NON-COMBUSTION TECHNOLOGY ALREADY AVAILABLE

WE DON'T NEED TO BURN POPS WASTE!

The global community has an opportunity to prevent toxic recycling through the substantial strengthening of limit values for persistent organic pollutants (POPs)[1] in waste, known as Low POPs Content Levels. Establishing strong limit values for POPs in waste today will significantly promote the future of a toxic-free circular economy, because it will promote innovation in recycling, increase the pressure on industrial designers to remove POPs from products, and ensure that the circular economy is not poisoned in its infancy.

The Stockholm Convention requires the destruction of wastes that exceed Low POPs Content Levels. However, some industry players are pushing regulators to set weak limits that would allow them to use materials heavily contaminated with POPs in recycling. Recycling of POPs goes against the whole objective of the Stockholm Convention! This fact sheet explodes the myth that POPs waste needs to be destroyed with high-temperature incineration that creates a further cycle of dioxin emissions to air and mountains of toxic ash laced with more POPs. Some countries have already been moving beyond polluting incinerators, implementing non-combustion technologies for POPs waste destruction. These advanced, clean technologies are able to destroy POPs waste without dioxin emissions and without generating toxic ash residues. This paper provides a brief description of the proven POPs waste destruction technologies that can be used to clean the waste from POPs before its further use or disposal.

SUPERCRITICAL WATER OXIDATION (SCWO)

Both *supercritical* and *subcritical* water oxidation systems have over 30 years development and commercial experience in destroying POPs waste such as PCBs. The term *supercritical* refers to the state of water just prior to its phase change from liquid to gas under heat and pressure (e.g., 374°C and 218 atmospheres). In this state, organic materials can be rapidly oxidised and decomposed. General Atomics have developed a relatively high throughput feed model designed for general industrial hazardous wastes as well as non-hazardous wastes. Their technology is referred to as Industrial Supercritical Water Oxidation or iSCWO. A GEF-funded project to treat large stockpiles (5,000 tonnes) of DDT waste at a contaminated site in Tajikistan and the Kyrgyz Republic is currently being implemented using this technology (GEF 2017).

Installation costs were 15% less expensive and running costs for SCWO were only around 10% of the costs of incineration of hazardous liquids (Aki et al. 1998). SCWO is now used extensively by the US military for destruction of hazardous wastes and chemical weapons, including using mobile ship-based units. Both iSCWO mobile units (right) and fixed units have been developed by General Atomics. SCWO can destroy **PBDEs, SCCPs, dioxins, and all other POPs** according to the Basel Convention General Technical Guidelines on POPs waste.

1 Persistent Organic Pollutant (POP) waste is the most toxic chemical waste on earth. Its persistence means that it does not break down easily in the environment contaminating soil for decades, building up in the food chain causing dangerous levels of human exposure. They have been added to many plastics and contaminate the recycling chain if they are not separated and destroyed. These man-made substances are banned under the Stockholm Convention and include PCBs, dioxins, brominated flame retardants, and PFAS.

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BASE-CATALYZED DECOMPOSITION (BCD)

BCD is an ex-situ technology that has been used for destruction of PCBs and treatment of soil contaminated with PCBs at high concentrations. BCD was developed jointly between the US Navy and the US Environmental Protection Authority (US EPA) to decontaminate liquids, soils, sludge, and sediments contaminated with chlorinated organic compounds, especially PCBs, dioxins, and furans. Modular, transportable, and fixed BCD plants have been built. Throughput capacity for the desorption stage differs according to application and ranges between 100 kg/hr and 20 tonnes/hr (STAP GEF 2004). For example, one large-scale BCD treatment of contaminated soils and waste at Spolana, Czech Republic, involved 200 tonnes of pesticides and 1,200 tonnes dioxins/pesticide concentrate from the remediation of 35,000 tonnes of soil.

BCD has also been used to treat POPs waste outside of Europe, including the Sydney 2000 Olympics site remediation at Homebush Bay, which involved treatment of 400 tonnes of chlorinated benzenes/dioxins. Also, over 2,500 tonnes of PCBs were treated in a fixed facility in Mexico by S.D Meyers de Mexico and 3,500 tonnes of HCH pesticide was treated between 2000-2002 in Spain by IHOBE S.A.

GAS-PHASE CHEMICAL REDUCTION (GPCR)

Gas-Phase Chemical Reduction (also known as Hydrogen Reduction) is a technology that was developed in Canada in the 1980s and has been successfully implemented for POPs waste destruction in Australia, Japan, the US, and Canada from the 1990s onward. The GPCR process involves the thermochemical reduction of organic compounds at temperatures greater than 850 °C and at low pressures where the hydrogen reacts with chlorinated organic compounds to yield primarily methane, hydrogen, and hydrogen chloride. Excess hydrogen from the process can be recirculated or sold as fuel. It was so effective that a full-scale commercial plant managed to destroy the entire stockpile of POPs waste in Western Australia in the mid-1990s. The Basel Convention General Technical Guidelines on POPs Waste confirm GPCR can destroy PBDEs, SCCPs, dioxin, PFOA, HCB, and all other POPs, even in very high concentrations, to the highest levels of destruction efficiency. GPCR developer Dr Doug Hallett of TRUE ENERGY INCORPORATED has also recently confirmed its effective application to difficult POPs-contaminated wastes such as automotive shredder residue (ASR) which is heavily contaminated with PBDE and also sewage sludge which is contaminated with POPs.

ALKALI METAL REDUCTION

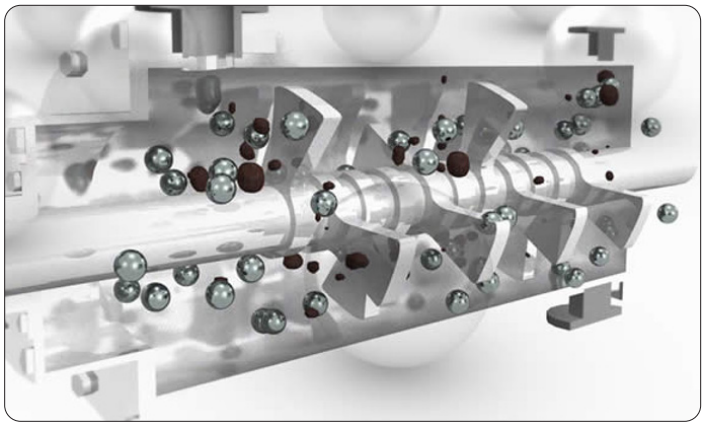
Alkali metal reduction involves the treatment of wastes where dispersed alkali metal reacts with chlorine atoms contained in the chlorinated compounds of halogenated waste to produce salts and non-halogenated waste. Many examples of this technology have been developed and the CDP Process® of SEA Marconi has been widely used throughout Europe to dehalogenate PCB transformer fluids. This mobile and modular process can treat PCB oils in transformers while they remain operational reducing costs and avoiding transport and handling of PCB waste. The modular units are attached to the transformers and circulate the fluid through an alkali metal reduction process destroying the PCB content and revitalising the dielectric fluids.

CATALYTIC DECHLORINATION USING COPPER CATALYSIS (CDC)

CDC is a process based on selective dehalogenation as its primary operation while suppressing coupling reactions. The process uses a reaction via an arylcopper intermediate which drives electron transfer. It has a demonstrated ability to treat different types of wastes including contaminated soil and construction materials, fly ash, liquid and solid wastes containing POPs, and filtration sands (Ocelka 2010). CDC technology has been used at one commercial operation in Jaworzno, Poland, and has partly also been applied to decontamination of POPs pesticides-contaminated soils from Klatovy, Czech Republic (Ocelka 2011; Ocelka 2017).

BALL MILLING TECHNOLOGY VARIANTS

These processes have been developed by a number of companies and are also known as Mechanochemical Destruction (see EDL Europe) and triboREMEDY (EU), the first of which has been successful in destroying POPs waste on a large scale in New Zealand at contaminated sites and in Vietnam where the UN trialled the technology to destroy high-concentration dioxin in contaminated soils at the former Bien Hoa US Air Force base used to stockpile Agent Orange during the Vietnam War (GEF 2015). TriboREMEDY uses mechanochemistry and tribolysis to destroy brominated and chlorinated POPs and is under patented development with European Commission funding[2] to destroy POPs waste as well as pathogens in drinking water.



Mechanochemical Destruction (MCD) by EDL Europe

The exact design of the Triboreactor is currently confidential due to patent processes. The EDL MCD reactor is based on adding POPs waste to a sealed metal cylinder in which steel balls are agitated vigorously (see cutaway graphic above) along with non-hazardous low-cost reagents. The chemical reactions obtained in this environment destroy POPs waste.

These are just a few examples of the clean non-combustion technologies developed to destroy POPs waste without resorting to burning waste in polluting incinerators. Many more such technologies are being used, including:

- **EcoSPEARS and RIDS** with innovative techniques to extract PCBs and dioxins from sediment and destroy it in a modified alkali-reduction technology (RIDS).
- **Catalytic hydrogenation** (Hydrodec) destroying PCBs in Australia, Japan, and the US.
- **Alkali-reduction technology** for transformers with PCB oil
- See also IPEN (2021) report on Non- Combustion Technology for POP Waste Destruction.

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2 https://cordis.europa.eu/project/id/829047