

To: Member Secretary
Tamil Nadu Pollution Control Board
76, Anna Salai, Guindy
Chennai 600 032

10 December 2015

Sir:

Enclosed are my comments on the proposed remediation of the mercury contaminated site of M/s Hindustan Unilever Ltd in Kodaikanal. I have based my comments on a study of the following reports.

1. Report of ERM 2006 Site Specific Target Levels
2. NEERI report 2007 - techno-commercial viability excavation to 30 cm - burrowing organisms, microbial colonies, methylation
3. IIT Delhi report 2010 on site specific clean up levels Quail/sparrow
4. CSWCRTI-Udhagamandalam 2010 report on soil conservation
5. NBRI Lucknow 2010-2011 report on Plant Protection Measures discrepancy between NEERI report which recommends removal up to 30 cm, and NBRI which advises caution in removing soils from certain steep slopes.
6. NEERI 2015 - Assessment of mercury levels from off-site areas

Additionally, I have also glanced through the two basic documents prepared by URS Dames & Moore in 2001 and 2002, both of which are available in the public domain.

Overall Comments:

- All reports presented to me seem to have been sponsored by M/s HUL, the party responsible for the pollution. An independent verification would have vastly enhanced decision-making.
- Mercury is a dynamic substance that is affected by the environment to change forms into organic and inorganic compounds. All three forms - metallic, inorganic and organic - have well-documented toxic effects. The studies presented do not adequately reflect this aspect of mercury. Barring the 2001 and 2002 studies, none of the other studies present comprehensive data on mercury speciation and methylation. This is serious flaw needs to be rectified before a meaningful conclusion can be drawn on a clean-up level that will be protective of environment and human health.
- I was unable to find any information on the acidic-alkaline condition of the soil on site and in the vicinity. The pH of the soil has a direct bearing on the speciation of mercury. This in turn has a bearing on the bioavailability and toxicity of mercury. The absence of this basic information questions the reliability of the methodology used to arrive at the Site Specific Target Level.
- The 2001 and 2002 data seem to have a massive discrepancy in the mercury balance. The 2002 data seems to have accounted for an additional 10.8 tonnes of mercury input. This is too significant a discrepancy to be explained away by a purely mathematical

accounting exercise unsupported by fresh environmental assessment. The entire exercise would be better informed by an up-to-date and impartial study into the exact extent (spread and depth) and nature (speciation and presence across different media) of mercury contamination.

- The 2002 report claims that 1.3 tonnes of mercury has been discharged to the Pambar Shola environment, mostly as air emissions. It is well known that significant life activity within the shola happens at the upper canopy level. All studies presented only deal with ground-level mercury and impacts, and no attention has been paid to arboreal movement and dynamics of the toxin.
- As a biologist and ecologist, I was interested in information relating to mercury levels in relevant food chains. The reports sent to me do not contain any such information. Mercury is known to accumulate in aquatic food chains. In settings such as in Kodaikanal, mercury can also be found in high levels in moss and lichen, and in hard-shelled invertebrates like cicadas. Analysis of food chains that involve these life-forms are absolutely essential to understand or rule out the impacts that mercury may already be exerting on the environment. Assessment in litter and the consequent impregnation in the detritus cycle and soil organisms like the earthworms need to be reported as earthworms are known to bio-accumulate some heavy metals.
- Finally, the fact that the contaminated factory site is surrounded by ecologically sensitive and protected ecosystems such as Pambar Shola and Bombay Shola, both of which are part of the hydrologically sensitive Kodaikanal Wildlife Sanctuary, is not reflected adequately to estimate clean-up levels.

Specific Comments

1. Report of ERM 2006, Site Specific Target Levels

The target levels have been calculated with reference to protection of human health; and without regard to protection of ecological values. In an urban setting, this may be excusable and even justifiable. However, this factory is located within an ecologically sensitive area with several ecosystem components.

- a) Shola ecosystem - From an ecological perspective, shola systems are extremely sensitive. Soil microflora and fauna that breakdown leaf-litter constitute the bulk of the ground-level substrate in such a system. Given that such micro-organisms constitute keystone species in the shola environment, the toxicity of mercury to such organisms ought to have been studied but has not been taken into account. The target level of 20-25 mg/kg may harm soil microbes. (See "Effects of mercury on soil microbial communities in tropical soils of French Guyana" Harris-Hellal, J., Vallaey, T., Garnier-Zarli, E., Bousserhine, N. [Applied Soil Ecology](#), 41 (1): 59-68, 2009)

- b) Aquatic ecosystem – The report establishes that Pambar Shola ecosystem and Pambar River systems are subject to mercury loading primarily via sediment-bound mercury from the factory site. However, this report does not evaluate the risks to aquatic food chain due to the migration of mercury from the factory site through sediment-bound run-off even though exceedingly high levels (up to 330 mg/kg) of mercury has been reported in sediments. (“Studies of mercury pollution in a lake due to a thermometer factory situated in a tourist resort: Kodaikkanal, India” Karunasagar D, Balarama Krishna MV, Anjaneyulu Y, Arunachalam J. *Environ Pollut*, 143(1):153-158, 2006)

2. NEERI report, 2007

This report is not worth commenting on from an ecological point of view for a number of reasons. The report cannot be relied on as a scientific document for ecological protection because of the following statement: “techno-commercial aspects are also to be considered. . .The benefits likely to accrue out of stricter norms are to be compared against the additional cost [to M/s HUL] that may be incurred while undertaking such projects.”

As a soil scientist, I cannot emphasise enough the importance of soil ecology particularly with regard to mercury whose residence in soil is the starting point for its mobility into the environment and various life-forms affecting every aspect of abiotic and biotic environment.

3. IIT Delhi report, 2010, on site specific clean up levels

This report attempts to assess ecological toxicity, but is not site-specific. Neither does it inform mercury's behaviour in this specific environment. Quails are a terrestrial bird species. But sediment-bound mercury from the HUL site is leaking into the aquatic ecosystems downstream. The use of “Terrestrial Toxicity Reference Values (TRVs), Manual: ERD-AG-003, 04/06/99) seems inappropriate. Instead, HUL's consultant should have referred to “Aquatic Toxicity Reference Values (TRVs), Manual: ERD-AG-003, 11/08/99) which lists a sediment toxicity reference value for mercury of 0.15 mg/kg.
https://clu-in.org/download/.../Toxicology/DOE_SW_tox_valuep76.pdf

Also, the report ought to have considered piscivorous fauna prevalent in the region. Given the findings that confirm that mercury has and is migrating off-site, the target species should not be restricted to those that feed exclusively on the site. The ecological toxicity assessment to my knowledge therefore seems without relevance.

4. CSWCRTI-Udhagamandalam, 2010, report on soil conservation & 5. NBRI, Lucknow, 2010-2011 report on Plant Protection Measures

These reports recommend that no excavation be carried out in certain steeply sloping areas. In such case significant levels of mercury contamination are to be assessed in those areas as well. The other reports that detail remediation measures do not explain how these sites will be remediated without excavation. This would mean that a significant amount of mercury in the steeply sloping areas will be allowed to remain as it. This is unacceptable and ecologically destructive.

6. NEERI, 2015 – Assessment of mercury levels from off-site areas

This report is significant as it finds mercury at or above levels of concern in three out of five sediment samples collected from the vicinity of the HUL factory.

LP1: 0.507 mg/kg

PS1: 0.353 mg/kg

LP5: 0.228 mg/kg

The amount of mercury in these three samples are above background levels which should be below 0.1 mg/kg – Seven sediment samples taken from relatively distant sites show below the detection limit of 0.1 mg/kg.

In Section 8.0 “Observation and Conclusion,” NEERI states: “Even in the Levange Path area, the concentrations of mercury were well below the risk-based target remediation levels of 20 mg/kg derived and validated through various studies.”

This appears unscientific, and underscores my earlier point about the need for independent studies as against the current situation where decision-making relies solely on data and conclusions offered by HUL. The risk-based remediation level of 20 mg/kg is set for mercury in soil, not sediment. Mercury in sediments can pose an altogether different and higher risk to aquatic life because of its greater tendency to convert to methyl mercury and the greater exposure that aquatic life (including piscivorous animals) have to mercury in sediments as opposed to mercury in soils.

Finally, all readings of mercury in sediment are spot values. It is well known that in terrains such as the Palani Hills, just three to four rain events can account for 30 to 40 percent of the sediment transported out of a catchment. Considering this, it would be unwise to come to any hurried conclusion about the post-remedial integrity of the site without a long-term study with a continuous assessment of movement of sediment-bound mercury at least during the seasons with most intense rainfall.

Conclusion:

Overall, I observe the assumptions in the reports provided to me to be unsatisfactory. The data, methods and target specie considered do not allow for a confident conclusion that remediation as proposed will render the site safe for human and non-human users on and off-site. The absence of emphasis on methyl mercury, and the implicit assumption that metallic mercury will not methylate, is a fatally flawed premise in these studies. It is unclear why more stringent target levels cannot be proposed when technologies are available to reduce mercury levels to background concentrations.

Recommendations:

- Given the massive discrepancies in mercury balance between 2001 and 2002 - nearly 10.8 tonnes of mercury input - a fresh independent rapid time limited study to assess mercury contamination is warranted.
- The study should pay particular attention to mercury speciation, and mercury presence in various media including various components of relevant food chains.
- Site-specific target levels have to be arrived at by assessing risk to piscivorous organisms such as kingfisher. If the Board believes that much time will be lost in conducting such assessment, it should apply the precautionary principle and set the target to less than 1 mg/kg.
- Remediation techniques for steeply sloping areas should be considered keeping in mind the undesirability of excavation in those areas.
- Because of the proximity of forests with multi-tiered biomass, and because mercury forests transform mineral mercury to methyl mercury, it is important to have a long-term post-remediation study paid for in advance with clear terms of reference, identified media for sampling, and protocol for protective actions when findings warrant such action.

Sincerely,

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