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MEMORANDUM

Subject: Hydrogen Peroxide-RED

From: David Edelstein, Soil Scientist David Edelstein
Review Section #3
Environmental Fate and Groundwater Branch
Environmental Fate and Effect Division (H7507C)

To: Evert K. Byington, Ph.D., Chief
Science analysis and Coordination Branch
Environmental Fate and Effect Division (H7507C)

Thru: Henry M. Jacoby, Chief
Environmental Fate and Groundwater Branch
Environmental Fate and Effect Division (H7507C)

Attached is the environmental fate Science Chapter on Hydrogen Peroxide for inclusion in the RED of Reregistration case 4072.

As indicated in the Phase IV Review (10/8/92), hydrogen peroxide breaks down rapidly to water and oxygen almost immediately upon application. It is used indoors only, and so does not represent an exposure concern for the environment at large.

HYDROGEN PEROXIDE; PEROXYACETIC ACID

Science Chapter-RED

Peroxyacetic acid and hydrogen peroxide are exclusively for indoor use, with no direct exposure to the environment. The chemistry of these compounds is well known. Both of these active ingredients degrade rapidly to innocuous compounds.

Hydrogen peroxide acts as an oxidizing agent in a variety of reaction. Pure hydrogen peroxide is a colorless liquid (boiling point 150.2°C, melting point -0.43°C). Hydrogen peroxide is a strong oxidizing agent in both acid and basic solutions, but the reduction potentials (E°) vary as a function of pH.

Dilute or 30% hydrogen peroxide solutions are commonly used as oxidizing agents. Oxidation with hydrogen peroxide in acid solution is slow, but they are rapid in basic solution. It also behaves as a reducing agent (both in acid and in basic solutions) when it reacts with stronger oxidizing agents, such as permanganate ion in acid solution. Many redox systems and metal surfaces can serve as catalysts for peroxide decomposition.

Peroxyacetic acid is made by the interaction of hydrogen peroxide and acetic acid. Peroxyacetic acid is also an oxidizing agent, although it can act indirectly by decomposing to acetic acid and releasing a hydrogen peroxide molecule. It can also provide a source of free radicals, which can attack C-H bonds in target molecules (e.g., the C-H bonds in a microbial cell membrane). The primary degradates of peroxyacetic acid are acetic acid, water, and oxygen. Acetic acid is rapidly metabolized by ambient aerobic microbes to carbon dioxide and water.

Hydrogen peroxide and peroxyacetic acid are short-lived due to the inherent instability of the O-O bond (peroxide bond). Instead of the usual oxygen oxidation number of -2, peroxide oxygen atoms have an oxidation number of -1 due to the presence of two additional electrons. As a result, the peroxide bond is weak, and breaking it to form water and O_2 is so highly favored thermodynamically that improperly stored quantities of highly concentrated peroxides may explode. A more positive aspect of this instability is that at typical pesticide concentrations, peroxides are not explosive, but do degrade rapidly.

BACKGROUND

LUIS reports and labels indicate that peroxyacetic acid and hydrogen peroxide are active ingredients of disinfectants. The products vary in germicidal strength from general deodorant/disinfectants to hospital strength surface disinfectants. They are used as disinfectants and air treatments (indoor medical, non-food and residential use), as a food treatment in eating establishments and dairies (indoor food use) and as animal treatments (indoor non-food use). Hydrogen peroxide is the active ingredient in a swimming pool disinfectant. Hydrogen peroxide degrades rapidly to oxygen and water. In the presence of air, peroxyacetic acid degrades first to acetic acid, then to carbon dioxide and water.

REFERENCES

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