

## DECHLORINATION OF THE OIL EFFLUENTS FROM THE GEORGWERDER LANDFILL

R. Kilger\*, E. Bilger\*\*, R. Jacob\*\*\*

\* Freie und Hansestadt Hamburg  
Amt für Altlastensanierung  
Bernmannstr.40  
D-2000 Hamburg

\*\* Degussa AG  
GB Industrie und Feinchemikalien  
Anwendungstechnik ATA  
Rodenbacher Chaussee 4  
D-6450 Hanau 1

\*\*\* Umweltschutz Nord GmbH & Co  
Bergedorfer Str 49  
D-2875 Ganderkesee 1

### Abstract

From the Hamburg-Georgswerder landfill oily effluents contaminated with CHC (chlorinated hydrocarbons) are seeping into the environment. Up till now there was no standard procedure for their disposal available. A pilot test run has proved now that rather large amounts of oils containing CHC can be dechlorinated successfully by means of metallic sodium turning the CHC into sodium chloride and polymeric hydrocarbons. A mobile pilot plant developed by Degussa AG has been used for that purpose.

### 1. Introduction

On the Georgswerder landfill more than 150.000 m<sup>3</sup> of liquid toxic wastes have been dumped into ten basins for liquid waste, and more than 100.000 drums into four dumps, between the years 1967 and 1974 /1/.

Penetrating rain water mobilises the dumped toxic wastes which seep out of the landfill as an oily effluent.

In 1983 2,3,7,8-TCDD has been found /2/ there. Further analysis of the effluents showed concentrations of such highly toxic substances as listed below: 54.324 ppm of chlorinated benzenes, 2141 ppm of chlorinated phenols, 5064 ppm of HCH, 259 ppm of PCB, 54.878 µg/kg of PCDD/PCDF and finally 63 µg/kg of the 2,3,7,8-TCDD, the Seveso dioxin.

## 2. The Process

For the time being only a few high-temperature incineration kilns are capable of and available for the disposal of such highly toxic, non aqueous liquid wastes.

Therefore, an increasing number of alternative processes are tested in order to destroy the chlorinated hydrocarbons, prior to any disposal of, by incineration or by other means /4/.

Of special interest in this field is a process cleaving the C-Cl bonds by means of finely dispersed sodium metal, yielding sodium chloride and polymeric hydrocarbons as reaction products.



This exothermic reductive dehalogenation is well known as "Wurtz-" and "Wurtz-Fittig-reaction" in organic synthesis /5/.

## 3. Pilot Plant

Based on this process Degussa AG has designed and constructed a mobile pilot plant, mounted in several 20 ft containers /6/. Because of it's mobile character an on-site treatment is possible. Transportation of these highly toxic substances to be treated is not necessary anymore. Fig.1 shows the equipment used for the testwork at the Hamburg-Georgs-werder landfill.

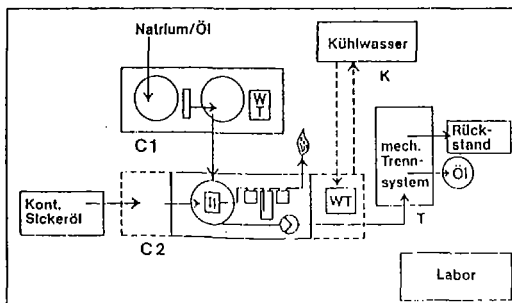


Fig.1 Pilot plant

Container C1 is used for the preparation and the storage of the sodium-in-oil dispersion (reagent). In container C2 the 1 m<sup>3</sup> reaction vessel is installed. The reactor is filled with a surplus of sodium dispersion, calculated accordingly to the amount of organo-chlorine (TOCl) and water in the oil that has to be dechlorinated. In order to facilitate the stirring during the reaction (formation of solids) the dispersion is diluted with oil. This oil can be taken from the product already dechlorinated. At a temperature of 190°C the contaminated oil is added in small portions. The exothermic reaction takes place at once; after adding all the oil to be treated the reaction mixture is allowed to react for approx. 1 hour to complete the reaction. After cooling down to 90°C the sodium surplus is destroyed by adding water. Low boilingpoint compounds that might break through the attached condenser are passed through a column filled with hot sodium dispersion, leading to a propane fired torch. Finally, the dechlorinated mixture is passed through a decanting/separating system T and thus separated into oil and sludge. The whole equipment is flushed with nitrogen during the operation to carry away the hydrogen formed by the reaction of sodium with the traces of water contained in the oil.

#### 4. Testwork

The equipment shown in Fig.1 has been installed on the Hamburg-Georgswerder landfill in summer 1988 /7/. Within the three weeks of testwork technicians of Umweltschutz Nord and Degussa treated in total approx. 1,2 m<sup>3</sup> of the oily effluents of the landfill. As a result approx 1,4 m<sup>3</sup> of dechlorinated oil and 0,6 m<sup>3</sup> of sludge were obtained. These residues have been incinerated at the Hamburg incineration plant.

#### 5. Analytics

The testwork has been accompanied on site analytically by Umweltschutz Nord /7/. Prior to the treatment, every single batch of oil has been analysed for chlorine and water to calculate the proper amount of sodium dispersion for dechlorination. After the reaction each batch of decontaminated oil has been analysed gaschromatographically already on site. No chlorinated compound was detected.

After finishing the testwork an analytical program to detect all relevant substances has been conducted by the Ergo Forschungsgesellschaft in Hamburg. More than 400 tests showed that there are no compounds like CHC, PCB, PCDD/PCDF and chlorinated benzenes left in dechlorinated oil and sludge in concentrations above the detection limit. Only a few chlorinated phenols were detected in concentrations near the detection limit of 0.1 ppm.

## 6. Conclusion

This testwork demonstrated that the sodium process is suitable for the treatment of chlorinated organic substances from leachates of contaminated sites. Irrespective of the initial concentration, for a lot of compounds a dechlorination near or below the detection limit has been obtained

## 7. References

- /1/ Umweltbehörde Hamburg, Amt für Altlastensanierung (Hrsg.): Sanierung der Deponie Georgsverder. 1988
- /2/ Götz, R.: Chemismus der dioxinbaltigen Sickeröle der Deponie Georgsverder/Hamburg. Müll u. Abfall (1986), 2
- /3/ Die Untersuchungen wurden zwischen 1983 und 1988 von den Hamburger Firmen Ergo und Matec sowie vom Amt für Umweltuntersuchungen der Hamburger Umweltbehörde durchgeführt.
- /4/ Kilger, R.: Grundverfahren für die Behandlung nichtwässriger Flüssigkeiten aus Altlasten - Überblick. In: Handbuch der Altlastensanierung (Hrsg. Franzius, V., Stegmann, R., Wolf, K.) Beitrag 5.4.3.3.0. Beidelberg: R.v. Decker's Verlag 1988
- /5/ Houben-Weyl: Methoden der organischen Chemie (Hrsg. Müller, E.). 4. Aufl., Bd 5/1a ("Kohlenvasserstoffe"), 347 u. 480 sowie Bd. 8/1 ("Metallorganische Verbindungen"), 389 u. 486. Stuttgart: G. Thieme Verlag 1970
- /6/ Abbau organischer Chlorverbindungen. Wasser, Luft u. Betrieb 10/1987, 63
- /7/ Degussa AG: Pilotversuch zur Dechlorierung von Sickeröl der Altdeponie Hamburg-Georgsverder mit dem Degussa-Natrium-Verfahren. Banau 1989