

Quat Salt Solubility

Quaternary ammonium salts generally begin to show significantly decreased water solubility and increased lipophilicity (hydrophobicity) when the total number of carbon atoms in their alkyl chains exceeds **10 to 12**.

- **Long-chain behavior:** When quaternary ammonium salts (QAS) possess one or more alkyl chains of at least **10–12 carbons** (e.g., decyl, dodecyl, or lauryl groups), they act as surfactants, with hydrophobic character that reduces their solubility in water and increases their solubility in organic solvents.
- **Optimal hydrophobicity for biocides:** Many commonly used cationic disinfectants (such as BAC or DADMAC) are designed with C12, C14, or C16 chains, which provide the best balance of limited water solubility and strong membrane-active properties.
- **Threshold:** If the hydrocarbon chains are short (e.g., methyl, ethyl), the salt is highly water-soluble. Increased chain length beyond 10-12 carbons results in lower water solubility. [2, 3, 4, 5, 6]

Summary of Chain Lengths:

- **Less than 6 carbons:** Highly water-soluble.
- **8–10 carbons:** Increased hydrophobic character begins.
- **10–16 carbons:** Strongly hydrophobic/low water solubility (long-chain quaternary ammonium salts). [1, 7, 8]

AI can make mistakes, so double-check responses

[1] <https://www.sciencedirect.com/topics/chemistry/quaternary-ammonium-salt>

[2] <https://pubmed.ncbi.nlm.nih.gov/articles/PMC7350379/>

[3] <https://npic.orst.edu/ingred/whatarequats.html>

[4] <https://pubmed.ncbi.nlm.nih.gov/36526659/>

[5] <https://www.sciencedirect.com/science/article/abs/pii/S0167732222010121>

[6] <https://labinsights.nl/en/article/pros-and-cons-of-quaternary-ammonium-disinfectants>

[7] <https://www.chegg.com/homework-help/questions-and-answers/ammonium-salts-less-6-carbon-atoms-water-soluble-false-35-true-q29874914>

[8] <https://www.sciencedirect.com/science/article/abs/pii/S1093326323001596>

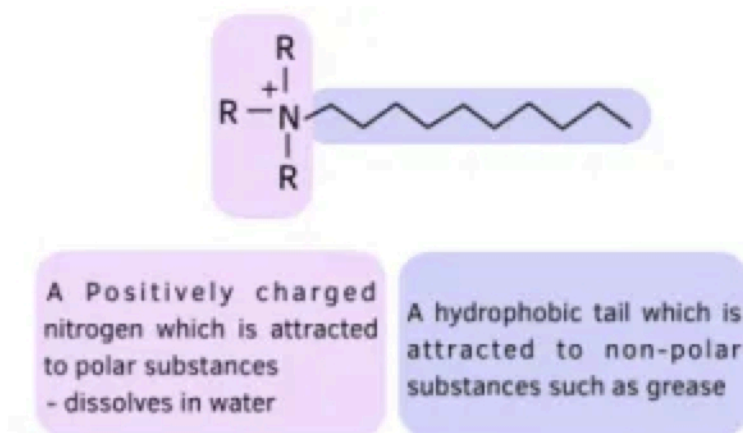


Fig 9. Quaternary Ammonium Salt with a Hydrocarbon Chain.