

Evaluation of styrene from solid-phase extraction cartridges used for on-site urine sampling

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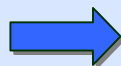
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Introduction

The urinary excretion of unmetabolized styrene can be a very good indicator for biomonitoring styrene in occupationally exposed people [1].

A method using solid-phase extraction combined with GC-MS has been developed. The variables affecting the styrene recovery have been studied [2].

The method could offer the possibility of extracting styrene from urine using an on-site sampling device easily transported to the laboratory for further analysis.

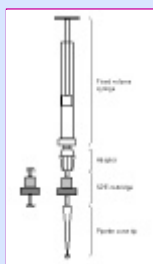


Objectives

- Evaluate the analytical performance of the method
- Study the analyte stability in SPE cartridges and compare with stability in urine matrix
- Study the adequate storage conditions

Experimental

Collection of urine samples and SPE procedure



| | | |
|---|----------------------------------|--|
| 1 | OASIS HLB Cartridge conditioning | 3 mL ethyl acetate 3 mL methanol 3 mL water 4 mL |
| 2 | Urine sampling | 4 mL |
| 3 | Cartridge washing | 2 mL water |
| 4 | Solvent elution | 1.5 mL ethyl acetate at 0.5 mL/min Anhydrous sodium sulfate CG HP6890 – MS HP5973 |
| 5 | GC-MS analysis | HP1-MS 50mx0.25mmx1mm Helium, 1.2 mL/min Splitless, 1 mL sample Inlet temperature, 120 °C Oven temperature, 120 °C Acquisition mode, SIM, m/z 104 |

Study of styrene stability

- Urine from unexposed people spiked with styrene in three concentration levels
- Stability was evaluated as the ratio R of the mean values from the measurements at each of the three storage times to the amount of spiked urine

Number of urine samples studied of each storage condition

| Concentration level [2] | Storage time (days) | | | | | |
|-------------------------|-----------------------------|---|----|----------------|---|----|
| | SPE cartridges (ambient T°) | | | Vials (-18 °C) | | |
| | 1 | 7 | 30 | 1 | 7 | 30 |
| 100 ?g/L | 8 | 8 | 8 | 8 | 8 | 8 |
| 25 ?g/L | 8 | 8 | 8 | 8 | 8 | 8 |
| 5 ?g/L | 8 | 8 | 8 | 8 | 8 | 8 |

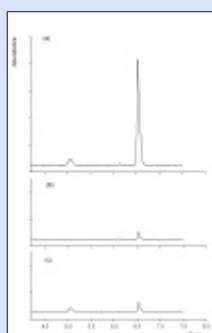
Results and conclusions

Precision, accuracy and detection limit of the method

| Styrene concentration in spiked urine samples | | |
|---|----------|-------|
| 100 ?g/L | 4.4 ?g/L | |
| 82.2 | 4.4 | |
| 105.3 | 4.5 | |
| 93.5 | 4.6 | |
| 98.4 | 4.4 | |
| 102.8 | 4.2 | |
| 89.8 | 4.5 | |
| Mean | 95.3 | 4.5 |
| RSD% | 9.03 | 5.31 |
| OU * | 21.9 | 12.19 |

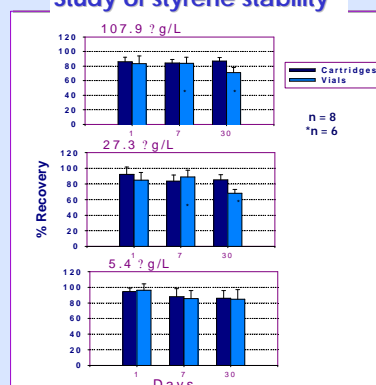
$$*OU = \left(\frac{\bar{X} - X_{\text{true}}}{s} + 2s \right) / (X_{\text{true}}) \times 100 [3]$$

- Detection limit: 2.2 ?g/mL of styrene in urine for a 4-mL sample
- Sampling higher volume of urine can increase the sensitivity



Mass chromatograms of m/z 104 obtained from standard urine samples:
(a) 4 mL of a 100 ?g/mL styrene solution
(b) 4 mL of 4.4 ?g/mL styrene solution, and
(c) 8 mL of 4.4 ?g/mL styrene solution

Study of styrene stability



- There is no statistically significant differences between the recoveries obtained for styrene from cartridges at the three storage periods in the range of styrene concentrations studied
- Styrene recoveries from vials, for the 107.9 and 23.7 ?g/L concentration levels, are statistically different
- The differences arise from the recoveries obtained after 30 days of storage, which are lower for vials

- Changes in styrene concentration, with respect to one-day recovery value, were between 14 and 20%
- Results of the present study have shown that SPE cartridges are also a good alternative to storage of the urine matrix. No significant loss of the compound was observed after 30 days of storage at room temperature

[1] M. Imbriani, S. Guittori. Int. Arch. Occup. Environ. Health 78 (2005) 1-19

[2] C. Prado, P. Marín, P. Simon, J.F. Periago. J. ChromatogrB, in press, 2005

[3] Adopted European Standard. Workplace atmospheres - General requirements for the performance of procedures for the measurement of chemical agents. EN482. 1994.