Appendix J. Environmental Fate and Transport Summary

Degradation Studies

Hydrolysis

^{14}C-trichloromethyl captan hydrolyzed in sterile aqueous buffer solutions at pH 5, 7, and 9 with half-lives of 18.8 hr, 4.9 hr, and 8.3 min, respectively. Two unidentified degradates, both of which degraded rapidly to $^{14}CO_2$, were detected in the study (MRID 41176301).

Two previous captan hydrolysis studies were also reviewed. One study (MRID 00096974) partially fulfilled the data requirement by providing information on the hydrolysis of 14C-carbonyl captan and describing the fate of the ring portion of the molecule in sterile aqueous solutions at a pH range of 2-9. Another study (MRID 40208101) provided acceptable information on the hydrolysis of ^{14}C-trichloromethyl captan at pH 9. Taken together, these three studies fulfill the data requirement. Hydrolysis is an important route of captan dissipation in the environment (MRID 00096974, 40208101, 41176301).

Photodegradation in Water

Because hydrolysis, not photolysis, was responsible for captan degradation in an aqueous photolysis study reviewed previously, the Agency concluded that the photodegradation in water data requirement for captan would be fulfilled upon submission of acceptable hydrolysis data for pH 5. Acceptable captan hydrolysis data at pH 5 have been submitted. The Agency concludes that captan is stable to photolysis in aqueous solution at pH 5 (MRID 40208102, 41176301).

Photodegradation on Soil

In studies where ^{14}C-captan labeled in the cyclohexene and trichloromethyl positions was applied to moist sandy loam soil and irradiated with natural sunlight, captan degraded with registrant-calculated half-lives of 5 and 15 days, respectively. The registrant-calculated half-lives for dark controls were 10 and 21 days, respectively. After 5 days of irradiation of ^{14}C-cyclohexene captan, 21.3% of the applied radioactivity was present as tetrahydrophthalamide (THPI) and 9.4% was present as cyclohex-4-ene-2-cyano-1-carboxylic acid (THCY). No other single degradate contained >3.2% of the applied radioactivity. For ^{14}C-trichloromethyl captan, the only reported degradate was ^{14}CO, which comprised 41.7% of the applied radioactivity after 16 days of irradiation.

The soil photolysis data submitted are acceptable and fulfill the data requirement (MRID 40658009, 40658010).

Aerobic Soil Metabolism

Carbonyl-labeled captan incubated aerobically in a sandy loam degraded very rapidly with 99% degradation by day 7. Ninety-five percent of the applied ^{14}C was present as ^{14}CO, after 322 days. THPI and THPAm were the major degradates identified, the maximum reported THPI concentration occurred at day 7, when 66% of the applied

radioactivity was present in this degradate. THPAm reached its maximum reported concentration at day 14 when it comprised 16.5% of the applied radioactivity. Other soil metabolites of captan in quantities exceeding 0.01 ppm were tetrahydrophthalic acid (THPAI), 5, 6 dihydroxyhexahydrophthalamide (diol), and THPI-epoxide.

In an aerobic soil metabolism study using trichloromethyl (TCM)-labeled active ingredient, captan degraded with a half-life of <1 day in a sandy loam. After 1 day, 46% of the applied radioactivity was detected as $^{14}C0_2$, 19.4% was undegraded captan, and 16.7% was unextractable ^{14}C residues. No non-volatile metabolites were detected. In a study submitted in support of captafol, a compound similar to captan in structure and degradation products, THPI degraded with a half-life of approximately 4 days. Degradation products were not identified (MRID 00070414, 40658007).

Two studies were submitted to determine the degradation rates of THPI and THPAm in soil. For THPI, the data provided supplemental information that shows 10 ppm THPI degraded with half-lives (using best fit equations) of 5.4, 6.8, and 19.5 days, respectively in, aerobically incubated Hyde Farm sandy loam, Speyer 2.2 loamy sand, and Speyer 2.1 sand soils. The agency calculated half-lives were similar (using linear regression of the natural logarithms - (ln) of concentration): 5.8, 6.9 and 20 days, respectively, for Hyde Farm sandy loam, Speyer 2.2 loamy sand, and Speyer 2.1 sand soils. THPI accounted for <0.1 ppm at Day 26 (Hyde Farm sandy loam), Day 33 (Speyer 2.2 loamy sand), and at Day 50 (Speyer 2.1 sand soil). No degradates of THPI were looked for in the study (MRID 43868902).

Anaerobic Soil Metabolism

After 1 day of aerobic incubation plus 29 days of anaerobic incubation, only 4.0% of the radioactivity applied to a sandy of anaerobic incubation, only 4.0% of the radioactivity applied to a sandy loam soil was undegraded trichloromethyl-labeled [^{14}C] captan, 85.6% had evolved as $^{14}CO_2$, 0.8% was uncharacterized, and 16.6% was unextractable. About 80% of the parent captan had degraded during the 1-day aerobic period. In addition to THPI, THPAm, and THPAI, a cyano-acid metabolite of captan, THCY, was identified. Up to 20% of the applied radioactivity was detected as THCY. THCY and THPAm were stable in anaerobic conditions (MRID 40658008).

In another anaerobic soil metabolism study, carbonyl-labeled ^{14}C captan was completely degraded after one week of anaerobic soil conditions. Qualitative reporting of results indicated that four metabolites, including THPI and THPAm, were detected with very little $^{14}C0_2$ evolved. This implies that the degradates formed were stable to further anaerobic degradation (MRID 00098881).

Aerobic Aquatic Metabolism

This study was designed to determine the fate of captan and degradates in water-sediment systems with two contrasting types of sediment. The Old Basing water system included a pH 8.01 clay loam with 12.5 % organic carbon, and the Virginia water system included a

pH 6.2 loamy sand with 3.1 % organic carbon. The application rate was chosen to simulate accidental spraying into a water body during normal agricultural practices.

The study provides acceptable information that shows that captan degrades in the aerobic aquatic environment with a half-life of less than 24 hours in soil and water, and fulfills the guideline requirement. Maximum concentrations of degradates detected, as a percentage of parent captan applied, were: 81.2% THPI at Day 0, 27% THPAm at Day 7, 10.8% THPAL at Day 14, and 9.4% THPI epoxide at Day 1 (MRID #s 00096974, 40114502).

EFED calculated the half-life of THPI in the Old Basing system to be 7 days. THPI concentrations in the Virginia Water system decreased from 51.1% of applied at Day 30 to 0 .1% by Day 60.

The Agency concluded that once captan reaches surface water and hydrolyses (within 24 hours), the degradates (THPI, THPAm, THPAI, and THPI epoxide)probably will not persist in surface water longer than 60 days (MRID 43868905.

Mobility Studies

Leaching, Adsorption/Desorption

Soil thin layer chromotography (TLC) data indicate that captan is slightly mobile to relatively immobile in various soils. These data, combined with the hydrolysis, soil metabolism, and terrestrial field data which indicate that captan is labile, demonstrate that the parent compound is not likely to leach significantly in soil.

Two of captan's degradates, THPI and THPAm, appear to have the potential to be mobile in the soil and to reach surface water via runoff and/or erosion during periods of precipitation and/or irrigation (MRID # 43868911). As further confirmatory data, laboratory data submitted for captafol, a pesticide with a chemical structure similar to captan, also indicate that the degradates THPI and THPAm are mobile (MRID # 40658011)

Laboratory Volatility

Volatility does not appear to be an important route of dissipation for parent captan. Over a 9-day period, approximately 0.003% of ring-labeled captan volatilized from a sand soil treated at a rate of 1 lb a.i. /A. Approximately 3.9% of the applied radioactivity volatilized from TCM-labeled captan. None of the labeled volatiles were parent captan (MRID 00160301).

Dissipation Studies

Terrestrial Field Dissipation

Six studies were submitted, all of which provide supplemental information. Parent captan-degraded with half-lives of 2.5 to 24 days and was relatively immobile to slightly mobile at six sites. The maximum depth at which captan was detected was 6-12 inches. The degradate (THPI) was detected at all sites and declined to less than detectable (0.01 ppm) levels between 14 and 184 days after the final captan treatment. THPI was relatively immobile to slightly mobile in the study soils. Its maximum depth of detection was 6-12 inches.

The field studies provide relatively consistent estimates of the parent compound's half-life and the rate of formation and decline of THPI. It is unlikely that any further studies of this type will change the overall assessment of the dissipation, degradation, mobility, or accumulation of captan residues in the environment (MRIDs #s 40823901, 40893601, 40893602, 40893603, 40932201, 40932202).

Accumulation Studies

Bioaccumulation in Aquatic Organisms

Two studies, one each for cyclohexene-labeled and TCM-labeled captan, were submitted. Although neither study is completely acceptable, the data indicate that residues do not accumulate substantially in bluegill sunfish. Accumulated residues were largely eliminated during the depuration period. The Agency therefore does not need additional fish accumulation data for captan at this time. When exposed to a nominal concentration of 5 µg/L of ring-labeled ^{14}C-captan for 28 days, bluegill sunfish had ^{14}C bioaccumulation factors of 102X, 126X, and 113X for edible, non-edible, and whole fish tissue, respectively. After a 14-day depuration period, ^{14}C-residues in edible tissue, non-edible tissue, and whole fish declined by 94%, 96%, and 95%, respectively. Degradates in exposure water and fish metabolites were not identified (MRID 40756601, 40756602, 40225601, 00160301).