Optical fibre detector for alcohols

M. Senthilraja

Industrial facilities that use volatile organic compounds can prevent their vapours from leaking outside using appropriate trapping technology. But, they face an almost impossible battle to restrict them within their facilities. It is inevitable that vapours will escape into the air and place workers at risk by inhalation, ingestion or skin contact. However, there is a multitude of detection devices designed to monitor the indoor air quality and help maintain safe levels of pollutants.

One type of environmental analyser that has been gaining popularity is that based on optical fibres. These have demonstrated good durability, safe and sensitive operation, and have been deployed with an assortment of detection systems such as reflection from polymeric films, fluorescence from dye coatings and surface acoustic waves. In this area, Portuguese scientists have developed a polymer-coated optical fibre as a detector for a gas chromatograph for the specific detection of volatile alcohols that are encountered in the industry. It is based on the variation in optical signals from the fibre as the alcohols are adsorbed. Overexposure to low molecular mass alcohols such as the isomeric butanols and pentanols causes irritation to the eyes and throat, nausea, dizziness and even depression. Hence it is important that their airborne concentrations are kept to a minimum.

Silva *et al.*[1] from the University of Aveiro and the Instituto Piaget in Viseu, Portugal, used an optical fibre coated with poly[methyl(3,3,3-trifluoropropyl)-siloxane]. The fibre was positioned in a glass tube and aligned with an outlet of a gas chromatography capillary column, which was placed at the opposite end of the tube. A laser diode was used to illuminate the fibre and a photodetector to measure the changes in intensity of the optical signal in the visible region at 658 nm. This simple device was tested with a standard solution of nine alcohols (allyl, *n*-propyl, sec-butyl, isobutyl, *n*-butyl and isoamyl alcohol with methyl isobutyl carbinol, cyclohexanol and diacetone alcohol). With a Supelcowax column, 30 m long and 0.32 mm in internal diameter, the alcohols were well separated with retention times from 1102 to 1432 s.

In general, the optical fibre sensitivity increased in the order of the individual alcohol boiling points. However, the response for diacetone alcohol was lower than expected. This was attributed to the fact that the compound is a ketone as well as an alcohol. Other variations within the general trend were explained by changes in the respective vapour pressures. A comparison with the results from a Flame Ionization Detector (FID) revealed that the methods could not be statistically differentiated. The detection limits were of the same order of magnitude, although the optical fibre values were slightly lower than the FID values. For instance, those of allyl alcohol and cyclohexanol were 0.67 and 0.73 μg using the optical fibre, and 0.90 and 0.99 μg using FID. The analysis times were both about 24 min.

The technique was used to analyse five air samples collected from a confined environment in a facility for the Portuguese solvent industry by adsorption on coconut-shell charcoal. The alcohols were desorbed with 5% isopropanol in carbon disulphide, both components being shown not to interfere in the analysis. For all nine alcohols, the levels were found to be below recommended NIOSH limits, the optical fibre and FID values being similar. Although there appear to be no performance advantages of the optical fibre detector over the FID, the researchers pointed out that the former is far less expensive and easy to operate. In addition, its ready amenability to miniaturization could lead to remote *in situ* monitoring of industrial atmospheres, freeing personnel and removing them from potentially risky areas of the facility.

1. Silva, L., Rocha-Santos, T. and Duarte, D., *Talanta*, 2008, **76**, 395–399.

M. Senthilraja is in the Department of Pharmaceutical Analysis, J.K.K. Natarajah College of Pharmacy, Natarajapuram, Salem Main Road, Komarapalayam 638 183, India.
e-mail: rajdanish2k@gmail.com