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SAFE PERMANENT STORAGE OF METALLIC MERCURY IN UNDERGROUND WASTE DISPOSAL SITES

As a part of EU's overall strategy to reduce global exposure to mercury, the European Commission has proposed a regulation on banning of mercury exports from July 2011 and the safe storage of metallic mercury. The proposed regulation would require that, after July 2011, the excess mercury no longer used in the chlor-alkali industry would need to be stored. Euro Chlor advocates that permanent storage of metallic mercury in underground waste disposal sites represents the safest way of disposing of the mercury.

1. How much mercury will be stored?

Currently there are about 9600 tonnes of mercury still in use as a catalyst in 43 chlor-alkali electrolysis plants in Europe. Due to the high density of mercury, this tonnage only represents a volume of about 700 m^3.

2. Where will the mercury be stored?

The metallic mercury will be permanently stored in hermetically sealed steel containers in underground hazardous waste disposal plants in rock salt formations.

3. Why should the storage be permanent?

Permanent storage of metallic mercury in underground salt mines is considered to be the best environmental option as the mercury will be stored at a depth of 700-800 meters and cannot get back into the biosphere without human intervention.

Permanent storage will also eliminate risks of emissions, accidental spills and occupational exposure that can occur when mercury is handled.

4. What makes an underground disposal plant in rock salt formations the best place to dispose off metallic mercury?

An underground disposal plant in rock salt formations, which has remained stable for more than 200 million years, has natural barriers which guarantee the long-term safety of the waste and isolates it from both the hydrosphere (water) and biosphere (air).

- Gas-tight salt rock formation (~ 300 meters thick):
  Waste stored in the salt deposit is safely enclosed and sealed off by the impermeable salt rock formation, which reacts plastically to stress and strain in the earth's crust so that no joints or cracks can occur.
- Clay layers (~ 100 meters thick):
  The clay layers above the salt deposit are the most important barriers isolating the waste, as they react plastically to stress, and ensure the tightness against groundwater.
- Bunter sandstone (~ 500 meters thick):
  In the sandstone layer further sections with groundwater barrier functions are interacted.

In addition to these natural/geological barriers the storage containers and separate storage chambers serve as artificial/technical barriers.

5. How will the mercury be stored?

Before any waste is accepted for underground storage it will undergo an individual approval procedure. The quantity of waste is checked, as well as the material and conditions of the prescribed packaging and labelling of each individual container with the code number applicable to the waste.

The metallic mercury will be stored in airtight steel drums that comply with hazardous waste safety requirements and with the European regulation for the transport of hazardous substances ADR/RID regulations. The mercury can remain in the steel containers for unlimited time as there is no risk of corrosion in a salt mine as the air is extremely dry (humidity between 15 to 40%). In addition the containers are tested to ensure that they are physically robust and leak proof.

The mercury will be stored in a separate chamber, which will be documented in detail e.g. location (including a map), time of storage etc.

6. How can the long term safety of the disposed mercury be ensured?

An underground waste disposal plant needs to fulfil strict safety requirements established by community legislation (e.g. Directive 1999/31/EC and Decision 2003/33/EC) and national laws. Only storage sites that have the necessary permits for the deposit of hazardous waste underground can be used. In addition to this the Commission, through comitology procedure, will develop specific storage acceptance criteria for the metallic mercury.

In order to obtain a permit to operate an underground deposit plant a long-term safety analysis must be performed to ensure that the setting-up, the operation and the post-operational maintenance does not lead to any negative impact on the environment. There are also regular inspections by external experts and official agencies in order to control that the operations are in conformity with the permit requirements.

7. What will happen in the case of closure of the disposal site?

In the case the underground waste disposal should cease to operate in the future, the shafts (the only connection between the underground chambers and the surface) will be sealed by appropriate solid materials and a watertight secure closing of the mine will be undertaken. The filling of the shafts will block the only connection to the wastes and thereby the stored waste will be withdrawn from the biosphere for good.

However, if there would be a need a comprehensive and detailed documentation regarding the location and time of storage would make it possible to also in the future determine where a particular waste has been deposited.

8. What would happen if some mercury leaked?

The ventilation and aeration system is monitored through gas detection instruments, which ensures that in case of any accidental leak, the incident would rapidly be detected and taken care of.

If some liquid mercury was to be released into the salt mine chamber, it would form a pool on the lowest part of the chamber floor, giving rise to a low concentration of mercury vapours in the air. The mercury spill could then be recovered by workers wearing specific protective equipment and using a special vacuum cleaner. The contaminated salt surface will be scraped and disposed as hazardous waste.

There would be no migration of mercury into the environment, either in liquid or vapour form, thanks to the compact structure of the salt.

9. Who will pay the cost of the disposal?

The chlor-alkali industry will take the full financial responsibility for the permanent storage of mercury (as outlined in article 3 of the Council Common Position) and enter into commercial contracts with storage operators.

The ownership of the mercury will then transfer from the chlor-alkali industry to the waste disposal operator. Thus, uncertainties about length of the storage period and future responsibilities of the operator in terms of final disposal would make it difficult to reach a contract and would have a negative impact on the ability of the industry to attain a safe permanent storage solution for the mercury.

10. Is it possible to transform metallic mercury into a solid compound?

To date, there is no proven technology on an industrial or even pilot scale to convert mercury into another form. Small scale laboratory tests to transform liquid mercury into the solid compound mercury sulphide by mixing mercury with sulphur and cement has shown that it would be very difficult to apply this technique to a large quantity of mercury.

The very high density of mercury (more than 13 times the density of water) would make it difficult to achieve/maintain a homogeneous mixture and the reaction time can take up to 2 years. Such a process would be energy intensive and vastly increase the volume of the material to be stored. Also the handling and processing stages associated with solidification would increase the risks of emissions and spills into the environment.

For further information or additional technical background in support of the points made in this paper, please contact:

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