

## SCS TRACER ENVIRONMENTAL

*Formerly Tracer Environmental Sciences & Technologies, Inc., now a part of SCS Engineers.*

### The Science of Odors

Of all the air pollution related complaints received by regulatory agencies each year, most are related to odors. But unlike all other air pollutants, there is no single “odor molecule”. Detected odors usually are a result of a combination of chemicals/molecules that are airborne and inhaled. The sensation of odor is triggered by a very complex response of the human brain and is linked to our sensory of taste and smell. This combine interplay between our sensory to taste and smell enables a human to characterize thousands of types of tastes as well as odors. The perception of odor is very subjective and is largely considered as a learned response rather than one that is instinctive. The ability to detect and characterize odors varies considerably from individual to individual. How pleasant or offensive an odor is perceived, is often a matter of association in the mind of the individual who detects an odor.

Odor scientists generally define odors by way of four distinct odor dimensions. These include (1) detectability, (2) Intensity, (3) character, and (4) hedonic tone. It is through these dimensions we define the sensory properties of odors and how to understand them.

**Detectability** refers to the theoretical minimum concentration of odorant stimulus necessary for detection by a population. Odor concentration is defined as the incremental dilution of an odor sample with odor-free air, to a point at which only a specified percentage of a population will notice the odor. This point represents **odor detection threshold**. Often times, the detection threshold concentration of an odor is much too low to characterize the odor detected. The next level of odor detection is viewed as the **odor recognition threshold** and represents the concentration value when a population becomes able to differentiate the analyzed odor from other odors or odor character. The method by which scientists determine odor concentrations and thresholds is defined in ASTM Standard Practice for Determination of Odor and Taste Thresholds by a Forced-Choice Ascending Concentration Series of Limits (ASTM E679-91).

**Odor Intensity** refers to the perceived “strength” of the odors detected. Intensity of odors increase as a function of concentration – in other words as the concentrations goes up the intensity or perceived strength increase by greater factors. The odor intensity behavior and characteristics varies by odorant. Whereas for some chemicals, the odor intensity multiplies as the concentration increases and for other odorants, the intensity does not change much with changes of concentration. Odors that have a high slope of change with concentration dissipate rapidly with dilution and as a result are easier to mitigate or control. Odorants with low slope values are more difficult to eliminate as they are perceived at lower concentrations. Odor intensity is determined using a known odorous reference sample, such as n-butanol, and comparing it to intensity changes with the odorant of question (ASTM Method E-544-99).

The third dimension to odor is its **character**. In simple terms, odor character refers to what an odor smells like. ASTM data series DS-61 provides character profiles for over 180 chemicals using a 146



descriptor scale. The scale includes such terms as fishy, rotten eggs, hay, nutty, creosote, turpentine, rancid, sewer, ammonia, etc.

The fourth dimension to odor is **hedonic tone**. Hedonic tone is a judgment of relative pleasantness or unpleasantness of the odor and incorporates a consideration to combined effects of frequency of occurrence, odor character, odor intensity and duration.

The characterization of odors by way of the above dimensions has no relation to the toxicity or health risk potential associated with the exposure to odors. While an odor index is generally assigned to most toxic chemicals (i.e. a concentration in parts per million of a specific chemical or molecule at which an individual population would generally detect an odor), these denote odor concentrations levels far below the chemical concentration exposure levels at which there is any known health risk concern. In other words, generally when people smell something offensive, it does not necessarily translate into a health risk.