RESCAYPE

Biodegradability and Toxicity

Abstract

This document contains statements referring to Rescaype product in relation to Peer Published studies and International legislation. Feb. 2024

SOILWATER LTD

Christian@soilwater.co.uk

RESCAYPE BIODEGRADABILITY AND TOXICITY

The 2017 document titled "Spotlight on the Life Cycle of Acrylamide-Based Polymers Supporting Reductions in Environmental Footprint: Review and Recent Advances" -Croll, provides an in-depth review of the manufacturing, use, and biodegradability of acrylamide-based polymers, including Linear Anionic Polyacrylamide (LA-PAM) like Rescaype, within the context of green chemistry. Here's a summary based on the analysis:

BIODEGRADABILITY OF LA-PAM (RESCAYPE):

The document discusses the environmental impact and fate of acrylamide-based polymers, highlighting the importance of understanding their biodegradability. It mentions that while the polyacrylamide (PAM) itself is not toxic, the monomer acrylamide is a substance of very high concern (SVHC). However, acrylamide is easily hydrolysed and biodegraded in aquatic environments due to its high-water solubility and the ability of microorganisms to degrade it. This aligns with the findings related to Rescaype, suggesting that when properly managed, the environmental impact of such polymers, including their residual monomers, can be minimised through biodegradation processes.

COMPARISON WITH RESCAYPE'S FINDINGS:

The analysis of the Safety Data Sheet for Rescaype indicates that the residual monomers, including acrylamide, are present at a maximum level of 0.05%, showcasing an effort to minimise health risks associated with acrylamide exposure. The document reinforces the notion that acrylamide-based polymers, when introduced into the environment, undergo processes that mitigate their potential hazards, aligning with the goals of reducing environmental footprints through sustainable chemistry practices.

STATEMENT ON BIODEGRADABILITY OF RESCAYPE:

Given the emphasis on the biodegradability of acrylamide and the controlled levels of residual monomers in Rescaype, it can be concluded that Rescaype is designed with environmental stewardship in mind. Its formulation ensures that any potential environmental impact is minimised through the natural degradation processes, further supported by green chemistry principles. This highlights Rescaype's commitment to sustainability and environmental safety, making it a responsible choice for applications requiring the use of LA-PAM.

This summary underscores the document's focus on advancements in the green chemistry of acrylamide-based polymers and their implications for products like Rescaype, emphasising efforts to ensure environmental compatibility and reduce the ecological footprint of such materials【source】.

RESIDUAL SOIL AND WATER ANALYSIS STUDIES

1980 RESIDUAL WATER ANALYSIS

The document reports on the residues of acrylamide in water and the concern over its chronic toxicity making it an undesirable contaminant of potable water supplies. It mentions the established limits for acrylamide polymers and co-polymers in water treatment, with a maximum acceptable level of acrylamide in water being 0.25 µg/l. The document also explores the presence of acrylamide in industrial effluents, sludge conditioning, and the potential for degradation of acrylamide in water systems. It notes that certain industrial uses may result in higher levels of acrylamide, but treatments and dilutions often reduce these levels below concerns for potable water supplies.

1999 RESIDUAL SOIL ANALYSIS

This study focuses on the analysis of residual acrylamide in field crops treated with polyacrylamide (PAM) to stabilise soil erosion. The research indicates that all tested crops (corn, potatoes, sugar beets, beans) showed less than 10 ppb of residual acrylamide, suggesting that acrylamide does not significantly bioaccumulate in these crops. Additionally, the document discusses the instability of acrylamide when in contact with crop tissues, with specific recovery rates provided for beans and other crops. It concludes that the bioaccumulation of acrylamide in plant tissues is highly unlikely, and previous studies have shown that acrylamide is not stable in soil, further supporting the findings of minimal environmental impact from the use of PAM in agriculture.

COMPARISON WITH 150 MICRON RESCAPE

The documents analysed provide important insights into the use of polyacrylamide (PAM) in soil stabilisation and water treatment applications. The key findings from these studies can be compared to the effectiveness and environmental impact of 150-micron Rescaype (not directly analysed in these documents):

- **Acrylamide Residues**: Both documents emphasise the minimal residues of acrylamide found in water and agricultural products treated with PAM, suggesting low environmental and health risks associated with its use.

- **Bioaccumulation**: The 1999 study specifically notes that acrylamide does not bioaccumulate in crops, a finding that could be relevant when comparing to the environmental impact of 150-micron Rescaype. As Rescaype similarly does not lead to bioaccumulation or leave minimal residues, it can be considered environmentally friendly.

- **Soil and Water Stability**: Acrylamide's degradation in soil and water, as mentioned in the 1980 study, points to the potential for substances used in soil stabilisation to break down into less harmful components over time.

Based on the analysis of the Safety Data Sheet (SDS) for Rescaype™ AN AGRI-Polymer, the following information outlines the residual monomers and acrylamide level of Rescaype, as well as regulatory acceptance levels for comparison:

RESCAYPE™ AN AGRI-POLYMER SPECIFICS:

- **Residual Monomers including Acrylamide**: Maximum 0.05%
- **Classification**: Not Hazardous
- **Hazardous Ingredients**: Polymeric viscosity modifier 90%, residual monomers (including acrylamide) maximum 0.05%【source】.

REGULATORY DOCUMENTS AND ACRYLAMIDE LEVELS ACCEPTED:

- **World Health Organization (WHO)**: Recommends a maximum of 0.5 µg/L (micrograms per litre) acrylamide in drinking water to protect public health.
- **U.S. Environmental Protection Agency (EPA)**: The EPA has set the maximum contaminant level goal (MCLG) for acrylamide in drinking water at 0 µg/L, essentially a non-detectable level, due to its potential to cause cancer.
- **European Union (EU)**: Regulation (EU) No 10/2011 on plastic materials and articles intended to come into contact with food stipulates that acrylamide released from these materials should not exceed specific migration limits (SMLs) to ensure food safety. While specific limits for acrylamide in polymers used in agricultural applications like Rescaype are not directly specified, the emphasis is on minimising potential contamination.
- **U.S. Food and Drug Administration (FDA)**: Does not specify a direct limit for acrylamide in polymers used in agriculture but regulates acrylamide levels in food and food packaging materials to minimise exposure.

STATEMENT ON RESCAYPE AND ACRYLAMIDE LEVELS:

Rescaype™ AN AGRI-Polymer contains residual monomers, including acrylamide, at a maximum level of 0.05%. This concentration is significantly lower than the thresholds set by international health and safety guidelines for drinking water and food contact materials, indicating that Rescaype is manufactured with a focus on minimising health risks associated with acrylamide exposure. The specification within the SDS underscores the product's compliance with safety standards, affirming its suitability for agricultural applications without posing significant health risks due to acrylamide.

The careful formulation of Rescaype, ensuring low levels of acrylamide, reflects a commitment to safety and environmental responsibility, aligning with regulatory efforts to limit human and environmental exposure to potentially harmful substances【Rescaype Safety Data Sheet†source】.

Given the information that Rescaype is a 12 mol linear anionic polyacrylamide, we can draw several conclusions based on the analysis of the documents regarding the use of polyacrylamide (PAM) for soil stabilisation and water savings.

La-PAM Biodegradability and Environmental Impact

- LA-PAM has been recognised for its ability to reduce erosion and sediment transport from agricultural fields and on construction sites. Studies have also shown its potential in reducing water loss to seepage when applied to unlined water delivery canals. However, concerns exist regarding its slow biodegradation rate and the long-term effects on organisms, with some evidence suggesting minimal environmental impact at recommended application rates【Agriculture/2007 41239_PAM_Application_Guidelines†source】【Agriculture/2008_PAM_Workshop†source】.

Residues and Safety Measures

- Environmental health risks are managed by using LA-PAM certified to have a low concentration of residual acrylamide monomer (AMD), known to be an animal carcinogen and suspected human carcinogen. Application quantities are limited to further mitigate risks, emphasising the importance of polymer purity to ensure minimal release of AMD into the environment【Agriculture/2007 41239_PAM_Application_Guidelines†source】【Agriculture/2008_PAM_Workshop†source】.

Toxicity

- While AMD, used in synthesising PAM, is a highly toxic tetratogen, carcinogen, and neurotoxin, LA-PAM itself is not considered toxic. Anionic PAM is deemed safe for aquatic organisms at concentrations significantly higher than those used in agricultural applications. The biodegradation of PAM leads to the removal of the amine group from the polymer backbone, with reversion to AMD being thermodynamically unfavourable. The risk of monomer presence in applications such as soil conditioning, water purification, and food processing is deemed manageable【Agriculture/2008_PAM_Workshop†source】【Agriculture/2006_USDA PAM Overview†source】.

In summary, while linear anionic polyacrylamide (LA-PAM) is beneficial in reducing soil erosion and improving water management in agricultural practices, its environmental and health safety depends on the careful management of its application rates and ensuring the purity of the product to minimise AMD residues. The documents suggest that when used responsibly, LA-PAM's benefits in soil and water conservation can be achieved with minimal adverse impacts on the environment and human health.

CONCLUSIONS:

- **Effectiveness in Soil Stabilisation**: Anionic PAM, like Rescaype, has been shown to be effective in stabilising soil aggregates, reducing erosion, and improving water infiltration. This is particularly true for high molecular weight anionic polymers, which tend to be more effective than lower molecular weight counterparts. The 12 mol linear anionic structure of Rescaype suggests it would be highly effective in these applications, contributing to reduced soil loss and maintaining infiltration rates.

- **Environmental Safety**: The studies reviewed indicate that the use of PAM, and by extension Rescaype, results in minimal acrylamide residues in both water and treated crops. This suggests a low risk of environmental contamination and human exposure to acrylamide, a known neurotoxin and carcinogen, when using such products for soil and water management practices.

- **Water Savings**: By improving soil structure and increasing water infiltration, anionic PAMs like Rescaype can help in water conservation. Better soil structure allows for more efficient use of water in agricultural and landscaping applications, reducing runoff and increasing water retention in the soil.

- **Application Considerations**: The effectiveness of Rescaype, as with other anionic PAMs, is influenced by factors such as soil type, presence of divalent cations, and the specific environmental conditions. Applications may need to be tailored to these factors to maximise benefits while minimising any potential risks or inefficiencies.

- **Degradation and Environmental Fate**: PAMs undergo degradation through various environmental mechanisms, which can affect their longevity and performance. The specific degradation pathways and rates for Rescaype would be essential to understand its long-term environmental impact and effectiveness as a soil stabiliser and water conservation agent.

-

COMPARISON TO OTHER ANIONIC PAMS:

Rescaype, with its specific molecular structure, is expected to perform similarly to other anionic PAMs in terms of soil stabilisation and water savings. The unique molecular weight and charge density associated with its 12 mol linear anionic structure may offer specific advantages in certain applications, such as enhanced performance in particular soil types or improved environmental safety profiles.

In conclusion, Rescaype appears to be a promising agent for soil stabilisation and water conservation, with environmental safety considerations similar to those of other anionic PAMs. Further specific studies on Rescaype would be beneficial to fully understand its performance characteristics and environmental impact.

REFERENCES

The analysis of the documents within the "Residuals" folder provides insights into several key areas related to the use and impact of polyacrylamide (PAM) and its degradation products in environmental systems. Here are the common findings across the documents:

- **Environmental Footprint Reduction**: A focus on reducing the environmental footprint from the manufacturing and use of acrylamide-based polymers is evident. Efforts include replacing fossil-based raw materials with bio-sourced or recycled ones and incorporating cleavable monomers to favour biodegradability. This aims to meet regulatory requirements regarding the fate of these molecules in the environment【Residuals/2021-Polymers-reduction in footprints.pdf†source】.

- **Effectiveness in Soil Erosion Control**: The effectiveness and durability of PAM in reducing soil erosion under simulated rainfalls were investigated, showing that PAM can significantly lower runoff rates and sediment concentration, hence controlling soil erosion effectively【Residuals/2017 Effectiveness_and_Durability_of_Polyacrylamide_PAM-CHINA.pdf†source】.

- **Microbial Degradation of PAM**: Studies on the microbial degradation of PAM and its deamination product polyacrylate highlight the biodegradation process, pathways, and microbial catabolism of these polymers. This research underscores the importance of understanding the environmental impact and biodegradability of PAM【Residuals/2019-Microbial degradation of polyacrylamide.pdf†source】.

- **Residual Acrylamide in Field Crops**: Analysis of residual acrylamide in field crops treated with PAM to stabilise soil erosion shows minimal residues, suggesting low environmental and health risks associated with its use in agriculture【Residuals/1999 Residual Polyacrylamide in field crops.pdf†source】.

- **PAM Degradation and Environmental Implications**: The degradation of PAM and its implications in environmental systems were discussed, covering the applications of PAM in water and wastewater treatment, soil conditioning, and oil recovery. The potential environmental challenges and methods for treating wastewater containing degraded PAM were explored【Residuals/2017-PAM Degradation s41545-018-0016-8.pdf†source】.

- **Acrylamide Residues in Water**: The potential contamination of potable water supplies by acrylamide residues was addressed, emphasising the need for monitoring and controlling acrylamide levels in water【Residuals/1980-Residuals of Polyacrylamide in water-Croll.pdf†source】.

These common findings highlight the multifaceted approach to understanding and mitigating the environmental impacts of polyacrylamide use, including efforts to enhance its biodegradability, effectiveness in soil erosion control, and safety in agricultural and water treatment applications.

Contact : Christian J Murray

44 7480367301

christian@soilwater.co.uk