REPORT BY

tsg

a science group company

Atmosphere

the science of clean

March 23, 2021

INTRODUCTION

Atmosphere RTU product is a multisurface cleaner and deodorizer comprising a dilute solution (0.13%) of alkyldimethylbenzylammonium chloride (ADBAC). Atmosphere RTU is intended for use on nonfood contact surfaces in residential, industrial, institutional, and commercial settings.

ADBAC, a quaternary ammonium compound ("quat"), is a common and well-studied active ingredient in antimicrobial cleaning products used by consumers and institutions. The first ADBAC active ingredient was registered with U.S. EPA in 1947. As such, an in-depth dataset addressing potential human health and environmental effects of ADBAC exists. At high concentrations, ADBAC is acutely toxic to human health. However, at low concentrations, ADBAC does not cause adverse health effects, other than being slightly irritating to the eyes if contact should occur.

Atomsphere RTU will not pose a significant risk to the environment. First, only low levels of quats are released to the environment because most is effectively reduced at wastewater treatment sites. That which is released biodegrades quickly or is strongly bound to organic matter. The sorption of ADBAC to organic matter in the environment makes it less bioavailable to aquatic and terrestrial organisms and thus dramatically reduces its toxicity.

ENVIRONMENTAL FATE AND ECOTOXICITY

Atmosphere RTU environmental exposure is only expected after the product is disposed of down the drain and treated in a wastewater treatment plant (WWTP). Exposure via air is unlikely because the vapor pressure of ADBAC is very low (3.53 x 10-12 mm Hg; EPA 2006a).

In WWTPs, the vast majority of ADBAC, generally more than 90%, is removed during treatment by biodegradation and sorption (Boethling & Lynch 1992). A semi-continuous activated sludge (SCAS)) study (OECD 302A) of ADBAC determined that the average percent carbon removal by biodegradation and sorption together was between 94% and 100% over a seven- day period (DeLeo et al. 2020). There was at least 98% removal of ADBAC by municipal wastewater treatment facilities with conventional secondary activated sludge technology, in which at least 80% was via biodegradation (Clara et al. 2007).

After treatment in a WWTP, there are two primary pathways of release: 1) via effluent that is released into the aquatic environment and 2) via biosolids that are land-applied. The low level of ADBAC that is release post-WWTP is unlikely to cause adverse effects in the environment because ADBAC is readily biodegradable, which will rapidly decrease its environmental concentration even more, and because the strong sorption of ADBAC to organic matter results in the compound having very low bioavailability to aquatic and terrestrial organisms.

HUMAN HEALTH TOXICITY

Atmosphere Global LLC carried out U.S. EPA guideline acute toxicity testing on Atmosphere RTU (0.13% ADBAC). These results are summarized below in the Table. The 96-hour oral LD50 was >5,000 mg/kg bw and the 4-hour inhalation LC50 was > 3.05 mg/L, indicating **the product is not toxic by the oral or inhalation routes of exposure**, respectively (both EPA toxicity category IV). Atmosphere RTU was slightly toxic to the eye, with effects clearing within 72 hours (EPA toxicity category III) and was not a dermal sensitizer in a standard Buehler test. Finally, a higher concentration of Atmosphere RTU product containing ADBAC at 0.36% was not irritating to rabbit skin in the primary skin irritation test (EPA toxicity category IV).

ATMOSPHERE RTU ACUTE TOXICITY TEST RESULTS

Test	Result	EPA Toxicity Category
Acute oral toxicity (OPPTS 870.1100)	96-hr LD50 >5,000 mg/kg bw	IV
Acute inhalation toxicity (OPPTS 870.1300)	4-hr LC50 >3.05 mg/L	IV
Primary eye irritation (OPPTS 870.2400)	Irritation clearing in 72 hours	III
Primary skin irritation (OPPTS 870.2500)	Irritation clearing in 72 hours	IV
Dermal sensitization (OPPTS 870.2600)	Non-sensitizer	(NA)

ADBAC Biodegradation

The biodegradation of ADBAC has been tested extensively. At environmentally relevant concentrations, ADBAC is readily biodegradable under aerobic conditions. In a modified Sturm test (OECD 301B; CO2 evolution), ADBAC at 5 mg/L was demonstrated to be readily biodegradable with 95.5% degradation after 28 days (TRS 2011). In another modified Sturm test, ADBAC was considered readily biodegradable with 84.0% and 82.6% degradation at 5 mg/L and 10 mg/L, respectively. In a biochemical oxygen demand test similar to OECD 301B, 72% of Alkyl(C12-C18) dimethylbenzylammonium chloride had degraded after 28 days at 5 mg/L (TRS 2011). Finally, in a 28-day Closed Bottle Test (OECD 301D) using a WWTP inoculum, the 28-day biodegradation was between 82% and 85%, indicating that ADBAC is ultimately biodegradable (i.e. complete mineralization of ADBAC to CO2, biomass and inorganic substances) (TRS 2011).

ADBAC Sorption

The toxicity of ADBAC in the environment is heavily mitigated by its tendency to adsorb to soil, sediment, sludge and dissolved organic matter. In natural environments, **ADBAC will be essentially non-bioavailable due to its strong propensity to bind to organic matter.** The positively charged moiety of ADBAC binds tightly to negatively charged groups in all types of soil and sediment or dissolved matter in the water column, decreasing its potential to leach from soil or sediment into surface or groundwater. In natural waters, the bioavailable fraction of quat is reduced by up to 95% by the presence of suspended solids and other anionic matter (Landis et al 1993). The effect of this extensive sorption on ecotoxicity has been demonstrated in acute toxicity studies using fish and Daphnia, in which organisms are exposed to ADBAC in clean water versus water with organic matter. The difference in LC50 value is up to 20-fold.

CONCLUSION

Atmosphere RTU contains a very low concentration of ADBAC (0.13%) and is not toxic to human health, other than being irritating if eye contact is made. Environmental exposure to ADBAC from Atmosphere RTU will be very low because the concentration of ADBAC is low to begin with and the majority will be removed during wastewater treatment. Some ADBAC will be released from WWTPs, but most of this will biodegrade rapidly in the environment and the rest will be strongly adsorbed to organic matter in aquatic and terrestrial environments, making it essentially unavailable for uptake and therefore a low risk for toxicity to organisms living in these environments.

REFERENCES

Boethling, R.S., Lynch, D.G., 1992. Quaternary ammonium surfactants. In: de Oude, N.T. (Ed.), Detergents. Anthropogenic Compounds, 3/3F. Springer, Berlin, Heidelberg.

DeLe PC, C. Huynh, M Pattanayek, KC Schmid, N Pachacek. 2020. Assessment of ecological hazards and environmental fate of disinfectant quaternary ammonium compounds. Ecotoxicology and Environmental Safety 206. 111116.

Clara, M., Scharf, S., Scheffknecht, C., Gans, O., 2007. Occurrence of selected surfactants in untreated and treated sewage. Water Res. 41, 4339–4348.

Landis, W.G., Hughes, J.S., Lewis, M.A. (Eds.), 1993. Environmental Toxicology and Risk Assessment. ASTM STP 1179. American Society for Testing and Materials (ASTM), Philadelphia, PA, 431 pp.

TRS, 2011. Alkylmethylbenzylammonium Chloride (ADBAC) Category High Production Volume (HPV) Chemicals Challenge Final Test Status and Data Review. Toxicology Regulatory Services, Inc.

USEPA, 2006a. Reregistration Eligibility Decision (RED) for Alkyl Dimethyl Benzyl Ammonium Chloride (ADBAC). EPA739-R-06-009. U.S. Environmental Protection Agency.

USEPA, 2006b. Environmental Fate Assessment for Alkyl* Dimethyl Benzyl Ammonium Chloride *(50%C14, 40%C12, 10%C16)(ADBAC) for the Reregistration Eligibility Decision (RED) Document. Memorandum Dated July 27, 2006. U.S. Environmental Protection Agency.