UNEP Global Mercury Partnership

Mercury releases from the cement industry – A new partnership area

Business Plan, March 2013

This business plan for the Cement Industry partnership area of the Global Mercury Partnership (GMP) provides a framework for developing and implementing actions in the cement industry that address the overall objective of the GMP. It serves as a common, cohesive structure within which partners can plan, implement and communicate work with the cement industry leading to reduced mercury releases. It serves as a planning and communication vehicle both for Partners and others.

The partnership area is open to government and non-government partners and UNEP welcomes the broadest possible collaboration. In UNEP Governing Council Decision 24/3 part IV paragraph 27, UNEP is tasked with working in consultation with Governments and stakeholders to strengthen the UNEP Global Mercury Partnerships. New activities and partners are encouraged within the UNEP Global Mercury Partnership.

I. Summary of the Issue

- The cement manufacturing process typically involves heating a mixture of limestone ($CaCO_3$) and additive materials-containing silica, alumina, and iron to produce "clinker" which is mixed with gypsum to produce cement. In many countries the primary use of cement is the production of concrete, formed by mixing it with gravel, sand and water.
- The major pathway for mercury releases from the cement industry is via emissions to the atmosphere, in which mercury that is present in the raw materials (e.g., limestone) and/or in the fuel (e.g., coal) is released in the combustion process. It has been estimated that the cement industry contributes an estimated 10% or about 190 metric tons of the estimated total of 1921 metric tons per year of global anthropogenic mercury emissions[1].
- The worldwide average emission factor for mercury from cement kilns is around 35 mg/t cement but the quantity of mercury emitted by different cement plants can vary significantly and is dependent on the amount of mercury in the raw materials and fuels; and the kiln process[2]. The range of mercury emissions from the European cement industry is reported to vary between 0 to 69 mg/t clinker[2]. The major contribution of mercury entering the kiln system is from the natural raw materials rather than the fuels. However, in some specific places the fuel may add significant quantities of mercury into the system. The fuel most commonly used by the cement industry is coal, which is known to have a widely varying mercury concentration.
- Rapid development and strong growth in demand for cement in many emerging markets of the world has led to an unprecedented rate of construction of new cement plants. Thus, the industry may be becoming a more important source of global mercury emissions even while technologically advanced new plants may have lower emission factors.
- The most current European analysis of best techniques for reducing air emissions of mercury from cement plants indicates an approach that controls, as best as possible, the mercury entering the cement kiln system from the raw materials or fuel[3].
- Other techniques for reducing air emissions of mercury are reported, such as dust purging (bleeding) or dust shuttling. Other techniques have not been validated yet in the cement industry for the designated purpose, such as wet scrubber for SO_2 abatement, and activated carbon injection well established in waste incinerator applications. Their possible applications to the cement industry for the designated purpose could be investigated. .[3]

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[1] Document INC2.4, Paragraph 29 study, «Study on mercury sources and emissions and analysis of the cost and effectiveness of control measures», John Munthe, Jozef Pacyna, Simon Wilson, Damian Panasiuk, November 2010.

2 Renzoni, R., Ullrich, C., Belboom, S., German, A. (2010) « Mercury in the Cement Industry », University of Liège, April 2010, Independent report commissioned by CEMBUREAU - CSI http://www.wbcsdcement.org/index.php?option=com_content&task=view&id=219&Itemid=235

[3] «Reference Document on Best Available Techniques in the Cement, Lime and Magnesium Oxide Manufacturing Industries», European Integrated Pollution Prevention and Control (IPPC) Bureau ,European Commission, May 2010.

[3] US Environmental Protection Agency, publication in Federal Register / Vol. 74, No. 86 / Wednesday, May 6, 2009 / National Emission Standards for Hazardous Air Pollutants From the Portland Cement Manufacturing Industry, page 21142.

Objective of the partnership area

The objective of this partnership area is to minimize mercury releases to the environment from cement manufacture.

The partnership area aims to supplement existing programs in key, strategically selected ways to ensure that reductions are globally significant. The partnership area aims to support such efforts while providing additional information on cost-effective approaches for enhancing reductions of mercury emissions.

Setting numerical targets of achievement for the partnership area has not yet been discussed and may not yet be feasible. However, updated inventory information should enable the partnership to make a more advanced assessment of a baseline scenario and project a goal.

Priority actions

1. Establish sectoral mercury inventories and baseline scenarios for the industry.

A. Disseminate information on mercury monitoring techniques and systems applicable to the sector.
B. Support the development and/or improvement of sectoral mercury emission inventories to evaluate both mercury emissions and the effectiveness of emission reduction approaches.
C. Develop mercury emission factors dependent on input material and fuel and process specific factors.
D. Establish accurate database focusing on developing countries and countries with economies in transition.
E. Encourage the inclusion of cement manufacturing in country mercury inventories.

2. Encourage use of most appropriate techniques to reduce or minimize mercury releases into the environment.

A. Identify and establish primary and secondary mercury abatement measures.

B. Provide information and technical assistance on methods to optimize pollution control systems to improve mercury control.

C. Demonstrate most appropriate techniques through pilot projects and installations, especially in developing countries.

3. Increase the awareness of the cement industry to mercury as a pollutant through increased outreach efforts.

A. Develop outreach materials and collaborate with complementary programs to disseminate information about mercury releases from the sector, opportunities to reduce these releases and the experience gained by the industry, including through pilot projects.

B. Capacity building, in order to promote an understanding of techniques that should be used for management and control of mercury emissions.

C. Support the development of policies and regulatory frameworks supporting the objective of the partnership area.

D. Facilitate exchange of information on emerging technologies for existing and new facilities.

II. Partner Efforts and Timelines

The Cement Partnership is still in its organization phase. Therefore the participants from governments, industry, and NGOs are not identified, funding is not secured, nor has finalization of the work program taken place.

At present, there is no consensus amongst the cement industry stakeholders regarding the most appropriate and cost-effective techniques to reduce mercury emissions. Only a very small number of abatement systems have been installed world-wide to control mercury emissions so that current experience is limited. Technologies successfully employed in other industries should, in principle, be applicable to the cement industry but detailed differences between cement manufacturing and other industries are seen to have a dramatic effect on the cost-efficiency and applicability of some technologies. Particular differences of relevance include:

- The primary source of the mercury in cement production is often raw materials, e.g., limestone, rather than fuels. Mercury released from raw materials is volatilized as the raw material is preheated rather than released during a combustion process which is typical of fuel bound mercury. This may result in a much higher percentage of the mercury being emitted as elemental mercury and therefore not soluble in wet scrubbers that are often cited as a multi-pollutant abatement technology when installed as a SO_2 pollution control device. Other multi-pollutant approaches, such as primary dust collection in some locations may also prove effective in reducing mercury emissions from some cement kilns.

- The high levels of dust emitted from a cement kiln system and the recycle of this material back to the kiln must be taken into consideration when installing activated carbon injection systems, as the captured carbon with its absorbed mercury must be collected separately from the main capture of dust.

- In many cement systems where all the kiln gas passes through the raw grinding mill where they are used for drying the raw material, mercury is often condensed on the raw material due to the relatively low operating temperatures. The majority of mercury emissions from these types of plants often occurs during a relatively brief period of time when the raw mill is not operating. This presents the opportunity to either treat the gas at this time or utilize other methods such as “dust shuttling” to remove the mercury from the system during these periods and prevent it from being exhausted with the kiln gas.

These are but a few of the areas that the Cement Partnership could investigate in order to determine the technical and cost effectiveness of various known technologies for which there are little data from existing cement installations.

Future work the partnership may get involved with includes:

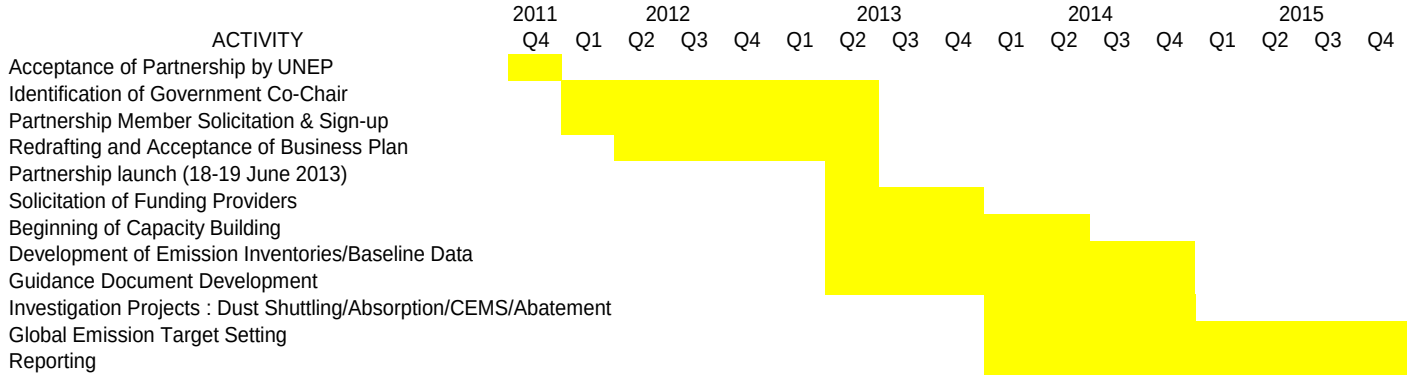
1. Wet Scrubbers: investigate under what conditions in a multi-pollutant abatement scheme control technology for SO_2 could be economically applied to mercury.

2. Absorption Technologies: determine types of sorbents and cost effectiveness of absorption technologies.

3. Dust Shuttling: determine the effectiveness of removing mercury from a cement kiln system by using dust shuttling[4] over a wide range of process conditions.

4. Continuous Emission Monitoring (CEMs): As of 2012, there are a few CEMs for mercury monitoring installed in the cement industry. Past history in terms of reliability, up-time and accuracy, as well as their relatively high cost, have slowed the implementation of this technology's adoption. In the last few years though, there have been significant gains made in this technology that deserve further attention.

A preliminary schedule for Partnership activities could be the following:



III. Opportunities

1. Opportunities for enhancing information/knowledge:

   A. For Emissions Inventories:

      a. Aside from national registries existing in many parts of the world, CEMBUREAU in Europe and PCA in the USA have undertaken specific actions to collect more detailed information on the performance of kilns in regards to mercury emissions. These on-going efforts could help in making preliminary inventory assessments.

[4] Dust shuttling: Mercury adsorption on particles within the dry kiln system naturally occurs when the kiln exit gases are used in the drying of raw material in the raw mill. The raw mill can either be on-line (in operation) or off-line (shut down). When the raw mill is on-line, the gases from the preheater pass through the mill before being collected in the dust collector. The high dust loading and increased contact time between solids and the gas when the raw mill is on-line allow for mercury adsorption on solids before the particulate control device. Volatilized mercury condenses at relatively low temperature (120-150°C) on raw material particles in the kiln system. With the low temperature of the flue gas, mercury will be adsorbed on particles and be collected together with the particles in a particle collection device. The mercury adsorbed on the particles is normally returned to the kiln system with the freshly ground kiln feed in the raw grinding system. With dust shuttling mercury enriched dust is removed from the kiln system, typically when the mill is not running.

b. In 2012, the CSI revised its guidelines for reporting and monitoring air emissions from cement kilns. The revised guidelines are recommending annual (or bi-annual in the case of proven low emitting kilns) testing for kilns. As the CSI now represents almost 40% of cement capacity from all areas of the world, regular testing of cement kilns will greatly enhance the ability to better understand emission inventory levels.

B. Specialist assistance could be provided to allow the production of up to date emission inventories in target regions. This would include, where necessary, help with mercury measurement in both coals and stack gas emissions. Guidance could also be given on how to include current and impending emission legislation and control technology application in future emission estimates.

2. One of the primary opportunities for the Cement Industry Partnership is to add value by providing a forum of exchange between the cement industry, member states, and NGOs in regards to the establishment of guideline emission limits. Many of the less sophisticated (and less costly) control techniques for mercury in the cement industry are not well known and have not been widely adopted. Therefore discussions of emission limits often start with divergent views from industry, regulators, and other stakeholders. Development of a more common viewpoint may help in the speed of implantation and adoption of many of these techniques which can lead to real emission reductions.

IV. Evaluation

The partnership areas will report biannually to UNEP in accordance with the UNEP reporting format[5]. Reporting will include monitoring performance (tracking partnership activities and partner contributions) as well as assessing effectiveness (measuring the impact of partnership activities on target beneficiaries).

Amongst other means, results will be characterized in terms of:

- Expanding the knowledge base of effective tools for managing and reducing mercury emissions from cement plants.
- Availability of guidance tools to assist countries in achieving emission reductions.
- Emission reductions achieved.

V. Resource Mobilization

Partnerships and the associated business plans are a way of mobilizing funding in a systematic, focused and harmonized way. The Partnerships' objectives and business plans should provide clarity for potential donors and finance institutions. The business plans should encourage and