RESIDENCE TIME AND ITS EFFECT ON REMOVAL EFFICIENCY FOR WAGER ODOR CONTROL VALVES

One of the main compromises in using sorption (adsorption or chemisorption) for the control of gaseous contaminants is between the objectives of efficient contaminant control and minimizing the resistance to airflow. This can be achieved by maximizing the contact efficiency of the system by using granular media in the size range of 4 to 6 mesh (or approximately C") With such media size, the half-life of a molecule in the gas phase (before it reaches the surface of the media) is about 0.01 second. Then, if an air stream that contains a concentration of contaminant, C_r enters such a media bed, the concentration of contaminants that have never reached the surface of the media after n seconds of residence time C_n , is"

$$C_n = C_r (2^{-100n}) \qquad (1)$$

The ration of C_n / C_r is the penetration, P, of the media bed. Thus, the contract efficiency, E, (Fraction of contaminant molecules that have contacted the surface of the media) is:

$$E = 1 - (2^{-100n}) \qquad (2)$$

It mist be noted that the contact efficiency is not the same as the removal efficiency. The contact efficiency is the percentage of total contaminant molecules that have come into contact with the media. Removal efficiency is the fraction of the contaminant is the removed either by physical or chemical means. However, higher contact efficiencies will result in higher removal efficiencies until such time where the media approaches its total removal capacity for the contaminant(s).

In any gas-phase air filtration system the contaminant gases must first come in contact with the media before they can be absorbed. By maximizing the contact efficiency of the system, one can virtually be assured that the maximum removal efficiency of the system is realized. Examples of the relationship between residence time, n, and contact efficiency of a media bed are shown below.

Relationship Between Residence Time, N, of a Gaseous Molecule in a Granular Media Bed and the Contact Efficiency, E, of the Bed

Residence Time (sec.)	2^{-100n}	$E = 1 - (2^{-100n})$x 100%
0.01	0.500	50%
0.02	0.250	75.0
0.03	0.125	87.5
0.04	0.0625	93.75
0.05	0.03125	96.88
0.06*	0.01562	98.84
0.07	0.00781	99.22
0.20	0.00000095	99.9999
0.40	0.000000000000909	99.9999999999

* Minimum recommended residence time for Wager dry- scrubbing air filtration media

Residence times used for these calculations are more correctly termed "superficial" residence times. This is because they represent the time it takes air to cross a distance equal to the thickness of filter without accounting for the resistance of the media through which it travels. For Wager systems, a minimum residence time of 0.06-0.07 seconds is designed into all systems employing the media in bed depths of 1" or greater.

It must be understood that maximizing the contact efficiency, does not necessarily guarantee a 100% contaminant removal efficiency. All it means is that the system has the opportunity to operate at its own particular maximum efficiency. However, for a properly designed, installed, and maintained Wager gas-phase air filtration system, removal efficiencies ≤99.5% can be achieved in our modular systems and efficiencies ≤99.95 % can be achieved through our deep=bed systems. Wager systems can be expected to operate at or near these levels over the useful life of the media.