Case Study
(Hoechst Industrial Park Frankfurt, Germany)

Catalytic Oxidation of Soil Vapors

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in cooperation with
Hoechst Site until 1997
Hoechst Industrial Park (2001)

Property owner and operation of site services
Hoechst Industrial Park (2004)
Hoechst Industrial Park (2001)

Property owner and operation of site services
**Hoechst Site (before 1950)**

- **Site Situation**
- **Legal Situation**
- **Strategy**
  - Precautionary measures
  - Construction work
  - Local remediation
- **Catalytic Oxidation**
- **Results**

![Hoechst Site Image]
Hoechst Site (early 1960s)

Site Situation

Legal Situation

Strategy
- Precautionary measures
- Construction work
- Local remediation

Catalytic Oxidation

Results
Aerial Photograph Hoechst Site (1962)

Disposal areas

- Precautionary measures
- Construction work
- Local remediation
Legal Situation in Germany

- **Federal Soil Protection Act** (BBodSchG, 17.03.1998)
  - definitions, principles, methods for examination and planning of remediation
  - remediation: decontamination or long term precautionary measures

- **Federal Soil Protection Ordinance** (BBodSchV, 12.07.1999)
  - specific methodical regulations for examination and evaluation
  - important principle: utilization based concentration values for soil pollutants

- **State Regulations** (e.g. Bavaria, Hessen)
  - assignment of supervising and licensing authorities
  - register of contaminated sites

- **Local authority permits**
  - permits e.g. for observation and extraction wells, general remediation permits
Legal Situation in Germany

- Soil regulations are supplementary to special regulations (e.g. water)
  - for already contaminated (ground) water the water legislation has to be applied

- The Federal Soil Protection Ordinance (BBodSchV)
  - covers investigation and evaluation of suspect sites and defines requirements for remediation plans
  - lays down requirements for hazard prevention (e.g. decontamination, alternatively containment or longterm precautionary measures)
  - specifies utilization based trigger-, action- and precautionary-values for several soil pollutants
  - based on BBodSchV fixed methods and standards are defined for deriving additional trigger and action values

- Experience of 5 year application period of Soil Protection Act
  - The equivalence of decontamination and longterm precautionary measures and the concept of utilization based remediation activity has proved as very helpful
  - The authority competence and actions - esp. supervising authorities for water and soil - should be further harmonized / standardized
  - Work has to be done to harmonize the - actually still different - concentration limits of special federal and country regulations for soil, waste, drinking water etc.
General Strategy

- The contaminations result from activities more than 40 years ago and are wide spread nearly over the whole site.
- The site is fully operating under actual state of the art protecting the ground from new contaminations.
- The surface is mainly sealed or planted, therefore the only relevant contamination path is via groundwater flow.
- The key measure to protect the environment is to stop the outflow of pollutants via groundwater.
  - this is done hydraulically by operation of an abstraction well gallery and subsequent cleaning of groundwater.
- Additional measures to reduce the contamination are e.g.
  - local excavation of sources (tanks, pipes, hot spots) or
  - local remediation via soil vapor abstraction
Dr. Michael Schneider
Corporate ESHA

Site Situation
Legal Situation
Strategy
- Precautionary measures
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Catalytic Oxidation
Results

Hydraulic Gallery (Key measure)

Influence sphere of well

Groundwater isohypses

source:

Stand Mai 2002
Pile foundation for new buildings
(minimization of excavated soil in contaminated areas)
Local decontamination
(Soil excavation or removal of contaminants)

Removal of contaminants
(e.g. by extraction and cleaning of soil air via activated carbon filter)
Soil vapor extraction
Drilling profile and design of wells

4°-Pegel

- Precautionary measures
- Construction work
- Local remediation

source: infraserv höchst
„Katox 2000“ at Hoechst Industrial Park

Site Situation

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Catalytic Oxidation

Results

power supply: 400 V AC; 55 kW, 80 A
flow rate: max. 2000 m³/h
pressure: - 350 mbar
size: 12 x 2,45 x 2,6 m (l x b x h) * 2
weight: ca. 11 t * 2
heating system: liquid gas burner
catalyst: EF 257 HD
water consumption: ca. 2 m³/d
max. organic concentrations: ca. 5 g/m³ CHC; ca. 4 g/m³ BTEX
Catalytic oxidation of soil air

Flow diagramm „Katox 2000“

- Crude gas mixing unit
- Catalytic unit
- Gas scrubber unit
Efficiency monitoring

- Conversion
- Crude gas
- Cleaned gas

Source:

Dr. Michael Schneider
Corporate ESHA

Site Situation
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Catalytic Oxidation
Results
Soil vapor concentrations

- BTEX
- Aliphatic CHC
- Aromatic CHC

Source:
- Infraserv hochst
VOC’s removed 2001 - 2003

Soil gas extraction Industrial site Höchst

VOC’s [t]

<table>
<thead>
<tr>
<th>Year</th>
<th>Katox 1000</th>
<th>Katox 2000</th>
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<td>14.2</td>
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<tr>
<td>2002</td>
<td>6.7</td>
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<tr>
<td>2003</td>
<td>5.1</td>
<td>12.2</td>
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</tbody>
</table>

source: infraserv höchst
Operating costs VOC removal 2003

Operating costs* 700 T€ / a
= 40 € / kg VOC
= 30 € / m² x a

source: infraserv hochst

* incl. maintenance, analytics, energy, reporting, administr.
Summary

- Chemical production sites actually are operating under actual state of the art e.g. for ground protection
- The most relevant contamination path is via groundwater
- The key measure to protect the environment is to stop the outflow of pollutants e.g. hydraulically by operation of an abstraction well gallery
- Additional measures to reduce the contamination are e.g.
  - local excavation of sources (tanks, pipes, hot spots) or
  - local remediation via soil vapor abstraction
- Many techniques are technically feasible and may be applied, but ...

➤ The main issue always is to find an appropriate cost benefit ratio under evaluation of the specific situation!