's focus is on the assessment and management of new POPs, the management of hazardous waste, the protection of children's environmental health and addressing the combined impact of chemicals and climate. Our Senior Advisor was a member of the UN Expert Group on Climate Change and Chemicals and a co-author of the report 'Climate Change and POPs; Predicting the Impact'. NTN's Senior Researcher is a member of the Stockholm Convention BAT/BEP Expert Group and the Small Inter-sessional Working Group (SIWG) of the Basel Convention on the Control of Transboundary Movements of Hazardous Wastes and their Disposal (1992).

As Australia's peak NGO dealing with toxics and pollution issues, NTN has maintained a keen interest in the HCB controversy over many years and has been represented on a number of bodies dealing directly and indirectly with HCB waste including the:

- National Advisory Body on Scheduled Waste (NAB)
- HCB Management Plan Panel
- Stockholm Convention Reference Group
- Hazwaste Act Policy Reference Group
- Dioxin Consultative Group
- NGO Observer to the POPs Review Committee
- NTN Observer on Hazwaste Technical Advisory Group
- NTN Observer on the Botany Community Participation and Review Committee.

The proposal by Orica to ship the toxic HCB waste across the globe to Finland has caused great concern among national and international environmental organisations. Within weeks of the proposal announcement the National Toxics Network has been joined by Greenpeace, Friends of the Earth, Doctors for the Environment, the Global Alliance for Incinerator Alternatives, the Basel Action Network, the International POPs Elimination Network and Zero Waste Europe in condemning the proposal and calling for the export to be halted. On August 30, 2016, all of these organisations signed a letter to the Australian Minister for the Environment, the Hon. Josh Frydenberg MP, calling for him to honour our international legal obligations, reject the application for export by Orica and to implement a domestic solution.

Executive Summary

This objection to the application by Orica Australia to export HCB waste to Finland is supported by the International POPs Elimination Network (IPEN), Basel Action Network (BAN) the Global Alliance for Incineration Alternatives (GAIA), Friends of the Earth (FoE), Doctors for the Environment Australia, Greenpeace and Zero Waste Europe.
The Australian chemical manufacturer Orica has announced its plans to export its stockpile of highly toxic hexachlorobenzene (HCB) waste to an incinerator in Finland; the Ekokem incinerator in Riihimäki located 69 kilometres north of Helsinki.

The National Toxics Network and supporting organisations oppose this attempt to ‘dump’ the responsibility for Australia’s most toxic waste on another country. Australia is a developed country and should deal with its own POPs (persistent organic pollutants) waste as it has in the past.

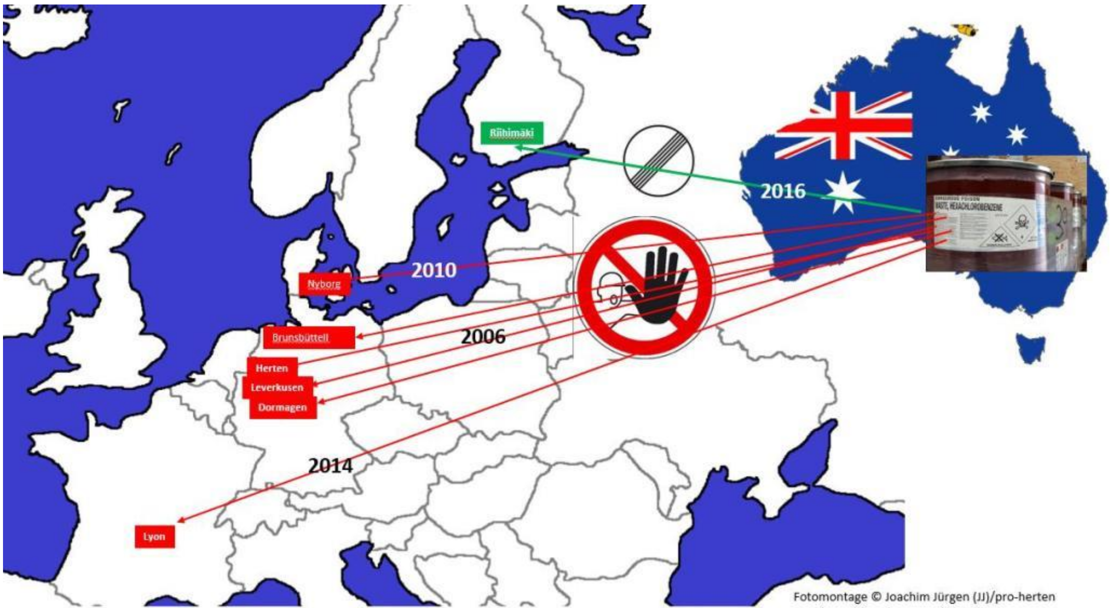
Australia has the financial capability and technical expertise to operate suitable technologies capable of destroying HCB which are currently commercially available. It is possible and feasible to site destruction facilities in Australia. Australia urgently needs a hazardous waste destruction facility that can address both the bourgeoning amounts of current POPs waste (e.g. PBDEs, PFOS) as well as future POPs waste. Newly listed POPs are present in large quantities in Australian building and electronic wastes, unwanted consumer products, as well as in remediation condensates, all of which require environmentally sound destruction.

Australia has an obligation to destroy its wastes within national borders, under Basel Convention Article 4 to *“take the appropriate measures to (b) Ensure the availability of adequate disposal facilities for the environmentally sound management of hazardous wastes and other wastes."*

Transport of such a large amount of toxic POPs waste across the globe is in itself hazardous. While this current permit is only for 135 tonnes, there is at least another 10,000 tonnes that would need to be shipped and transported for incineration. This current proposal for the Ekokem Riihimäki incinerator will not include all the HCB waste at Botany and large quantities of related HCB waste will remain in Australia and need to be destroyed. The *Stockholm Convention on Persistent Organic Pollutants* 2001 warns that the incineration of hazardous POPs waste leads to the creation of more toxic POPs byproducts in the incinerator dust, fly ash, liquid scrubber waste and air emissions. These dioxin contaminated waste residues will need disposal and management into perpetuity.

This is the fourth attempt by Orica to ship the toxic waste overseas for burning. Previous attempts to export the waste to Germany, Denmark and then France were rejected after public outrage and community demonstrations. Angry French protesters even demonstrated at the Tour de France where Orica sponsored a cycling team. The German, Danish and French governments concluded that Australia has a legal and moral responsibility to manage its own waste and is financially and technically capable of doing so.

Orica’s proposed exports were soundly rejected and Australia’s reputation as a leader in environmentally management was seriously impacted. In 2006, Orica was quoted in the media as saying, "where there is opposition we will not go" (Environmental Manager, No 547, 11 July 2006). There is expected to be growing opposition to this proposal in Finland and increasing international concerns. The proposal by Orica to export its highly toxic HCB waste to Finland for incineration is unacceptable and should be rejected. Suitable destruction technologies that can achieve far better environmental outcomes than incineration are available and can be established in Australia, thus avoiding all the risks associated with long range transport of the toxic waste. Australia has an international obligation to manage and destroy its own waste.



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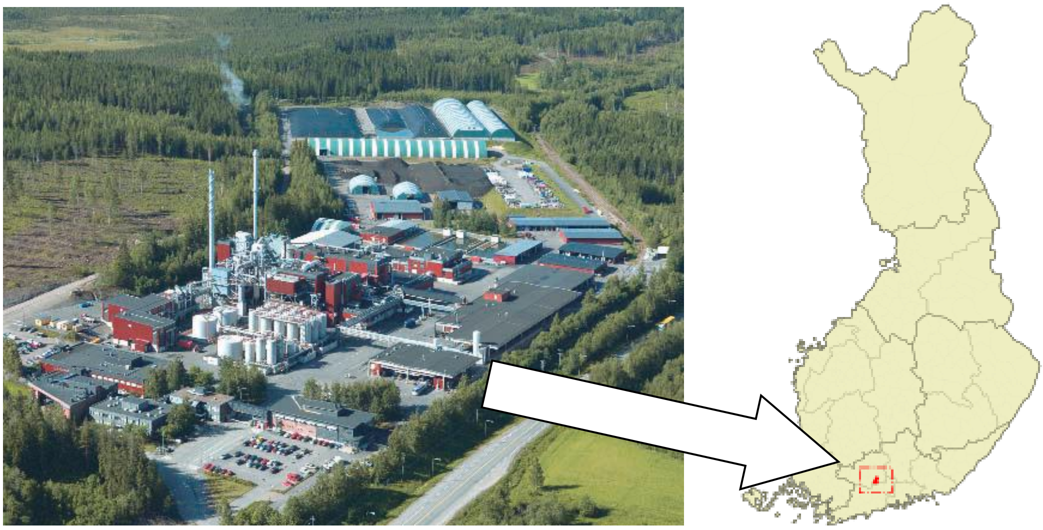
1. The Proposal

Ekokem Riihimäki incinerator (Riihimäki, Finland)

The proposed location for burning the Orica HCB waste is the Ekokem Riihimäki incinerator approximately 70 km north of Helsinki. The Ekokem group is a Nordic waste management company with operations in Denmark (Ekokem A/S), Sweden (Ekokem AB) and Finland (Ekokem Corporation) and Norway. Ekokem manages hazardous waste using a range of technologies to treat liquid and solid waste. A significant part of its operation is dedicated to final disposal in the form of waste incineration. Ekokem principle hazardous waste incinerator operates in Riihimäki, Finland.

The waste shipment would land at the Port of Hamina and be transported to the incinerator at Riihimäki. The first shipment would take about 60 days and transport of the entire stockpile will take 5-6 years. Ekokem suggests it will obtain approval from the Finnish Environment Institute, SYKE in the northern autumn with shipments commencing toward the end of 2016.



Riihimäki Incinerator, Finland

Over recent years the Riihimäki facility has struggled to operate within its environmental permit limits for air emissions. There has also been a series of permit violations in relation to liquid waste releases in Ekokem Finland operations though it is not clear how many of the liquid waste discharge permit violations relate directly to the Riihimäki facility[1].

Air emission permit violations: Ekokem Riihimäki Incinerator, Finland 2011-15

2011 - 2 air emission permit violations
2011 - The second high-temperature incineration line in Riihimäki was shut down.
2014 - Half-hour emission limit was exceeded on 22 occasions.
2012 - 8 air emission permit violations
2015 - air emissions permit limit was violated two times.

Liquid effluent release permit violations: Ekokem Finland 2011-15

2011- 2015 Sixty water release permit violations[2].

Ekokem group report 2014

"Although we continued our systematic efforts to reduce the environmental impact of our operations and improve occupational safety in line with our 2014 plans, we did not achieve all of our targets. During the year, there were nine incidents in which the daily average concentrations in flue gases exceeded the values set in the EKOKEM Group's environmental permit. Concentration and loading limits in wastewater emissions exceeded permitted limits on nine occasions."

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[1] http://sustainability2015.ekokem.com/sustainability/safe-for-environment/permit-limit-violations/

[2] (It is not clear how many of these permit violations are specifically related to the Riihimäki Incinerator.)

Ekokem also manages a series of disposal sites for incinerator residues, which are classified as hazardous waste due to their high concentrations of persistent organic pollutants such as PCDD/DF (dioxin and furans) and toxic metals.

Ekokem operated eight landfill sites in 2015, six of these are in Finland located at Riihimäki, Kuopio, Kouvola, Salo, Valkeakoski and Pori. At least one of these (Pori) is used for the disposal of hazardous ash residues from incineration. It is likely that the Riihimäki facility also disposes of incinerator ash in its landfill. Some ash from Ekokem hazardous waste incineration is reused for 'landscaping'.

According to Ekokem's publication on *Advanced Waste Treatment and Utilisation Processes* (2006) 80% of the ash from its high temperature incineration processes (including ash from flue gas treatment) is '*recycled abroad as material*'[3].

Hazardous waste incinerators have been described as POPs *diffusers* rather than as POPs destruction technology as they create unintentional POPs emissions and releases through the combustion process including highly toxic PCDD/DFs (chlorinated dioxins and furans) PBDD/DF (brominated dioxins and furans) and dl-PCBs (dioxin like PCBs). Modern incinerators attempt to control these emissions with expensive and complex air pollution control (APC) equipment such as electrostatic precipitators (ESP), fabric filter baghouses, activated carbon injection, wet scrubbers and a range of other devices. The net effect of filtering the contaminants in flue gas is to capture a significant fraction of it and convert it to solid or liquid residues (fly ash and effluent), which contain high concentrations of pollutants. The bottom ash from the combustion chambers also contains significant levels of pollutants. These materials are then either landfilled or used as road base where eventually the contaminants will migrate back to the environment. Between the air emissions, effluent and solid residue disposal incinerators remain a source of POPs diffusion into the environment.

1.1 The Community Response

The current proposal by Orica to ship highly toxic HCB to Finland for incineration follows closely from the complete failure of the waste holders to convince either the German authorities in 2006/7 or the Danish government in 2008-9 to accept Australia's HCB waste for incineration.

In 2014, the French government rapidly rejected yet another proposed export shipment. After angry protests during the Tour de France bicycle race. Environmentalists across the world applauded the decision after a petition with 23,746 signatures was collected calling for the shipment to be stopped.

French Ecology Minister Segolene Royal said she would not back the plan to send the Hexachlorobenzene (HCB) waste to an area in south-east France because of fears something could go wrong to the ship which could cause marine pollution.

"The transport of dangerous waste ... is an environmental aberration," she was reported as saying.

Minister Royal also said such waste "should be treated near their source of production"[4].

International concern has now been expressed by the global organisation, IPEN, representing over 700 organisations concerned with POPs elimination, as well as Greenpeace, Friends of

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[3] EKOKEM (2006) *Advanced Waste Treatment and Utilisation Processes p.5*

[4] O'Brien., N. (2014) French reject Orica's toxic waste. *The Sydney Morning Herald*. July 27 2014.

the Earth, Zero Waste Europe, Global Alliance for Incinerator Alternatives and the Basel Action Network whose expertise is in the transport and management of hazardous waste.

2. Australia Obligations

Australia has a moral and legal obligation to deal with its own waste and should not shift its responsibilities for hazardous waste management off-shore.

2.1 International Obligations

Orica's current proposal to export its HCB waste contravenes the obligations and principles of environmentally sound management of hazardous waste as developed by the UN Secretariat of the *Basel Convention on the Control of Transboundary Movements of Hazardous Wastes & their Disposal* (1989). Basel Convention Article 4 requires Australia to *“take the appropriate measures to (b) Ensure the availability of adequate disposal facilities, for the environmentally sound management of hazardous wastes and other wastes.”*

Basel Convention principles include:
f) the self-sufficiency principle - management and disposal of waste in the country where it was created.
g) the proximity principle - the disposal of hazardous waste as close as possible to their point of generation.
h) the least trans-boundary movement principle – trans-boundary movements of hazardous waste reduced to a minimum.

2.2 National Obligations

In 1996 the Australian National Advisory Body (NAB) on Scheduled Waste released the National Management Plan for Hexachlorobenzene (HCB) to oversee the destruction of the HCB waste stockpile. The plan recommended that the waste should be destroyed as "close to the source as possible" in the light of the risk in transporting such a large stockpile of POPs waste and Australia's proven ability to destroy hazardous waste in an environmentally sound manner. The HCB Management Plan was endorsed by the Federal Australian Government and NSW State Government.

3. Options for domestic HCB destruction using Non-Incineration Technology

Orica’s key argument for exporting the waste is that technology is not available in Australia to dispose of their waste, yet successful engineering scale destruction trials of Orica’s HCB waste have been undertaken.

3.1 Available Technology in Australia

Australian waste treatment companies demonstrated the capability to treat POPs waste such as HCB to a high level of Destruction Efficiency (DE) without incineration. The Eco Logic Gas Phase Chemical Reduction (GPCR) process in Kwinana destroyed Australia’s major stockpiles of POPs.

This technology relocated overseas following requests from other countries to clean up POPs stockpiles, having exhausted supplies of POPs for treatment and destruction in Western Australia. The vendor and technology developer for GPCR is currently based in Canada and operates under the company name *True Energy*. The patent holder for the technology has increased the efficiency of the operation since it was used to destroy HCB in engineering trials in 1999 and it is now considered to be a closed loop system.

Technology developer True Energy have recently approached NTN to confirm that they are in a position to immediately commence the process to re-establish a GPCR facility in Australia to destroy Orica's HCB waste and that the only barrier to establishing the plant is a commercial arrangement with Orica to do so. In the past GPCR technology has been welcomed by public interest groups internationally as an environmentally sound management option for destroying POPs waste. This position has not changed and GPCR is regarded as a sound alternative to incineration.

3.2 Gas Phase Chemical Reduction Technology

The Gas Phase Chemical Reduction (GPCR) technology uses hydrogen gas and elevated temperatures to chemically reduce halogenated organic compounds to methane and hydrogen chloride. Water (steam) is used to facilitate heat transfer and is also a source of hydrogen through the water shift reactions. The formation of hazardous dioxins and furans are precluded because there is no free oxygen in the process.

The semi-modular GPRC plant can treat a range of HCB contaminated waste matrices to destroy the HCB content including polymers, liquids, crystals contaminated soils, pallets, spent protective equipment and associated materials.

Unlike other destruction technologies GPCR has the ability to treat a range of contaminated materials because the feedstock to the process does not require special treatment such as liquefaction to allow it to be fed to the reaction chamber. Whole 205 litre drums (44 gallon drums) can be placed in the Sequencing Batch Vaporizer (SBV).

The materials in the drums are heated to 600ºC in a hydrogen and steam environment. The organic materials are evaporated at this temperature and they are conveyed to the Reactor for destruction. Larger materials can be treated directly in the SBV in bins.

GPCR Sequencing Batch Vaporizer

Orica HCB waste in destruction trials at GPCR facility in Kwinana, Western Australia. 1999

In April 1999, a commercial trial was executed on HCB waste from Orica. The waste treated was a dry crystalline material, containing primarily HCB (84 %). The waste was stored in polypropylene bags, which were in turn packed into polypropylene-lined drums. The drums were loaded into the SBV for processing. The quantity of waste in each drum ranged from 117 to 254 kg. The test program involved three separate test runs of 3, 9 and 27 drums, processing 514, 1,584 and 4,610 kg of waste, respectively. Only 2% of the input mass was present following treatment. This material was tested and found to be silicon and carbon residue. The HCB was destroyed in the reactor with a DE >99.9999% for all tests.

Trevor Bridle, former manager of the Ecologic GPCR facility confirmed that in Australia:
"The GPCR process was demonstrated, at commercial scale, using the Ecologic facility in Kwinana in 1999, as being suitable for the safe destruction of drummed HCB waste from Orica. The commercial trials showed that the organic compounds in the HCB waste were destroyed with greater than 99.99999% efficiency."

GPCR technology is supported by a range of international organisations and governance bodies.

In 2004, the Global Environment Facility published a review of technologies for POPs destruction[5]. GPCR was listed as a *commercialised technology with considerable experience* (treating POPs). The use of GPCR was highlighted for the destruction of POPs. Further supporting details for the technology were provided by Vijgen (2002) in a review of technology to destroy obsolete pesticides[6]

The report, "Non-Combustion Technologies for POP Destruction: Review and Evaluation", prepared by the UNIDO agency, the International Centre for Science and High Technology (ICS) in March 2007 is supportive of the use of the GPCR technology for commercial destruction of POP wastes.

In addition the United Nations Environment Program support the use of GPCR for POPs destruction[7].

3.3 The Availability and Benefits of non-incineration technology

In 2016, GPCR is available and there are companies interested and willing to work with Orica to establish such facilities in Australia. This form of HCB destruction provides a safe clean alternative to incineration with a significant reduction in both toxic and greenhouse gas emissions associated with a hazardous waste incinerator. Importantly, no toxic ash is produced through GPCR processes. Non-incineration technologies like GPCR have a high degree of public and regulatory acceptance based on the concept of a "closed loop" system. By avoiding the large scale ash generation of incinerators there is no need for a dedicated, engineered hazardous waste landfill such as those in Riihimäki and Pori, Finland which are required to service the EKOKEM incinerators.

For further information on the advantages of non incineration technologies see Annex 2 of this document.

3.4 Why has Orica rejected proven technologies in favour of export?

The reason that Orica has chosen to overlook these technologies is not clear but is likely to be based on their commercial considerations. While the cost of export and destruction of the

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[5] GEF (2004) *Review of emerging, innovative technologies for the destruction and decontamination of POPs and the identification of promising technologies for use in developing countries.* The Scientific and Technical Advisory Panel of the GEF United Nations Environment Programme. 15 January 2004

[6] Vijgen, J., (2002). *Evaluation of Demonstrated and Emerging Remedial Action Technologies for the Treatment of Contaminated Land and Groundwater (Phase III) New, emerging and/or less expensive solutions for the destruction of land contaminated with pesticides*. NATO/CCMS Pilot Study, International HCH & Pesticides Association, Elmevej 14, DK-2840 Holte, Denmark.

[7] UNEP, 2003. Technical Guidelines on the Environmentally Sound Management of Persistent Organic Pollutants as Wastes. UNEP/CHW/OEWG/1/INF/6 25 March 2003.

wastes in Finland has not been revealed some general costs for the alternative technologies are available.

- BCD (Spolana): 1400-1700 US $/t for organochlorines with a chlorine content of 50% (150 tonnes/month)
- BCD (Australia) $AU250-$1000 p/tonne
- Gas Phase Chemical Reduction – HCB contaminated soils $500 p/tonne
- Gas Phase Chemical Reduction – pure HCB $ 3,500 p/tonne

The prices are indicative only and may be subject to significant variation on a contractual basis.

For more information on the use of BCD to treat POPs waste in Spolana see Annex 1.

Orica's narrow approach has again failed to adequately consider alternative non-combustion technologies or upgrading of existing local technology to technology standards that are effectively treating HCB waste in Europe to high Destruction Efficiency (DE) levels. Despite claims by Orica that non incineration technologies cannot handle the diversity of waste types in the HCB stockpile, it is evident that this is not the case. By utilising a combination of non incineration techniques, the HCB waste stockpile could and should be destroyed within Australia. Gas Phase Chemical Reduction is capable of treating a wide range of contaminated feedstock from pure HCB crystals and polymers in drums to HCB contaminated wooden pallets and discarded PPE equipment.

3.5 Australia's Growing Need for POPs Destruction Capacity

In the coming years, the Australian government and community will be faced with ever growing stockpiles of newly listed POP chemicals requiring environmentally sound destruction.

The recent listing of a POPs chemical used in building products; hexabromocyclododecane (HBCDD) means considerable quantities of POPs contaminated building insulation products will enter the waste stream with ongoing house renovations and demolitions. Stockholm Convention experts have noted that this waste stream will require management for the next 70-80 years as housing built in recent years using POPs contaminated foam for insulation are eventually demolished creating an ongoing stockpile of such waste.

Australia is already faced with massive quantities of electronic waste contaminated with the Stockholm Convention listed brominated flame retardants (e.g. polybrominated diphenyl ethers (PBDEs), as well as the waste phase of consumer goods contaminated with poly and perfluorinated compounds.

More recently there has been the emerging issue of PFOS (perfluorooctane sulfonic acid) and PFOA (perfluorooctanoic acid) contamination around civilian and military air bases in Australia (and overseas) from the use of fire fighting foams containing these persistent chemicals. PFOS is already restricted under the Stockholm Convention while PFOA is currently under consideration by the POPs Review Committee of the convention and may be added later. It is evident that there are large volumes of soil and water contaminated by these compounds that will require treatment in years to come.

All of these toxic compounds will require POPs destruction and treatment capability. Rather than facilitating the export of toxic waste overseas, the Australian government should be convening a working group of stakeholders to plan the establishment of a POPs treatment facility in Australia to address the many and varied waste streams that are now known to contain POPs.

4.0 Transport Dangers

There are risks and danger associated with transport of hazardous waste over long distances, particularly with regard to the marine environment where the consequences of spills and cargo loss may lead to irreversible, long-term environmental harm.

The Commonwealth Government has an obligation to thoroughly investigate and exhaust all Australian options for treatment of the HCB waste before setting in train a range of high level risks for the environment and human health by shipping the waste to Finland.

The most significant transport related risks include:

- risk of spills, accident or loss of containers at sea with potentially long-term irreversible pollution damage to marine ecosystems due to the long persistence and toxicity of HCB in the environment;

- risk of spills and or other incidents at transit and destination ports with potentially long-term, irreversible damage to inshore aquatic ecosystems; and

- security risks such as piracy, terrorism or hijack.

5. The Case Against Incineration of HCB waste

As noted above, incineration is often referred to as a ‘diffuser mechanism for POPs’ rather than a destruction mechanism. The diffusion takes place via releases to air (gas and particulate emissions), land (fly ash, bottom ash) and via liquid waste from the wet scrubbers. The environmental problems associated with waste incineration and reasons to avoid its use are outlined below.

5.1 *Stockholm Convention on Persistent Organic Pollutants* 2001

The *Stockholm Convention on Persistent Organic Pollutants* 2001 lists incineration of hazardous waste as having the potential for comparatively high formation and release of dioxins and furans to the environment. The convention states that polychlorinated dibenzo-p-dioxins and dibenzofurans (PCDD/DF) hexachlorobenzene (HCB) and polychlorinated biphenyls (PCB) are unintentionally formed and released from thermal processes such as waste incineration involving organic matter and chlorine as a result of incomplete combustion or chemical reactions. The higher the chlorine content of the waste materials burned, the greater the quantity of dioxins formed.

Dioxins and furans are among the most toxic of all compounds and by incinerating Orica’s HCB these will be formed and are either released to air, or remain in the ash by products or liquid waste from the dioxin wet scrubbers. Once released, dioxins and furans have the potential to pollute the local and global environment through scientifically established phenomena such global distillation processes. This effect results in dioxins and furans (as well as other POPs) from emissions in industrialised countries depositing in the cooler artic regions where it impacts through the food web on local fauna thereby contaminating the food supply of indigenous people. Use of non-combustion processes to treat the HCB waste can prevent further contribution from Australia to this natural cycle.

5.2 High Temperature Incineration does not destroy HCBs, it creates new toxins

The incineration of HCB at high temperatures does not ensure its destruction. HCB is noted for its high levels of stability even at temperatures beyond 1000° C as well as its tendency to generate reactions, which give rise to a range of other persistent and toxic chemicals. Mejdoub et al (1998) cite a number of studies in which toxic chemicals are generated as a result of high temperature incineration, finding that HCB plays an important role (as a precursor or as an intermediate) in formation of chlorinated dibenzodioxins and dibenzofurans.

Destruction facilities for the Orica HCB stockpile must, at a minimum, be able to demonstrate that they can maintain dioxin air emissions within the 0.1 ng/ m3 N I- TEQ regulatory limit using the continuous AMESA monitoring system. Other monitoring systems currently in use are known to underestimate ongoing dioxin emissions from stacks by between 30-50 fold[8]. The AMESA system[9] monitors across a 14 day period detecting the high dioxin output events that occur during start up, shut down and process upsets.

However, even if the Finnish incinerator is able to constantly meet this regulatory limit for dioxin air emissions (and it has clearly not been able to meet all air emissions limits in recent years), it does not resolve the problem of dioxins and other byproducts in scrubber residues bottom ash or fly ash which will be landfilled or used as road base in Finland or Norway..

Improved scrubber efficiency in recent decades has increased the concentrations of unintentionally produced POPs such as dioxin and furans in the incinerator residues. Even the best run incinerators are plagued by *de novo* synthesis of dioxins[10] (that is the formation and reformation of dioxins in flue gases), which escapes monitoring devices.

For more on the incineration byproducts and dioxin monitoring see Annex 3

In summary, incineration of HCBs does not ensure destruction and almost certainly leads to the generation of many harmful compounds that can escape to atmosphere and other environmental media. It is clear that incineration is a poor method by which to attempt to destroy HCB waste when better alternatives are available.

5.3 Destruction Efficiencies (DE) versus Destruction and Removal Efficiencies (DRE)

Compared to non-combustion technologies, incinerators have poor Destruction Efficiencies (DE) and are commonly measured against Destruction and Removal Efficiencies (DRE). The primary reason is that incinerators have become better at removing pollutants from the stack gases by various scrubbers. The pollutants have not been destroyed merely transferred to another media such as fly ash, filter cake, scrubber liquors or bottom ash. In evaluating the Orica export application, regulators need to assess whether the waste will be sent to a facility that produces the highest available Destruction Efficiencies or whether a better outcome can be achieved in Australia without the risks of transport halfway around the globe.

5.4 Fate of Contaminated Incinerator Ash - Disposal of Incineration Byproducts

While the community pressure to reduce airborne dioxin emissions from waste incinerators led to better efficiency and performance of dioxin scrubber technology, particularly through the use of activated carbon beds and sprays, this has resulted in increased dioxin contamination in filters, scrubber matrices such as the electrostatic precipitator (ESP's) dusts, baghouse dusts and filter cake, liquid wastes (from wet scrubbers), adsorption onto activated carbon and of course fly ash and to a lesser extent bottom ash.

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[8] De Fre R., and Wevers M., (1998) Underestimation in dioxin emission inventories. *Organohalogen Compounds* Vol 36 1998

[9] http://www.environnement-sa.com/products-page/en/emission-monitoring-en/amesa-2/

[10] Environment Australia (1999), *Incineration and Dioxins: Review of Formation Processes*, consultancy report prepared by Environmental and Safety Services for Environment Australia, Commonwealth. Department of the Environment and Heritage, Canberra.

Karolina Sulova of the Czech Republic Environment Ministry rejected German imported waste for incineration stating:

"The remnants after the incineration always make up about one-third of the original quantity. They have hazardous qualities and must be stored at an appropriate dump,"

Studies as far back as the 1980's confirmed that the generation of ash by hazardous waste incinerators is reported to range from 9 to 29% of the weight of wastes burned. For example in 2008, it was reported that the Danish Kommunikemi incinerator dumped around 40,000 tonne of ash per annum in landfill while also exporting around 1,000 tonnes per annum of toxic fly ash to Langoya in Norway. EKOKEM group also sends ash from some of its incinerator operations to Langoya.

A 2005 report by IPEN focusing on the unregulated and partially regulated use of incinerator ash in Europe provided average composition of fly ash and bottom ash from Dutch waste incinerators. These ash byproducts were contaminated with high concentrations of heavy metals, POPs and PICs (products of incomplete combustion). Scrubber waters also contain elevated pollutants that are extracted through wet scrubber systems designed to capture contaminants in the flue gas train.

Conclusion

The proposal by Orica to export its highly toxic HCB waste to Finland for incineration is unacceptable and should be rejected. Suitable destruction technologies are available and can be established in Australia. These have the potential to destroy the HCB waste in a way that achieves a far better environmental outcome than incineration. Treatment in Australia also avoids most of the risks associated with transport of the waste across the globe.

NTN requests that the Federal Minister for the Environment consider this controversial proposal carefully, and fully examines the options and advantages of domestic treatment. We believe any reasonable assessment of this HCB export proposal must lead to its rejection and strongly urge the Minister to reject this proposal outright and establish a stakeholder driven process to set up a treatment facility for POPs waste in Australia to destroy the Orica HCB stockpile and manage other POPs wastes into the future.

ANNEX 1

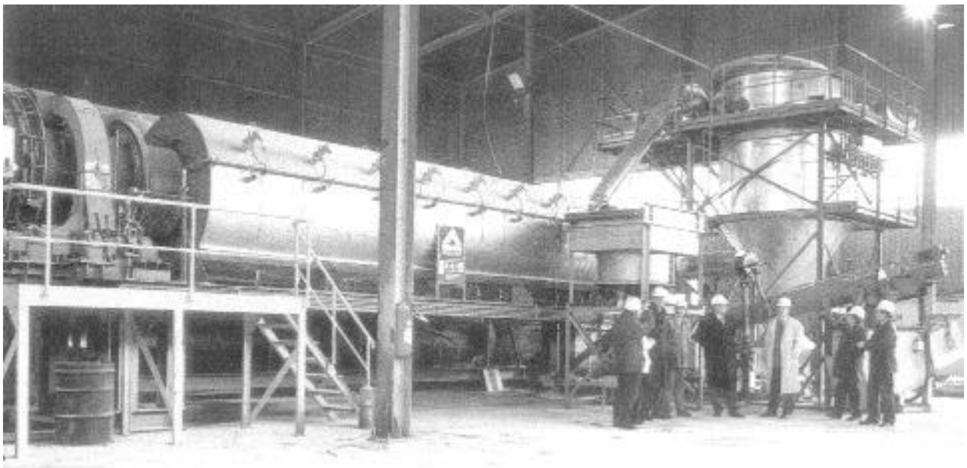
The Spolana Experience – BCD technology and Indirect Thermal Desorption

Within the massive Spolana chemical complex flanking the Elbe River at Neratovice, 30km north of Prague, is a 17 hectare plant once used to make Agent Orange and other herbicides, as well as pesticides. Spolana produced dioxin contaminated chlorinated compounds including the so-called Seveso dioxin, a by-product of herbicide production, during a three-year period during the 1960s.

When production was abandoned, the buildings were sealed, and scant attention was paid to the hazard until August 2002, when severe flooding raised concerns that the contaminants could be washed into the river and cause widespread hazards to health. The Czech government put up US$90 million to decontaminate the plant, using technology from a
British company, TCSR, working in partnership with French contractor Suez Environment.
Part of the challenge was to process the toxins on site, without disrupting output from the neighbouring PVC plant, which employs 1,000 people.

An Indirect Thermal Desorption (ITD) unit was built on site. This technology separates organic pollutants from soil and other materials in a rotating drum *without* direct contact with the heat source. This arrangement prevents process gases from heating fuels from becoming contaminated and then having to be subject to complex and expensive flue gas cleaning operations which generate contaminated solid and liquid residues that must be managed as hazardous waste. Note: Direct Thermal Desorption does not separate the heating fuel gases and so must be subject to extra flue gas scrubbing and generation of hazardous residues.

Using patented technology from TCSR, a Base Catalysed Decomposition plant was also assembled for the first time in Europe to break down chlorinated hydrocarbons chemically. Its end products: salt, water and carbon. A shell building was built over the contaminated areas, allowing a negative pressure as workers in special suits and breathing apparatus remove contaminated soil, materials, and ultimately the plant itself, for treatment in the processing facility. The aim of the work is to process an estimated 35,000 tonnes of contaminated soil and materials and leave a site fit for re-use.



The Thermal Desorption Unit (TDU) at Spolana.

The thermal desorption unit heats contaminated materials to 500-600 C stripping in absence of oxygen and POPs are collected in filter and condensation system. The BCD unit (see below) then treats this concentrate.

The BCD Unit at Spolana

Destruction capability of HCB & Lindane

Material	Inlet mg/kg		Outlet Oil Matrix mg/kg	
	HCB	Lindane	HCB	Lindane
Chemical waste	29,000	1,500	< 1.0	< 1.0
Chemical waste	200,000	900	< 2.0	< 2.0
Chemical waste	550,000	1,000	< 2.0	< 2.0
Chemical waste	270,000	1,000	< 2.0	< 2.0
Chemical waste	160,000	1,000	< 2.0	< 2.0
Dust	7,607	7	< 2.0	< 2.0
Chemical waste	1,598	19,000	< 2.0	< 2.0
Concentr Aqueous	630	< 2.0	< 2.0	< 2.0
Concentr Organic	11,000	< 2.0	< 2.0	< 2.0

Dioxin destruction rates

Material	Inlet ng/kg I-TEQ	Outlet Oil Matrix ng/kg I-TEQ
Chemical waste	209,000	0 (Reported value)
Chemical waste	200,000	4.3
Chemical waste	11,000	0.23
Chemical waste	47,000	0
Chemical waste	35,000	0
Dust	1,620,000	0.52
Chemical waste	78,000	0
Concent Aqueous	96,000	0
Concent Organic	876,000	0

The tables below indicate the stripping capacity of the Indirect Thermal Desorption Unit at Spolana, a necessary first step in removing and concentrating the POPs from heterogeneous waste matrices such as soil, rubble and concrete.

Treatment of Solid Matrices in Upstream Desorber - HCB & Lindane Removal

Material	**Inlet mg/kg**		**Outlet mg/kg**	
	HCB	*Lindane*	*HCB*	*Lindane*
Soil	2,643	1.34	< 1.0	< 1.0
Brick & Concrete	49,000	11	< 1.0	< 1.0
Concrete	5,100	18	< 1.0	< 1.0
Plaster	270	< 1.0	< 1.0	< 1.0

Treatment of Solid Matrices in Upstream Desorber - Dioxin Removal

Material	**Inlet ng/kg I-TEQ**	**Outlet ng/kg I-TEQ**
Soil	46,500	2.9
Brick& Concrete	2,420,000	6.3
Concrete	4,780,000	66.0
Plaster	3,800	5.6

The Spolana experience is but one of a number of emerging projects for POPs destruction that are seeking to avoid the use of high temperature incinerators due to their poor destruction efficiencies. The United Nations Development Programme (through the Global Environment Facility) is also encouraging non-incinerator alternatives for POPs destruction. The Slovakia project is another example of the growing range of non-incineration technologies being commercialized internationally.

In the words of UNIDO, the *"Slovakia Project will build on the significant level of Civil Society involvement that has begun during project preparation and also on the Australian experience (*ed's note:'Austalian experience' is GPCR use for destroying PCB*) where public policy is to avoid the use of incinerators for the destruction of hazardous wastes and to involve Civil Society in the approval and the operational oversight of selected destruction technologies. As a result of the Australian experience, groups within Australian Civil Society that had vigorously opposed incineration and/or land burial of PTS-containing wastes participated in the decisions to utilize these newer technologies, participated in reviews of these technologies, and generally accepted them. The Australian experience resulted in a remarkable level of Civil Society agreement (Government, industry, international, national and community-based NGOs) on the successful deployment of a Non-combustion approach to the destruction of Australia's PCB containing equipment and wastes, and can be viewed as a model "barriers reduction" effort. Early indications from this Programme and Project show similar promise for achieving strong Civil Society support for the activities that will be undertaken in the participating countries."*[11]

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[11] United Nations Development Programme, Global Environment Facility, Government of Slovakia Project Document, 21 November 2005 ' Non-combustion Demonstration project in Slovakia', Executing Agency: United Nations Industrial Development Organization (UNIDO)

ANNEX 2
Principles and Advantages of non-incineration technologies

Principles of Gas Phase Chemical Reduction

Gas Phase Chemical Reduction (GPCR) is a proven, non-incineration technology for the destruction of hazardous organic chemicals and has been successfully applied to pesticides, dioxins, PCBs, CFCs, and chemical warfare agents. The process involves the heating of organic compounds in a hydrogen and steam atmosphere at temperatures of 850°C to 900°C.

Chlorinated hydrocarbons, such as polychlorinated biphenyls (PCBs) are chemically reduced to methane or natural gas and hydrogen chloride (HCl). The HCl is further reduced to sodium chloride (NaCl) in the scrubber. The technology is suitable for organic wastes in all matrices including soil, sediment, sludge, high-strength oils, watery wastes, and bulk solids such as electrical equipment, equipment casings, drums, etc. Many of the outputs from waste treatment are recyclable. The product gas output that consists mainly of methane can be used as fuel for ancillary system components or converted to a liquid fuel.

Advantages of Gas Phase Chemical Reduction (GPCR) technology

The GPCR technology has considerable advantages as a waste treatment for the HCB:

1. The technology does not involve combustion or oxygen in the destruction process. The process uses hydrogen, steam and medium temperatures to chemically reduce rather than oxidize the organic waste compounds. The absence of oxygen in the destruction process precludes the formation of dioxins or furans, which require oxygen for their formation.

2. The technology operates in essentially a closed system. All process effluent streams are contained and analyzed to ensure that no hazardous compounds are released into the environment. If any of the process effluent streams exceed the allowable discharge criteria then the waste streams can be reprocessed prior to release.

3. The technology achieves total destruction efficiencies (DEs), for POPs and other substances of concern that approach 100%. Extensive testing and commercial operation of the technology has demonstrated destruction efficiencies that exceed 99.9999% (six nines) for all POPs wastes tested. The destruction efficiency calculation includes all effluent streams as opposed to the DRE, which only includes gaseous emissions and does not consider POPs entrained in residues or ash.

4. The technology is commercially available for technology transfer. The GPCR technology has been used commercially for PCB destruction and cleaning of transformers and electrical capacitors in Kwinana, Western Australia, and in St. Catharines, Ontario, Canada.

5. The technology is demonstrable and inherently safe. The GPCR technology has over ten years of safe operation with no cases of death, or life threatening injuries. GPCR provides a safe clean alternative to incineration with approximately a 90% reduction in CO2 emissions or greenhouse gases associated with a comparable incinerator. Importantly, no ash is produced. GPCR has a high degree of public and regulatory acceptance based on the concept of a “closed loop” system.

BCD technology

Base Catalyst Dechlorination (or Decomposition) is a process where organochlorines are reacted with an alkaline polyethylene glycol, forming a glycol ether and/or a hydroxylated compound, which requires further treatment, and a salt. In order to feed the BCD reactor the HCB material must first be dissolved in mineral oil and is then fed to the reactor through a manifold of the appropriate temperature to maintain the HCB waste in a liquid form.

Significant improvements have been made with the technology (such as in Spolana) to improve the recovery of oil used in the process above 90%. In the past BCD technology has been trialled in Australia on HCB waste and found to have acceptably high DE. Orica has claimed that this technology is only capable of treating the high concentration wastes in liquid forms. The Orica waste stockpile also contains large amounts of contaminated soil, rubble, packaging, concrete and personal protective equipment. Orica contends that the BCD technology does not have the capacity to accept these other materials through the feed manifolds to the reactors. (It is worth noting that GPCR technology does have the ability to treat all of these forms of contaminated wastes.)

Indirect Thermal Desorption

However, an intermediate technology known as Indirect Thermal Desorption Units (ITDU) provides a solution to this problem. One of the best examples of how these technologies (ITDU and BCD) can combine is found in the Spolana site in the Czech Republic. The Spolana chemical manufacturing complex is one of the most polluted in the world (more on this below) with high concentrations of dioxin, HCB, pesticides and other POPs in soil, demolition rubble, concentrates and other forms.

High temperature incineration was ruled out at the Spolana site as it was considered a diffuser mechanism that did not necessarily destroy the POPs but transferred them to ash and other residues of the incinerator which ultimately ended up in the environment.

The same logic ought to apply to any consideration of incineration of HCB in Finland. A combination of two technologies, Base Catalyst Dechlorination (BCD) and Indirect Thermal Desorption Units (ITDU) overcame the issue of difficult feed stocks. The ITDU uses a rotating kiln to heat the contaminated rubble, soil or other materials to a temperature (usually 500-600^{o} C) in the absence of oxygen to strip the POPs via volatilisation from the other wastes where they are then collected in a filter and condensed. The resulting concentrate of POPs are then removed and fed into the BCD plant (as in Spolan**a).**

ANNEX 3
Incineration and its Byproducts – Monitoring for Dioxins

Sampling for dioxins in European nations is usually conducted periodically (quarterly or annually) using the EN 1948 dioxin sampling method. This involves capture of a stack gas sample over a 6 hour period usually conducted while the incinerator is carefully operated in a steady state.

In 1993, concerns over lack of correlation between elevated PCDD/PCDF soil concentrations and stack emission concentrations around a waste incinerator in Belgium led to a broader study of the accuracy of the EN 1948 point sampling method and whether it produced representative results of long-term operating emissions. The study compared the results of PCDD/PCDF sampling using the EN 1948 method and the 'AMESA' air monitoring system[12] which was used for continuous sampling periods of 15 days. The results indicated that the standard measurement underestimated dioxin emissions by a factor of 30 to 50[13].

The sampling of incinerator flue gases for PCDD/PCDF analysis is almost universally conducted during steady state operation at optimum temperatures for dioxin suppression. It has been known for some time that incinerator plants produce higher levels of dioxin and dioxin-like emissions during upset conditions and during start-up phases[14].

Temperature fluctuations during start-up and operation can also lead to 'scrubber bypass' situations unless prohibited by statutory mechanisms. If gas temperatures in the incinerator are too high baghouse fabric filters can be damaged causing elevated emissions. In some facilities the flue gases are switched to bypass mode to prevent baghouse fabric damage until normal temperatures can be reached. In this case untreated or partially treated flue gasses are released to atmosphere with high concentrations of contaminants. Conversely, low temperatures can cause collation or clogging of lime injection mechanisms increasing emission concentrations.

A 2006 paper[15] examining PCDD/PCDF emissions for a Japanese incinerator during both start up and steady state operations concluded that the incinerator clearly met the 0.1 ng/ Nm3 WHO-TEQ regulatory limit while operating in steady state conditions but exceeded the regulatory limit 19 fold at the stack exit during start up conditions. Of particular interest is the comparison between boiler and stack exit concentrations. The average concentration of the dioxins at start up (RUN1-RUN5) was 18 ng WHO-TEQ/m3 N at the boiler outlet, and 1.9 ng WHO-TEQ/m3 N at the stack.

This study also provides an indication of the transfer of PCDD/PCDF to scrubber waste matrices through measurement at both the boiler and flue gas exits. PCDD/PCDF's are reduced by around 90% by the time the combustion waste gas leaves the boiler and exits the incinerator via the scrubbing devices and stack during the start-up phase. This dioxin is almost largely adsorbed onto fly ash and captured in the scrubbing systems. Some PCDD/PCDF escapes in a volatile state, some adsorbed onto particulate and yet more can be formed by post-scrubber *de novo* synthesis all of which escapes to atmosphere.

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[12] http://www.environnement-sa.com/products-page/en/emission-monitoring-en/amesa-2/

[13] De Fre R., and Wevers M., (1998) Underestimation in dioxin emission inventories. *Organohalogen Compounds* Vol 36 1998

[14] Takasuga et al., 2004. Formation of Polychlorinated Naphthalenes, Dibenzo-*p*- Dioxins, Dibenzofurans, Biphenyls, and Organochlorine Pesticides in Thermal Processes and Their Occurrence in Ambient Air. *Archives Environ Contam. Toxicol.* Vol 46 : 419-431

[15] Hajime Tejima, Masahide Nishigaki, Yasuyuki Fujita, Akihiro Matsumoto, Nobuo Takeda and Masaki Takaoka *2007 Chemosphere*, Vol 66, Issue 6 *:1123-1130*

Table 1
PIC Contaminants identified in Bottom Ash from Hazardous Waste Incinerators[16]

Parameter	Concentration (ppb)
Acetone	20,000
Benzene	42
2-Butanone	2,000
Chlorobenzene	27
Chloroform	46
1,2-Dichloropropane	32
Diethyl phthalate	120,000
2,4-Dimethylphenol	23,000
Dimethyl phthalate	55,000
Ethylbenzene	380
Methanol	410,000
Methylene chloride	38,000
4-methyl-2-pentanone	2,300
Naphthalene	24,000
2-Nitroaniline	180,000
Nitrobenzene	29,000
Phenol	40,000
Styrene	320
Tetrachloroethylene	1,200,000
Toluene	2,500
1,1,1-Trichloroethane	12
Trichloroethylene	120
Xylenes	1,900
TOTAL	**2,308,679**

Heavy metals in hazardous waste incinerator ash have been a widely studied problem for many years and are the focus of regulatory measures that control the final distribution and fate of incinerator ash. Standard assessments of bottom ash for metal contamination consist of weak leachate tests (such as the ASLP) using distilled water to simulate leaching conditions in a landfill environment or the more aggressive Toxicity Characteristic Leaching Procedure (TCLP) using dilute hydrochloric acid. The focus on leachability of metal to the exclusion of other contaminant represents a serious data gap when assessing the environmental fate of incinerator ash that is reintroduced into the environment for 'beneficial purposes' such as construction materials, masonry additives and road-base.

While research during the 1980s and 1990s clearly demonstrated that heavy metals and POPs such as dioxins and furans were contaminating fly ash and bottom ash from municipal, hazardous and medical waste incinerators, since then researchers have discovered a much broader range of contaminants in the Air Pollution Control (APC) residues such as dust and scrubber water.

Scrubber waters also contain elevated pollutants that are extracted through wet scrubber systems designed to capture contaminants in the flue gas train. The following table identifies some of the more hazardous pollutants reported in scrubber water from a US hazardous waste incinerator. It should be noted that phthalates feature prominently and continue to be investigated for their potent endocrine disruption capabilities.

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[16] Boegel, J. Assessment of Residues from Incineration of RCRA Wastes (1987). In: Land Disposal, Remedial Action, Incineration, and Treatment of Hazardous Waste, Proceedings of the Thirteenth Annual Research Symposium, USEPA Hazardous Waste Engineering Laboratory, Cincinnati, July 1987, EPA1600/9-87/015.

Pollutants Found In Scrubber Effluents from Hazardous Waste Incinerators

Pollutant	**Scrubber Wastewater (micrograms per litre)**
Acetone	32 (1)
Methylene Chloride	<5 (1)
Naphthalene	<20 (1)
Benzoic acid	260 (2)
Bis (2-ethylhexyl)phthalate	32 (2)
Chloroform	4,100 (2)
Chloromethane	2,500 (2)
1,2-Dichloroethane	32,000 (2)
Diethyl phthalate	30 (2)
Di-n-butyl phthalate	22 (2)
Phenol	100 (2)
Tetrachloroethane	5,200 (2)
Toluene	5,000 (2)
1,1,1-Trichloroethane	6,800 (2)
Trichloroethene	14,000 (2)
Total xylenes	1,200 (2)
Dioxins and furans (total)	43 (3)