Use of a Centrifugal evaporator to increase productivity in toxicological hygiene and occupational health screening

POLLUTION MONITORING

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Screening of humans for exposure to toxic pollutants in the environment is an important facet of Occupational Health & Hygiene. The wide prevalence of trace levels of polyaromatic hydrocarbons (PAHs) and polychlorinated biphenyls (PCBs) from industrial processes means that in the Western world, screening for levels of these agents is becoming increasingly important. As well as broad epidemiological data, such mass screening can identify early problems associated with specific industries, regions or processes, none more so than in Italy where the Seveso chemical plant disaster of July 1976 contributed to a widespread background pollution from 1,4-Dioxin and 2,4,5 Trichlorophenol (Figures 1 & 2). These are two of the most potent and long-lived PCBs, which were used in the manufacture of herbicides at the plant.

Ocurring in the area of Meda, roughly 15 km north of Milan, the disaster released a cloud of chemicals containing dioxin that rose an estimated 50 metres into the sky before being carried into the surrounding area by the wind, where the toxic cloud enshrouded the municipality of Seveso and other local communities. Researchers believe that approximately 3 tons of chemicals were released, among them was anywhere from 100 grams to 20 kg of dioxin, according to Dr. Paolo Mocarelli of the Hospital of Desio.

The aftermath of that tragic day has lived with the people of Northern Italy ever since, despite a large-scale clean up operation. Ever mindful of the continuing threat to health and the environment from an industrial legacy, the local hospitals screening programme samples a wide range of workers from across the region and tests them for trace levels of dioxin and PCBs, as well as poisonous heavy metals such as mercury, cadmium and lead. It also carries out screening of ambient PAH levels in the workplace.

A number of local testing laboratories in Northern Italy undertake routine screening exercises for local health authorities, following the recently updated testing regimen. Samples for testing are normally in a biological matrix, commonly urine. After simple clean up a solvent extraction into n-hexane is performed. For PAHs, the extraction is in to dichloromethane. In each case the solvent extraction tubes are then evaporated to dryness in a Genevac centrifugal evaporator – in this case an EZ-2 (figure 3). The importance of this step cannot be over emphasised. Too much heat will drive off the more volatile analytes leading to false negatives. However, for good chromatography it is important that all of the hexane or DCM is driven off before re-suspension in the solvent of choice for optimised chromatography.

The ability of the EZ-2 to control accurately the temperature of the sample holders and thus the samples themselves was a primary consideration when choosing what to buy.

Using data from an infra-red pyrometer, the EZ-2 software ensures that the samples never rise above a selected temperature, normally set to 40°C. In addition, the automatic stop function of the EZ-2 turns off the system when the samples reach dryness. When a sample reaches dryness there is no longer any evaporative cooling to keep it from over-heating and thus it is important to know when the samples are dry and switch off the heater lamps accordingly. The EZ-2 does this automatically and this helps to ensure that volatile compounds are not inadvertently driven off during the drying phase through over-heating.

Chromatography is carried out on either GC-MS or on LC-UV-MS, with GC-MS used for the detection of PCBs and predominantly HPLC for PAHs. Heavy metals are determined in the traditional way using graphite-furnace atomic absorption or more recently, inductively coupled plasma emission spectroscopy.

Figure 3 – EZ-2 evaporator

The recent introduction of a modern centrifugal evaporation system to the sample preparation area has provided several advantages compared with conventional methods previously used.

These include:

- Automation, given the ability to set just the programme and temperature and start the analysis, with the advantage that the instrument stops by itself at the end of evaporation. This frees up analysts time to do more productive work and increases the through put of the laboratory.

- User safety. The enclosed nature of the evaporator and cold trap ensure that PCB or PAH residues are not released into the laboratory.

- Reliability of the analysis: avoiding cross contami nation betweensamples, thanks to the special programmes for each solvent class already set by Genevac; this, combined with the temperature control, avoids sample degradation and hence the need to repeat the analysis or doubts about the analytical result obtained

- Productivity: a large number of samples per run can be evaporated in reasonably short time periods.

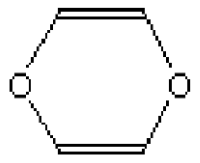

Fig 1

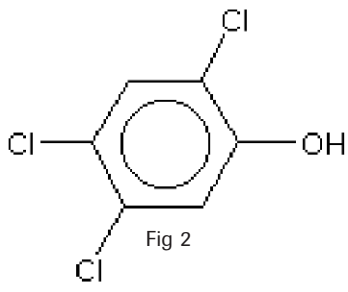

Fig 2

Figure 1 – 1,4-Dioxin
Figure 2 – 2,4,5-Trichlorophenol

The introduction of this type of machine to the testing process has contributed to better and more consistent results without having to repeat individual samples, and with reduced operator fatigue in the laboratory. Local staff say they would find it hard to go back to the old manual methods of evaporation that were used before the EZ-2 arrived.

This screening programme and others like it around Europe will continue for some time as there is still, unfortunately, a great need for this type of occupational health work in our modern world. Any advances that make better use of the techniques used to help analyse the thousands of samples received each year are therefore, very welcome.

Reference:

De Marchi, B, Funtowicz, S, and Ravetz, J; 4 Seveso:
A paradoxical classic disaster
http://www.unu.edu/unupress/unupbooks/uu21le/uu21le09.htm