POLYON® POLYMER COATING ENVIRONMENTAL IMPACT

Summary. The degradation of the polymer coating material of POLYON® coated fertilizers applied to turfgrass/soils is caused by microbial, chemical, and mechanical mechanisms. Laboratory tests in 1992-93, and research of relevant scientific literature and other sources suggest that soil fungi are the principal degrading microorganisms. The eventual products of the degradation process are understood to be water, carbon dioxide and ammonia. Neither the POLYON® coated fertilizer particles, nor the empty polymer "shells" remaining on the surface following complete release of the fertilizer, present a hazard to grazing animals, birds, or fish.

In the production of POLYON® coated fertilizers the polyurethane polymer coating is formed in situ in the fertilizer coating process, which is designated RLC (reactive layers coating). This unique coating process and the controlled-release POLYON® fertilizers are patented.

Degradation Mechanism. There is no detectable degradation of the polymer coating in the initial months following the application of POLYON® fertilizer to the soil. Degradation essentially does not occur during the time the fertilizer is diffusing by osmosis through the nonporous, semipermeable polymer membrane coating encapsulating the urea granule, or other fertilizer granule. The empty polymer shells initially would be incorporated as aggregate into the shallow soil matrix prior to degradation. At first the rate of degradation is very slow. Then, as polymer molecules are split in the degradation process to form new, shorter chain molecular structures, or oligomers, degradation of these remaining coating molecules accelerates, since more molecular chain termini are exposed to microbial and abiotic attack. Because of this acceleration no buildup of nontoxic, or toxic, oligomers in the soil can occur. The microorganisms probably incorporate into their cellular structure some oligomeric fragments, or pieces of the parent polymer consisting of only a few monomer units. Any nondegraded coating polymer becomes incorporated as aggregate in the soil profile, where eventually it is broken down by microbial, chemical and mechanical mechanisms. After several years, the coating fragments will be degraded and/or indistinguishable from the soil matrix. The eventual products, which are formed by the degradative processes, are understood to be **water, carbon dioxide** and **ammonia** in soil solution.

Scientific Studies. The environmental fate of the POLYON® polymer coating material, or the polymer "shell", was studied extensively during the two-year period, 1992-1993. Laboratory tests were conducted by ABC Labs, Inc., Columbia, MO, under the auspices of Environmental & Turf services, Inc., (ETS), Wheaton, MD. ETS also conducted an exhaustive search of the scientific literature on the subject and interviewed scientists in the field or related fields, focusing on the mobility and persistence of the polyurethane coating material, principally is an MDI reacted polyester-polyol urethane.

Laboratory Studies. Laboratory studies conducted by ABC Labs, Inc. that were relevant to the polymer mobility in the environment, included water solubility, octanol/water partition coefficient and vapor pressure; and those which were relevant to the polymer persistence in the soil, included hydrolysis and ultraviolet and visible light absorption. The mobility tests demonstrated extremely low water and octanol solubility of the polymer and a nonexistent vapor pressure. Therefore, leaching, runoff or volatilization of the polymer coating material is highly unlikely. The persistence tests suggest a hydrolysis half-life (t1/2) of many years and a slight possibility of photodegradation in the presence of UV light, but even this is unlikely due to shading by the vegetative canopy and several other factors.

Literature Studies. Laboratory and landfill studies on MDI polyurethanes indicate half-lives in excess of one year. Certain mathematical model assumptions of POLYON® polymer degradation rate indicate it is stable polymer with a half-life in the range of up to five years.

There is no reason to presume grazing animals, birds, or aquatic animals intentionally will ingest significant quantities of POLYON® coated fertilizer, or polymer "shells", since these animal species are very selective of what is or what is not ingested. Birds and aquatic animals are well-equipped to deal with unintentional occasional ingestion of soil aggregate materials, including fragments of POLYON® polymer "shells". Such materials can be crushed in birds' gizzards and excreted or regurgitated, rejected by mouths or gills of fish, digested harmlessly in
the strong stomach acids of carnivores, or in the long gut of detritivores or herbivores.

Research conducted by Stuart Cohen,Ph.D; President and CEO Environmental & Turf Services, Loganville, GA. Findings reported February 22, 1994.