USE OF COMPOUND SPECIFIC ISOTOPE ANALYSIS TO DIFFERENTIATE SOURCES OF INDOOR AIR CONTAMINATION

Daniel Bouchard[1]; José Carlos R. Gouvea Jr.[2]; James K. Henderson[3]

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Abstract

The use of Compound Specific Stable Isotopes (CSIA) in environmental applications is well known, and typically centers on verifying biodegradation or lending a forensic component to environmental assessments (i.e., determining ownership of releases). Following successful CSIA applications on volatile organic compounds (VOC) dissolved in groundwater, there is increasing interest in the use of CSIA to assess VOC in gas-phase, such as to evaluate vadose zone attenuation processes and the potential differentiation of sources of indoor air contamination. New methodologies for collection and analysis of vapor-phase samples from the indoor air are presented. Potential applications and field studies will be summarized, as well as their potential relevance and use in Brazil.

Resumo

O uso de Isótopos Estáveis para Compostos Específicos (CSIA) em aplicações ambientais é bem conhecida, e, normalmente, gira em torno de verificar a biodegradação ou avaliar forensicamente um composto (isto é, determinar o proprietário da contaminação). Após aplicações bem sucedidas de CSIA em compostos orgânicos voláteis (COV) dissolvidos em águas subterrâneas, há um interesse crescente na utilização de CSIA para avaliar VOC em fase gasosa, tal como para avaliar os processos de atenuação na zona vadosa e o potencial de diferenciação das fontes de contaminação do ar interior. Novas metodologias para coleta e análise de amostras em fase de vapor a partir do ar interior ambiente são apresentados. Aplicações potenciais e estudos de campo serão resumidos, assim como a sua relevância e potencial uso no Brasil.

[1] Centre d'Hydrogéologie et de Géothermie, University of Neuchâtel (Switzerland), 1 450 463-5432, daniel.bouchard@unine.ch
[2] Companhia Siderúrgica Nacional, Rodovia Lucio Meira s/n, Volta Redonda RJ, Brasil tel.: 55 24 3344 4999, jose.gouvea@csn.com.br
[3] DuPont do Brasil, Al. Itapecuru 506, Barueri SP, Brasil tel. 55 11 9 9110-2817, James.K.Henderson@dupont.com

1- INTRODUCTION AND OBJECTIVES

Compound Specific Stable Isotopes (CSIA) is commonly used in environmental sciences as a technique to verify biodegradation or forensic environmental assessments in order to determining ownership of releases. This work involves developing and testing methodology centering on differentiation of indoor-air sources of contamination using stable isotopes. A simple and innovative sampling device to collect VOC from the gas phase in view to perform CSIA was developed.

2- RESULTS AND CASE STUDY

Contrasting with common solid matrix adsorbing the VOC, the proposed sampling device uses an organic solvent to dissolve the VOC. Laboratory experiments were first carried out to evaluate the VOC dissolution efficiency in solvent during constant air flow injection, to identify suitable solvents (solvent volatility, VOC solubility) and to confirm reproducible isotopic measurements on selected VOCs (benzene and trichloroethene).

After successful preliminary results, the performance of the sampling method was evaluated during an experiment performed in a former industrial building. A TCE liquid source with known isotopic composition (δ13C and δ37Cl) was used to create a gas-phase plume inside an isolated room. The room air was sampled using the solvent-based method, which consists of pulling the ambient air through the solvent. During transition in the solvent, gas-phase VOC is dissolving and accumulating. Results are compared to Summa canisters used as the reference method. The δ13C value for TCE showed excellent agreement between the two sampling methods. Furthermore, the δ13C and δ37Cl values measured for the TCE sampled with the solvent method were similar to the source values.

3 - CONCLUSION

The field investigation proved the reliability of the method to link gas-phase TCE to its emitting source. The reliability and the practicability of the solvent-based dissolution method hence offer an attractive alternative sampling method to classic sorption tube

method. More importantly, the innovative sampling method simplifies the tasks related to analytical measurements; strengthen confidence results, while keeping the field application procedure simple. Consequently, the proposed sampling method is likely to contribute expanding the use of CSIA to gas-phase contaminants.