



Analysis of Volatile Organic Compounds in Indoor Air

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INTRODUCTION

• Volatile organic compounds (VOCs) are a cause of concern for human health due to their increased presence in the indoor environment.

• They are responsible for a phenomenon known as the sick building syndrome (SBS).

• Air monitoring is being used to assess indoor pollution.

• Solid phase extraction (SPE) procedures are used extensively for trapping and removing VOCs from indoor air.



AIM

• The aim of this work is to develop a method for the determination of the VOCs toluene, ethylbenzene, o-xylene and cumene (TEXC) in air. VOCs are extracted using solid phase extraction cartridges and the extracts are then analysed and quantified using a gas chromatograph with flame ionisation detection (GC-FID).

SPE Procedure

- The cartridge was conditioned and washed with 3 mL of methanol.
- The system was then equilibrated with 3 mL of 50:50 solution methanol:water.
- 3 mL of a standard solution containing $100 \mu\text{g mL}^{-1}$ of all analytes in methanol:water were loaded onto the cartridge.
- The analytes were eluted with 3 mL of dichloromethane (DCM) into a 5 mL volumetric flask.
- 100 μL of a dichlorobenzene (DCB) external solution was added to the extract giving a DCB concentration of approximately $80 \mu\text{g mL}^{-1}$.
- The extract was analysed and quantified using GC-FID.
- The cartridges that were used during the SPE method were Waters C18 cartridges and Anasorb CSC coconut shell charcoal cartridges.

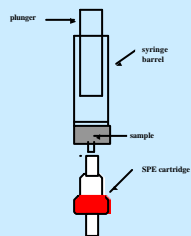


Figure 1: A schematic diagram of the SPE apparatus.

INSTRUMENTATION

PERKIN - ELMER 8500 Gas Chromatograph
PERKIN - ELMER GP - 100 graphics printer



RESULTS AND DISCUSSION

• Standard solutions of different concentrations containing all analytes and DCB in DCM were prepared in order to investigate the linear calibration range. The GC response was found to be linear up to $400 \mu\text{g mL}^{-1}$.

• The minimum elution volume of DCM required to desorb all of the analytes from the sorbent was found to be 3 mL.

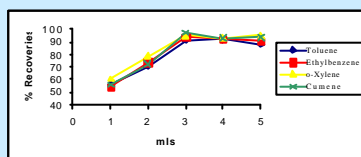


Figure 3: Recoveries for analytes using Activated Charcoal cartridges in different elution volumes.

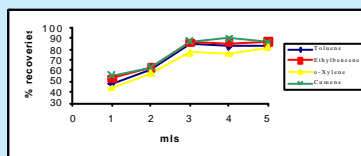


Figure 4: Recoveries for analytes using C18 cartridges in different elution volumes.

• The SPE method was found to be precise at the optimum conditions by performing 4 replicate extractions.

Table 1: Recoveries for all analytes using C18 cartridges.

Analyte	% Recoveries			
	91	92	88	92
Toluene	91	92	88	92
Ethylbenzene	93	91	90	94
o-Xylene	98	91	96	96
Cumene	92	92	96	94

• Cartridges were found to be reliable even after repeated use. Recoveries of approximately > 90 % for each analyte were obtained for cartridges used 10 times previously. After each experiment cartridges were cleaned by washing with DCM.

• Stability of the VOCs retained in the SPE cartridges was investigated over time. Immediately after preparation, the analyte recoveries were approximately 95 % and 85 % for C18 and activated charcoal cartridges, respectively. In room temperature significant loss of analytes was obtained for both cartridges. Even when the cartridges were stored at -4°C , recoveries of approximately 60 % were obtained after 30 days suggesting that new methods of storage will have to be developed.

Table 2 : Recoveries of analytes for cartridges stored in -4°C .

Analytes	% Recoveries					
	C18 Cartridges			Activated Charcoal Cartridges		
	after 1 day	after 2 days	after 30 days	after 1 day	after 2 days	after 30 days
Toluene	92	88	56	72	64	47
Ethylbenzene	95	90	63	76	68	51
o-Xylene	99	95	65	60	58	43
Cumene	100	96	75	80	73	60

Table 3 : Recoveries of analytes for cartridges stored in room Temperature.

Analytes	% Recoveries			
	C18 Cartridges		Activate Charcoal Cartridges	
	after 1 day	After 2 days	1 day	after 2 days
Toluene	85	81	54	48
Ethylbenzene	89	83	58	57
o-Xylene	93	91	45	44
Cumene	94	92	62	60

CURRENT AND FUTURE WORK

• The SPE procedure developed in this work is currently being assessed for analytes in the vapour phase. An environmental chamber has been constructed to obtain VOC contaminated air, and an active sampling pump is used to draw the air over the C18 and activated charcoal cartridges.

• Remedial technologies are also being addressed. New crystalline silicates are being designed, synthesised and tested for the removal of VOCs from contaminated air.

