AkzoNobel

About the Company

AkzoNobel is a leading global paints and coatings company, as well as a major producer of specialty chemicals.

Substitution Summary

Chelating agents, such as ethylenediaminetetraacetic acid (EDTA) and sodium tripolyphosphate (STPP), are used in many cleaning formulations, but some are not readily biodegradable. Moreover, because it is phosphate-based, STPP causes algae blooms. The Chelates group within AkzoNobel developed the new chelating agent Dissolvine GL-47-S (GLDA). GLDA is readily biodegradable and has improved human safety and aquatic toxicity safety profiles.

Motivation

Chelating agents (e.g., EDTA) and those based on phosphates (e.g., STPP) are used in many cleaning formulations and industrial processes throughout the world. Phosphates are known to promote excessive algae growth that results in eutrophication of natural waters. By 1994, widespread state regulation had effectively eliminated the use of phosphates in household laundry detergent.[1] However, phosphates were still allowed in automatic dishwasher detergents (ADW) until 2010, when several states began banning their use. In anticipation of the 2010 ban, the ADW industry sought a new chelating agent was that was phosphate-free and had an improved human health and environmental profile.

Achievement

AkzoNobel developed the process to manufacture the new GLDA chelate years before state regulation prompted its introduction to the marketplace. GLDA is manufactured using monosodium glutamate (MSG)—a natural amino acid made from the fermentation of corn sugars—which is a bio-based raw material that replaces most of the carbon content that usually comes from petroleum-based sources. However, modifications to the manufacturing process were needed to ensure that both the quality and performance of the GLDA product would meet customer and consumer requirements in the ADW application. This development proceeded and work was completed under a partnership with key customers in time for the 2010 replacement deadline.

As a crucial part of the overall project, AkzoNobel collaborated with a key customer to develop a new approach to directly test ingredient biodegradation in waterways. These innovative field studies, which were conducted in several states, showed that GLDA is readily biodegradable in each state where the reformulated ADW product has been commercially introduced.

In addition, AkzoNobel was aware that the U.S. EPA had human health effects concerns for certain other chelating agents. It therefore proactively collaborated with EPA scientists to develop a short-term test methodology that measured kidney biomarker proteins and minimized the use of

laboratory animals. The results of this new testing approach showed that GLDA has an improved human health safety profile. AkzoNobel has shared its novel test methodologies and results in public scientific meetings and with the U.S. EPA.[2,3,4,5,6]

GLDA has proven to be effective in the ADW application; in comparison to STPP, the efficacy of GLDA is quite similar.[7] Since GLDA does not contain phosphorous, it does not contribute to eutrophication as STPP does. In addition, Dissolvine GL-47-S has a very high water solubility that allows more concentrated products to be shipped and formulated into cleaning products; thus truck transport, packaging, and packing waste is reduced by 25% over other chelates.[8]

Business Impact

Supply Chain Changes

The primary difference between EDTA and GLDA manufacture is the bio-based MSG raw material, which is purchased from a completely different supplier than the conventional petroleum-based raw materials.

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Profitability

GLDA costs more to manufacture than EDTA, due to the current higher cost of the MSG bio-based raw material versus the petroleum-based raw material used for EDTA. AkzoNobel expects the price difference to close and reverse sometime in the future.

However, AkzoNobel does not know the complete cost differential between a conventional STPP-containing ADW product and a GLDA-containing one, since the overall composition of the two detergents is very different.

Industry Effect

Because of its benefits, GLDA is now also replacing other less environmentally friendly chelates in other applications. The oil and gas sector is one example of where GLDA's unique solubility at low pH is showing particular benefit. Older wells tend to get plugged with calcium scales; the conventional treatment for dissolving these scales involves the injection of concentrated hydrochloric acid into the well. Not only is hydrochloric acid dangerous to workers and potentially to the environment, it is highly corrosive to metal piping in the wells—which, if not properly maintained, can lead to leaks of oil and gas to the environment. The GLDA product shows very low corrosion, compared with hydrochloric acid, and workers and the environment are at much less risk of injury during the treatment of the well.

By introducing and advancing the understanding of new tools, such as those described above, AkzoNobel took a leadership stance that supports the responsible development of safe, biodegradable chelating agents. AkzoNobel has openly shared these innovative testing strategies with all stakeholders in hopes of advancing the science in this area and promoting development of safer alternatives.

Certifications/Eco-labels Received

AkzoNobel has pursued and achieved the following eco-certifications for Dissolvine GL-47-S (GLDA):

- U.S. EPA Design for Environment: full green circle
- USDA Bio-preferred Procurement Program: Intermediate, containing 58 % bio-based carbon
- Ecogarantie certification: Authorized for use in cleaning products and cosmetics
- COSMOS: Authorized for use in cosmetics
- EU Ecolabel (Euro-flower): Authorized for use in both Industrial and Institutional categories, all five Cleaning categories, and Cosmetic category for rinse-off products
- Nordic Ecolabel (Swan): Authorized for use in all seven Swan Industrial and Institutional Cleaning categories, all seven Consumer Cleaning categories, and the Cosmetic category
- French Positive List: Approved substance

[1] All URLs in references accessed as of June 2014. Litke, D.W. 1999. Review of Phosphorus Control Measures in the United States and Their Effects on Water Quality: U.S. Geological Survey. Water-Resources Investigations Report 99–4007. Denver, CO: USGS. http://pubs.usgs.gov/wri/wri994007/pdf/wri99-4007.pdf. [2] Schaefer, E., N. Itrich, K. van Ginkel, T. Federle, K. Casteel, M. Mathews, J. Menzies, E. Bisinger, and J. LePage. 2013. How a New Builder (Chelate) in Automatic Dishwashing Detergent Became Ready Biodegradable: Widespread Microbial Adaptation in the Field. Presentation at the 17th Annual Green Chemistry & Engineering Conference, Bethesda, MD, USA, June 18–20, 2013. http://presentations.acs.org/common/media-player.aspx/GCE2013/GCE/GCE003/GCE12. [3] Ginkel, C.G. van, R. Geerts, P.D, Nguyen, and C.M. Plugge. 2008. Biodegradation pathway of L-glutamatediacetate by Rhizobium radiobacter strain BG-1. International Biodeterioration & Biodegradation 62 (1): 31–7. [4] Ginkel, C.G. van, R. Geerts, and P.D, Nguyen. 2005. Biodegradation of L-glutamatediacetate by Mixed Cultures and an Isolate. Chapter 10. In Biogeochemistry of Chelating Agents, edited by B. Nowack and J. VanBriesen. Washington, DC: American Chemical Society. [5] LePage, J., R. Krishnaraj, K. Van Ginkel, and E. Bisinger. 2013. AkzoNobel: Innovation in Product Stewardship. Poster at the 17th Annual Green Chemistry & Engineering Conference Poster Session, Bethesda, MD, USA, June 18–20, 2013. [6] Krishnaraj, R., E. Bisinger, N. Edgerton, D. Dodd, and J. Mapes. 2013. A Comparative Study on the Renal Toxicity of Industrial Chelates Using Novel Urinary Protein Biomarkers as Early Predictors of Nephrotoxicity. Presentation at the 52nd Annual Meeting of the Society of Toxicology and ToxExpo, San Antonio, TX, USA, March 10–14, 2013. [7] Kincaid, P. Results of Anti-filming Tests: 30 washes (65 degrees C.) comparing GLDA, STPP and Citrate. In, 102nd AOCS: Readily Biodegradable Chelating Agent for Improved Detergent Efficiency. AkzoNobel Functional Chemicals LLC. May, 4, 2011. [8] Boren, T., K. Ludvig, K. Andersson, and J. SeetzJ. 2009. Eco-efficiency Analysis Applied on Chelating Agents, SOFW Journal 135 (10-2009): 2–10.

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