

Reaction series during a photochemical smog.

Peroxyacetyl PA

FETS OF PHOTOCHEMICAN formation reactions SMOG 31

EFFECTS OF PHOTOCHEMICAL OXIDANTS ON HUMAN

Both ozone and PAN are the products of photochemical smog.

Both of these are harmful to plants, animals and human beings. Ozone and PAN cause irritation of the eye and respiratory tracts of human beings. Exposure to 50 ppm of O₃ for several hours may lead to mortality because of pulmonary edema, i.e., accumulation of fluid in the lungs. Lower levels of O₃ cause non-lethal accumulation of fluid in the lungs and can damage the lung capillaries. Exposure to ozone smog thus causes asthma and other chronic lung diseases.

The generation of free radicals are probably responsible for the biochemical effects of O₃ and PAN. These oxidants attack the -SH group on enzymes. These groups are oxidised by O₃ and PAN. An amino acid, cysteine, is strongly attacked by PAN because of the presence of sulphur in it.

These photochemical oxidants also inactivate various enzymes which include isocitric dehydrogenase, malic dehydrogenase and glucose-6-phosphate dehydrogenase. These enzymes play an important role in the citric acid cycle and in the degradation of glucose releasing cellular energy.

Primary photochemical pollutant, i.e., NO₂ produces a brownish haze causing nose and eye irritation and pulmonary discomfort. NO_x also cause several chronic diseases of heart, lungs and eyes. Lower concentration of ozone irritates the nose and throat while its higher concentration causes headache, cough, dryness of the throat, chest pain, difficulty in breathing etc. Experimental studies have shown that exposure of ozone upto 0-2 ppm, creates no ill effect but a level of

0.3 ppm, appears to be the threshold level at which nose and throat irritation begins. However, exposure to ozone concentrations of 1.0 to 3.0 ppm, for a period of two hours produces extreme fatigue and lack of coordination in central nervous system.

Aromatic hydrocarbons which are conductive to smog formation pose a greater threat than the alicyclic hydrocarbons. Their vapours are much more irritating to the mucous membranes and their inhalation causes systematic injury to the trachea.

Peroxybenzoyl nitrate, PBN, a secondary photochemical pollutant, occurs in polluted atmosphere involving aromatic hydrocarbons, NO_x and ozone. It acts as a powerful eye irritant and lachrymator.

Smog might be causing some serious health problems. Modern office machines such as fax, photocopiers, and printers, can create ozone, which reacts with various commonly found chemicals to produce volatile organic compounds. These agents are found in automobile exhausts and help in creating photochemical smog, a smog formed when a plethora of pollutants react in the presence of light and affect the upper respiratory tract of commuters. Inside offices, this smog is more dangerous. Deodourants and perfumes widely used by office staff also contribute to the problem. A perfume may contain even more than 100 different organic ingredients, all of which gradually evaporate. Also, there are solvents from dry cleaned clothes, paint work on office walls, and from the glue that keeps comfortable padded chairs together.

The powerful adhesives that hold down floor tiles and the stains that make desks look like mahogany, all contribute to the creation of air borne soup of organic volatile compounds. Among these compounds are hydroxyl radicals that tear apart other chemicals, creating harmful substances such as CH3COOH and HNO3. These attacks humans and machines alike. They can coat the chips inside computers destroying them in the process.

EFFECTS OF PHOTOCHEMICAL OXIDANTS ON PLANTS

PAN and other members of its family (PBN, PPN etc.) are produced photochemically in air having olefins and NO_x. It is very damaging to plants, attacking younger leaves and bringing about bronzing and 'glazing' of their surfaces. Photochemical smog is characterized by brown hary fumes which leads to cracking of rubber and extensive damage to plant life. Exposure for several hours to PAN, atmosphere at the level 0-02 to 0-05 ppm causes a great loss to vegetation. The sulphydryl group present in proteins has been susceptible to damage by PAN. It acts both as an oxidising and acetylating agent while reacting with sulph hydryl groups contained in proteins.

Experimental results indicate that ozone is the most toxic photochemical oxidant. Among visible effects of ozone injury to plants are bleached or light flecks or stipples (clusters of dead cells) on the upper surface of leaves. Fully expanded, mature leaves are more susceptible to damage. Leaves tip burn, a disease of white pines is mainly caused by ozone.

Smog which contains O₃, PAN and other photochemical oxidants is regarded to produce early maturity in plants. A six hour exposure of this smog even at a very low concentration of 0-01 ppm, is reported to cause injuries to petunia, lettuce and pinto bean, citrus, forge and salad crops and coniferous trees. PAN causes injury in beets, spinach, pepper, lettuce, alfalfa, aster and primrose etc. It also causes silvering of leaves. NO_x and PAN cause death to forest trees. Actually PAN inhibits Hill reaction of photosynthesis and ozone promotes excessive transpiration from the leaves of plants causing dehydration. All these pollutants also destroy the cells of leaves, damage the shoots and interfere with the plant's metabolic processes. Ozone, together with PAN form small drops in air forming smog, thus blanketing the sunshine which inhibits the rate of

photosynthésis in plants. Ozone is also harmful for vegetables like radish, carrot, tobacco and

These oxidants (O₃ and PAN) have also been found to inhibit the activity of enzymes that are responsible for the synthesis of cellulose and lipids in plants.

Some sulphates and nitrates which are formed during smog formation due to the oxidation of sulphur containing components (SO₂ and H₂S) and NO_x (N₂O₃, N₂O₅, NO₂), nitric acid and live stock. They adversely affect plant growth, damage crops