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Creavis Technologies & Innovation

Environmental Care

Toxicological and Environmental Safety Data of STOCKOPAM & HYDROPAM

Introduction

STOCKOPAM and HYDROPAM are anionic polymers primarely used for hydroseeding and erosion control e.g. for preventing irrigation-induced erosion. Both products are copolymers of acrylamide and sodium acrylate. STOCKOPAM and HYDROPAM show the same physical and chemical properties as anionic synthetic flocculating agents of the brand PRAESTOL® manufactured by STOCKHAUSEN. Not all of the different variations of the anionic PRAESTOL® types were tested with all the following test systems due to ethical and economical reasons. Therefore, the data were drawn in analogy from studies with PRAESTOL® 2530 TR and PRAESTOL® 2540.

All studies were performed in the Laboratory for Toxicology and Ecology, Stockhausen, Germany.
In the following STOCKOPAM and HYDROPAM together are referred to as PAM.

Summary of toxicological data

Acute oral toxicity:

LD_{50} > 1,200 mg/kg body weight.
Up to 1,200 mg / kg body weight of PAM were applied with a stomach tube to 10 male mice. This was the highest oral dose level applicable due to the high viscosity of PAM in saline solution. Only slight and reversible toxic symptoms were observed in the highest dosage group; no death was recorded. Body weight development was normal during observation over 14 days after single application.

PAM has to be regarded as essentially non-toxic after oral intake.

HET-CAM-Test:

Hen's egg test (HET) - Chorion allantoic membrane (CAM) assay : 200 mg of PAM were applied onto the CAM of hen embryos of 10 days of age. There were moderate effects with respect to vascular injection and hemorrhaging within 2 minutes after application but no effect regarding coagulation. Potential for cell toxicity and adverse effects on membranes seems to be low.

Cytotoxicity in vitro:

PAM was examined regarding its influence on mammalian cells in a cell culture system using a fibroblastic cell line derived from mice. The cells were incubated for 24 hours with a 1 % (v/v) solution of PAM in cell culture medium. No adverse effects on the morphology or viability of the cells were observed with this concentration.

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Ames Test: Salmonella typhimurium reverse mutation assay

Mutagenicity was tested with the Ames Salmonella plate test (in vitro) with and without metabolic activation by rat liver microsomes. The strains TA 100 and TA 1553 were used as well as TA 98 and TA 1537. An increase in the revertants was not detected in any of the examined cases. Therefore, there was no indication of a mutagenic potential in S. typhimurium of PAM.

In vivo micronucleus test:

PAM was assayed in an in vivo mouse bone marrow micronucleus test with an oral dose of 600 mg/kg body weight. Groups of 5 male and 5 female animals were used and were killed at intervalls of 24, 48 and 72 hours after treatment. At no time point there was a significant increase in micronucleus frequency in the test groups. Therefore it is concluded that PAM is not able to induce micronuclei in polychromatic or normochromatic erythrocytes of bone marrow of mice.

Summary of ecotoxicological data

Chronic bacterial toxicity:

Growth behavior and propagation of the microorganism Pseudomonas putida was determined with PAM in concentrations up to 1,600 mg/l. Inhibitory effects on the growth behavior were not observed, i.e. no cytostatic or biocidal effects are to be expected. The EC_{50}-value for half maximum propagation is higher than the highest concentration tested.

Therefore no critical effects to bacteria are expected under relevant use and disposal conditions.

Chronic algae toxicity :

Growth behavior of the single cellular algae Scenedesmus subspicatus was determined with PAM up to a concentration of 500 mg/l. Inhibition of growth was observed in concentrations of 1 mg/l and higher but the EC_{50}-value which defines half maximum growth is higher than the highest concentration tested. However, the observed mild toxicity is thought to be of minor practical importance under realistic environmental exposure conditions.

Acute daphnia toxicity :

Acute effects on the swimming ability of the daphnids Daphnia magna were determined with PAM in concentrations up to 640 mg/l. The EC_{50}-value for half maximum swimming inhibition is approximately 300 mg/l, the EC_0 –value, the concentration where no effect on the swimming ability occured, is approximately 40 mg/l. The observed slight toxicity of PAM to daphnids is thought to be of minor relevance when realistic environmental exposure conditions are taken into account.

Acute fish toxicity :

To determine the potential acute lethal effects on fish, the cold water species Leuciscus idus (golden orf) and the warm water species Brachydanio rerio (zebra fish) were exposed to PAM. The LC_{50}-value which defines the mean lethal concentration is approximately 140 mg/l and 160 mg/l for the golden orf and the zebra fish respectively. Therefore, PAM has to be regarded as slightly toxic to fish.

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Biodegradability in aquatic systems:

Two different degradation studies on PAM in liquid systems with sewage microorganisms as inoculum have been conducted:

- The Modified Sturm Test (CO_2 evolution test)
- The BODIS Test (closed bottle test)

In the CO_2 evolution test PAM was incubated over 28 days under aerobic conditions with activated sludge. The amount of carbon dioxide produced from the test substance is measured as a result of biodegradation.

In the BODIS Test degradation is followed by analysis of dissolved oxygen over a period of 28 days. PAM was inoculated with mixed microorganisms and kept in completely full, closed bottles. The amount of oxygen taken up by the microbial population during biodegradation is measured.

The results of both laboratory tests indicate that PAM is poorly biodegradable.

Conclusion

STOCKOPAM and HYDROPAM are anionic polyacrylamides which exhibit a low toxicological profile: there have been no signs of acute oral toxicity and there is no evidence for marked irritative properties; no mutagenic potency was found. With respect to the environmental compatibility of STOCKOPAM and HYDROPAM the data indicate some slight toxic effects on aquatic organisms. However, under realistic environmental exposure conditions no critical deleterious effects are expected.

In standard laboratory test systems biodegradation could not be observed. Nevertheless, due to results of the latest research there is sufficient and increasing evidence that polyacrylamides do not constitute persistent, non-degradable man-made polymers.

Therefore, STOCKOPAM and HYDROPAM are regarded as essantially compatible to the environment, especially taking into account the very low dosage levels used for application.

To support this assessment the following facts should be taken into account:

- anionic flocculants are used successfully in sewage disposal plants for several decades
- for preparation of drinking water similar PRAESTOL® types are approved by relevant authorities
- the use of polyacrylamides as soil conditioner is well known.

No negative effects on the environment have been reported with respect to these areas of applications.

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1. Aufl. GGS-dd-07-HM-MS-th-069