Name of Process:
Alkali Metal reduction
(Sodium reduction)

Applicable POPs wastes:
Alkali metal reduction has been demonstrated with PCB-contaminated oils containing concentrations up to 10,000 ppm and for Askarel transformers (>10,000 mg/kg of PCBs).

In Japan, successful destruction has been performed on Pesticides e.g chlordane and hexachlorobenzene (Ministry of Environment of Japan, 2004). Also first lab scale tests have been performed for BHC (HCH).

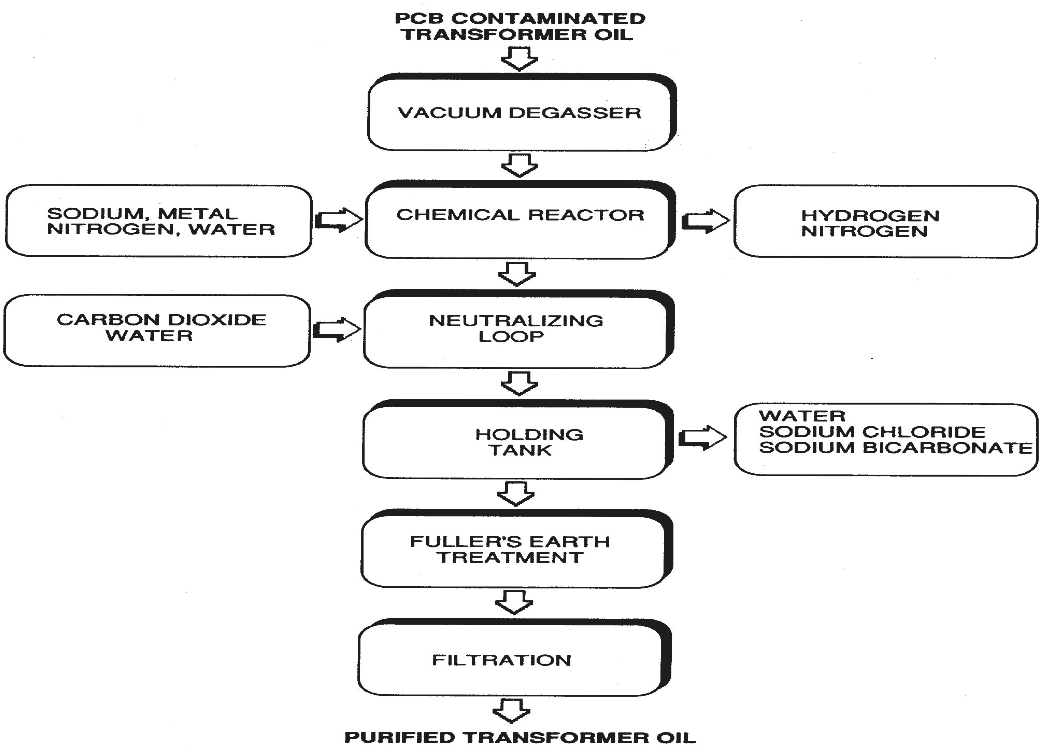
Status:
This process has been used commercially for approximately 20 years. It has been used extensively in particular in North America and in Germany where most of the oil above 50 ppm has now been treated. Plants are also in France, Spain, Iran and Japan.

In the last years, one of the Canadian technology suppliers has commercialised a variation the so called Sodium Dispersion Process for the destruction of PCBs in contaminated solids, specifically fluorescent light ballast wastes and capacitors. A commercial plant operated in Canada in 2003. The PCB was extracted from the capacitors and processed in a standard PCB sodium dispersion process.

The process was optimized for the destruction of pure PCBs by a Canadian company in 1995. This process was approved by Ontario Ministry of the Environment. The destruction efficiency for low and high strength PCB liquid is complete with residual level of the toxic material less than detectable limits. This process was the first foreign technology approved for use by the Japanese government in 1998.

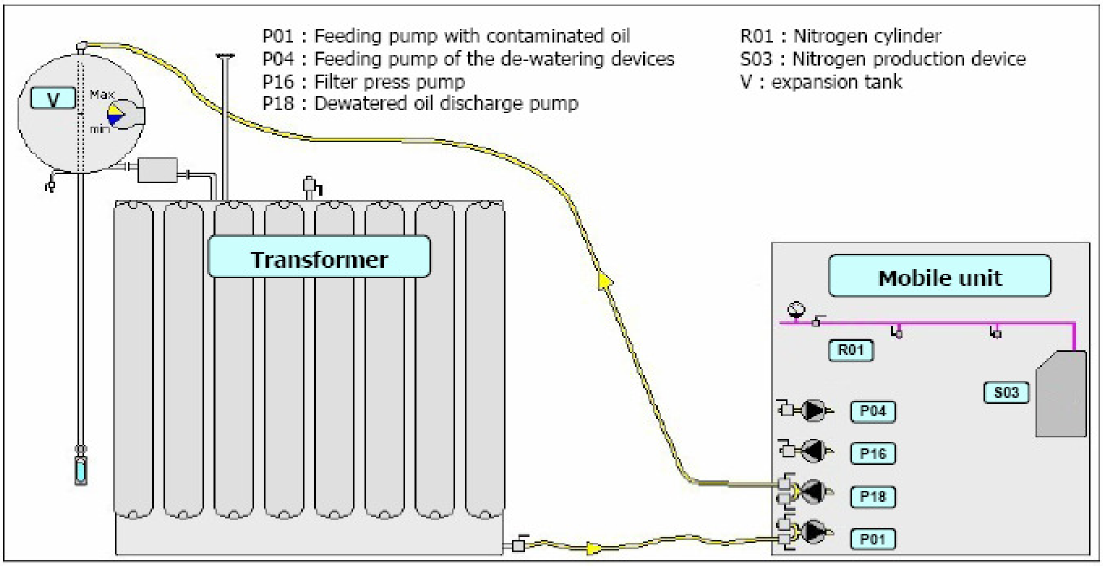
The process used in Japan has been developed since 1997 based on the Canadian process, for the dechlorination of PCBs and Dioxins in the contaminated wastes to adopt Japanese regulatory standards, and was approved by the treating technology evaluation committee of the government in 1999. At present, as part of the PCB destruction programme in Japan by JESCO (Japan Environmental Safety Corporation), there are now 3 plants for the treatment of low contaminated PCB (Mineral oil with PCB concentration usually under 100 ppm) and 3 treatment plants for High contaminated PCB (~100%). A fourth one will start production in May 2009.
A French supplier applies since 1995 the so called Sodium Hydride process, which involves Na H instead of sodium in its metallic form. The reductive element is here the H- ion, which is also very reactive, but there is no chance of flames or explosions and the supplier claims a much more safe system.

Technology description:
Process diagram: Process Flow Schedule in Canada (fixed plant)

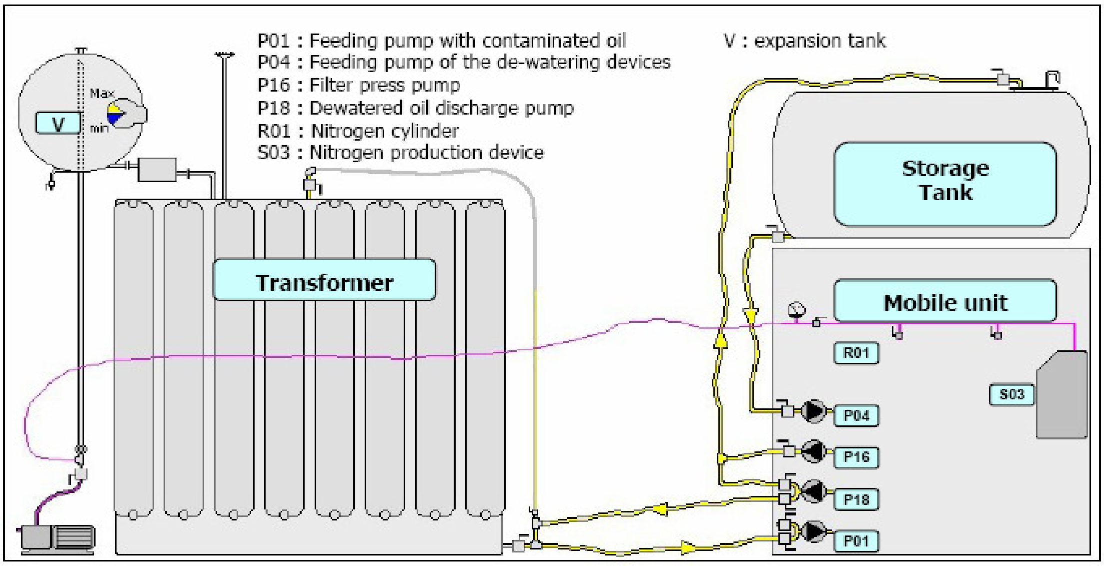


Alkali metal reduction involves the treatment of wastes with dispersed metallic alkali. Metallic alkali reacts with chlorine in halogenated non-aqueous waste to produce salt and non-halogenated waste. Typically, the process operates at atmospheric pressure (sometimes up to 4 atmospheres) and temperatures between 100˚C and 180˚C (Ariizumi et al., 1997) (actually normally between 90 ˚C and 165 ˚C, the quality of transformer oil deteriorates above 165 ˚C, so higher temperatures are undesirable as most chemical decontamination is followed by dielectric regeneration to allow re-use of the oil as a transformer fluid). Treatment can take place either in-situ (i.e. PCB contaminated transformers) or ex-situ in a reaction vessel (the term in-situ is probably misleading, treatment almost always takes place in a processing unit that is exterior to the transformers; the two main treatment variations are bulk treatment whereby oil flows from a feed tank to the processing unit and then to a treated oil tank, and on-line treatment, whereby oil flows from a transformer to the processing unit and back to the transformer; in this second mode, some of the PCB associated with the internals of the transformers are removed and destroyed). (see further on page 2).

There are several variations of this process. Although potassium has been utilized, metallic sodium is the most commonly used reducing agent (other reagents, mostly organo-metallic ones, are also used). The remaining information is based on experiences with the metallic sodium variation.



Example of Canadian Mobile Unit with direct operation mode with transformer



Example of Canadian Mobile Unit with indirect operation mode with transformer using intermediary oil tank

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PART I: Criteria on the Adaptation of Technology to the Country

A. Performance:

1. Minimum pre-treatment:
Ex-situ treatment of PCBs can be performed, however, following solvent extraction of PCBs. Treatment of whole capacitors and transformers could be carried out following size reduction through shearing.

Pre-treatment should include de-watering to avoid explosive reactions with metallic sodium. Drying of oil is normally accomplished to achieve a moisture content of approximately 100 ppm. This is normally done using the vacuum degasser that is also used for the regeneration of the dielectric properties of the oil. Reactors are equipped with pressure and temperature sensors that automatically shut down the feed pump if the monitored values come to exceed the normal operating range. It can be noted that some other dechlorination reagents such as K-Peg are much less sensitive to water and do not require the same extent of safety precautions.

2. Destruction efficiency (DE):
DE nor DRE has been reported (DE varies typically between 99% and 99,9% in most applications, it is also possible to go to a much higher DE as some vendors do when processing askarel or other PCB-chlorobenzenes commercial fluids). The sodium reduction process has been demonstrated to meet regulatory criteria in the EU, United States, Canada, South Africa, Australia and Japan for PCB transformer oil treatment, i.e. less than 2 ppm in solid and liquid residues (to less than 0.5 ppm in Japan; the North American target most often used for chemical dechlorination of oil is 2 ppm, but the process has the ability to reach 0.5 ppm in most cases) (note that this type of treatment is used almost only for transformer oil; it is ineffective in liquid residues that contain an aqueous component and the effectiveness is low for solid residues)(UNEP, 2004a).

Destruction efficiency (DE) values of greater than 99.999 percent have been reported for chlordane and hexachlorobenzene (Ministry of Environment of Japan, 2004).

Test results of the Canadian based technology included in the Japanese Government report can be used to demonstrate greater than 99.9999% destruction efficiency when the process is applied to high level PCB liquid. Detection level of analytical tools currently available do not permit to prove the 99.9999 % destruction efficiency when the technology is used in low level PCB contaminated waste, nevertheless, the residual PCB in the oil is also less than MDL of analytical method.

For destruction Removal efficiency (DRE) values of 99.9999 percent have been reported for chlordane and hexachlorobenzene (Ministry of Environment of Japan, 2004).

One Canadian fixed plant indicates DE for PCB residual < 2 ppm for solids and < 0.05 ppm for liquids and another one indicates total destruction of the residuals (UNEP, 2004)

A commercial Canadian plant with the sodium dispersion process for the destruction of PCBs in contaminated solids, specifically fluorescent light ballast wastes and capacitors, operated in Canada in 2003. Capacitors containing 20% PCBs by weight are shredded and decontaminated to a level of lower than 5 PPM, for an equivalent destruction efficiency of 99.997%.

3. Toxic by-products:
The by-products of the reaction are most often a salt solution that contains some oil and biphenyl polymer. These wastes have been characterised with respect to dioxins and furans and have been found to be innocuous in this respect. The residue can have a high pH because of the presence of NaOH or of KOH. Air at the vent of the units is routinely analysed for PCB, chlorobenzene and other organic compounds in Canada. The PCB concentration at the vent must be less than 1 ug/m^3 in Canada.

4. Uncontrolled releases:
Units are constructed with a steel pan under the process equipment to collect any leak from the piping and vessels. Hoses between the units and the tanks and transformers are typically wrapped with sorbent material at the connections and are underlain by a plastic liner.

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5. Capacity to treat all POPs:

Pesticides that are not halocarbons will likely not respond appropriately to this type of treatment. Sodium reduction has been demonstrated with PCB-contaminated oils containing concentrations up to 10,000 ppm (UNEP, 2004a). A Canadian vendor obtained the permit to use the technology for the destruction of pure PCBs. Furthermore, the same vendor successfully transferred this technology into Japan where it presently used at Toyota City PCB destruction plant. Some vendors have also claimed that this process is capable of treating whole capacitors and transformers (UNEP, 2000). Whole transformers have been decontaminated routinely with this process over the past 20 years when the initial PCB concentration in the transformer was low enough; when transformers are processed on-line, PCB associated to the internals is partially removed, and if a further reduction is required, a second visit is planned with the processing unit after approximately 90 days, which is the time required for PCB remaining in the porous constituent of the core and coil assembly to leach back in the dielectric oil of a live transformer; depending on initial concentrations, a third visit is planned,(more is rare) (capacitors normally contain about 30% of PCB and it is not cost-effective to treat them with sodium as it is not cost-effective to deal with the porous constituents of transformers when PCB concentrations are above 10,000 ppm).

Compounds treated by Alkali Metal reduction: PCB's , dioxins and furans, hexachlorobenzene, dieldrin (only small quantities have been treated for compounds other than PCBs

6. Throughput:

6.1 Quantity [tons/day, L/day]

Mobile facilities are capable of treating 15,000 litres per day of transformer oil.

For mobile units average flow rate 1000 L/hr, depending on the concentrations of PCB.
Full-Scale Plants: Data since about 1983 for several units, mostly in the US and Canada. PCB in transformer oil treated to less than 2 ppm. About 400 million litres treated since 1983.

Two fixed plants in Canada, one having a capacity of 7,000 t/y and the other one 2.400 million L/y. The solids plant was shut down for commercial reasons.)

Mobile units of one Canadian treatment companies are installed in a 12 meter (40') container. The modules are positioned close to the inventory of contaminated oil and close to the tankage used for storage of the treated oil.
In the smaller models, contaminated oil is processed in batch. Oil with low level of PCBs is decontaminated in batches of 3000 L. The dual reactor unit allows for treatment of low level PCBs at an average rate of 1000 L/hour.
In the bigger model, the contaminated oil is processed directly in a continuous flow system. Processing of the oil is performed by chemical decontamination followed by the regeneration of the dielectric properties of the transformer oil.

Through the process, PCBs are destroyed irreversibly in reactors by adding an alkali based reagent to the pre-treated oil. The reagent is stable at room temperature, easy to handle but is incompatible with water or oxidizing materials.
The mobile unit can be constructed to meet the client's needs in PCB oil decontamination and regeneration. It is assured that contact with water and oxidizing materials is avoided. Transformer oil is the fluid treated with these units. Water is not soluble in this type of oil and the oil is inspected and tested beforehand to verify that there is no colloidal water present in the oil. In such an occurrence, the oil is dehydrated prior to chemical dehalogenation.

6.2 POPs throughput : [POPs waste/total waste in %]

Mobile unit oil treatment capacity :

Average treatment flow rate"	PCB concentration range	Maximum throughput"
1,000 L/hour	50 to 10,000 ppm	24,000 L/day

"For PCB concentration in oil that are less than 500 ppm. The processing rate decreases with increasing concentrations of PCB.

Generally PCB 1254 and 1260 is the type of PCB found in transformer oil.

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7. Wastes/Residuals:

7.1 Secondary waste stream volumes:
Residues produced during the process include sodium chloride, sodium hydroxide, polyphenyls and water. In some variations, a solidified polymer is also formed UNEP, 2000).

After the reaction, the by-products can be separated out from the oil through a combination of filtration and centrifugation.

The decontaminated oil can be reused (after processing to regenerate the dielectric properties of the oil, involving normally dehydration, degassing, Fuller's earth treatment and microfiltration; this must be part of the processing for on-line treatment otherwise the transformer will fail, probably in a catastrophic fashion).

The sodium chloride solution cannot be re-used, but centrifuged organo-metallic reagent is normally re-used in the chemical dechlorination process.

A small amount of sludge is generated which contains both sodium chloride and the solidified polymer with some oil and water; it is normally solidified and directed to an approved landfill).

7.2 Off gas treatment:
Air emissions include nitrogen and hydrogen gas. Emissions of organic compounds are expected to be relatively minor. A granular activated carbon filter is used to intercept organic contaminants that may be present in gas vented; this is sampled and analysed periodically to ensure compliance with applicable environmental standards

However, it has been noted that PCDDs can be formed from chlorophenols under alkaline conditions at temperature as low as 150°C (Weber, 2004). This very recent issue could not be clarified at present: Chlorophenols are not present in transformer and the gases are vented through an activated carbon filter to intercept any organic contaminant. It is important to keep a low reaction temperature. One of the Canadian sodium processes never exceeds 125°C and has always tested negative for PCDDs and other dioxins in the exhaust.

7.3 Complete elimination:

Sodium reduction used for "in-situ treatment" of PCB contaminated transformer oils will not destroy all the PCBs contained in the porous internals of the transformer. It has to be noted that there are certain limits on such treatment. In case that decontaminated oil is circulated in a transformer and is returned to the treatment unit, a certain amount of cleansing of the internals of the PCB transformer takes place, especially if the transformer remains in operation; some of the PCB in the porous constituents gets desorbed in the hot clean oil that returns to the treatment unit; (no reagent is directed to the transformer).

After 20 years of commercial operation, there is a lot of information on this, equations have been developed to anticipate % decontamination in transformers after on-line treatment, and a lot of experience has been acquired on this over this period, it is advised to discuss % decontamination and PCB leachback with experienced technology vendors. The bounce-back issue is not particular to the sodium process.

Detailed information and treatment examples:

In the separate Annex the following information is given:
Table 1: Technology Overview – Summary Technical Details
Table 2: Overview project experience per technology supplier
Table 3: Overview detailed project information per project - Project name (from Table 2)
Table 4: Utilities Required for PCB Capacitors Treatment

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PART II: Criteria on the Adaptation of the Country to the Technology

Examples on basis of real case: mobile decontamination units in 3 Models used in Canada.
The smallest model enables PCB oil decontamination in a batch process.
The medium model additionally generates transformer oil
The largest one operates on a direct mode instead of a batch process and has an on-line continuous process.
Other fixed types are mentioned specifically if such information is available.

Note: This part has to be filled in every time the "suitability" of the technology has to be examined for a certain country situation!!

A. Resource needs:

1. Power requirement :
Power requirements for mobile units are electrical (60 amp at 575 V) and no 2 fuel oil for heating of the oil (about 750,000 BTU/hr depending on the unit). Units can also be built to be entirely electrically powered.

For one of the fixed plants power requirements are 100 A. Electrical heating of the oil is preferred if oil heat will require # fuel oil of about 750 000 BTU/h

2. Water requirements:
None for the mobile units.

For the fixed unit about 80 L/1000L of PCB contaminated oil is needed.

3. Gas volumes:

4. Reagents volumes:
Maximum reagent volumes carried with a unit are approx. 200 kg (for a 40% sodium dispersion in oil) or approx. 2000 litres for K-Peg.

5. Weather tight buildings:
the mobile units are built to prevent contact between water and reagent and are built to work outside

6. Hazardous waste personnel requirement:
One Canadian fixed plant operator indicates that all workers receive training on the hazards and how to deal with them (UNEP, 2004)

7. Sampling requirements/facilities:
All analysis are done in an off-site laboratory. No sampling equipment works in - situ. At the beginning of the operation, a sample of the first litres of treated oil is sent to the laboratory in order to validate the running parameters.

One other Canadian company uses PUF (Poly-Urethane Foam) for air monitoring, solvent extraction and GC for solids (UNEP, 2004)

8. Peer sampling:

9. Laboratory requirements:

On site requirements:
A laboratory module is provided for the smallest model. The company offers an optional gas chromatograph for PCB analysis in oil.

Requirements in country:
Dependent on the specific country's regulatory requirements.

10. Communication systems:

Mobile network:

Fixed network:

11. Number of personnel required: 2 technicians in total are sufficient or alternatively it could be run with only 1 technician and 1 labourer, if the technician is skilled enough to supervise alone the operation.

11.1 Number of Technicians required (skilled labour):
2 people are sufficient to run a unit. 1 typically is responsible mainly for the process, the second one being responsible for sampling, analysis in the on-board lab and quality control. People are on day shift and on night shift. When significant work is required to connect to many tanks and/or transformers and to rinse tanks, a third person is on the day shift. Typically, a chemist or engineer works from the office to communicate with clients and provide overseeing for the company.

11.2 Number of Labourers required (unskilled labour):

B. Costs:

Transformer oils: Costs are the same in Canada, the US, England and other locations, but the method of calculation may change from one organisation to another; costs reflects the assumed initial PCB concentration and other factors such as the economy of scale; prices are about the same in Canada and in the US; the US$0.15/L is a cost for oil with low PCB concentration and the US$3.3/gallon, US$0.70/kg is a price for oil with higher PCB concentrations or with more impurities. Here the costs of pre-treatment and disposal of the residuals are included. The processing cost for destruction of pure PCBs is in the order of US $ 4 to 5 per kg of waste.

Waste oils: US$0.50/kg (UNEP, 2000). Actually treating waste oil is more expensive than treating transformer oil, by a factor of 2 or more depending on the viscosity of the oil and on the impurities present in the oil; waste oil often contains solvents, water, solids, paint, etc., which requires extensive pre-treatment and makes a 2 ppm decontamination target often impractical; often the target for waste oil is less than 50 ppm of PCB rather than 2 ppm of PCB and the treated waste oil is then used as a fuel supplement in an authorised cement kiln. For waste oils, the costs of pre-treatment and disposal of the residuals are not included.

One of the Canadian fixed plants indicates (UNEP, 2004):

PCB contaminated mineral oil: CAN $ 0.15 /L

PCB contaminated capacitors: CAN $ 5.10 /kg

PCB contaminated fluorescent light ballast waste: CAN $ 1.10 /kg

1. Installation and commissioning costs [US Dollars]:

2. Site preparation costs [US Dollars]:

3. Energy & Telecom installation costs:

4. Monitoring costs:
Amount of monitoring dependent on regulatory requirements

5. Complying costs:
Amount of compliance testing, oversight, etc., will depend on regulatory requirements

6. Reporting costs:
Amount of reporting dependent on regulatory requirements

7. Running costs with no waste:

8. running costs with waste:

9. Decommissioning costs:

10. Landfill costs:
Depending on the local situation – Should be filled in by the concerned country

11. Transport costs of residues:
Depending on the local situation – Should be filled in by the concerned country

C. Impact:

1. Discharges to air:
The PCB concentration at the vent must be less than 1 ug/m³ in Canada.

In France, so far, no analysis at the exhaust of the electrofilter has been required by the customers

2. Discharges to water:
less than 2 ppm in solid and liquid residues (to less than 0.5 ppm in Japan; the North American target most often used for chemical dechlorination of oil is 2 ppm, but the process has the ability to reach 0.5 ppm in most cases

In France, no water analyses have been required, because the machine has its own retention: the components are in no way in contact with the ground. Additionally, a plastic sheet is placed under the installation before deployment for the projects listed in Annex, Table 2.

3. Discharges to land:
See under 2.

4. Soil impact (noise etc):

D. Risks

A French technology supplier working with the Sodium Hydride process involves Na H instead of sodium in its metallic form. The reductive element is here the H- ion, which is also very reactive, but claim that there is no chance of flames or explosions claims a much more safe system.

1. Risks of reagents applied:

a. Dispersed metallic sodium can react violently and explosively with water, presenting a major hazard to operators. Metallic sodium can also react with a variety of other substances to produce hydrogen – a flammable gas that is explosive in admixture with air. Fine sodium dispersion in mineral oil is very stable, however it has to be handled with care to avoid contact with water.

→ *Measures taken: reagent handling and decontamination in the reactors is performed under nitrogen atmosphere.*

b. Naphthalene has a flash point 174 degrees F and does not really react with oxidizers. Naphthalene only to be used in a well-ventilated area. Since the vapor is heavier than air, a potential asphyxiant hazard exists when stored or used in confined spaces. In contrast to Naphthalene, sodium naphthalene is one of the chemical reagents used to treat PCB contaminated oil, and does react violently with oxidizer. Naphthalene enters in the preparation of the reagent

--> no measure needed! It should be mentioned that this is not used in all systems. Several Canadian technology suppliers do not use this. and one applies sodium dispersion in mineral oil.

c. Another reagent used in the process is a member of the glycol ether family. Polyethylene glycol has a flash point of about 470 F and is not flammable, and can form organic peroxides when combined with water under certain conditions.

→ *No measures needed. It should be mentioned that this is not used in all systems. Several Canadian technology suppliers do not use this and one applies finely dispersed metallic sodium in mineral oil.*

d. Hydrogen gas is a by-product of the sodium process. It is created as the sodium encounters and reacts with waters and/or alcohols in the oil. Main cause of concern is its flammable nature, however since it much lighter than air it dissipates rapidly.

e. Sodium hydroxide is produced as another by-product of the treatment process. It is corrosive and destroys human tissue at a rate based upon concentration, and may be fatal if swallowed. Waste sodium hydroxide is a regulated waste material that requires special storage, handling, and disposal in both US and Canada.

→ *No further measures needed*

2. Risks of technology:

Overall several hazards exist with operating the process like most environmental and/or chemical processes. The risk for fire and explosion is well above the norm for chemical processes due to the use of sodium metal. The environmental risk is above the norm due to the handling of PCB oils and fluids.

The worst-case scenarios associated with this process are fire, explosion, injury/fatality, and environmental release. The worst case of all would involve all of these at once. Note: This green sentence has been deleted as it was a false statement mentioned in the Open Ended Working Group: In the history of the PPM process only three instances of fire have occurred (A facility in Delfzijl, The Netherlands, has been severely damaged by a fire) and in each case they were related to operator error.On the other hand one of the Canadian companies declared that since the plant began commercial operation in 1987, there had not been a single safety incident from the plant. Another Canadian company stated also no accidents after 20 years of experience (UNEP, 2004)

However through planning, worker training, engineering controls, and the use of personal protective equipment these risks and hazards are reduced to acceptable levels.

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3. Operational risks: Main information is drawn from Canadian mobile units
a. Water contact. Great care must be taken in process design and operation to (please, be aware of the fact that some water in the ppm range is needed in the reaction) exclude water (and certain other substances, e.g. alcohols) from the waste and from any other contact with the sodium.

b. Electricity. The mobile treatment unit is equipped with a transformer and a power panel to operate the various pump motors, mixer motors, sensors, and alarms. The panel is a high voltage source and must be kept closed when not being maintained.

All wiring is 480 V, three phase and designed to the applicable electrical code:
Design and construction depending on the standards of the country where the unit is used, for example 575 V in Canada)
If the mobile unit will be operated inside a building or in a confined area, the wiring, motors, and conduit must be upgraded to explosion proof due to the potential presence of hydrogen gas.

Measures taken: In such a case, any hydrogen by-product would be vented outside of the building)

Safety is a priority and is highly controlled during operation of the mobile system:
The mobile unit is also equipped with gas detection and fire prevention equipment.

Operational parameters are automated for fail safe modes from a control panel in the laboratory area.
Safety features include :

- A spill tray on the container floor capable of holding more than the entire system's oil capacity.
- A separate reagent preparation area with a nitrogen injection system.
- A flammable gas LEL detector (lower explosion limit) that automatically controls the unit ventilation and shuts off the operations in case of abnormal conditions.
- Smoke and heat detectors with automatic shut-off of the decontamination unit.
- Controls interrupting the processing in the case of abnormal pressure or temperature conditions in the reactors.

E. Constructability:

1. Ease of installation/construction of plant:
Example smallest model:
· Two 3000 L insulated reactors, with mixers.
· A dehydrator / degasifier unit.
· Oil heating units.
· Cooling and condensation unit, with vacuum pump and GAC filter.
· Process and auxiliary pumps.
· Instrumentation, control and automation system.
· A laboratory module.
· Reagent handling and injection system.
· Inert gas blanketing system.
· Ventilation system with built-in safety features.
Example middle model:
· All equipment of smallest model.
· Fuller's earth filters with accessories.
· Anti-oxidant injection system.
Example largest Model:
· All equipment of smaller models.
· A centrifuge with accessories.
· A refrigeration unit.
· Additional heat exchanger for cooling of oil.

Optional Process Equipment
The mobile units can be adapted to the specific needs of customers with optional equipment. A partial list of the main optional equipment available follows :

- The regeneration package including two Fullers earth filters and an antioxidant module.
- A centrifuge for on-line separation of by-products.
- A chiller to enhance off gas condensation.
- A HDS injection system for treatment of mixed wastes.
- A gas chromatograph for PCB analysis in oil.
- Dielectric measuring equipment.
- Trailer mounted system.

2. Ease of shipping/transit:
For example the mobile units are installed in a 12 meter (40') container.

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3. Ease of operation:
All operators of the process must complete a training class in health and safety, environmental management, and on-the-job operation.

The Canadian system has a large operating experience, and has operated units in a mobile fashion (for about two hundred different customers over 20 years) and in two fixed facilities in Canada, receiving oil from many customers. All work was performed with mobile units between 1985 and 1995. Most of the oil is now treated in fixed facilities nowadays because very few clients remain who have a sufficient quantity of oil to justify mobilisation/demobilisation of a mobile unit. This is a dying market in Canada and in the United States as most of the PCB contaminated oil has been treated. Most of the PCB contaminated oil we treat nowadays contains less than 50 ppm because only a bit more than 50 ppm oil is left.

4. Ease of processing :
In terms of operation, in Canada one uses continuous processing units to treat transformer oil (this represents about 97% of the work done) and has used a batch processing unit to treat waste oil with miscellaneous junk and contaminants (oil contaminated with solvents, fuels, aqueous wastes, radioactive elements, paint, dioxins and furans, etc.). In the latter cases, one conducts laboratory scale treatment to develop the proper recipe and methodology to carry out treatment in the full scale. One has carried out this second type of treatment mostly between 1994 and 1999. Of particular interest is a full scale treatment which was performed to decontaminate residues from a magnesium plant; the residues contained HCB, PCDFs and PCDDs (all POPs) as well as many other organochlorinated contaminants (about 75 drums or 15,000 litres).

F. Output/generation waste

1. Generated waste (% of input waste)
The estimate waste production is about 120 kg of solid waste per 1000 l of treated oil. Those wastes are not contaminated by PCB, because of the complete chemical destruction of the product. However, they have to be treated as hazardous industrial waste, due to a possible presence of remains of Sodium Hydride.

One Canadian fixed installation quotes (UNEP, 2004):
Sludge (NaCl, NaOH, Biphenyls) 20 kg/t waste treated
Another Canadian fixed plant (UNEP, 2004):
Waste water: 80 L/t waste treated
Sludge: 1kg /t waste treated
For the waste water which is a caustic oil, the oil is removed and the water is neutralized by a waste contractor (UNEP, 2004)

2. Deposited waste at landfill (% of input waste)
For both fixed plants, it cannot be stated if the waste is landfilled. Companies indicate that sludges and waste waters are disposed of by waste management contractors and/or waste disposal companies (UNEP, 2004)

3. Waste quality properties (pH, TCLP)
No liquid effluent generated.

**Note: This Technology Specification and Data Sheet (TSDS) does not certify any particular technology, but tries to summarise the state of the art of the concerned technology on the basis of data delivered by the companies or other sources, which have been made available to the author and refers the reader to original documents for further evaluation. Without the efforts below listed technology suppliers it would not have been possible to set up this TSDS. Date:01.09.2008*

Technology suppliers that have contributed to this TSDS:

Kinectrics Inc., Canada,

Powertech Labs Inc., Canada

Sanexen Environmental Services Inc., Canada

TREDI - Groupe Séché, France

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