TECHNICAL ARTICLE

Colormetric Tubes, Why Not?

It's simple and convenient to analyze my compressed air with Draeger™ tubes". That's the usual comment when comparing scientific methods against colormetric stain tubes for analyzing breathing air. Let's look at the reasons that stain tubes may not be the correct method, however.

Colormetric (or stain) tubes are highly advertised as dependable and simple to use. While these claims are true under many circumstances, they are misleading in others. The analysis of breathing air for quality assurance and especially litigant support, by this method, is questionable. This is proven by the

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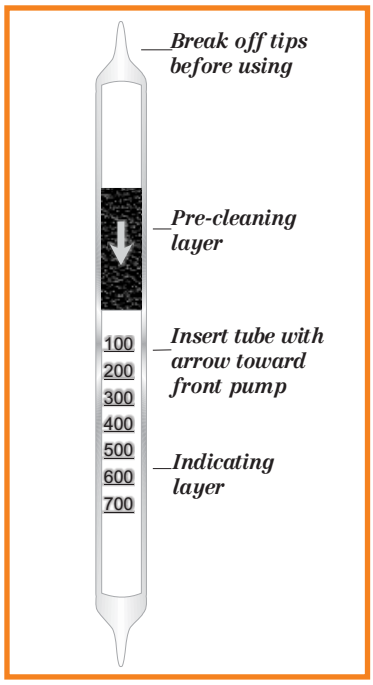
somewhat uncontrollable conditions under which the tubes are manufactured. Add the subjective interpretations of the readings, human error, and lack of permanent record and you'll discover the frightening reality.

For instance, there are naturally occurring variations in the properties of each batch of indicating gel used in the tubes. This is evidenced by the number of active centers in the reagent, which is sensitive to trace impurities, and the erratic reaction rate under test conditions. The quantitative response is considerably loose. This effect will yield sensitivity levels which are unacceptable for our purpose.

A great deal of disappointment with stain tube performance is, no doubt, due to inadequate shelf life. Minor impurities or moisture content will largely affect the shelf



life differently from batch to batch. The storage temperature affects recommended shelf life as well and exposure to temperature extremes will diminish accuracy of the particular tube tremendously. Unfortunately, these kinds of "spoiling" are not detectable by the layman. Since many types of tubes have been in the marketplace for a short time, the manufacturer himself may not have adequate experience with the shelf life or may have estimated the shelf life with accelerated tests.

Shipping and handling conditions of the tubes will affect accuracy also. Loosely packed tubes might shift, causing an error in the zero point of the scale which is imprinted on the tube. In this case there will be an error in the stain length as well.

The greatest deficiency arises out of stain length judgement. These errors are usually related to inaccurate sample volume, flow rate through the tube, and variation in tube diameters. The latter is an interesting subject and calls for close evaluation. Manufacturing variations produce equivelant variations in tube diameters which, in turn, cause an appreciable variation in the cross section of the tube. This results in a calibration error which can be as high as 50%. An additional complicating factor rises out of the flow rate per unit of cross sectional area. The results of the stain length may be dangerously misleading in the case of breathing air testing.

In conclusion, testing has shown color stain tubes to be unreliable in cases where accuracy is mandated or where permanent data must be filed. For air and gas analysis when human life is involved, true scientific methods are the only acceptable means of certification.

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