

Silver dihydrogen citrate

Biocide Characteristics Profile



Material Name:	Silver dihydrogen citrate (SDC); Axenohl
Active ingredients	Stabilized ionic silver ;citric acid
Delivery system	Liquid – Concentrate: Axenohl (2400ppm silver ion), Use Level: Varies upon application.
Activity:	
Target activity (bacteria, molds, yeast, algae, protozoa)	Effective against bacteria, fungi & viruses
Recommended use concentrations	Varies based on application
Recommended use concentration and time	Dilution at 30 ppm silver for hard surface disinfectant:
	Effective in 30 seconds against: Pseudomonas aeruginosa ATCC 15422; Staphylococcus aureus ATCC 6538; Salmonella choleraesuis ATCC 10708 ; Listeria monocytogenes ATCC 19111; HIV type1, Strain HTLV=III _B
	Effective in 1 minute against: Herpes simplex type I ATCC VR-733, Strain F(1)
	Effective in 2 minutes against: <i>E. coli</i> 0157 ATCC 43888; <i>Enterococcus faecium</i> (VRE)ATCC 700221; <i>Staphylococcus aureus</i> (MRSA) ATCC 700698
	Effective in 10 minutes against: Rhinovirus R37 ATCC VR-1147, Strain 151-1 Influenza A ATCC VR-544, Hong Kong Strain Poliovirus type 2 ATCC VR-1002, Strain Lansing <i>Trichophyton mentagrophytes</i> ATCC 9533
Primary use	Hard surface disinfection; (HSD contains Sodium Lauryl Sulfate)
Potential applications	Pharmaceutical/Cosmetics --- mouthwash, acne, athletes food control, toenail fungus control, wound care, mouthwash, cold sores, preservative
	Environmental – swimming pool treatment, biofilm
	Agriculture – preservative, teat wash, stall wash, wound care
	Industrial – Fluid clean-up, cooling towers, biofilm control
	Disinfection – hard surface, wipes/towelettes, hand soap, bandages
	Odor elimination – carpets, mouthwash, garbage cans, mops, diaper pails and cleaning aids.
Mode of Action	It is generally believed that transitional metals react readily with proteins by combining the SH groups, leading to protein inactivation. Recent microbiological and chemical studies suggest that interaction of ionic silver with thiol groups play an essential role in bacterial inactivation. As a reaction against the denaturing effects of silver ions, DNA molecules become condensed and lose their replication abilities. "Mechanistic Study of the Antibacterial Effect of Silver", Q.L Feng et al, <i>Journal of Biomedical Materials Research</i> , Vol. 52, #4, October 2000. Furthermore, Ag ⁺ induced a total collapse of both the pH gradient and membrane potential. H ⁺ leakage occurs in membrane proteins or phospholipid bilayers. This would in-turn cause cell death. "Chemiosmotic Mechanism of Antimicrobial Activity of Ag ⁺ in <i>Vibrio cholera</i> ", Pavel Dibrov et al, <i>Antimicrobial Agents and Chemotherapy</i> , Vol. 46, #8, August 2002.
Recommended use pH, effect on activity	Effective pH range 1-8
Temperature, effect on activity	Accelerated storage temperature and stability showed no significant drop-off in biocidal activity
Efficacy against biofilms	Yes

Residual Microbicidal effect	Possesses a significant residual effect
Physical Properties:	
Liquid/solid/gas	Liquid, water based
Foaming/non-foaming	Yes,(when formulated with SLS)
Odor	Odorless
Color (impart color to product)	Colorless
Stability	Tested to 1 year under warehouse conditions; Prolonged storage under warehouse conditions did not significantly alter stability
pH of product	1.4-2.0
Freeze/thaw stability (0-25C)	N/A, similar properties as water
Crystallization, freeze, & pour points > 0C	N/A. similar properties as water
Interactions:	
Compatibility with other ingredients	Incompatible with: Al sulfate, Al ammonium chloride, Al orthophosphate, chlorides above 300 ppm, sequestering agents designed to remove transition metals from solution, EDTA (above 1.5%), calcium hardness above 300 ppm, prolonged UV exposure
Partitioning into oil/aqueous phase	Because Axenohl is water based, if combined with an oil based matrix separation will occur.
Corrosivity	Non-corrosive
Monitoring:	
Product/active detectability	ICP, HPLC or ion selective electrode
Environmental Profile:	
Biodegradability	Readily degraded
Photolysis	Extended exposure to UV or direct sunlight
Bioaccumulation	NA; readily degraded in environment
Toxicity:	
Aquatic toxicity	Unknown, higher levels may have some toxic effect on aquatic life.
Acute mammalian toxicity package	Acute oral: > 5000 mg/kg ; Acute dermal toxicity > 5000 mg/kg ; Primary eye irritation: Minimal effects clearing in less than 24 hours ; Skin irritation: Mild or slight irritation (no irritation or slight erythema)
Marketing	
Registration --- US	EPA registration: Hard Surface Disinfectant (72977-1 MUP , 72977-2 (12 ppm HSD) & 72977-3 (30 ppm HSD)
Registration -- claims	Hard surface disinfectant
Patentable (application or formulation) - exclusivity	US Patent # 6,197,814; #6,583,176 ; Supplemental and Use patents filed; International patents filed