Project information

Project title

Emission, Exposure and Effects of Cyclic Siloxanes in Tromsøysund

Year

2013/2014

Project leader

Nicholas Warner, NILU

Participants

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Flagship

Hazardous substances, Theme: The effects of contaminants and climate change on human health, indigenous peoples and Arctic communities

Funding Source

Fram Centre, NRC

Summary of Results

This project's objective was to help support analytical method development for the analysis of cyclic volatile methyl siloxanes (cVMS) within water and sediment for the NRC funded project NORDIC-LACS (Nordic Lake exposure to Cyclic Siloxanes: Assessment of transport, distribution, and fate; project number 22259) under the Mijø2015 program. These developed methods would then be applied to Tromsøysund to assess emissions and exposure to cVMS in as elevated concentrations within biota from this area.

This project implemented the technique of headspace analysis for the detection of cVMS in water matrices. Two modes of headspace analysis were assessed a) static headspace and b) dynamic headspace.

Static headspace method was established during this project where detection limits between 6-10 ng/L (parts per trillion) were achieved for cVMS investigated (e.g., D4, D5, and D6) (Figure 1.). Greater variability was observed in repeated measurements of D6. However, this may be attributed to contribution from headspace vial septa which are known to contain cVMS. Background variation in cVMS levels were also found to vary based on glass vial batches received from the instrument manufacturer. Pre-heating all headspace septa and glass vials has greatly improved the reproducibility between replicate measurements and helped lower background concentrations. This method has now been implemented into NILUs analytical services and is currently being used on several projects for the Norwegian Environmental Agency.

Dynamic headspace technique was also assessed in attempts to improve upon detection limits achieved by static headspace. In this technique, gas phase above the sample is continuously swept and concentrated on a sorbent trap in order to improve signal to noise ratio for analytes at lower concentrations. However, high background levels occurred with the dynamic headspace compared to the static headspace method. This higher background appears to be originating from sorbent traps that have been commercially produced. Various sorbent traps were assessed but their performance was considerably less compared to the static headspace method (Figure 2).

Due to delays in the project (late arrival of necessary equipment and principal investigator on paternity leave) the method development of the extraction of cVMS from sediment is not yet complete but is currently underway. Due to these delays, field sampling and sample analysis in Tromsøysund could not be completed in 2013 and will commence in late winter/early spring of 2014.

In vitro toxicity measurements for this project, which were in cooperation with UiT's Flaggskipp project WP2.11 (*Effects of organophosphourus flame retardants in benthic and pelagic Arctic fish species*), has been delayed due to problems in implementing the methodology at UiT. Trial experiments have recently been completed and are awaiting results from international partners (WHOI).

For the Management

The results from this project have established a method capable of analyzing trace levels of cVMS in water. Very little reliable information exists regarding water concentrations of cVMS as concentrations within this matrix are very low and often influenced/affected by background contamination. This has resulted in a knowledge gap regarding partitioning behavior and exposure of cVMS through water matrices. The method developed under this project have provided a means to answer this knowledge gap and is currently being applied to investigate cVMS contamination in various water matrices (e.g., lake water, wastewater, agricultural run-off) in several projects for the Norwegian Environmental Agency (e.g., URBANFJORD, STORE INNSJØRER)

Although this project has focused on cVMS, methods developed can also be applied to other contaminant classes that are of emerging interest within Nordic regions. In separate collaboration with UniLab Analyse, this technique has also been applied to measuring oil

components within water matrices. As oil exploration activity continues to increase in Nordic regions, such techniques will be valuable for exploring the potential environmental impacts of this type of industrial activity.

Published Results/Planned Publications

- Journal Article: Ingjerd S. Krogseth, Nicholas A. Warner. *Comparison of static and dynamic headspace extraction techniques for the analysis of cyclic volatile methyl siloxanes in water (in preparation)*
- Conference abstract: Ingjerd S. Krogseth, Nicholas A. Warner, Knut Breivik, Mick J. Whelan, Anita Evenset, Guttorm N. Christensen. *Nordic lake exposure to cyclic siloxanes*. SETAC Europe. Basil, Switzerland. May 11-15, 2014
- Conference abstract: Ingjers S. Krogseth, Nicholas A. Warner. *Extraction of cyclic volatile methyl siloxanes (cVMS) from sediment matrices using headspace extraction*. SETAC North America, Vancouver, British Columbia, Canada. November 9-13, 2014.

Communicated Results

None

Interdisciplinary Cooperation

- This project incorporated a combination of both chemistry (analytical method development) and toxicology (*In vitro* toxcity testing). However, due to problems with implementation of *In vitro* methods for toxicity measurements, the project did not benefit from this cooperation. However, if these methods can be implanted, they will more toxicity data on cVMS exposure, which is extremely lacking within the literature.

Budget in accordance to results

The budget is in accordance to the results obtained from the project. Funding from the Fram Centre aided in providing financial support for research hours to develop a method for the analysis of cVMS in water matrices. This was a key objective for not only this project but also the NRC funded project ,NORDIC-LACS. Although a method for water analysis of cVMS was completed, method development for analysis of cVMS in sediment by headspace extraction is still currently underway. This is due to delays in the project timeline (late arrival of necessary equipment (May 2013), principal investigator being on paternity leave between September 1, 2013 - November 1, 2013) resulting in the completion of sediment extraction method, field sampling and sample analysis of Tromsøysund being delayed until 2014.

The Flaggskipp funding has helped relieve costs of research hours that would have been applied to the NFR project. This will aid the NFR project to be more flexible and pursue additional research objectives.

If Yes

The static headspace method developed under this project has been incorporated into NILUs analytical services it offers to customers/research partners. It is an excellent tool for rapidly screening/quantifying water samples for various volatile and semi-volatile contaminants. The extraction technique is fully automated and incorporated into the instrument detector allowing for direct analysis without sample cleanup. This method is currently being applied to several projects for the Norwegian Environmental Agency (e.g., URBANFJORD, STORE INNSJØRER)

Conclusions

- Future research will investigate ways on how to minimize background contamination from the sorbent traps that were commercially purchase. Attempts will be made into exploring preparing specialty sorbent traps in collaboration with the sorbent trap provider to make traps which are more appropriate for cVMS analysis. Research will also continue to develop a headspace method for the extraction of cVMS from sediment.
- Techniques that have been developed under this project is "static headspace extraction of cVMS from water matrices"