



# Chlorinated solvents in Cities

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# Chlorinated solvents (VOC)

## Content:

- Characteristics of Chlorinated solvents (VOC)
- Problem: Chlorinated solvents in urban areas
- Inner city groundwater pollution in the Netherlands → from single case to area oriented approach





# Characteristics of VOC

I made this stuff already in 1821



ICSC: NENG0076 Internatio x Plato Agentschap NL x About CityChlor | C Internatio

www.cdc.gov/niosh/ipcsneng/neng0076.html

## TETRACHLOROETHYLENE

1,1,2,2-Tetrachloroethylene  
Perchloroethylene  
Tetrachloroethene  
 $C_2Cl_4$  /  $Cl_2C=CCl_2$   
Molecular mass: 165.8

ICSC # 0076  
CAS # 127-18-4  
RTECS # [KX3850000](#)  
UN # 1897  
EC # 602-028-00-4  
April 13, 2000 Validated

TYPES OF HAZARD/EXPOSURE	ACUTE HAZARDS/ SYMPTOMS	PREVENTION	FIRST AID/ FIRE FIGHTING
<b>FIRE</b>	Not combustible. Gives off irritating or toxic fumes (or gases) in a fire.		In case of fire in the surroundings: use appropriate extinguishing media.
<b>EXPLOSION</b>			
<b>EXPOSURE</b>		STRICT HYGIENE! PREVENT GENERATION OF MISTS!	
• <b>INHALATION</b>	Dizziness. Drowsiness. Headache. Nausea. Weakness. Unconsciousness.	Ventilation, local exhaust, or breathing protection.	Fresh air, rest. Artificial respiration may be needed. Refer for medical attention.
• <b>SKIN</b>	Dry skin. Redness.	Protective gloves. Protective clothing.	Remove contaminated clothes. Rinse and then wash skin with water and soap.
• <b>EYES</b>	Redness. Pain.	Safety goggles, face shield.	First rinse with plenty of water for several minutes (remove contact lenses if easily possible), then take to a doctor.
• <b>INGESTION</b>	Abdominal pain. (Further see Inhalation).	Do not eat, drink, or smoke during work.	Rinse mouth. Do NOT induce vomiting. Give plenty of water to drink. Rest.
<b>SPILLAGE DISPOSAL</b>	<b>STORAGE</b>	<b>PACKAGING &amp; LABELLING</b>	
Ventilation. Collect leaking and spilled liquid in sealable containers as far as possible. Absorb remaining liquid in sand or inert absorbent and remove to safe place. Do NOT let this chemical enter the environment. Personal protection: filter respirator for organic gases and vapours.	Separated from metals, (see Chemical Dangers), food and feedstuffs. Keep in the dark. Ventilation along the floor.	Do not transport with food and feedstuffs. Marine pollutant. Xn symbol N symbol R: 40-51/53 S: (2)-23-36/37-61 UN Hazard Class: 6.1 UN Packing Group: III	
<b>SEE IMPORTANT INFORMATION ON BACK</b>			

ICSC: 0076

Prepared in the context of cooperation between the International Programme on Chemical Safety & the Commission of the European Communities (C) IPCS CEC 1994. No modifications to the International version have been made except to add the OSHA PELs, NIOSH RELs and NIOSH IDLH values.

## International Chemical Safety Cards

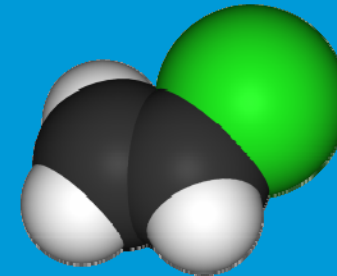


# Characteristics of VOC

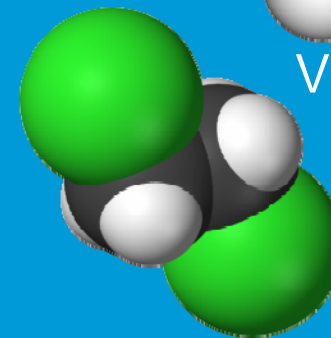
- Degradation product is vinylchloride (carcinogenic)



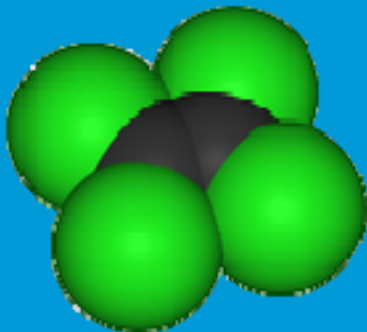
Ethylene



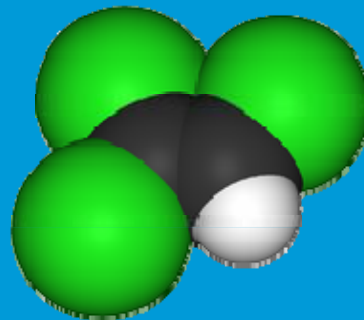
Vinylchloride



Dichloroethylene

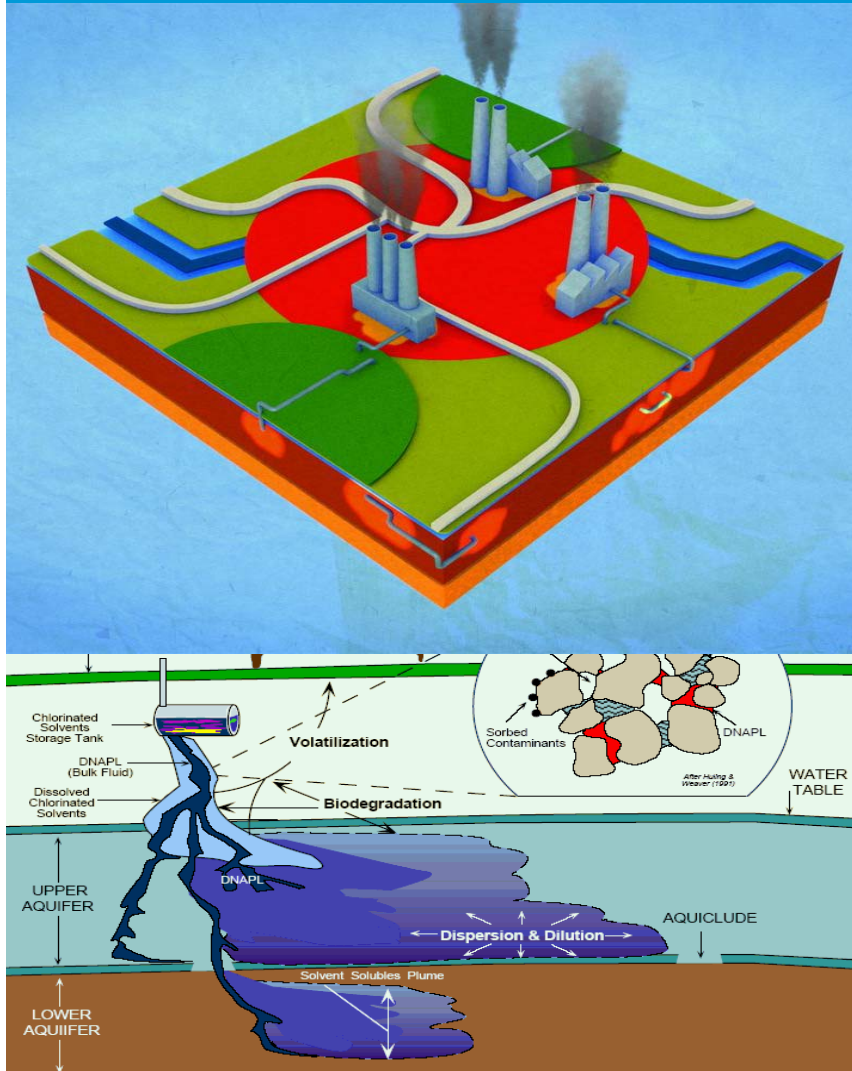


Tetrachloroethylene



Trichloroethylene

# Characteristics of VOC



- **More heavier then water** → DNAPL (dense non aqueous phase layer);
- **Spread easily in groundwater** → large plumes and volumes of groundwater polluted
- **Pollutions are mixed, single case approach no longer works**



# Characteristics of VOC

- Biodegradable



**Jamie's delicious  
bacterial recipe:**

-chlorinated solvents;  
-nutrients;  
-redox conditions.

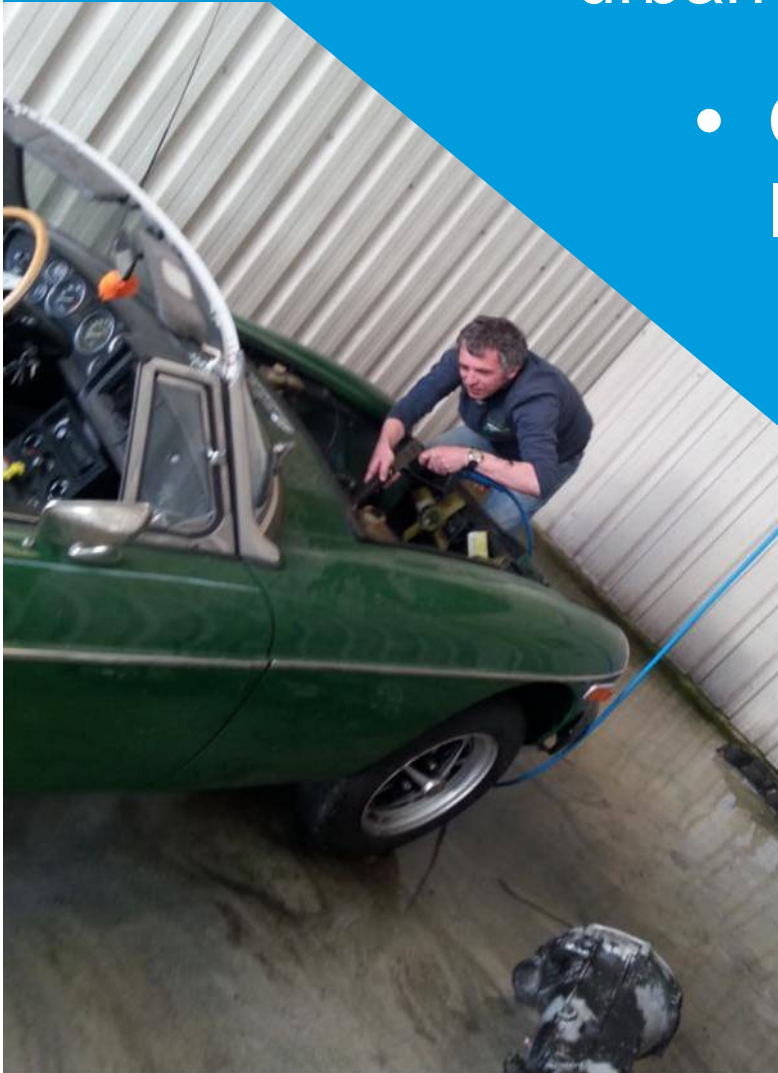
**Bon appetite !**





## Problem: Chlorinated solvents in urban areas

- Often caused by companies with little capital



**Stomerij CityCleaning**  
ook kledingreparatie



# Problem: Chlorinated solvents in urban areas

- Urban environment poses additional limiting conditions for research and remediation.







# Problem: Chlorinated solvents in urban areas



- City developments are delayed
- Doing nothing is not an option!
- CITYCHLOR

# Netherlands: from single case to area oriented approach

- Lekkerkerk 1979



- Polluted residential area
- 1<sup>st</sup> Public performance of Queen Beatrix
- Costs M€ 80 (M€ 144)
- Estimated cases 350
- Soil protection act
- 30 years!



# Netherlands: from single case to area oriented approach



- Soil covenant 2009
- est. 2500 Urgent cases
  - 2000 spreading plumes
  - Mainly in cities
  - State stimulate for area oriented approach
- Soil protection act changed in 2012 towards AOA



# Spatial development is the driving force..







**....pollution is part of the solution !**