

Member Summary Comments
March 2021 SAB meeting
Quaternary Ammonium Compounds

Reproductive

Melin shows effect, guideline studies don't, so results are mixed.

Timing of neural development

Defaulted to effects from the mixture here.

Note lipid and sterol biosynthesis importance in brain and spinal cord development; potentially disrupted/impacted. Neurogenesis and neural system development and timing.

Based on available data from guideline and academic studies there is some concern for early neural developmental effect; no evidence for frank defect.

Some of these effects may be supported by potential endocrine activity in screening assays in addition to mechanistic studies, [like Xu which is in vitro]

Asthma

Evidence in case reports, surveillance studies, and animal studies indicate that QACs are associated with respiratory system irritation and inflammation including those outcomes consistent with occupational asthma and work-exacerbated asthma. Epidemiologic evidence is suggestive with limitations in terms of exposure characterizations (mixtures vs individual Quats), and study population (exclusion of most vulnerable persons or distinguishing between new-onset vs prior asthma).

Corrosivity/worker health

Concern with corrosion: irritation and serious eye damage listed as 1 on multiple SDS skin; irreversible

In concentrated mixtures; some ready to use listed 1, but may be overly cautious.

Corrosive.

Environmental

Environmental effects in specific aquatic organisms seen in low microgram per liter concentrations.

Wastewater treatment effluent and some surface water concentrations approach these levels.

Sorption to sediment and sludge are major environmental endpoints/significant fate.

Persistent? Identified in other agencies -some in soil and anaerobic

Wastewater treatment can't handle plugs > disrupt bioreactors and cause downstream effects. Bacteria can become resistant.

Salamova air samples, small sample size passive air sampling

From chat:

Though QACs are removed from the previous studies relying on enrichment and isolation of QAC-liquid stream during conventional wastewater treatment via a combination of sorption to biosolids and biodegradation, these compounds are still detected in aquatic environments, especially at higher concentrations in locations downstream of the discharge of municipal WWTP effluents and hospital and industrial (e.g., laundry and food processing) effluents. QACs compounds will increasingly enter the environment through point source pollution, land application of biosolids, or treated municipal and industrial effluent discharges. There are three main attenuation mechanisms for QACs in the aquatic environment: photolysis, biodegradation, and sorption to suspended particles followed by sedimentation. Generally, QACs have been considered stable or relatively slow to degrade by hydrolysis, photolysis, or microbial activity.

QACs like BACs and DADMACs have previously exhibited relatively long photolysis half-lives in aqueous and soil environments. WWTP process is dependent on QAC concentration, structure, microbial consortia, and treatment conditions. If the concentration of QACs is too high, the presence of QACs proves inhibitory to microbial activity and even detrimental to the microorganisms. If concentration of QACs is too low, the QAC may no longer serve as an attractive carbon source for the microorganisms. Levels higher than 2 mg/L have been shown to affect performance and increase biofouling in membrane bioreactors. If given time removal systems can adjust to increasing QAC loadings,⁷⁴ but sudden increases in QAC inputs could cause operational problems.

The QACs were not biodegraded under anaerobic conditions indicating that QACs present in anaerobic digesters will remain with biosolids that are land applied. Increasing QAC concentrations could lead to one of two results: digester failure or further acclimation via changes in microbial community structure, potentially to communities that harbor more antibiotic resistance. Perhaps of greatest concern is the proliferation of pathogenic multidrug resistant bacteria ("superbugs"), following exposure to QACs. Indeed, methicillin-resistant *Staphylococcus aureus* (MRSA) strains exposed to BAC as well as benzethonium chloride had increased resistance to oxacillin and β -lactam antibiotics. *Salmonella enterica* and *Escherichia coli* O157 exposed to BAC also developed cross-resistance to antibiotics

Exposure to BAC at subinhibitory levels in an aerobic sediment microbial community altered microbial community composition and increased resistance to BAC as well as penicillin G, tetracycline, and ciprofloxacin. Collectively, these studies indicate that BAC is not a universal selective agent for antibiotic resistance, but rather it will alter the antibiotic resistance profiles of microbial communities.

Multiple studies revealed that BAC increased resistance to ciprofloxacin, which is currently a top 5 prescribed antibiotic, and was the most abundant antibiotic found in biosolids in the U.S., an indication of its high usage. Lethal toxicity of ATMACs toward rainbow trout increase with chain length and LC50-24h of 0.6-41 mg/L.