5) Screening air cargo for explosives

Problem:

At airports huge amounts of air cargo have to be screened for explosives every day. The cargo typically comes in closed containers or on palettes completely wrapped in adhesive foil. One method for cargo screening used for example in France, the UK and the Netherlands is to suck air from the inside of the palettes or the containers through a filter and then present these filters to dogs that are trained to alert on explosives.

How would one find the optimal filter for this procedure? Is it possible to present the animals sniffing at the filters with an odour concentration similar to or even higher than the original gas phase concentration inside the container / palette?

Answer:

Let us first look at a somewhat different scenario. Imagine that the filter would have to be analysed by a conventional chemical analysis including extraction and GS/MS analysis. In this case one would want to catch all explosive molecules that were available in the gas phase of the cargo. To this end one would try to suck as much air out the cargo as possible (and one would not bother much if this also meant to suck in some fresh uncontaminated air) and one would choose a filter that would prevent any filter breakthrough to occur. The latter can easily be identified if sorption coefficients $K_{filter/air}$ for the explosives are known or can be estimated.

If a dog smelled on such a filter it would not detect much scent on the filter outlet (because filter breakthrough was not allowed). At the filter inlet the dog would likely find a concentration similar to the one in the container. This is because enough air has likely passed the filter inlet to create an equilibrium between the sampled air and the filter. In this case the gas phase concentration created by the filter inlet when presented to the animals will be similar to the original gas phase concentration. Of course, this only works if the chosen filter did not possess too strong sorption properties (otherwise even the filter inlet would not have achieved equilibrium with the incoming air yet) and provided that no fresh air had been sucked in at the end of the sampling procedure. It follows that the best filter for the dogs would be one that did allow breakthrough because this means that the whole filter was equilibrated with the air from inside of the container. Of course the filter would still have to be strong enough so that it is not quickly deprived of the odours during the presentation. Sampling of fresh air would have to be avoided because this would lower the sorbed concentration in the filter and thus also lower the equilibrium air concentration during presentation.

There also is a possibility to create gas phase concentrations during presentation of the filter that are higher than the original gas phase concentrations inside the container but this is not further discussed here.

Download this page as a pdf

 **proceed to end of chapter**