OCCURENCE OF ANTIMONY IN SOIL AND GROUNDWATER AT FORMER SHOOTING RANGES

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Background: Up until 2014, site investigations at military shooting range locations in Denmark have focused on lead as the primary contaminant of concern. Studies of sampling and analytical practice in other NATO countries have identified antimony as a contaminant of possible concern. Currently, Denmark has no quality criterion for antimony in soil or groundwater, which presents problems with respect to the drivers for site investigation and risk assessment.

Prior to site remediation at three shooting range locations, the Danish Defense have analyzed soil and groundwater samples in order to assess the occurrence of antimony. Subsequently, site remediation has been performed based on findings from the site investigations including the screening for antimony and the final risk assessment.

The site investigations have provided information on the presence of both lead and antimony as critical contaminants at former shooting range locations.

Aim: The aim of this presentation is to present recent studies on the occurrence of antimony in soils and groundwater at former military shooting ranges in Denmark. The presentation will include information concerning projectiles and activities that form the basis for the occurrence of antimony at shooting ranges, a correlation between the presence of both lead and antimony, and a comparison with contaminant levels at similar sites in other countries.

A secondary aim of the presentation is to highlight the process (focus on communication with environmental authorities) involved for site remediation if no national quality criteria are derived. The process requires the derivation of clean-up goals and approval by the environmental authorities based on documentation of the risk assessment process.

Relevance: The presentation may be relevant to administrative personnel (national regions, environmental authorities etc.), consultants, entrepreneurs and others involved in site investigation and remediation at shooting range locations.

Project: The project has included a literature study on the occurrence of antimony at shooting range soils, including a correlation for the presence in the soil of both lead and antimony (no national data existed).

Pre-investigations, including discrete soil and groundwater sampling, prior to site remediation, at three Danish shooting range locations have been performed in order to assess the occurrence of antimony. At the three locations, antimony was found in top soil in concentrations up to 515

mg/kg DW, 265 mg/kg DW and 12 mg/kg DW, respectively, and lead was present in concentrations up to 18,600 mg/kg DW.

As a significant supplement to the discrete soil sampling, Multi Incremental Sampling (MIS®) has been used to estimate average contaminant concentrations in target areas.

Groundwater samples have been collected from screened intervals in wells in the target area. Antimony concentrations in groundwater (ranging from non-detects to 2.2 µg/l) have been compared to the average antimony concentrations in soil in target areas illustrating the potential for leaching of antimony to the groundwater.

Based on these investigations, risk assessment has been performed in order to evaluate the potential risks to human health due to soil contact and on groundwater quality.

In relation to site remediation at the three specific shooting range locations, a proposal for a soil criteria for antimony has been prepared. The Danish EPA has undertaken to publish by early 2015, a national Danish soil and groundwater criterion for antimony which will be included in the presentation.

The presentation will also include data from the three site remediations, including the procedure for clean-up documentation.

Conclusion: Antimony and lead do co-exist in soil at shooting range locations. As the bullet core consist of 92-95% lead, 2-5% antimony and traces of other metals, contaminant concentrations at shooting range locations will be dominated by lead, but antimony can be a significant contaminant.

The mobility of antimony due to leaching from contaminated soil is greater than the mobility of lead, however both contaminants are strongly adsorbed to soil particles and transport in the unsaturated zone is thus greatly retarded.

Nevertheless, groundwater concentrations of antimony have been documented, indicating that the leaching of antimony does occur, although the calculated vertical transport times are very low.

For future investigations at shooting range locations, it will be relevant to sample for antimony, especially in relation to the pending national Danish soil and groundwater criteria for antimony.