ALPINE INDUSTRIES

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ESSENTIAL OZONE

Ozone or trivalent oxygen is perhaps the most misunderstood, hated and loved element in the air we breathe. On one hand we are told that it is a harmful, poisonous gas capable of doing great harm to our lungs. On the other hand we are told that it has the potential of being the greatest natural purification element we have available to deal with man-made pollutants.

The truth lies in the understanding of the nature of ozone itself, the mechanisms of ozone formation, the nature of the pollution problem that requires a solution and finally any adverse health effects involved with ozone as compared with other health risks encountered in our modern indoor environments.

Ozone is commonly accepted to be a pollutant associated with large urban areas typified by Los Angeles. It is true that ozone is a part of smog, but it is also true that ozone exists outside of the smog environments in even the purest of outdoor environments.

In unpolluted areas ozone is created by the action of nitrogen oxides and ultraviolet light from the sun with the natural agricultural and animal husbandry sources of methane and even the hydrocarbon compounds of isoprene and terpene emitted from trees of the forest. In fact, anywhere in nature that hydrocarbons exist with strong sunlight and moisture, ozone will occur in some quantities. Areas that are considered the most healthy vacation spots in the country have some of the highest levels of naturally occurring ozone.

Ozone is also created electrically in nature during active thunderstorms. The electrical discharge creates that positive sweet smell that we understand as clean fresh air and that we can recall as the fresh smell of laundry hung outside in the sun to dry. Who can deny the positive values associated with sleeping on sheets exposed to and purified by sunlight?

In urban areas ozone is also created in two other important ways. First there is the direct breakdown of chemicals that are spewed into the environment in industrial processes. Formaldehyde, xylene, and olefin also combine with nitrogen oxides and ultraviolet light to create ozone while at the same time reducing the feed stock of these harmful industrial chemicals. The second is related to the photochemical production of ozone from automobile emissions and mass burners.

It can be seen that in the last case ozone is being created by the breakdown of the hydrocarbons but that it is also aiding in the breakdown of these same chemicals. It is, therefore, natural that the highest concentrations of ozone will be found in areas with the highest concentration of unoxidized or unburned hydrocarbons. It is this confusion with cause and effect that have given rise to the notion that ozone itself is the source of the problems related to smog rather than just one of the chemicals present in the process.

The additional problem in the air quality of urban areas is related to the magnitude of the feed stocks of unburned hydrocarbons. With heavy industries and the associated heavy automobile traffic, the amount of chemical involved with this process is immense. While the ozone and the hydrocarbons are eliminating each other there are enough of both in the air to be a problem.

As the noted toxicologist Dr. Robert Olcerst wrote in his paper Ozone Monograph: Toxicity and Evaluation, "Toxicology is the science of poisons. Every chemical substance has a range of effects on biological systems that range from no effect to levels of lethality." In effect, every chemical has the capacity to be toxic, and it is dosage that becomes significant. Too much of any substance will upset and become harmful to a biological system.

Ozone is no exception. At extremely high concentrations there are indications that ozone itself is harmful. However, in the case of smog, studies show that its other ingredients, the nitrogen oxides, sulfur oxides, suspended sulfuric acid, nitric acid particles and suspended hydrocarbons are the real health risks.

It is unfortunate that smog and ozone have been interchanged in the discussion of air pollution because it has masked the positive characteristics of ozone as the natural way of dealing with air quality problems. The focus on smog as "air pollution" has prevented us from seeing the even greater problem of indoor air quality problems.

The same chemical soup exists in our indoor environment as exists in smog. The only variant is the concentration of the pollutant and the total lack of any means of reconditioning that air to natural standards. What are the sources of indoor air pollution? The most common sources are:

a. The building itself and the furnishings in the building emit hazardous chemicals such as formaldehyde and styrene. Sources range from particle board to ceiling tile to carpets and furniture to paints and finishes.

b. Chemicals inadvertently brought into the home such as the residue in dry cleaned clothing, the hydrocarbons collected on our clothing while driving home, the small amount of chemical residue on the food from the grocer.

c. Cleaning products of all types.

d. Tobacco smoke and the 3600 chemicals resulting from that smoke.

e. Organic residue from insects, rodents, roaches, pets, etc.

f. Mold, mildew and fungus.

It is interesting to note that most of the pollutants are organic in nature and that the chemicals which we consider to be problems exist all around us in nature where they are not considered problems. To become a problem, as noted earlier, the dosage must be such that adverse effects result. Dosage is, of course, a function of both concentration and time of exposure. Even small amounts of pollutants will cause adverse effects if the time of exposure is long enough. These adverse effects occur so gradually that they are not associated with their true cause.

The gradually increasing frequency of headaches may never be associated with the move to a new home or the acquisition of new furniture, or a child's allergy problem may not be associated with an exposure to pollutants in the bedroom that began at birth, or the hyperactivity of a child may not be connected to the fact that it began with a subtle change in the environment.

These changes have accelerated since the date of the first oil embargoes when the cost of energy for heating and cooling our environments soared. From that date we have attempted to eliminate all outdoor air from our indoor environment. By doing so we have also trapped all of the pollutants indoors and have eliminated the one chemical that has the capacity to restore the air to its pure state - ozone.

Ozone, the most powerful oxidizing agent occurring naturally in our clean outdoor environment, has the capacity to break down most of the organic chemicals that foul our indoor environment.

Ozone is, however, missing from our indoor environment. Ozone, because of its reactivity must be continually renewed. Ozone concentrations reduce quickly with ozone initially at a concentration of 30 ppb outside totally reverting to oxygen in a period of 20 to 50 minutes depending on a variety of conditions. Unless efforts are made to restore this level in a modern building the ozone level will normally be zero.

In a study recently commissioned by Alpine Air Products to determine the effect of ozone on chemicals emitted from the opening of returned dry cleaning, the following was determined:

1. There is a possibility of 53 chemical substances which are emitted from clothing recently cleaned and stored in air restricting packaging.

2. Fully 2/3 of these chemicals are controlled and regulated by OSHA in industrial settings but not in a home environment.
3. These chemicals may be broken into eight groups, all but one of which react with ozone to form harmless compounds.

1. Organic acids, alcohols, aldehydes, and keytones:
   Forms carbon dioxide, water vapor, and releases oxygen
2. Aromatic Compounds such as benzene and camphor:
   Forms carbon dioxide, water vapor, and releases oxygen
3. Aliphatic Compounds such as butane and mineral spirits:
   Forms carbon dioxide, water vapor, and releases oxygen
4. Chlorides such as methylene chloride:
   Forms carbon dioxide, water vapor, CL2O and releases oxygen after an intermediate hypochlorite state
5. Nitrogen Compounds such as Hydrogen Cyanide:
   Forms carbon dioxide, water vapor, and releases nitrogen and oxygen
6. Sulphur Compounds such as Ammonium Thiglycolate:
   Forms carbon dioxide, water vapor, sulphur trioxide and release oxygen (occasionally nitrogen)
7. Other Alkylated Silicates and non Ionic detergents:
   Forms carbon dioxide and water vapor and releases oxygen
8. Non reactive compounds such as calcium oxide, silica titanium oxides, etc...
   No reaction

While these chemicals are not totally inclusive of all the chemicals found in the home and work place, they are representative of the families of chemicals that do exist there. As long as pollution levels remain low, small amounts of ozone are sufficient to break them down at a rate that will reduce significantly the exposure rate.

In addition, other tests have shown that common household bacteria, mold, mildew, and fungus are greatly reduced by the addition of as little as 50 ppb in typical household environments. Specifically, E. Coli, Salmonella Choleraesuis, Staphylococcus Aureus, Candida Albicans and Aspergillus Niger have been shown to have dramatic reductions in population in tests commissioned by Alpine Air Products.

In a series of studies published in a Journal Priroda (1976) the Russian Department of Health established a number of important facts concerning the use of ozone in closed indoor environments.

They established that air loses its basic "freshness" quality merely by being drawn into air conditioning and heating systems with as much as 90 percent reduction of the ozone and ion levels. They established that the effect of the loss of these elements could cause the occupants to complain of headaches, weakness, and a general poor feeling. (What we would identify as sick building syndrome.) As a part of the study, they found that after five months of testing with both a test group and a control group that a feeling of well being returned to those exposed to a level of 15 ppb, and that these same levels they were able to observe increased immune potential, higher oxygen content in the blood, improved blood pressure reading, and the reduction of many of the stress characteristics associated with working in modern office environments.

They found that by reactivating the air, by the injection of ozone to raise the level to a mere 15 ppb, the overall effect was similar to that of taking an outdoor walk of 2 hours during the day.

In additional studies done by the Institute of Child and Adolescent Hygiene they concluded that injection of ozone into the air of schools raising the level to 15 ppb had very positive effects on the students. In these tests, 69% of the students exposed to these levels of ozone decreased the time required to complete tasks

requiring high levels of concentration. In addition, it was found that favorable changes in the functions of external respiration, increases in mental reserve capacities, and overall increases in general state of health and mental efficiency were observed.

These results agree with the results and anecdotal testimonies of users of this type of equipment in this country. Alpine Air Products has produced approximately 100,000 ozone air purification systems for use in home and office environments. These systems permit the adjustment of ozone to a level of from 3 to 50 ppb.

Testimonies show that with the use of this type of device:

Allergic reactions are reduced
Sleeping is improved
Non specific headaches are reduced
General poor feeling about the environment improved
Depression reduced
Symptoms of sinus problems relieved

In general the use of this type of device to reactivate the air results in the same effect as being in an outdoor environment in a clean unpolluted part of the world.

With all of these obvious benefits it would seem that everyone should use this type of device. It is because sweeping generalization have propagated the myths about the dangers of ozone that wide acceptance of ozone and its benefits have been ignored.

A study of all of the applicable literature found in the National Library of Medicine's Medline, Toxline, and Toxback database was conducted for Alpine by Dr. Robert Olcerst. The search resulted in over 4,500 documents.

A summary of these documents is as follows:

a. High and extremely high levels of ozone result in decrements in lung function.

b. Physiological studies suggest that at these high levels athletes and children may be sensitive to lung functional changes, and that these changes are largely statistical in nature with no visible symptoms.

c. Tabulation of chamber studies for continuous and intermittent exercise do not indicate lung function decrements of FVC and FEV-1 in excess of 10% (the accepted level of criteria of adverse effect) until levels exceed 200 parts - per - billion.

d. People with lung disorders and with respiratory problems have no more sensitivity to ozone levels than normal people.

e. There is no indication of adverse effect below 200 ppb.

f. There is no indication that there are any long term effects to prolonged exposure to ozone at levels lower than 120 ppb.

g. Respiratory problems are more affected by other organic pollutants than by ozone, and ozone has the capacity to reduce the levels.

Considering the safety, the wide range and level of effectiveness, the cost of energy and the make up of our current indoor environment it would seem that the closest alternative to opening the window is to replace the vitality of the air by replacing the ozone that occurs naturally outdoors each day.