POLICY BRIEFING:

Safe Storage and Disposal of Redundant Mercury

An output from a workshop held at the University of Oxford (UK) on 13th and 14th October, 2009

Introduction

Export bans in the European Union and the USA will mean that within a few years, mercury in these regions can no longer be placed on the worldwide market. Much of this mercury has no alternative use and can therefore be considered as redundant. The greatest quantity of mercury that will become redundant arises from that no longer needed by the chloralkali industry, but there are other sources such as the mercury removed from obsolete products such as mercury thermometers.

The *Oxford Workshop on the Safe Storage and Disposal of Redundant Mercury* provided a forum for the evaluation of scientific and engineering issues associated with this topic. The meeting, which was sponsored by the UK Department for Environment, Food and Rural Affairs, involved over 40 experts from industry, non-governmental organisations, academia, consultancies and public organisations. Further information on the event, including copies of presentations made to inform the discussions, is available at: http://www.mercurynetwork.org.uk/safe_repositories_for_mercury/.

This policy briefing has been prepared by the workshop organisers in order to inform public policy representatives about the main issues arising in the discussions.

Main points arising from the workshop discussions

1. Repositories based on placement of:
    a. a stable mercury compound in low permeability, water-bearing rock, or,
    b. elemental or a stable mercury compound in appropriate salt deposits,

    have the potential to provide safe disposal of redundant mercury. However, while some views were expressed that disposal in salt could proceed immediately, much of the expert technical opinion expressed at the workshop was that further research, development and demonstration activities are required before sufficient confidence is accumulated to proceed with disposal.

2. Key activities that need to be carried out before public policy is set are:

    2.1. Demonstration plants for the most well investigated stabilisation processes:
        a. formation of mercury sulphide (sulphidation) and
        b. SPSS (Sulphur Polymer Stabilisation/Solidification)

    to provide confidence in product consistency and quality on scale-up from current pilot-scale operations.

    2.2. Confidence building in the long-term integrity and performance of key repository components such as the stabilised form of mercury in water-bearing rocks and seals for underground access ways in salt formations.

    2.3. The further elaboration and peer review of what should constitute a safety case for a repository for mercury. This should include the ways in which different kinds of analysis and evidence (for example detailed and simplified models, natural analogues, qualitative arguments etc.) should be used to provide confidence to different stakeholders, the timescales for assessment, and the safety standards to be achieved.

    2.4. An enhanced specification of the requirements on host geologies and hence overview of the availability of potentially suitable sites in Europe.

    2.5. An assessment of the adequacy of current understanding of transport and retardation mechanisms for mercury in potential host geologies (including the impact of microbes and impurities, and due to co-disposal with other wastes), filling in gaps as necessary.

    2.6. Development of a better understanding of when mercury will arise in Europe to inform decisions on waste conditioning capacities. This includes the extent to which mercury will be recovered from other waste types.

3. While a timetable for the above activities was not explicitly discussed at the Workshop, the general impression from participant's comments was that some years (perhaps 5 to 10 years) may be required to undertake these activities. Responsibilities for undertaking these activities need to be established.

4. Much relevant knowledge and experience has been acquired through programmes to develop repositories for radioactive waste which may be translated to inform mercury disposal: the required levels of containment are of a similar order for the two cases. This knowledge and experience should be systematically reviewed to identify data, models and approaches to making a safety case that might usefully be adapted for mercury disposal.

5. For disposal in underground salt formations ('Concept A'), both elemental (i.e. liquid) and chemically stabilised mercury are candidate wasteforms, and for appropriate geological settings it is expected that an acceptable safety case could be made for either. Solidified mercury provides for enhanced containment (and public confidence) in a scenario where the seal provided by the salt is compromised (for example due to failure of access way seals), but this additional safety margin needs to be weighed against the costs and potential for mercury release from the chemical stabilisation process. Studies of the following are required:
    - the interaction between elemental mercury and rock salt over long periods of time,
    - the durability of repository access-way seals, and,
    - the likelihood of inadvertent future human intrusion.

6. For disposal in water-bearing host rock ('Concept B'), solidification of the mercury is required. The maintenance of low leachability over long time periods in the geochemical conditions expected at the candidate site needs to be demonstrated. This concept is not limited to granitic rocks, and a broader range of low permeability rocks may be suitable.

7. For both Concepts A and B, safety cases will need to be site-specific.

8. Packaging for redundant mercury contributes little to post-closure safety, but plays an essential role in ensuring safe transport of wastes and operation of storage and disposal facilities. External corrosion of mercury containers is unlikely to be a problem provided that the operating environment of the facility is well controlled. Careful attention to container design, particularly weld quality, and to the avoidance of contamination of the mercury should ensure that internal corrosion is similarly not an issue. A substantial body of experience and test work in the USA provides confidence that failure rates of containers should be very low. Nevertheless, given the consequences in terms of worker exposure and clean-up costs, great care should be paid to avoiding any spillages during transfer to and placement in a repository, as well as any processing facility.

9. Claims made that the mercury sulphidation process could enable surface disposal (as distinct from temporary storage) of mercury were met with some scepticism. Leaching tests currently utilised for assessing materials for placement in landfills may not provide assurance of long-term safety for mercury compounds. In particular, assessment of the effect of microbiological action on mercury sulphide is required.

Sources of additional information

- A list of information sources on mercury storage and disposal is available at http://www.mercurynetwork.org.uk/work-packages/integrated-hg-waste-management/literature-storage/.
- In 2009, the European Commission commissioned consultants BiPRO GmbH to carry out a study entitled *Requirements for facilities and acceptance for the disposal of metallic mercury*. Information and a copy of the final report (when published) will be available at http://www.bipro.de/mercury/.
- The UN Environment Programme is sponsoring international activities on mercury storage and disposal. For more information, see http://www.chem.unep.ch/mercury/.

The IKIMP Initiative

The Integrating Knowledge to Inform Mercury Policy (IKIMP) knowledge exchange initiative has been set up to ensure the scientific and technical knowledge base is used to inform and guide public policy relating to mercury. The 3 year Initiative, which started in October 2008, has core funding from the UK Natural Environment Research Council. For more information, see http://www.mercurynetwork.org.uk.