Feasibility Study of the Salt Mines Storage Route

Step 1 report

Appraisal of the salt mines storage route for residues from incineration
<table>
<thead>
<tr>
<th>Indice</th>
<th>Date</th>
<th>MODIFICATIONS</th>
<th>Authors / Checking</th>
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</thead>
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<tr>
<td>A</td>
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<td>C. KIRRMANN</td>
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<td>B</td>
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<td>C</td>
<td>7/2/00</td>
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<td>C. KIRRMANN</td>
</tr>
</tbody>
</table>

**Information on document**
- Main text + annex in Word form (.doc)
- Annex 4: see Eurosaltmembers2.doc
- Annex 5 (Additional data): files sdsalzwerke.doc + kalisalz.doc + spain1.xls
- Data included in main text but available on separate files:
  - EC99L0031.doc (April 1999 European Directive on wastes)
  - Hintergrunddossierbergversatz.doc
  - Kurzfassung Bergversatz.doc
- Complementary data on paper (on request):
  - Stocamine information (advertisement notice)
  - arrêté N° 970157 du 03.02.1997 (Stocamine local authorisation)
  - Other French Laws on Wastes
  - Retsof collapse article (from newspapers web data)
  - Norwegian laws (ask Mrs Musdalslien)
- Diffusion requested by Mrs. Unni Musdalslien (10 copies to ECVM)
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1. CONTEXT AND OBJECTIVES

1.1 CONTEXT

According to the OECD statistics [B1], 150 Millions tons of Municipal Solid Waste (MSW) have been produced in 1995 and 21% of them were addressed to incineration.

The incineration of MSW provides a solution in terms of reduction of the solid quantity and volume as well as an inertization of the waste which will minimize the content in organic matter.

The basic residues from incineration are as follows:
- Bottom Ash (or Slag) from the primary combustion chamber
- Boiler Ash (if considered separately from Fly Ash)
- Fly Ash from the filtration step
- Salts from the neutralisation step

According to the gas treatment employed to meet the gas effluent specifications, the residues from MSW incineration may have different nature and composition:

<table>
<thead>
<tr>
<th>Gas treatment process</th>
<th>Reactant</th>
<th>Nature of residues</th>
<th>Types of residues</th>
</tr>
</thead>
<tbody>
<tr>
<td>Dry</td>
<td>Lime, Bicarbonate</td>
<td>Solid</td>
<td>Bottom Ash/Fly Ash + salts or Bottom Ash/Fly Ash/Salts</td>
</tr>
<tr>
<td>Semi-Dry</td>
<td>Lime</td>
<td>Solid</td>
<td>Bottom Ash/Fly Ash/Liquid effluent/Filter cake</td>
</tr>
<tr>
<td>Semi-wet</td>
<td>Lime, NaOH</td>
<td>Solid + liquid</td>
<td>Bottom Ash/Fly Ash/Salts</td>
</tr>
<tr>
<td>Wet</td>
<td>Lime</td>
<td>Solid</td>
<td>Bottom Ash/Fly Ash/Salts</td>
</tr>
<tr>
<td>Semi-wet</td>
<td>Lime, NaOH</td>
<td>Solid</td>
<td>Bottom Ash/Fly Ash/Salts</td>
</tr>
<tr>
<td>Wet</td>
<td></td>
<td></td>
<td>Bottom Ash/Fly Ash/Salts</td>
</tr>
</tbody>
</table>

The management of the residues depends on the practices, regulation and site availability as a function of the country considered. Solid residues are possibly addressed either to landfills to be stored with possible stabilisation treatment, road construction applications or salt mines storage.

Liquid residues are released in the environment after being treated for pollutants removal (HM, acids, solids, pH control to 7).

In any case the residue has to fulfil with the regulation in force prior to be stored in its final destination.

The possibility to release liquid effluents in the environment becomes more and more limited. Most of the wet gas treatment previously exploited in Belgium and Germany have been replaced by dry, semi-dry, semi-wet or mostly semi-wet/wet systems.

1.2 OBJECTIVES OF THE STUDY

It is aimed at evaluating the present situation of MSW incineration in terms of management of the residues as well as corresponding quantities involved. A special attention will be paid to the route for storage in salt mines.

This first part of the study is devoted to this salt mines storage route, in order to evaluate the current situation, its interest and possible future (sustainability of this route)

The largest salt mines facilities are located in Germany, but most of the authorisations for storing MSW residues will end up in 2001. The uncertainty of the possible exploitation follow up caused a price drop.
The second part will consist in the collection of the required data for the evaluation of the technico-economic interest of this way to manage the residues from MSW incineration.

This will be aimed at evaluating the capacities involved as well as the location of the mines and therefore the price for transportation. This will enable to estimate the competitiveness area for each salt mine in comparison with alternative surface landfilling possibilities.

Work programme is divided into two successive steps:

**STEP 1 : APPRAISAL OF THE SALT MINES STORAGE ROUTE FOR RESIDUES FROM INCINERATION**

1.1. **Salts mines location in Europe and corresponding capacities**

1.2. **Current practices for the storage of MSWI residues in salt mines**:
   - Identification of the salts mines which accept MSWI residues, corresponding technical specifications, capacities

1.3. **Regulations associated to MSWI residues storage in salt mines.**
   - This will include legislation when existing as well as possible specifications from local or regional authorities.
   - As an example, in France a single salt mine is used for MSWI residue storage and it is likely to have been given a "prefectoral" authorization thus at the department level. The regional or local authorities for each salt mines will be therefore contacted for this task.
   - It has been reported than Dutch incinerators used to address their residues to Norwegian mines for final storage. The corresponding specification and regulation will be identified.
   - The possible evolution of the regulation will be searched in order to appraise the sustainability of this route (refer to chapter 2)

**STEP 2 : COMPARISION OF THE SALT MINES STORAGE WITH COMPETING ROUTES FOR MSWI RESIDUES MANAGEMENT**:

This step of the study is aimed at evaluating the different competing routes already exploited:

- landfill storage (type of class to be identified) after stabilisation as in France, Belgium and Italy
- landfill storage without stabilisation (Great Britain, Belgium (Flandres), Denmark (temporary storage...)
- Salt mines storage (Germany)
- Equivalent storage (Austria ?, Norway where a part of the residues from Denmark are sent)
- Building and road construction.

For this purpose, an average composition of MSW and its PVC content will be identified to determine the nature, composition and quantity of residues. The impact of PVC content in the MSW will then be evaluated in terms of quantity, quality and corresponding cost of the residues in given scenarios for their final destination.

Then the different routes for MSW residues management will be compared in terms of specification requirements and cost (apart from transportation). Transportation costs will be further considered and the maximum distance from the incinerator to the mines determined for keeping the competitiveness of salt mines storage. This will also enable the evaluation of the corresponding capacities of residues production to be possibly addressed to the different salt
mines.
2. **Appraisal of the salt mines storage route for residues from incineration**

2.1 **Salt mines location in Europe and corresponding capacities**

2.1.1 **Statistics on salt production**

Salt exploitation in Europe and around is given by the following illustration:

<table>
<thead>
<tr>
<th>Country</th>
<th>Mt/year</th>
</tr>
</thead>
<tbody>
<tr>
<td>Germany</td>
<td>12936</td>
</tr>
<tr>
<td>Netherlands</td>
<td>5300</td>
</tr>
<tr>
<td>UK</td>
<td>4990</td>
</tr>
<tr>
<td>France</td>
<td>4932</td>
</tr>
<tr>
<td>Italy</td>
<td>4370</td>
</tr>
<tr>
<td>Romania</td>
<td>4100</td>
</tr>
<tr>
<td>Spain</td>
<td>2925</td>
</tr>
<tr>
<td>Turkey</td>
<td>1845</td>
</tr>
<tr>
<td>Portugal</td>
<td>935</td>
</tr>
<tr>
<td>Belgium</td>
<td>600</td>
</tr>
<tr>
<td>Denmark</td>
<td>600</td>
</tr>
<tr>
<td>Austria</td>
<td>500</td>
</tr>
<tr>
<td>Switzerland</td>
<td>600</td>
</tr>
<tr>
<td>Greece</td>
<td>200</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>44833</strong></td>
</tr>
</tbody>
</table>

Only part of the salt production comes from mines. Salt can be produced by mainly 3 types of production:
- rock mining → rock salt
- solution mining (brine pumping) → vacuum salt (salines)
- solar sea salt → sea salt

2.1.2 **Main producers**

Main salt producers are given on the following table, given by ESPA (European Salt Producers' Association). For each producers, it gives the country and the type(s) of production (vacuum salt, sea salt, or rock salt).

The last column gives whether they practise residue disposals, when this information is known, for Companies owning Rock Salt facilities only (Salines are out of the present focus, but could also be considered, see comments below on this question).

Usually, this activity is done by a subsidiary or an associated company, but not directly by the salt producers.
<table>
<thead>
<tr>
<th>Company Name</th>
<th>Country</th>
<th>Vacuum</th>
<th>Sea</th>
<th>Rock</th>
<th>Residue Storage</th>
</tr>
</thead>
<tbody>
<tr>
<td>Akzo Nobel International B.V. (The Netherlands)</td>
<td>NL</td>
<td>VS</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Akzo Nobel Salz GmbH (Germany)</td>
<td>DE</td>
<td>VS</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Amministrazione Autonoma dei Monopoli di Stato (Italy)</td>
<td>IT</td>
<td>VS</td>
<td>SS</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Aragonesas Industrias y Energia S.A. (Spain)</td>
<td>SP</td>
<td>VS</td>
<td>SS</td>
<td></td>
<td></td>
</tr>
<tr>
<td>British Salt Ltd. (United Kingdom)</td>
<td>UK</td>
<td>VS</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Cleveland Potash Ltd. (United Kingdom)</td>
<td>UK</td>
<td>VS</td>
<td></td>
<td>RS</td>
<td>No</td>
</tr>
<tr>
<td>Compagnie des Salins du Midi et des Salines de l'Est (France)</td>
<td>F</td>
<td>VS</td>
<td>SS</td>
<td>RS</td>
<td>?</td>
</tr>
<tr>
<td>Dansk Salt A/S (Denmark)</td>
<td>DK</td>
<td>VS</td>
<td></td>
<td>RS</td>
<td>No</td>
</tr>
<tr>
<td>General Directorate of Tobacco, Salt and Alcohol Enterprises (Turkiye)</td>
<td>TK</td>
<td>VS</td>
<td>SS</td>
<td>RS</td>
<td>?</td>
</tr>
<tr>
<td>Hellenic Saltworks SA (Greece)</td>
<td>GR</td>
<td>VS</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Irish Salt Mining Ltd. (United Kingdom)</td>
<td>UK</td>
<td>VS</td>
<td></td>
<td>RS</td>
<td>No</td>
</tr>
<tr>
<td>Italkali Società Italiana Sali Alcalini S.p.A. (Italy)</td>
<td>IT</td>
<td>VS</td>
<td></td>
<td>RS</td>
<td>?</td>
</tr>
<tr>
<td>Kali und Salz GmbH (Germany)</td>
<td>DE</td>
<td>VS</td>
<td></td>
<td>RS</td>
<td>Yes</td>
</tr>
<tr>
<td>Mines de Potasse d’Alsace (France)</td>
<td>F</td>
<td>VS</td>
<td></td>
<td>RS</td>
<td>Yes</td>
</tr>
<tr>
<td>New Cheshire Salt Works Ltd. (United Kingdom)</td>
<td>UK</td>
<td>VS</td>
<td></td>
<td>RS</td>
<td>No</td>
</tr>
<tr>
<td>Österreichische Salinen GmbH (Austria)</td>
<td>O</td>
<td>VS</td>
<td></td>
<td>RS</td>
<td>No</td>
</tr>
<tr>
<td>Saline d’Einville</td>
<td>F</td>
<td>VS</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Salinera Española S.A. (Spain)</td>
<td>SP</td>
<td>VS</td>
<td>SS</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Salrom (Romania)</td>
<td>RO</td>
<td>VS</td>
<td></td>
<td>RS</td>
<td>?</td>
</tr>
<tr>
<td>Salt Union Ltd. (United Kingdom)</td>
<td>UK</td>
<td>VS</td>
<td></td>
<td>RS</td>
<td>No</td>
</tr>
<tr>
<td>Société Vaudoise des Mines et Salines de Bex (Switzerland)</td>
<td>CH</td>
<td>VS</td>
<td></td>
<td>RS</td>
<td>No</td>
</tr>
<tr>
<td>Solvay S.A. (Belgium)</td>
<td>B</td>
<td>VS</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Solvay S.A. (France)</td>
<td>F</td>
<td>VS</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Solvay S.A. (Spain)</td>
<td>SP</td>
<td>VS</td>
<td></td>
<td>RS</td>
<td>No</td>
</tr>
<tr>
<td>Solvay Salz GmbH (Germany)</td>
<td>DE</td>
<td>VS</td>
<td></td>
<td>RS</td>
<td>Yes</td>
</tr>
<tr>
<td>S.p.A. Ing. Luigi Conti-Vecchi (Italy)</td>
<td>IT</td>
<td>VS</td>
<td>SS</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Südsalz GmbH (Germany)</td>
<td>DE</td>
<td>VS</td>
<td></td>
<td>RS</td>
<td>Yes</td>
</tr>
<tr>
<td>Südwestdeutsche Salzwerke AG (Germany)</td>
<td>DE</td>
<td>VS</td>
<td></td>
<td>RS</td>
<td>Yes</td>
</tr>
<tr>
<td>Union Salinera de España S.A. (Spain)</td>
<td>SP</td>
<td>VS</td>
<td>SS</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Vereinigte Schweizerische Rheinsalinen (Switzerland)</td>
<td>CH</td>
<td>VS</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Wacker-Chemie GmbH (Germany)</td>
<td>DE</td>
<td>VS</td>
<td></td>
<td>RS</td>
<td>Yes</td>
</tr>
</tbody>
</table>
2.1.3 Location of production sites in Europe

Location of main sites are shown on the following map. It corresponds to Western Europe situation in 1980, for units having big capacity (> 200 000 tons/year).

It shows that Main rock salt mines are located in Germany. Other rock salt mines are located in Northern Ireland (Killroot), England (Winsford), Italy (Sicilia), Spain (South of Pyrénées Mountains), France (Alsace). This map is not complete: only big facilities are indicated, and mines located in Eastern part of Europe are not mentioned (see Map of Germany further on which gives more complete information for Germany).

Sites de production de sel en Europe occidentale (situation 1980, capacités > 200 000 t/an)

Figure 1. Location of production sites in Europe
2.2 Current practices for the storage of MSWI residues in salt mines

2.2.1 Why using salt mines for residue storage or disposal

Salt mines are well suited for long-term or "perpetual" disposal of wastes, and especially for residues which have high leachability.

It offers a unique closed environment for storage: natural gas-impermeable salt layers, well isolated (depth from 150 to 1000 m), very dry, with stable atmosphere, allowing very long term conservation.

Natural water barriers (impermeable layers such as clay layers) protect the salt layers against water risk (infiltration or flooding).

In addition, artificial barriers can be added to natural ones, if necessary, creating further reliable sealing measures (packing, brick walls, massive damming walls) against any outside communications.

This combination ensures secure isolation of wastes which represent a hazard to human beings and the environment in above-ground landfills because of their water-solubility and concentration of toxic substances (e.g. dioxins and furans, and also APC residues).

Such underground storage has been practised for over 25 years in Germany, especially in the German Herfa-Neurode mine ([F3] & kalisalz.doc).

Other items such as valuables (art works, pictures, books, pieces of furniture, archives, licences,...) can be kept safe in mines ([F8]).

It could be considered as the better type of landfill sites, for it assures both security and no ground occupation (except already existing wells used for former or current salt production).

2.2.2 Why not salines?

Within the scope of the present study, we only consider storage of residues in rock mining facilities, but of Saline facilities (or equivalent cavern sites) could also be concerned by this question.

Disposal of liquid residues, or sludge by injection is practised in some countries, as suggested in [B2] (Canada) as follows: "Placement of solid wastes in dissolved cavern in salt is increasingly being view as an environmentally secure technology for low-toxicity wastes". Powdered residues such as APC residues could be involved in sludges and injected in salt caverns. Such practice seems not to be current in Europe, although [A29] gives an example in UK ("ICI has for many years disposed of wastes, including chlorinated organics, in brine cavities near..."
Northwich") and [F20] gives saline caverns as "type 2" sites for residue storage (see figure 2).

![Figure 2. Underground Storage in a salt layer](image)

"Prinzipskizze einer Untertagedeponie im Salzgestein" [F20]

The main problem with salines is that pure "storage" is not possible: there is usually no well to access to cavities, in order to check the environment, or to assure possible reversibility. But from that last point of view (no reversibility), salines are not fundamentally different as the "mine-valorisation" sites in Germany.

NB. There also exist equivalent sites where underground elimination of industrial wastes is practised by injecting them into deep cavities formed by gas exploitation, as the one operated near Lacq in France (SOBEGI, Mourenx, injection at a depth of 4000 m in a cretaceous layer, 100 000 m³/year waste water). This site has a restricted authorization for salt effluents produced by local chemical activities and is not allowed to treat external wastes [A32].

An attempt of underground elimination was done by 1990 by GEOFIX (subsidiary of ELF) in the South-East of France (Passaire, near Manosque), where it was intended to inject around 60 kt/year of wastes composed of 45% fly ash [M.Maes, A31].

2.2.3 Particular German situation

Storage of residues in salt mines is mainly practised in Germany, where there are currently two types of waste elimination sites:

- **underground landfills ("Untertagedeponien"),**
  where ultimate residues are stored
  These sites are classified as ultimate waste landfills (as "Class I" French disposal treatment centers, see Annex 2)

- **mine-valorisation sites ("Bergversatz"),**
  where residues are used as part of mine materials for filling or building and assuring security in the mines. This is considered as a recovery or recycling practise according the German law, and not as a landfill practise.

There are only 3 underground landfills and several mine-filling sites ("Versatzbergwerke"), as shown on the following tables, which refers to the German map below. Around 24 mine-filling sites are given on the list, but some are not in activity.
1) Underground landfills (Untertagedeponien)

<table>
<thead>
<tr>
<th>Location on map</th>
<th>Region Bundesland</th>
<th>Location Ort</th>
<th>Location Ort</th>
<th>Company</th>
<th>Comments</th>
</tr>
</thead>
<tbody>
<tr>
<td>A</td>
<td>Hessen</td>
<td>Herfa-Neurode</td>
<td>Heringen</td>
<td>Kali und Salz Entsorgung GmbH K+S [F3]</td>
<td>since 1972</td>
</tr>
<tr>
<td>C</td>
<td>Baden-Württemberg</td>
<td>Heilbronn</td>
<td>Heilbronn</td>
<td>Süddeutsche Salzwerke AG + UEV Umwelt GmbH</td>
<td>200 000 t/year (planned)</td>
</tr>
<tr>
<td>D</td>
<td>Nordrhein-Westfalen</td>
<td>Niederrhein</td>
<td>Borth</td>
<td>Solvay Salz Project 2000</td>
<td></td>
</tr>
</tbody>
</table>

More detail, and equivalent characteristics for SWS AG and StocaMine are given in annexes.

2) Mine-valorisation sites ("Bergversatz")

These sites don't practise "residue storage" but "residue valorisation" : residues are used as filling or building materials in mines.

Residues partly replaces other mineral materials which are strongly needed to strengthen mines and avoid collapsing, according to mine operators.

Some details on "Bergversatz" (text from Joachim Mügge):

"The so-called "Bergversatz" is in practice for many years, because it is necessary to stabilize mines and to avoid collapsing in order to reduce economical and environmental impacts. Collapsing mines lead to a sinking down of the ground surface thus damaging buildings like bridges, houses, water or gas pipes or sewage water pipes. Together with heavily influenced water flows this causes environmental burdens which should be avoided as far as possible. A material for the "Bergversatz" must contain a binder and a filler like cement and sand or well defined stones in concrete. The binder has to have hydraulic properties which can be found in cement or for example also in different ashes from incineration processes. As a filler all materials can be used which do not influence or even strengthen the hydraulic properties of the binder. At the end the definition of the material suitable as a filler is dependent of the chemical nature which itself defines the chemical behaviour and which is under scrutiny of the (sometimes politically influenced) authorities."
<table>
<thead>
<tr>
<th>Location on map</th>
<th>Region Bundesland</th>
<th>Type of site</th>
<th>Mine Name</th>
<th>Location Ort</th>
<th>Comments</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Baden- Württemberg</td>
<td>Schwerspatgrube und</td>
<td>Clara</td>
<td>Oberwolfach</td>
<td></td>
</tr>
<tr>
<td>2</td>
<td>Baden- Württemberg</td>
<td>Salt Mine</td>
<td>Bad Friedrichshall</td>
<td>Hauingen</td>
<td>UVW Umwelt GmbH (SWS) [A26]</td>
</tr>
<tr>
<td>3</td>
<td>Baden- Württemberg</td>
<td>Salzbergwerk Stetten</td>
<td>Bad Friedrichshall</td>
<td>Hauingen</td>
<td>K+S [F3]</td>
</tr>
<tr>
<td>4</td>
<td>Hessen</td>
<td>Kali und Salzbergwerk</td>
<td>Hattorf</td>
<td>Phillipsthal</td>
<td>K+S [F3]</td>
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<td>5</td>
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<td>Wintershall</td>
<td>Hauingen</td>
<td>K+S [F3]</td>
</tr>
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<td>6</td>
<td>NRW</td>
<td>Schwerspatgrube Dreislar</td>
<td>Bad Friedrichshall</td>
<td>Hauingen</td>
<td>K+S [F3]</td>
</tr>
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<td>K+S</td>
<td>NBW Umwelt GmbH (SWS) [A26]</td>
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<td>Port- Westfalica</td>
<td>closed (small mine) Montaith</td>
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<td>Bergkamen</td>
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<td>Gelsenkirchen</td>
<td>(closed) Montaith</td>
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<td>Bleicherode</td>
<td>Bleicherode</td>
<td>[A11]</td>
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<td>Sondershausen</td>
<td>Sondershausen</td>
<td>[A11]</td>
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<td>&quot;</td>
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<td>Unterbreizbach</td>
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<td>&quot;</td>
<td>Solstedt</td>
<td>Solstedt</td>
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</tbody>
</table>

NRW = Nordrhein-Westfalen  
Kali = Potash (KCl, Potassium chloride)  
Kali und Salzbergwerk = KCl or NaCl mines  

**Table 2. Mine-valorisation sites in Germany (1997+recent partial updating)**

**Example of Kali und Salz GmbH**

"Kali und Salz Entsorgung GmbH" Company (subsidiary of "Kali und Salz GmbH" in charge of residue questions) owns 6 mines (2 underground storage + 4 underground reutilization sites), which can be "visited" on their web site [F3] (see also annex kalisalz.doc). It shows some characteristics of sites and different "reutilization" method, called by K+S:

- dump stowing
- consolidation of waste
- stack stowing (stacking of big bags)

Wastes are first conditioned according to various formulations permitted by mining authorities.
Figure 3. German and French salt mine storage and mine-valorisation sites

(from a map and data published in Abfallwirtschaft magazine[A27])
Legal problem for mine-filling

Mine-filling is considered as a recovery practice in Germany, but is not yet classified in European Regulation.

This question was recently debated, first within Germany, and more recently between the German State and the European Commission (according to some recent information, no legal text could be opposed to the German point of view). Details on this question are discussed below.

2.2.4 Salts mines practising residue storage in Europe

From the strict point of view of residue storage, we have to exclude German mine-valorisation sites. Thus there are only 4 salt mine residue storage sites in Europe, and 2 other ones projected:

Currently under operation (see details in table 1)

- Herfa Neurode (DE) (Hessen) (since 1972)
- Heilbronn (DE) (Baden-Württemberg) (since 1972)
- Zielitz (DE) (Sachen-Anhalt, open in 1995) [F3, F11]
- Wittelsheim (F) (Alsace) (since 1999)

Projects

- Borth (DE) (Nordrhein-Westfalen) (Solvay Salz)
- Bostock (UK) (Middlewich) (Minosus Ltd)

2.2.5 Situation in various countries and possible equivalent storage practices

- France: the only underground storage salt mine is one of the 13 ultimate waste disposal centres (see French situation in annex 2). Overall capacity is large enough for France, although each region has to open such a site according to legal dispositions (proximity principle) (that is why new sites have to open in the South of France, e.g. near Toulouse).

- Norway and Scandinavian Countries: no salt mines are available (salt is only imported). One equivalent storage site is an old quarry located on an island (Langøya, exploited by NOAH), which is also used for Danish wastes (see Norway situation and the Langøya characteristics in Annex 2).

- Austria: 4 old salt mines exist but are not used as disposal sites (see annex 1). The main reason for not using them as waste storage sites seems to be a political reason, as expressed by [E4], but tourist activity can also be a strong reason.

- Spain: some salt mines are in exploitation (3 sites, South of Pyrénées Mountains, e.g. Suria (Solvay). No waste filling or storage seem to be practised.]. Torrevieja mines have tourism activities and that could hinder their use as landfill sites. The waste question for APC residues is not yet a big problem in Spain (only 7% of waste are incinerated, and 8 MSWI are in operation) [A30] (see attached file spain1.xls giving data on Spain MSW).

- Italy: no information yet available, but some rock salt mines exist (Sicilia).
• UK: no other site as the one projected
• Belgium: no such sites. Exportation to German mines would be under discussion [E3].
• The Netherlands: no such sites
• Swiss: salt mines are available, but hazardous residue storage is not practised; residues are exported to Germany. Although [F10] (Aurec / Panagora SA) describes such a site, which could be in fact located in Germany (no clear information on the location of the mine).

2.2.6 Capacities

1) In France (Stocamine):
• 50 000 tons of waste can be stored per year
• 320 000 tons of waste are licensed (for a period of 30 years)

For comparisons,
• 803 000 tons of waste were stored in other Class I sites in year 1998.

Other key figures and characteristics of StocaMine are given in Annex 2.

2) In Germany (from [A4, A10] & other sources)
• 194 000 tons of dangerous wastes were stored in Underground facilities in 1995.
• 395 000 tons of dangerous wastes used as mine-filling materials in the same year. They represents 27% of the total amount of wastes used as mine-filling materials (1500 000 tons).
• 136 000 tons, i.e. 35% of these dangerous wastes were put in Sachen-Anhalt mines, main region where this is practised, located in Eastern Germany

Table and figure below show this evolution from 1992 to 1996. Total for 1998 is around 800 000 tons according to [A7] (Dr. B. Breuer).

Various other figures of interest:
• 200 000 ton/year = planned for Heilbronn underground deposit, permission given for 30 years [A8].
• 2 500 000 m³/year = overall mine-filling capacity in Germany [A16]
• 150 000 tons/year = capacity for Sondershausen [A23]
• 12 000 000 m³ = volume to be filled in Bad Friedrichshall-Kochendorf [A26]

NB. all units are metric: 1 ton = 1 tonne = 1000 kg.
### Table 3. Residue Recycling in Germany

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<thead>
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<td>1721150</td>
<td>348797</td>
<td>1476192</td>
<td>1703843</td>
</tr>
</tbody>
</table>

Dangerous waste = "waste which need cautious treatment" (included in other quantities)


No figures are given for region who do not practise mine-valorisation (Bayern, Berlin, Bremen, Hamburg, Mecklenburg-Vorpommern, Rheinland-Pfalz und Schleswig-Holstein). Niedersachsen figures concerns a single cavern for hazardous wastes.

### Figure 4. Residue mine-recycling in Germany

**Evolution from 1992 to 1997**

(*) "davon besonders überwachungs-bedürftige Abfälle" (hazardous wastes ?)

These figures show the importance of the question, and the recent increase trend, due partly to the fact that some authorisation will end up in 2001, added to very low prices (see below).

#### 2.2.7 Storage prices

Prices depends on quantities (price is higher for small quantities because of analysis and handling procedures).

Typical ranges:
- Ultimate Waste disposal site: 200 to 450 Euros / t (400 to 900 DM / t) [A4]
- StocaMine (France) (for APC residues): 200 Euros / t (1300 F / t) [E9]
- Bergversatz (hazardous w.) (*): 100 to 150 Euros / t (150 to 300 DM / t) [E3]
- Bergversatz (lowest price, non dangerous wastes): 15 Euros / t (30 DM / t) [A4]

"Bergversatz" prices are fairly low as compared to Class I sites in France (see annex 2). According to [E3], import from France is mainly hindered by French competitors, while import from other countries (Holland, Denmark, Belgium) is or would be possible.

(*) From Mr. J.M.: The price for the "Bergversatz" is extremely dependent on the characteristics of the material itself (chemical nature, kind of additional work which has to be used to convert it in a building material suitable for mine filling, legal classification...) Although minimum price given for some mines is 15 Euro/ton, no mine will accept APC residues at such a price. Usual price for APC residues is in the range of 100 Euro to 140 Euro.

2.3 Additional technical considerations on coal and salt mines

2.3.1 German coal mines

(according to information on Montalith [A1-A3, E3].

Coal mines are also considered as waste valorisation facilities, although geological conditions are very different from salt mines (high humidity, permeable ground).

Residues are used only in mines which are under exploitation, and for two applications:

- filling material (Versatz): material needed to fill abandoned cavities and holes
- building material (Baustoffe): material needed in underground constructions, in order to stay (strengthen) mine galleries.

In both case, the main objective is to assure the security of underground workers. They need in fact any cheap mineral material which is compatible and lead to a high enough bounding effect (≈ puzzolanic efficiency).

Legal authorisation were given in 1987 for 3 sites:

- Hugo/Consolidation, D-45897 Gelsenkirchen
- Walsum, D-47179 Duisburg
- Haus Aden/Monopol, D-59192 Bergkamen

Two of these sites are given on the German map in annex. Main site is Walsum (near Duisburg). Bergkamen mine is closed, but there is a waste treatment facility on the site. Hugo/consolidation is now closed (see information on Duisburg in [F19]).
Characteristics: Depth around 800 m or more, high humidity (acid humidity due to natural mineral content). Natural Heavy Metal content of the ground can be much higher than APC or Fly Ash content (but only for some chemical species) [E3].

Residues are never used in raw form, but are always incorporated (5 to 15%?) in other materials including binders and stabilisers. This operation can be done on the surface and produce a mortar which can be used directly in the mines. Montan-Entsorgung GmbH & Co KG (subsidiary of Ruhrkohle Montalith) is the only German company to produce such a mortar [E3].

Admission of wastes is submitted to some limitations, and laboratory verification, from points of view of usability, security and environment: nature (maximal grain size 5 mm), content analysis (organic matter < 1.5% or 2%, Heavy metals content), no toxic reaction with water.... Precise criteria are not available.

Fly ashes from Municipal Waste Incineration or Coal combustion (and some neutralization residues: De-SOx flue gas treatment residues of coal combustion) are generally accepted.

Acceptance of MSW APC residues is not clear: these residues have a high leachable content and should not be accepted in a raw form regarding the high humidity inside coal mines. Stabilisation by binders may be sufficient to reduce leachability. No precise information was found on this point.

2.3.2 Salt mines

The problem of leachability is much different in salt mines, which are very dry and should be able to store MSW APC residues safely, provided no communication with water layer is possible.

Communication with water layer is a problem for mines which are to close to the surface. Recent complete collapse of the Retsof mine in USA [B5] gives a good illustration of the question. The mine was only 300 m deep and was located under a river, under a sedimental (shale) layer. The underground flooding resulted not only in the destruction of the mine (and end of any exploitation), but in damages on the surface (collapses).

On the opposite, a site like "Stocamine" is 600 m deep, very far from the phreatic ground water layer (30 m deep). Special tunnels are dug into an NaCl layer, located under formerly exploited KCl layers. Geological studies were done previous to licensing. Ecological movement nevertheless claims that a communication with water layers is not completely excluded according to these studies (see StocaMine complete data in annex 2). According to StocaMine operators, a countervaluation done by INERIS experts confirmed there isn't any flooding risk for this well.

Note that the well casing is regularly checked; there are protection such as gates against any
possible water coming the surface. Some residual water is collected at the bottom of the mine and is pumped to the surface.

Attention should be given to this safety problems for all salt mines practising residue mine-filling of storage. Perhaps it can influence the sustainability of the mine-filling salt mine route.

A complete approach of the flooding or collapsing question has in fact to consider different aspects such as:

- exploitation risk: partial or total end of exploitation
- ground safety: damage to ground construction (collapses, earthquakes)
- environmental risk: pollution from residues by leaching after flooding or by infiltration and also from salt,...

Considering all the risks, complete mine filling can in fact be a good solution.

For the use of residues in that filling, it must at least be demonstrated that no pollution hazards will remain when the mine is filled. The use of residues can lower the price of filling thus can be encourage mine owners to do fill dangerous mines.
2.4 Regulations associated to MSWI residues storage in salt mines.

2.4.1 European regulations

A comprehensive list of current European directives concerning wastes is given in annex "Regulations". Main relevant directives are the following:

  (waste must be recycled/recovered by means that do not endanger human health and that do not employ procedures or methods that could damage the environment).


- A future Directive on Incineration of waste is being worked on (first reading 14 April 1999, Last reading 2 December 1999) [D10]

International transport of waste through Europe (import/export) is regulated through:


2.4.2 Storage current rules: regulations and status of disposal sites

1) German basic regulation [D1] gives the current basic legal principles for Germany. It refers to above European regulations (75/442/EEC and amendments, 91/689/EEC and amendment, Import/export rules). It doesn't take into account "mine recycling" sites for wastes, and it contains only a single quotation on salt caverns and mines (see comments in annex) (complete text is available in English on request, or in German on the web). It doesn't refer to the recent directive on landfill of waste.

The question of mine-filling practices is discussed below.

2) France basic principles are given in annex. The only salt mine disposal site, StocaMine has a special authorisation from regional authorities [D4], referring to French 1975 law [D5] (*), and is an official ultimate waste disposal site. The French green movements claims this disposal site may discourage recycling, but disposal price seems to be high enough to avoid "Eco-dumping", while it may not be the case for some German mines which offer very low prices [A24].
(*) and to European Directive 259/93 and French law [D7] on the transport of wastes. No references to recent 1992 and 1994 French laws [D8] and [D9] on industrial wastes was found, for these laws don't apply to underground storage.


4) Austria: Austrian current regulation on waste landfill is given in [D3]. We have not found any reference to salt mines.

Reference to salt mines in regulations?

None of these regulations refer to salt mine, except for the European regulation on landfill of wastes, in which salts mines are considered as possible "underground storage" disposal sites. This law is still to be transposed to regulations of the European states.

2.4.3 German mine-filling (Bergversatz)

Mine-filling residue valorisation sites are not considered as disposal facilities by the German law. They are considered as "recycling" or "reutilization" sites and not as "disposal" sites, as thus have not to respect the laws on disposal of wastes.

This practice currently refers to regional (Bundesland) regulation and permitting, and to general German regulations on mining exploitation rules (Bundesberggesetzes).

No special classification has been devoted to this type of activity in European waste nomenclature (by the way, it raises a problem for export/import).

This question, whether this industrial activity has be classified as "recycling" or "disposal", is currently under debate, inside Germany and recently between the European Commission and the German State. Many articles are available on this question (see [A4-A24]).

The German Green movement claims that the current practice is against both current German law [D1] and European laws (see [A4-A7]), although the current law mainly addresses "waste for disposal" and not "waste for recycling" practices (see dosberg [A4] §4. Alles ganz legal..? §5. Verstoß gegen Europarecht ?).

An infringement procedure is under way since August 1999 (Vertragsverleztungsverfahren, Commission against Bundesrepublik Deutschland) [A21]. Text [D2] given in annex explains the legal base of an infringement procedure for non-compliance with community. If this procedure continues, this can lead to a judgement of the European Court such as the one which occurred recently for the disposal of waste oil (9 September 1999).
Debate on this question is to be taken into account. A clear common regulation for mine-filling practice is required by many people and companies, and is currently under work [A22]. The problem with the Commission should speed up the writing of a German regulation.

This problem doesn't concern the 3 official ultimate waste disposal sites ("Untertagedeponien"), but only the "mine-filling" sites. The attached text by Dr Breuer ([A7], in German, see annexe 3) gives an abstract of the legal situation, by comparing the different points of view on regulations.

From this debate, it seems that this practISE could be really considered as a reutilization practise if it is proven either that :

- at least: wastes are technically needed as material for building or filling in the mines (for exploitation purpose, or for a security reason such as avoiding collapses) (*)
- at best: wastes have special physical characteristics (for ex. binding properties) which not only allow their use but justify it ("notwendige bauphysikalische Funktion"). It may be proven by the use of a significant percentage of wastes in the mixing with other materials (UTA [A17])

Filling of very deep salt mines not longer under exploitation, if no security problems can justify it arise, could only be classified as "disposal" sites (although being environmentally safer).

The question will remain to prove that there is no damage to environment (which is to defined and controlled...), and that mine reutilization will apply environmental rules equivalent to the ones imposed for underground landfills (why should the law be more strict for deep storage which could be basically safer?).

(*) In many areas within Germany heavy problems exist because the ground is sinking gradually caused by collapsed mines. For example, some areas are expected to sink down 12 m in the next 20 years which makes it necessary to build or to enlarge dikes in order to avoid flooding of larger areas. In several parts of the Ruhrgebiet only hundreds of pumps guarantee that the water is flowing towards the Rhine river.

2.4.4 Possible consequences of April 1999 European Directive

The new European Directive of April 1999 on landfilling practices is not yet taken into account by European Countries. This law has to be applied before 2001 for new sites (obligation for states to transpose the law within two years), and before 2009 for old sites (obligation to apply the state law within 7 years).

A short analysis of this law, presented in annex, concludes that, concerning the residues storages :

1) This law gives place to a special classification and regulation for salt mine underground storage sites when declared as landfill sites. They can be exempted of parts of obligations (gas
analysis, leachate analysis, water surveillance and monitoring). This exemption has to be defined by each Country.

2) Future for "Mine-filling" is neither defined nor considered.

This practice can match this law either if :

- if it is accepted as a "recovery" practice and not as landfilling : in that case the law can't be applied
- or it applies the same rule as landfilling or underground storage and is classified as such sites.
- or it can benefit of some special criteria to be defined by a technical Committee, criteria for "certain hazardous waste to be accepted in landfills for non-hazardous waste". In that case mines should be classified as landfills for non-hazardous wastes (this possibility doesn't seems to be applicable to residues such as APC residues)

Of course, possible laws about "safe recycling practices" or special laws on salt mines could be issued in the future and oblige mine-filling practice to obey somewhat equivalent constraints as the law on landfilling.

2.4.5 Storage licensing

According to M.Paar [E1], permitting/licensing is a long and weary experience with much political implications and that, on top of that, prices are under severe pressure. There is excess capacity in Germany right now and this won't change in the near future.

This point of view is a good abstract of the current situation.

Excess of capacity is also the case in France, where 13 ultimate waste disposal sites are already available (see in annex), and a 14th is projected in the South of France. The opening of the first deep underground storage (StocaMine) is said to be strongly related to political reasons rather than economical reasons (avoid complete abandon of the facilities, create new jobs in the area, acquire technical knowledge in underground storage practice, offer a unique alternative to ultimate waste disposal...).

Opening of the site was nevertheless difficult, because of ecological pressures (see ecological point of view in annex).

Minosus Ltd, (Bostock, Middlewich, UK) [E8, A29] is also trying to open a salt mine as an ultimate waste storage, may be in 2000. Their told us licensing needs a long time. Two authorisations have to be obtained :

- permission in principle from the British Council (or from the Cheshire County Council)
- licence = "detailed permission " (licence for exploitation, giving precise types of waste), from the Environmental Agency.

Current conditions for future permitting is given in the April 1999 European Directive (especially art. 7 and 8).
3. **Conclusion on the sustainability of the mine storage route**

The question of "sustainability" is : "can it continue or not in the future ?"

The answer depends mainly on the regulations, thus the question can be turned into : "can it comply with existing and future European Regulations ?"

We must consider separately the two types of residue elimination sites :

1) **Underground storage or disposal sites**

Deep underground facilities like "Untertage Deponien" in Germany and StocaMine in France should be able to continue exploitation during at least the next 30 years.

Capacity of storage is only a question of legal authorization, for these storages can be extended as needed (other galleries can be used and if necessary, new galleries can be dug in the salt layers, as it is done by StocaMine). The acceptance of the opening of the new salt mine storage in the UK (Middlewitch) [E8, A29] will be a good test whether it can be extended to all Europe (for region where it could be economically viable).

Adaptation to recent laws, and especially to April 1999 European directive on landfill practices should not raise big problems for these facilities. Firstly, main obligations are already fulfilled by operators (analyses of residues, book-keeping...). Secondly, this directive lets each country give a special status to salt mine underground storage, and exempt them from obligations which are not relevant for these sites. Future country laws (to be issued before 2001) will give precise aspects of these exemptions.

2) **Mine-valorisation**

Continuation of German "mine-valorisation" practice is less sure. It depends on the ability to prove that this practice is in agreement with principles given in the European regulation.

It must either comply with new regulation on landfills and underground storage (that will be difficult) or keep to be considered as a recovery or recycling practice in order not to be obliged to comply with these regulations.

It seems that the European acceptance as a recovery practice is under way (no legal obstacles has been found, according to recent information).

Its future will thus depends on the future German law which should be prepared for this practice, and on the agreement of the Commission on that law.
Technically, the acceptance of Fly ashes and APC residues in mine-filling should depend on the confidence in their correct stabilisation, i.e. in leaching properties and durability of the final material in which they are incorporated. And of correct checking on each sites for each types of waste.

Logically, it should be proven that this material is really needed for the mine, in order to be considered as recycling. But the question of security (fill the mine in order to avoid collapsing) can probably always be considered as such a proof.

Technically, the Norwegian Langøya centre is in a similar situation as German salt mines, for it is in fact both a landfilling and a mine-filling site. But it applies rules of ultimate disposal centres. Sustainability should not raise problems for it, provided it also adapt its regulation to the last European Directive.

**Prospective point of view**: whatever the current issue of the legal debate, it will not be accepted in the future to have less strict rules for residue recycling (in mine-filling or in any other industrial activity, to broaden the debate) than for residue disposal. Perhaps the question should be opened to a more general question on "safe recovery practices", which could be the subject of some future environmental laws, may be within the next decade.
4. References

4.1 Documents on residue storage or recycling


[A7] "Kurzfassung Bergversatz". Dr. Barbara Breuer. in German. 3 pages paper given in annex 3.


[A14] AGS für nationale Verordnung zum Bergversatz von Abfällen. Umweltwirtschaft Re Nr49 v.01.12.1998 "Im Berversatz zunehmend auch gefährliche Abfälle entsorgt".

[A15] Call for end to disposal in German mines. HAZNEWS N°133, April 1999, p.7. (see in Annex).

[A17] Sondermüll : Streit um Bergversatz. UTA 1/IX/99 Seite 4-5 (contains a criterium on the use of waste in mine-filling)


[A22] Bundesverordnung zum Bergversatz in Arbeit*. Umweltwirtschaft Re Nr40 v.05.10.1999.

[A23] GSES darf Abfall unter Tage verbringen. Umweltwirtschaft Re Nr43 v.26.10.1999. (Sondershausen can put 150 000 tons)


[A25] Acceptance of waste in landfills : Final report / Institut für Umweltschutz und Energietechnik. Köln : TÜV Rheinland Sicherheit und Umweltschutz GmbH, 1999 - 196p. (Contract DGXI B4-3040/97/000090/MAR/E3) this study gives an overview of existing waste acceptance criteria in the 15 member states. Based on particularly the German situation the study also presents the state of the art concerning waste acceptance criteria in landfills. Finally, the study evaluates the waste acceptance criteria used in the 15 member states and proposes the harmonisation of specific criteria.

(not available : requested from DGXI information Centre ; fax from Marie-Anne PAUWELS, 16 déc. 1999 : No copy available ➔ Ask the Editor for it), requested also from Mr.Paquot. Will send a copy. Suggest contact Mrs Meret Kristoffersen, Centre thématique sur les déchets de l’Agence Européenne pour l’Environnement.)

[A26] Versatzbetrieb im Bergwerk Bad Friedrichshall-Kochendorf. UEV Umwelt, Entsorgung und Verwertung GmbH Salzgrund 67 - 74076 Heilbronn (subsidiary of SWS AG). (10 km North of Heilbronn - Salt exploitation from 1899 to 1994 - Capacity : 12 Mio.m3 has to be filled in 10 year programs - Depth 180 m - Acceptance of APC residues from MSWI.

• SWS AG = Südwestdeutsche Salzwerke AG


«L’injection d’effluents pollués dans le sous-sol de Lacq, pratiquée depuis 1978, est-elle dangereuse ? Ce procédé est jugé utile pour a chimie fine autour de laquelle s’organise la reconversion du site. Dominique Voynet pourrait y mettre un terme. Inquiétude des élus et industriels.»
4.2 Other technical papers


"Placement of solid wastes in dissolved cavern in salt is increasingly being viewed as an environmentally secure technology for low-toxicity wastes"....


4.3 Regulation or projected regulation

See also annex on Regulation (list of European laws + comments)


[D5] Loi n°75.633 du 15 juillet 1975 relative à l'élimination des déchets et à la récupération des matériaux.

[D6] Loi n°76-663 du 19 juillet 1976 relative aux installations classées pour la protection de l'environnement.
Arrêté ministériel du 3 janvier 1985 relatif au contrôle des circuits d’élimination des déchets générateurs de nuisances.

Arrêtés du 18/12/92 : (Installations existantes J.O. du 16 avril 1993, installations nouvelles J.O. du 30 mars 1993) :
• Stockage de certains déchets industriels spéciaux ultimes et stabilisés pour les installations nouvelles (JO du 30 mars 1993), modifié par l’arrêté du 29 juin 1993 et celui du 18 février 1994
• Stockage de certains déchets industriels spéciaux ultimes et stabilisés pour les installations existantes (JO du 16 avril 1993), modifié par l’arrêté du 18 février 1994 (J.O. du 26 avril 1994)
  Both laws don’t apply to underground storage sites) (excluent les stockages souterrains de leur champ d’application)

Arrêté du 9 septembre 1997 relatif aux décharges existantes et aux nouvelles installations de stockage de déchets ménagers et assimilés (JO du 2 octobre 1997)
  Don’t apply to underground storage sites) (exclut les stockages souterrains).

  Only one reference to residues : “Residues resulting from the operation of the incineration or co-incineration plant shall be minimised in their amount and harmfulness. Residues shall be recycled, where appropriate, directly in the plant or outside in accordance with relevant Community legislation [and national provisions]” (amendment by Parliament)
4.4 Main E-mails and other information exchanges

[E1] Wim.Paar@Akzonobel.com (Akzo Nobel Salt)  
* P.O Box 25, 7550 GC Hengelo  * (+31) 74 2443401, - fax  (+31) 74 2443041  
Tue, 7 Dec 1999 14:57:29 +0100,

I regret to inform you that I have no special knowledge or information on the subject other than you most likely already have in your position.

I know of existing underground salt mine disposal facilities in Germany (Herfa Neurode, Bernburg, Sondershausen (potassium) and Heilbronn(?)) and such that intend to develop such a facility (Borth). It is my understanding that permitting/licensing is a long and weary experience with much political implications and that, on top of that, prices are under severe pressure. It seems to me that there is excess capacity in Germany right now and that this won't change in the near future.

[E2] Johannes.Neises@suedsalz.de  
Date: Fri, 3 Dec 1999 14:57:24 +0100

Further to your questions, I have outlined some information.  
First of all, here you can find additional information:

• www.eu-salt.com (European Salt Producers Association)-- a map will also there available  
• www.saltinstitute.org (World Salt Producers Organisation)  
• www.salzindustrie.de (German Salt Producers Organisation)

Our key figures:

• largest supplier of salt in Germany  
• rocksalt: 3.5 m tons/year (SWS AG)  
• refined salt: 0.4 m tons/year  
• Salt mine : Berchtesgaden Heilbronn (SWS AG)-residues from incineration can be landfilled (Contact the UEV - Umwelt, Entsorgung und Verwertung GmbH, a subsidiary company of Südwestdeutsche Salzwerke AG (SWS AG)-www.salzwerke.de)

[E3] Peter Schmidt, Montan-Entsorgung Succursal Karlsruhe, Bunsenstrasse 22, D-76135 Karlsruhe, tel 00 49 721 9 81 72 10, fax 49 721 9 81 72 55. Phone conversation 14th dec 1999.

[E4] albert topitz , how2surf@image.co.at - 13 dec.1999

Question on the four Austrian Salt mines (Salzburg, Hallstatt, Altaussee, Bad Ischl).

• Are they the only ones ?  
  ➢ yes, there are no others in Austria  
• Are they still exploited ?  
  ➢ 3 of them are still exploiting - just Salzburg/Hallein is for tourism purposes only (they stopped production about 5 years ago)  
• Is there any mine in Austria where residues (ultimate waste) could be stored ?  
  ➢ technically YES - but politically NO

[E5] SVP report 14 dec.1999 from Gerhard Weinziger, SVP correspondent AUSTRIA.


[E7] Mrs Unni Musdalslien, Norsk Hydro - E-mail fax 3 Nov 1999 (included in main text).

[E8] Minosus Ltd: Jack Lane, Bostock, Middlewich, Cheshire, CW10 9JQ, Tel: 01606 550044, Fax: 01606 550088 (no answer yet)


*StocaMine est le premier site de stockage souterrain en France. Ce stockage est réversible. Pour ce faire, StocaMine provisionne un montant à la tonne stockée de manière à constituer un fond permettant d'assurer le
déstockage et le retraitement éventuel des déchets. Cette somme est incluse dans les prix qui sont remis à nos clients. StocaMine devient dès lors responsable des déchets se trouvant dans ses blocs de stockage. Notre prix de stockage pour les REFIOM est de 1300 F H.T. la tonne.

Mrs Unni Musdalslien, Norsk Hydro - E-mail 20 Dec 1999 (see annex data on Langøya).

4.5 Web sites

[F1] Salt production in Europe : from www.eu.salt.com/teacher/capacities.htm (European Salt Producers Association)

[F2] Keywords : from www.eu.salt.com/manufact/stats.htm. European Salt Producers' Association, 17, rue Daru - 75008 Paris Tél: 01 47 66 52 90 - Fax: 01 47 66 5266

[F3] K+S (Kali und Salz) web site : www.kalisalz.de (include precise information on waste handling)

[F4] www.groupe-emc.com/actu9002.htm (information on StocaMine)

[F5] www.saltinstitute.org (World Salt Producers Organisation) (good general information on salt, and list of salt association)

[F6] www.salzindustrie.de (German Salt Producers Organisation)

[F7] wacker.de (German Salt Producer) (no useful information found)

[F8] www.salzwerke.de (SWS WG) ../untertagearchiv/geschichte/index.htm (history of UTA= UnterTage Archivs, subsidiary of SWS AG). ../entsorgung-Verwertung (description of a storage site, see annex)

[F9] www.grupe-teutschenthal.de/historie.htm, abfall.htm, versatz.htm, unterg.htm : history, waste characteristics, discussion on reutilization, photos,... :


[F12] www.sondershausen.de expo/firmen.htm (K-UTECE) (various information, 5 pages)

[F13] www.tu-clausthal.de/ibb/ibbcp/fachaufssetze.htm (Fachaufsätze 1998, 97,96) (4 reports indicated)


    • Unweltverträglichkeit und Sicherung des Allgemeinwohls Dieter Pflugradt.
    • Genehmigungspraxis Bergversatz im Land Sachen-Anhalt, Klaus Rheda, MRLU.


Reinhard Müller, Birgit Süß.


ANNEX 1 Complementary data on salt production
### SALT PRODUCTION STATISTICS [F2]

**Dietary salt intake in EU Member States (g/day)**

<table>
<thead>
<tr>
<th>Country</th>
<th>Intake (g/day)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Belgium</td>
<td>8.3 / 8.7</td>
</tr>
<tr>
<td>Denmark</td>
<td>8.2</td>
</tr>
<tr>
<td>France</td>
<td>7.9 / 8.4</td>
</tr>
<tr>
<td>Finland</td>
<td>9.0 / 10.0</td>
</tr>
<tr>
<td>Germany</td>
<td>7.2 / 8.9</td>
</tr>
<tr>
<td>Italy</td>
<td>9.8 / 10.9</td>
</tr>
<tr>
<td>the Netherlands</td>
<td>8.2 / 8.8</td>
</tr>
<tr>
<td>Portugal</td>
<td>10.7</td>
</tr>
<tr>
<td>Spain</td>
<td>10.2 / 10.8</td>
</tr>
<tr>
<td>United Kingdom</td>
<td>8.3 / 8.8</td>
</tr>
</tbody>
</table>

**EU as a Community of 15 countries, 1995**

<table>
<thead>
<tr>
<th></th>
<th>Chemical Industries</th>
<th>Miscel. Industries</th>
<th>Food grade salt</th>
<th>Highways</th>
<th>Total sales</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>ESPA countries</strong></td>
<td>8000</td>
<td>3200</td>
<td>2100</td>
<td>5350</td>
<td>18650</td>
</tr>
<tr>
<td><strong>Other countries</strong></td>
<td>700</td>
<td>200</td>
<td>100</td>
<td>550</td>
<td>1550</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td>8700</td>
<td>3400</td>
<td>2200</td>
<td>5900</td>
<td>20200</td>
</tr>
</tbody>
</table>

**European Union : crystallized salt sales (1 000 metric tons)**

<table>
<thead>
<tr>
<th>Year</th>
<th>Chemical Industry</th>
<th>Miscel. Industries</th>
<th>Food</th>
<th>Highways</th>
<th>Total Sales</th>
</tr>
</thead>
<tbody>
<tr>
<td>1988</td>
<td>9 769</td>
<td>3 035</td>
<td>2 185</td>
<td>2 758</td>
<td>17 747</td>
</tr>
<tr>
<td>1989</td>
<td>9 920</td>
<td>3 104</td>
<td>2 195</td>
<td>1 402</td>
<td>16 621</td>
</tr>
<tr>
<td>1990</td>
<td>9 486</td>
<td>3 198</td>
<td>2 288</td>
<td>2 155</td>
<td>17 127</td>
</tr>
<tr>
<td>1991</td>
<td>9 091</td>
<td>3 246</td>
<td>2 246</td>
<td>5 045</td>
<td>19 628</td>
</tr>
<tr>
<td>1992</td>
<td>8 693</td>
<td>3 431</td>
<td>2 196</td>
<td>2 292</td>
<td>16 612</td>
</tr>
<tr>
<td>1993</td>
<td>8 344</td>
<td>3 405</td>
<td>2 033</td>
<td>3 531</td>
<td>17 313</td>
</tr>
<tr>
<td>1994</td>
<td>8 512</td>
<td>3 366</td>
<td>1 993</td>
<td>4 081</td>
<td>17 952</td>
</tr>
<tr>
<td>1995</td>
<td>7 714</td>
<td>3 534</td>
<td>2 015</td>
<td>5 215</td>
<td>18 478</td>
</tr>
<tr>
<td>1996</td>
<td>7 643</td>
<td>3 378</td>
<td>2 044</td>
<td>7 026</td>
<td>20 091</td>
</tr>
<tr>
<td>1997</td>
<td>7 691</td>
<td>3 453</td>
<td>2 035</td>
<td>4 506</td>
<td>17 685</td>
</tr>
</tbody>
</table>

(a) from EU enlargement to 15 Member States, Austria is included

(b) as net importers, Finland, Ireland, Luxembourg, and Sweden are not included.
SOLVAY Sites (1999)

SOLVAY Salt exploitation sites are shown on the following figures

Solvay Sites in Europe

Solvay Sites in Thailand

Only two sites correspond to rock salt exploitation:
- Borth (DE) (with a future underground disposal site)
- Suria (ES)
- Bernburg (DE)?
Austrian salt mines

There is only one company in Austria, Österreichische Salinen AG, who is operating salt mines and salt saline productions facilities. This was a former state monopoly and since 1997 a private company.

Main sites are shown on the landscape figure below:
- Salzburg/Hallein
- Hallstatt
- Altaussee
- Bad Ischl

[www.salzbergwerke.com]

The 3 last facilities are still exploited for salt production, according to [E4].

**Status of Austrian salt sites in 1999 [E5]**

- **Hallstatt** Salt mine active
- **Altaussee** Salt mine active
- **Bad Aussee** Salt mine shut down tourist attraction
- **Bad Ischl** Salt mine active
- **Hall in Tirol** Salt mine shut down tourist attraction
- **Salzburg/Hallein** Salt mine shut down by 1995 [E4], (?) see [E5]
- **Ebensee** saline active

Austrian Salt production is given by the following table [E5]:

<table>
<thead>
<tr>
<th>Year</th>
<th>Brine (x 1000 m³/year)</th>
<th>Salt (kt/year)</th>
<th>Number of Mines</th>
</tr>
</thead>
<tbody>
<tr>
<td>1960</td>
<td>1038</td>
<td>132</td>
<td>11</td>
</tr>
<tr>
<td>1970</td>
<td>1747</td>
<td>265</td>
<td>7</td>
</tr>
<tr>
<td>1980</td>
<td>2294</td>
<td>420</td>
<td>7</td>
</tr>
<tr>
<td>1990</td>
<td>2246</td>
<td>389</td>
<td>4</td>
</tr>
<tr>
<td>1995</td>
<td>2621</td>
<td>523</td>
<td>4</td>
</tr>
<tr>
<td>1998</td>
<td>2447</td>
<td>492</td>
<td>4</td>
</tr>
<tr>
<td>2000 (planned)</td>
<td>2900</td>
<td>550</td>
<td>4</td>
</tr>
</tbody>
</table>

These figures are consistent with the figure given above in European statistics (500 Mt / year).

Tourism is a common practice for old salt mines. We found many other tourism sites, like Berchtesgaden in Bavaria (Germany, mine opened in 1517), Wieliczka in Poland (still in activity [www.unesco.org/whc/sites/11752.htm]), and others in the USA.
Very old mines may not really be compatible with residue storage (insufficient depth, inadequate equipment, strong tourism activity, etc.).

For Austrian sites, the main reason for not using mines for waste storage seems to be a political reason, as expressed by [E4].

Austrian current waste regulation is given in [D3].
ANNEX 2
ultimate waste disposal practices
in various countries

CSDU : Centres de Stockage de Déchets Ultimes (Ultimate Waste Disposal centre)

REFIOM : Résidus d'Epuration des Fumées de l'Incinération d'Ordures Ménagères (APC from MSWI)

<table>
<thead>
<tr>
<th>Waste</th>
<th>France</th>
<th>Imports</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>Dangerous Industrial Waste</td>
<td>802 576</td>
<td>562</td>
<td>803 138</td>
</tr>
<tr>
<td>• Stabilised part</td>
<td>432 746</td>
<td>562</td>
<td>359 301</td>
</tr>
<tr>
<td>• APC (REFIOM)</td>
<td>261 454</td>
<td></td>
<td>261 454</td>
</tr>
<tr>
<td>Sewage Sludge</td>
<td>3428</td>
<td></td>
<td>3 428</td>
</tr>
<tr>
<td>Common Industrial Waste</td>
<td>87 975</td>
<td>87 975</td>
<td></td>
</tr>
<tr>
<td>Inert Waste</td>
<td>23 734</td>
<td>23 764</td>
<td></td>
</tr>
<tr>
<td>Municipal Wastes</td>
<td>104 790</td>
<td>104 790</td>
<td></td>
</tr>
<tr>
<td><strong>TOTAL</strong></td>
<td><strong>1 022 503</strong></td>
<td><strong>562</strong></td>
<td><strong>1 023 095</strong></td>
</tr>
</tbody>
</table>

These values don't take into account additives such as binders used for stabilisation.

For dangerous Industrial Waste, binders represent 20% added mass to total waste.

For the part which is stabilised, binders represent 80% added mass. For the total of dangerous Industrial Waste, they represent 20% added mass.

Classification of CET ("Centres d'enfouissement technique")

- **CET de classe I** : destiné à recevoir les déchets industriels spéciaux ultimes, il doit être implanté sur un site imperméable (perméabilité < 10^{-9} m/s sur une épaisseur de 5 m)
- **CET de classe II** : destiné à recevoir les ordures ménagères et les déchets assimilés, il est situé sur un site semi-imperméable, (perméabilité < 10^{-9} m/s sur 3 m ou < 10^{-9} m/s sur 1 m et 10^{-6} sur 5 m)
- **CET de classe III** : destiné à recevoir les déchets inertes, il peut être implanté sur un site perméable

Some regulation aspects


According to these acts, stabilisation is compulsory for hazardous industrial wastes, Waste of category A (REFIOM/APC, powdered waste from metallurgy, mineral wastes from chemical treatment), and category B.

- Loi du 13/07/92

Each French region must have a Class I site for ultimate waste disposal before 2002.

After 2002, ultimate wastes which cannot be valorised (≈ recycled) or treated will be the only ones which can be stored.
Ultimate Waste Disposal Centres in France (1999)

CSDU : Centres de Stockage de Déchets Ultimes (Ultimate Waste Disposal center) ("Class 1" disposal site)

13 CSDU are open in France (see map).

- Argence (calvados) CGEA-ONYX
- Bellegarde (Gard) France-Déchets
- Champteusse sur Baconnne (Maine et Loire) SEDA (France-Déchets)
- Changé Laval Service
- Guitrancourt (Yvelines) EMTA
- Jeandelaincourt(54) France-Déchets
- Laimont (Meuse) DECTRA
- Pontailler sur Saône (Côte d'or) France-Déchets
- Saint-Cyr des Gâts (Vendée) TOP Ouest
- Tourville la Rivière (Seine Maritime) SERAF (France-Déchets)
- Vaivre (Doubs) ECOSPACE
- Villeparisis (Seine et Marne) France-Déchets
- Wittelsheim-Mine Joseph Else (68). StocaMine (EMC + TREDI + MDPA)

A project for a new site in region "Rhône-Alpes" (Marboz(01) or Sury Le Comtal(42)) was presented in October 1998.

Sources :
- Data from ADEME Angers, fax from Katia Becaud, Département Industrie, Milieux et Technologies, 02 41 91 40 58 Fax 02 41 91 40 02, Stockage de classe I, 8 dec.1999.
- Map given by ADEME Angers, fax from Christian Militon, tel 02 41 20 41 22.
- List given by Bertin documentation department, and updated according to data from France Déchets and ADEME.
Démarrage de l’activité de StocaMine

La société StocaMine a reçu le 10 février 1999 sa première livraison de déchets ultimes destinés à être stockés en mine de sel : 20,7 tonnes de déchets ultimes (sels de trempe cyanurés provenant d’industries métallurgiques), conditionnés par le centre TREDI de Hombourg, ont été réceptionnés.

Rappelons que le préfet du Haut-Rhin avait délivré, par arrêté préfectoral du 3 février 1997 [D4], à la société StocaMine, filiale de l’EMC, de TREDI et des MDPA, l’autorisation d’exploiter un centre de stockage réversible de déchets ultimes à Wittelsheim-Mine Joseph Else (68).

StocaMine est le premier centre français d’enfouissement souterrain de déchets ultimes.
Une part importante des déchets que recevra ce centre, basé en Alsace, sera d’origine régionale.

Le centre est autorisé à recevoir des déchets, préalablement reconditionnés, contenant des résidus comme le mercure, le cyanure ou encore l’arsenic. Il peut également admettre des terres et résidus pollués par des métaux lourds, tels que le plomb ou le cadmium. À cela s’ajoutent les résidus de l’industrie électronique, les produits phytosanitaires non organiques, les catalyseurs usés, les déchets de laboratoire, les résidus provenant du traitement des fumées d’incinération de déchets ou encore l’amiante.

Sont exclus du centre les déchets radioactifs, les déchets toxiques biologiques, les produits volatils, inflammables, liquides, les déchets présentant des variations de température ou de volume, réagissant avec l’eau ou avec le sel.

L’arrêté préfectoral d’autorisation d’exploitation prévoit que la société pourra stocker une quantité maximale de déchets de 320 000 tonnes, avec une limite annuelle de 50 000 tonnes.

StocaMine table sur un rythme de 40 000 tonnes de déchets reçus chaque année, ce qui nécessitera le creusement de cinq à six blocs par an. La société a en effet adopté la technique minière des chambres et piliers. Des galeries perpendiculaires entre elles, d’une hauteur de 2,8 mètres, sont creusées à une profondeur de 600 mètres, en laissant subsister des piliers de 20 mètres sur 20. Les chambres de stockage se trouvent entre les piliers. Un bloc est constitué de trois allées parallèles de 225 mètres de long, traversées perpendiculairement par neuf recoupes de 72,5 mètres. Les dimensions des galeries ont été calculées par l’Ecole des mines de Paris afin de maintenir la stabilité du terrain. La couche de sel gemme dans laquelle sont creusées les cavités de stockage forme une enveloppe homogène, très résistante et parfaitement étanche.

Une part importante des déchets reçus par Stocamine sera d’origine régionale. L’Alsace a d’ailleurs inclus Stocamine dans son plan régional d’élimination des déchets industriels.

Par ailleurs, Stocamine est à l’heure actuelle la seule solution en France pour prendre en charge les déchets dits de "classe O", qui ne peuvent être stockés qu’en souterrain.

(from http://www.groupe-emc.com/actu9902.htm)
Characteristic figures on StocaMine
(according to Usine Nouvelle N°2675, 18 février 1999):

- Depth: 600 m
- Basic Investment: ≈ 100 MF (15 MEuro)
- Storage annual capacity: 50 000 t/year (maximum licensed)
- Storage overall capacity: 320 000 t (maximum licensed)
- Storage duration: 100 to 150 years.

Current Licence has been given for 30 years.
- Nature of wastes: 40% APC, 40% local Industrial Wastes, 20% others.

Stocamine exploits an old well which was active 30 years ago. It has been completely refitted for its new usage.

Stability is assured by pillars 20 m x 20 m, 4 times more large than storage galleries. Each pillar can stand 5 times its current stress.

Environmental debate on StocaMine
(according to Décision Environnement 54, Mars1997):

An environment defence association, "Alsace Nature" was opposed to the project, owing to some preoccupation:

- possible communication with water layers (there is a superficial water layer 600 m up, and another much deeper water layer). Studies done by L'Ecole des Mines de Paris" admit that a communication could be possible through plugged wells and permeable ground.
- This possibility of storage may discourage attempts to recycle or minimize wastes
- Reversibility of storage may not be really assured.

Sources: Direct mail [E9], www.groupe-emc.com/actu9002.htm.
Current practices in Scandinavian countries
(according to E mail from Unni Musdalslien, 3 nov 1999 [E7]:)

1. Denmark
Landfill disposal is limited to treated waste. Therefore from 1997 untreated MSW may not be landfilled.

Bottom ash is permitted to be recycled as construction materials, dependent of concentration of heavy metals.

Fly ash must be disposed off to a monocell within a hazardous waste landfill. This is officially regarded as temporary storage until an effective long-term solution is found.

Fly ash from Denmark, approximately 10 ktons (metric tonnes) in the first half of 1998, have been disposed off at Langøya in Norway.

APC residues are presently being collected, and will be treated when an appropriate treatment process is available.

2. Sweden
There is no consensus yet over whether the recycling of bottom ash is appropriate or not and what applications, apart from daily cover at landfill, are acceptable. Fly ash and scrubber residue are regarded as hazardous and landfilled.

Due to easily leachable contaminants in fly ash and APC residues (heavy metals and chlorides), Statens Naturvårdsverk recommends that these wastes should be stabilized with cement or other methods prior to landfilling.

3. Norway
Fly ash and scrubber residue are disposed off at Langøya (information from NOAH, Norwegian Company for waste treatment, 1999-02-05).

Regulations and laws

However, fly ash and APC residue are used to neutralise waste acids at Langøya in Norway, and in this way replace limestone. According to NOAH Norwegian Company for waste treatment, 1999-02-05) this reduces the emissions of CO2.

Norway disposal site in Langøya
Langøya (Long Island) is a hollow island in the Oslofjord. Nearly 50 Million ton of limestone was excavated in the years 1899 - 1985 as raw material to a cement factory. The cement factory was closed down in 1985, and the island at that time had two open craters going down to 50 meters below sea level. The island is water tight. NOAH now owns and operates a chemical factory which receives nearly all types of inorganic hazardous waste which is neutralized and chemically stabilized. The end products are stored in the interior of the island, and excess process water and rain water is pumped to the fjord under full control. The total annual quantifies received are now around 300,000 tons and increasing.

Fly ash from incineration of municipal waste have been treated since 1996, and we are now receiving nearly 40,000 tons per year, mainly from Norway and Denmark, but other countries have shown considerable interest. NOAH present treating capacity for this material is 100,000 tons per year. The fly ash is received either moist in bulk or dry in big bags. Ships with capacity up to 2000 tons can be received.

The fly ash is chemically treated, and not only stored. NOAH takes the full responsibility for the material when received. There is therefore no future liability to the original producer of the fly ash.

The Norwegian authorities have put strict regulations on the activities at Langøya. The fly ash is analyzed before any contract is signed. The fly ash must contain maximum 8 ppm EOCI and maximum 20 ppm PAH. Remains of other chemicals are normally easy to take care of.

All fly ash contents alcalies, and this is of value to NOAH because most of the wastes received are acid. We therefore have to excavate some 70,000 tons limestone from the island each year. Fly ash reduces the requirements for this limestone. All the waste deposits are slowly converting the island to almost the original shape. These facts should be taken into account when our alternative is evaluated.

The price for treating fly ash at Langøya depends on the types and quantities in question. We consider ourselves to be quite competitive with the prices to German salt mines.

Permission to export/import must of course be obtained from the authorities in both the country of origin and in Norway. The key to this is the attitude in the export country. If the deciding office is positive and consider the Norwegian alternative to be good, then the rest is easy.

**Comments and facts on Langøya center**

- **EOCI (maximum content in Cl)**: Content in leachable organic Chlorine. Organic Chloride ≠ mineral Chloride (no problem for mineral salt such as NaCl and KCl) (but leachability still high?).
annual quantifies of wastes : 300 000 tons.
annual quantifies of fly ashes from MSWI : 40 000 tons (capacity 100 000 tons).
Origin of fly ashes : mainly from Norway and Denmark
Prices : "quite competitive with German mines prices".
Use of "salt" APC residues ? : Perhaps Langøya uses only APC from dry treatment (common flue gas treatment in Norway), APC residues having low leachability and high neutralization (basic) characteristics.
Classification of the centre ? : considered as ultimate waste disposal site

Additional comments

From further contacts of Mrs. Musdalslien with the Environmental Authorities in Norway and also NOAH [E10] :
1. The disposal at Langøya is regarded to be classified as ultimate disposal
2. The residues, fly ash and APC, are mixed with sulphuric acid making a chemical stable mixture with no or minimal leakage of heavy metals
3. NOAH is operated according to the permits given by the Environmental Authorities in Norway (given in 1995 and 1997). These permits are available in Norwegian (obtained from the Environmental Authorities).
4. The permits include limits for aqueous and gaseous effluents. The limits for aqueous effluents are given for 13 metals, CN, N, EOCI and PAH. For the gaseous effluents limits are given only for dust. Limits are given for the effluents and parameters regarded to have the greatest environmental consequences. Furthermore, NOAH must survey the surroundings for any effect of the activity at Langøya.
5. The regulations should be based on existing EU regulation, although this is not said.
   The April 1999 EU landfill directive is currently being incorporated in the Norwegian regulations. Thus, the permits are not yet based on this directive.
6. NOAH has never rejected any waste based on the limits for EOCI and PAH.
Annexe 3

REGULATIONS AND LAWS
La décharge a été souvent l’exutoire de beaucoup de déchets. Mais, à compter du 1er juillet 2002, les installations d’élimination des déchets par stockage ne seront utilisées que pour accueillir des déchets ultimes.

Jusque dans les années 70, les décharges n’étaient soumises à aucune réglementation. Chaque commune disposait d’un lieu de dépôt ou d’incinération des déchets.

A partir de 1975 et de 1976, la mise en œuvre de la réglementation a permis la résorption de nombreux dépôts sauvages et la mise en conformité d’usines d’incinération et de décharges.

Néanmoins, en 1993, une grande part des *déchets ménagers* finissait toujours en décharge et des dépôts sauvages existaient encore.

Aussi, une nouvelle réglementation a été mise en place.

Elle fixe comme échéance le 1er juillet 2002, date à laquelle les installations d’élimination des déchets par stockage ne seront autorisées à accueillir que des déchets ultimes, à savoir des déchets résultant ou non du traitement des déchets, qui ne sont plus susceptibles d’être traités dans les conditions techniques et économiques du moment, notamment par extraction de la part valorisable ou par réduction de son caractère polluant ou dangereux.

Suivant la nature de leur toxicité, les déchets ultimes seront stockés dans des centres différents.

Ainsi, les résidus d’épuration des fumées d’incinération des déchets ménagers et assimilés étant toxiques, ils sont déjà stockés au même titre que les résidus d’épuration des fumées d’incinération de déchets industriels dans des centres de stockage de *déchets industriels* spéciaux après stabilisation et solidification.

Par contre, pour les mâchefers non valorisés, ils sont stockés dans des décharges de déchets ménagers.

À ce jour, il existe trois catégories de décharges, définies suivant la nature et l’imperméabilité du sol d’accueil :

- les décharges de classe 1 où sont stockés certains déchets industriels spéciaux après stabilisation et solidification ;
- les décharges de classe 2 de déchets ménagers assimilés ;
- les décharges de classe 3 de déchets inertes (déblais et gravats non souillés).

La décharge doit être considérée comme une installation d’élimination de déchets soumise à une réglementation stricte qui impose notamment les principes suivants.

- Des contraintes géologiques (imperméabilité du sol) et hydrgéologiques qui vont aboutir à l’acceptation ou non du site.
- Des contrôles à l’entrée des déchets.
- La collecte et le traitement des eaux de lixiviation. Les eaux de pluie percolent en effet les déchets, entraînant lors de leur passage des matières diverses, organiques, salines et toxiques (métaux lourds, hydrocarbures...). Ces eaux sont traitées de la même façon que les eaux usées domestiques, in situ ou dans des stations d’épuration.
- La collecte et le traitement du biogaz émis. Au cours de leur fermentation, les déchets organiques
se transforment et libèrent ainsi divers gaz, principalement CO2, CH4, N2, O2, H2S et autres mercaptans qu’il faut absolument récupérer par drainage et traiter (valorisation énergétique ou brûlage en torchère).

• Une méthode d’exploitation (travail en casiers avec étanchéification et drainage en vue de la récupération des eaux de lixiviation*, compactage et recouvrement des déchets, collecte et dérivation des eaux de ruissellement). L’objectif majeur est qu’il y ait le moins d’eau possible au contact du déchet, déjà riche en eau.

• Des contrôles de l’impact de la décharge sur l’environnement (analyses des eaux des piézomètres** mis en place autour de la décharge, des puits existants, des eaux souterraines, des eaux superficielles).

• Des dispositions pour la remise en état du site et le suivi du centre de stockage par l’exploitant après exploitation (traitement des effluents, sécurité et surveillance de l’air et des eaux superficielles et souterraines).

L’objectif de ces prochaines années c’est bien de ne stocker que des déchets ultimes, suivant des conditions d’exploitation et de post-exploitation beaucoup plus strictes et contraignantes.

* lixiviat : “jus” issu de la percolation des eaux de pluie.

** piézomètre : puits destiné à mesurer le niveau de la nappe d’eau souterraine.
European Community legislation in force on waste

Directory of Community legislation in force

Analytical register

15 - Environnement, consumers and health protection

15.10.30.30 - Waste management and clean technology

Secondary legislation

375L0442

  Amended by 1991 - 391L0156 (OJ L 078 26.03.91 p.32)
  Incorporated by 1994 - 294A0103 (OJ L 001 03.01.94 p.494)
  Amended by 1996 - 396D0350 (OJ L 135 06.06.96 p.32)
  Derogation in 1996 - 396L0059 (OJ L 243 24.09.96 p.31)

1976 - 376D0431 - Committee on Waste Management

76/431/EEC: Commission Decision of 21 April 1976 setting up a Committee on Waste Management. OJ L 115 01.05.76 p.73

Amended by 179H
Amended by 185I

1989 - 389Y0112 01 - transfrontier movements of hazardous waste to third countries

Council Resolution of 21 December 1988 concerning transfrontier movements of hazardous waste to third countries. OJ C 009 12.01.89 p.1

1990 - 390Y0518 01 waste policy

Council Resolution of 7 May 1990 on waste policy. OJ C 122 18.05.90 p.2

1991 - 391L0689 hazardous waste

  Amended by 1994 - 394L0031 OJ L 168 02.07.94 p.28)

1993 - 393R0259 - shipment of waste

  Derogation in 194N
  Amended by 1994 - 394D0721 (OJ L 288 09.11.94 p.36)
  Amended by 1996 - 396D0660 (OJ L 304 27.11.96 p.15)
1994 - 394D0003 List of waste


1994 - 394D0904 List of hazardous waste


1994 - 394L0067 incineration of hazardous waste


1997 - 397D0640 control of transboundary movements of hazardous wastes and their disposal

97/640/EC: Council Decision of 22 September 1997 on the approval, on behalf of the Community, of the amendment to the Convention on the control of transboundary movements of hazardous wastes and their disposal (Basle Convention), as laid down in Decision III/1 of the Conference of the Parties. OJ L 272 04.10.97 p.45

1997 - 397Y0311_01 strategy for waste management

Council Resolution of 24 February 1997 on a Community strategy for waste management. OJ C 076 11.03.97 p.1

1999 - 399L0031 Landfill of waste


1999 - 399R1421 shipment of waste

Council Regulation (EC) No 1420/1999 of 29 April 1999 establishing common rules and procedures to apply to shipments to certain non-OECD countries of certain types of waste OCID=1999l185&P.1

1999 - 399R1547 shipment of waste

Commission Regulation (EC) No 1547/1999 of 12 July 1999 determining the control procedures under Council Regulation (EEC) No 259/93 to apply to shipments of certain types of waste to certain countries to which OECD Decision C(92)39 final does not apply (Text with EEA relevance) OCID=1999l185&P.1

(Extracted from a list of Text given by europa.eu.int/eur-lex/en/lif/dat/1999/en_399L0031.html, As delivered by CELEX on: 05/11/1999)

(see complete text with some arrangements in separate file EC399L0031.doc)

This European Directive directly applies to (art. 1 (f) and (g)) :

- "underground storage": permanent waste storage facility in a deep geological cavity such as a salt or potassium mine
- "landfill": waste disposal site for the deposit of the waste onto or into land (i.e. underground), excluding sites for treatment and temporary storage (< 3 year) before recovery, but including
  - internal waste disposal sites (i.e. landfill where a producer of waste is carrying out its own waste disposal at the place of production),
  - permanent site (i.e. > 1 year) which is used for temporary storage of waste,

On the question of use of dangerous wastes for mine-filling :

- the law applies to landfilling or underground practices, but doesn't gives a clear definition which can exclude or include "mine-filling" : if it can be considered as a "recovery" or "recycling" practice, the law would not apply.
- "mine-filling" is not even spoken of in a way or another : no reference.
- salt mine is found in the above definition for underground storage only. No other reference.
- It is up to a committee to define specific criteria and/or test methods and associated limit values for landfilling or underground practices (art.16 + Annex II.1) (before 2 years)
- certain hazardous waste can be accepted in landfills for non-hazardous waste : acceptance criteria should be developed by the technical committee (foreword(22) + Annex II.1)
- "underground storage" can be exempted by Member States from some obligations (art. 3.5), concerning mainly analysis of gas, water protection and monitoring. (For salt mines, this appear to be technically logic : there is no water and leachates)

This law must be brought into force by each State Members within 2 years, and existing landfilling sites (art. 14) have to be adapted within 8 years after that, i.e. < 2009 at the latest, or else must close.

Conclusion : Mine-filling may continue in the future either if :

- if it is accepted as a "recovery" practice and not as landfilling. But how could such a practice avoid to apply the same rules as deep mine storage? If the waste are used in the same manner, they should apply at least the same criteria for avoiding environment possible nuisances (waste analysis, particular stabilisation, leaching tests for coal mines, book-keeping,...). This could be obliged by a future (hypothetical ?) law about "safe recovery practice", or by general principles concerning the waste handling.
- it applies the same rule as landfilling or underground storage. This can be difficult for it obliges the operator to follow more strict control and a to keep a register of waste type and location in the mine (art.11). Reversibility of the storage is not required. Costs must include a provision (financial security) for a long time period of after-care.
- It could match future criteria (to be defined by a technical Committee) for "certain hazardous waste to be accepted in landfills for non-hazardous".
Basic principles for Waste Handling in Germany

(Extracts from: Act for Promoting Closed Substance Cycle Waste Management and Ensuring Environmentally Compatible Waste Disposal [D1]

(Gesetz zur Foerderung der Kreislaufwirtschaft und Sicherung der umweltvertraeglichen Beseitigung von Abfaellen (Kreislaufwirtschafts und Abfallgesetz)

(complete text available in English, German text can be read on the Web)

The following extracts have been chosen in relation with mining activities:

" (art 2 §4) The provisions of this Act do not apply to..." waste occurring from prospecting, extraction, preparation, treatment, and processing of mineral resources in facilities subject to mining, inspection, except for waste not occurring directly and normally only in connection with the activities listed in the first half of this provision".

Art. 28 Execution of Disposal. (3) The party holding extraction rights for, or the entrepreneur of, a mineral-extraction operation, as well as the titleholder or owner of land used for mineral extraction, or party otherwise authorised to dispose over such land, can be obligated by the competent authority to tolerate disposal of waste in exposed tunnels in his facility, or on his land, to permit access and, to the extent that this is required, to make available existing facility equipment or facilities, or portions thereof. The party responsible for the disposal must reimburse the relevant party for incurred costs resulting from such use. The competent authority shall determine the content of this obligation. The priority of mineral extraction over waste management shall not be affected. The party required to tolerate such use shall not be liable for damage resulting from the waste disposal.

Annex IIA Disposal Procedures.

This Annex lists disposal procedures that are used in practice.


- D1 Deposition in or on the ground (i.e. dump sites etc.)
- D2 Treatment in the ground (for example, biological decomposition of liquid or sludgy waste in the ground, etc.)
- D3 Pressing (for example, pressing pumpable waste into bore holes, salt caverns or natural cavities, etc.)
- D12 Permanent storage (for example, storage of containers in a mine, etc.)
- D13 Mixing prior to application of one of the procedures described in this Annex
- D14 Reconditioning prior to application of one of the procedures described in this Annex
• D15 Storage until one of the procedures described in this Annex is applied (interim storage), except for temporary storage - until collection - on the site at which the waste is generated
Call for end to disposal in German mines

(article from HAZNEWS N°133, April 1999, p.7)

(given by Vestolit)

The German Association of State Hazardous Waste Management Companies (Arbeitsgemeinschaft der Sonderabfall-Entsorgungsgesellschaften der Länder, AGS), has called for the new German Environment Minister, Jürgen Trittin, to introduce federal regulations controlling the disposal of hazardous waste in mines. AGS spokesman, Jörg Rüdiger, says that the industry should not wait for the opinion of the European Commission, which categorizes mine back-filling as a disposal process, to be implemented at national level.

A change to the current federal waste law was required, said Herr Rüdiger, to exclude hazardous wastes from back-filling and set binding limits on hazardous substances. Furthermore, these limits should be applied before the mixing of back-fill in order to end the practice of diluting hazardous wastes, reports Entsorga-Magazin. In 1998, hazardous wastes firms in Bavaria called on the German Government to end hazardous waste disposal in mines in eastern Germany (see Haznews, April 1998, p.4).

Other articles, in German :

- Umweltministerium weist Vorwurf zum Versatz von Abfällen Zurück Re. Nr.33 cv.17.08.1999.
- Sondermüll : Streit um Bergversatz, UTA 1/IX/99, Seite 4 - 5.
- Bundesverordnung zum Bergversatz in Arbeit. Umweltpolitik Re Nr40 v05.10.1999.
- GSES darf Abfall unter Tage verbringen, Umweltwirtschaft Re nr43 v26.10.1999.
Kurzfassung: Bergversatz

1. Einleitung
In der Bundesrepublik Deutschland werden ca. 800.000 Tonnen Abfälle pro Jahr in stillgelegten Bergwerken ohne abfallrechtliche Deponiezulassung mit dem Ziel der Bergbausicherung und – rekultivierung entsorgt (sog. Bergversatz). Ende August 1999 hat die Kommission ein Vertragsverletzungsverfahren gegen die Bundesrepublik Deutschland eingeleitet. Die Kommission rügt darin die von der Bundesrepublik Deutschland vertretene Ansicht, bei Bergversatz handele es sich um eine Verwertungs- und nicht um eine Beseitigungsmaßnahme.

2. Regelung des Bergversatzes nach EG-Recht

a) Abfallrahmenrichtlinie
Die Europäische Kommission vertritt die Ansicht, daß Bergversatz als Beseitigungsmaßnahme im Sinne des Anhang II A der Abfallrahmenrichtlinie anzusehen ist

D 1 Ablagerungen in oder auf dem Boden (z.B. Deponien usw.)
D 3 Verpressung (z.B. Verpressung pumpfähiger Abfälle in Bohrlöcher, Salzdome oder natürliche Holz-(richtig wohl: „Hohl-„)räume usw.)
D 12 Dauerlagerung (z.B. Lagerung von Behältern in einem Bergwerk usw.)

Bergwerke, in denen Abfälle dauerhaft gelagert werden, bedürfen damit der abfallrechtlichen Genehmigung (Art. 9 Abs. 1 der Abfallrahmenrichtlinie).

b) Richtlinie über Abfalldeponien
Die Richtlinie 1999/31/EG über Abfalldeponien ergänzt die Abfallrahmenrichtlinie um spezifische Anforderungen an die besondere Beseitigungsart „Deponierung“.

Der Anwendungsbereich der Richtlinie 1999/31/EG umfaßt alle Deponien gemäß Art. 2 lit. g), d.h. jede „Abfallbeseitigungsanlage für die Ablagerung von Abfällen oberhalb oder unterhalb der Erdoberfläche (d.h. unter Tage), ...“.

Die Richtlinie findet keine Anwendung auf „die Verwendung von geeigneten Inertabfällen für landschaftspflegerische Arbeiten/ Rekultivierungen und für Auffüllungen oder bauliche Zwecke in Deponien“ (Art. 3 Abs. 2).

c) Richtlinie über die Umweltverträglichkeitsprüfung
Die allgemeinen Regeln für die Abfallbewirtschaftung gelten auch für die Entsorgung gefährlicher Abfälle. Die ordnungsgemäße Beseitigung gefährlicher Abfälle erfordert jedoch zum Teil zusätzliche, strengere Regeln, die den Besonderheiten dieser Art von Abfällen Rechnung tragen.

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Abfallbeseitigungsanlagen zur Deponierung gefährlicher Abfälle bedürfen neben der abfallrechtlichen Genehmigung einer Umweltverträglichkeitsprüfung im Sinne der Richtlinie 85/337/EWG⁴.

3. Regelung des Bergversatzes nach dem deutschen Recht

a) Anwendungsbereich

Das Kreislaufwirtschafts- und Abfallgesetz gilt für die Vermeidung, Verwertung und Beseitigung von Abfällen (§ 2 Abs. 1 KrW-/AbfG).


b) Abfallbegriff

Das Kreislaufwirtschafts- und Abfallgesetzes differenziert zwischen „Abfällen zur Verwertung“ und „Abfällen zur Beseitigung“.

c) Abfallbeseitigung oder Abfallverwertung?

Obwohl die Anhänge II A und B des Kreislaufwirtschafts- und Abfallgesetzes die Anhänge der Abfallrahmenrichtlinie (fast) wörtlich übernehmen, wird der Bergversatz in der Bundesrepublik Deutschland in der Regel nicht als Beseitigung, sondern als Verwertungsmaßnahme im Sinne des Anhangs II B angesehen.

(1) Argument aus § 7 Abs. 1 und Abs. 2 KrW-/AbfG

Aus § 7 Abs. 1 i.V.m. Abs. 2 KrW-/AbfG läßt sich – zumindest indirekt – herleiten, daß Bergversatz auch ein Abfallverwertungsverfahren im Sinne des Kreislaufwirtschafts- und Abfallgesetzes sein kann.

Art. 7 Abs. 1 KrW-/AbfG ermächtigt nämlich die Bundesregierung zum Erlaß von Rechtsverordnungen, soweit es „zur Sicherung der schadlosen Verwertung“ erforderlich ist.

§ 7 Abs. 2 KrW-/AbfG ergänzt hierzu, daß durch diese Rechtsverordnungen stoffliche Anforderungen festgelegt werden können, wenn „Abfälle in der Bergaufsicht unterstehenden Betrieben aus bergtechnischen oder bergsicherheitlichen Gründen“ eingesetzt werden.

(2) Argument aus § 4 Abs. 3 S. 2 KrW-/AbfG

Ein weiteres Argument für die mögliche Klassifizierung des Bergversatzes als Verwertung kann aus § 4 Abs. 3 S. 2 KrW-/AbfG hergeleitet werden. Danach ist eine stoffliche Verwertung gegeben, „wenn nach einer wirtschaftlichen Betrachtungsweise, unter Berücksichtigung der im einzelnen


⁵ Kloepfer, Umweltrecht, 2. Aufl. München 1998, § 10 Rn. 109 m.w.N.
Abfall bestehenden Verunreinigungen, *der Hauptzweck der Maßnahme in der Nutzung des Abfalls und nicht in der Beseitigung des Schadstoffpotentials liegt*“.

(3) **Anlagenbezogene Zulassungserfordernisse**


4. **Verhältnis zwischen Europäischem Recht und deutschem Recht**

a) **Pflicht zur ordnungsgemäßen Umsetzung einer EG-Richtlinie**


b) **Einleitung eines Vertragsverletzungsverfahrens gemäß Art. 226 EGV (= Art. 169 EGV a.F.)**


CK: This paper was prepared by Dr Barara Breuer for a speech given by M. Joachim Eckstein. Text firstly obtained from Dr. Bühl (fax 22 oct 1999), file given by Dr. Barbara Breuer (mail 20 dec 99).
EXPLANATION OF EUROPEAN COMMISSION INFRINGEMENT PROCEEDINGS FOR NON-COMPLIANCE WITH COMMUNITY LAW

MEMO/99/57 Brussels, 16 November 1999

Principles

Each Member State is responsible for the implementation of Community law (adoptions of implementing measures before a specified deadline, conformity and correct application) within its own legal system. Under the Treaties, the European Commission is responsible for ensuring that Community law is correctly applied. Consequently, where a Member State fails to comply with Community law, the Commission has powers of its own (action for non-compliance) to try to bring the infringement to an end and, where necessary, may refer the case to the European Court of Justice. The Commission takes whatever action it deems appropriate in response to either a complaint or indications of infringements which it detects itself.

Non-compliance means failure by a Member State to fulfil its obligations under Community law. It may consist either of action or omission. The term State is taken to mean the Member State which infringes Community law, irrespective of the authority - central, regional or local - to which the compliance is attributable.

Admissibility of complaints

Anyone may lodge a complaint with the Commission against a Member State for any measure (law, regulation or administrative action) or practice attributable to a Member State which they consider incompatible with a provision or a principle of Community law. Complainants do not have to demonstrate a formal interest in bringing proceedings. Neither do they have to prove that they are principally and directly concerned by the infringement complained of. To be admissible, a complaint has to relate to an infringement of Community law by a Member State. It cannot therefore concern a private dispute.

Stages of infringement proceedings

In infringement proceedings, a case may be handled in the following stages:

Information gathering

In response to complaints or after the Commission has on its own initiative become aware of potential violation of Community law, it may be necessary to gather further information to determine the points of facts and of law concerning the case.

Opening of an infringement procedure: formal contacts between the Commission and the Member State concerned

If the Commission considers that there may be an infringement of Community law which warrants the opening of an infringement procedure, it addresses a "letter of formal notice" to the Member State concerned, requesting it to submit its observations by a specified date (the deadline for a response is at the discretion of the Commission it is normally two months but may be one week or less). The Member State has to adopt a position on the points of fact and of law on which the Commission bases its decision to open the infringement procedure.
In the light of the reply or absence of a reply from the Member State concerned, the Commission may decide to address a "reasoned opinion" to the Member State, clearly and definitively setting out the reasons why it considers there to have been an infringement of Community law and calling on the Member State to comply with Community law within a specified period (again, the deadline for a response is at the discretion of the Commission it is normally two months but may be one week or less).

The purpose of these formal contacts is to determine whether there is indeed an infringement of Community law and, if so, to resolve the case as soon as possible without having to take it to the Court of Justice.

In the light of the reply, the Commission may also decide not to proceed with the infringement procedure, for example where the Member State provides credible assurances as to its intention to amend its legislation or administrative practice. Most cases can be resolved in this way.

**Referral to the European Court of Justice**

If the Member State fails to comply with the reasoned opinion, the Commission may decide to bring the case before the European Court of Justice. On average, it takes about two years for the Court of Justice to rule on cases brought by the Commission.

Judgements of the Court of Justice differ from those of national courts. At the close of the procedure, the Court of Justice delivers a judgement stating whether there has been an infringement. The Court of Justice can neither annul a national provision which is incompatible with Community law, nor force a national administration to respond to the request of an individual, nor order the Member State to pay damages to an individual adversely affected by an infringement of Community law.

It is up to a Member State against which the Court of Justice has given judgement to take whatever measures are necessary to comply with it, particularly to resolve the dispute which gave rise to the procedure. If the Member State does not comply, the Commission may again bring the matter before the Court of Justice seeking to have periodic penalty payments imposed on the Member State until such time as it puts an end to the infringement.

(text obtained from www.europw.eu.int/rapid/start/cgi/guesten/ksh?p_action.gettxt=....).
ANNEXE 4

Address list of European Salt Producers Association

(open the following window or see file "eurosaltmembers2.doc")
Members of European Salt Association
(Address list, per country)
http://www.eu-salt.com/membres.htm

Austria
Österreichische SalinenGmbH
Wirerstraße 10
A-4820 BAD ISCHL
phone: 43/6132 200 2114
fax: 43/6132 200 4100 or 4414
e-mail: monika.haim@salinen.com

Belgique
Solvay SA
Chemicals Sector - SBU Salt
33, rue Prince Albert
B-1050 BRUXELLES
phone: 32/2 509 66 58
fax: 32/2 509 65 05
e-mail: michel.brun@solvay.com

Denmark
Dansk Salt A/S
Hadsundvej 17
DK-9550 MARIA GÆR
phone: 45/96 68 78 88
fax: 45/96 68 78 90
e-mail: DanskSalt@DanskSalt.dk

France
Compagnie des Salins du Midi et des Salines de l’Est
51, rue d’Anjou
F-75008 PARIS
phone: 33/1 49 24 15 00
fax: 33/1 49 24 15.11

Mines des Potasses d’Alsace / SCPA
2, Place du Général de Gaulle
F-68100 MULHOUSE
tél.: 33/03 89 36 36 04
fax: 33/03 89 36 36 98
e-mail: SpecklinG@scpa.fr

Solvay Sels France
12 cours Albert 1er
F-75383 PARIS CEDEX 08
phone: 33/1 40 75 84 69
fax: 33/1 53 76 01 04
e-mail: Denis.Schwartz@solvay.com

Germany
Akzo Nobel Salz GmbH
Postfach 1729
D-21657 STADE
tel.: 49/ 4141795-100
fax: 49/4141 795-190

Kali und Salz GmbH
Geschäftsbereich Salz
Postfach 10 20 29
D-34111 KA SEL
phone: 49/561 301-2236
fax: 49/561 301-2286
e-mail: klaus.neubarth@kalisalz.de
web: www.kalisalz.de

Solvay Salz GmbH
Postfach 14 01 40
D-48476 WESSEL
phone: 49/2803 48-631
fax: 49/2803 48-630
e-mail: dietmar.oetterer@solvay.com

Südsalz GmbH
Herr Dr. Ulrich Kowalski
D-74177 BAD FRIEDRICHSHALL
phone: 49/71 36/9 60-1 10
fax: 49/71 36/9 60-1 19
e-mail: doris.eisenbarth@suedsalz.de

Südwestdeutsche Salzwerke A.G
Postfach 3161
D-7131 959-217
phone: 49/7131 179-071
fax: 49/7131 179-071
ADDITIONAL DATA
(on attached files)

German mines
(main underground deposits and recycling sites)

- Südwesdeutsche SalzWerke AG : see file sdsalzwerke.doc
- Kali und Salz GmbH : see file kalisalz.doc or paper copies

Municipal Wastes in Spain

- Spain1.xls