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Applications Note MO-101

USEFUL OZONE CONVERSION FACTORS

Standard Temperature and Pressure: 273.3 K (O^0 C, 32^0 F) and 1013.25 mb (14.706 psi)

Metric Volume and Length

(1) 1 m^3 = 1,000 liters 1 gallon = 4.546 liters

(2) 1 foot = .305 meter 1 ft^3 = .0283 m^3

Ozone in Water

(3) 1 g/m^3 = 1 mg/L = 1 ppm ozone (by weight) in water

Ozone in Air (Low concentrations such as work place safety)

(Concentrations by Volume)

(4) 1 g O_3/m^3 = 467 ppm by volume

(5) 1 ppm O_3 (volume) = 2.14 mg O_3/m^3

(6) .1 ppm O_3 (volume) = 214 ug/m^3 (used more often in Europe)

(7) 1 ppm = .00214 ug/ml 1 ug/ml = 467 ppm (used in medical ozone)

(8) 1 ppm = 100 pphm (used in rubber testing)

(9) Concentration by volume, v/v = C (g/m^3) X 1733 X T/P = 467C at STP

Ozone in Air (High concentrations such as at the outputs of corona discharge generators)

(Concentrations by Weight)

(10) 1 g O_3/m^3 = 782 ppm by weight

(11) 100 g O_3/m^3 = 7.82% O_3 in air

(12) 1% O_3 (by weight) = 12.8 g/m^3 in air

(13) Conc. by weight, G (or w/w) = C X .29 X T/P = .0782C at STP, C = Conc. in G/M^3

Ozone in Oxygen (High concentrations by Weight)

(14) 1 g O_3/m^3 (of O_2) = 699 ppm by weight

(15) 100 g O_3/m^3 (of O_2) = 6.99% O_3 in O_2

(16) 1% O_3 (by weight) = 14.3 g/m^3 in oxygen

Output of Small Ozone Generators

Ozone output = (a constant) X (air flow thru the generator) X (measured concentration)

For small generators this can be expressed as:

Output (g/hour) = K X (flow in cfm) X (measured ppm (vol))

= cfm X .0283 m^3/ft^3 X 60 min/hr X ppm (vol)/467 ppm/g/m^3

(17) Output (g/hr) = .00364 X cfm X ppm = .128 X m3/min X ppm

Typical Instrumentation Ranges by Application

Ambiental ozone: 0-1 ppm (volume)

Ozone for storage, etc. 0-20 ppm (volume)

High concentration ozone: 0-16% by weight 0-200 g/m^3 (note if O_2 or air)

Ozone dissolved in water: 0-20 mg/L 0-20 ppm (by weight)

Important Qualitative Ozone Relationships

- Ozone half-life in air is typically about 15 minutes in open areas (can be hours in enclosed areas) and increases with lower temperature and lower humidity.

- Ozone is about 50% heavier than air and has a low vapor pressure, so it tends to sink to the floor and does not disperse if there is no air circulation.

- Virtually all ozone instruments have cross-sensitivities with other gases. Chlorine compounds such as ClO_2 and nitrogen compounds such as NO_2 look very much like ozone to many instruments. Strong VOCs such as vapors of alcohols affect most VOC instruments.

- Maximum ozone concentration in water varies directly by concentration of the gas in air and inversely by temperature: for example 1.5% feed gas (by weight) will have a maximum concentration of about 11 ppm (mg/L) in water at 5 degrees C and 6.4 ppm at 20 degrees C. Doubling the concentrations of ozone in the feed gas will double the concentration in water.

- Dissolved ozone monitors also have cross-sensitivity and other operational problems. For example, the popular and low-cost ORP meters (oxidation-reduction potential meters) are sensitive to pH and various ionic conditions of the water.

- Ozone reactions in air are fairly well understood in terms of starting compounds and ending compounds, but the intermediate reactions and compounds are not always well understood.

- Ozone reactions in water are generally well-understood and documented, but areas of uncertainty still exist.