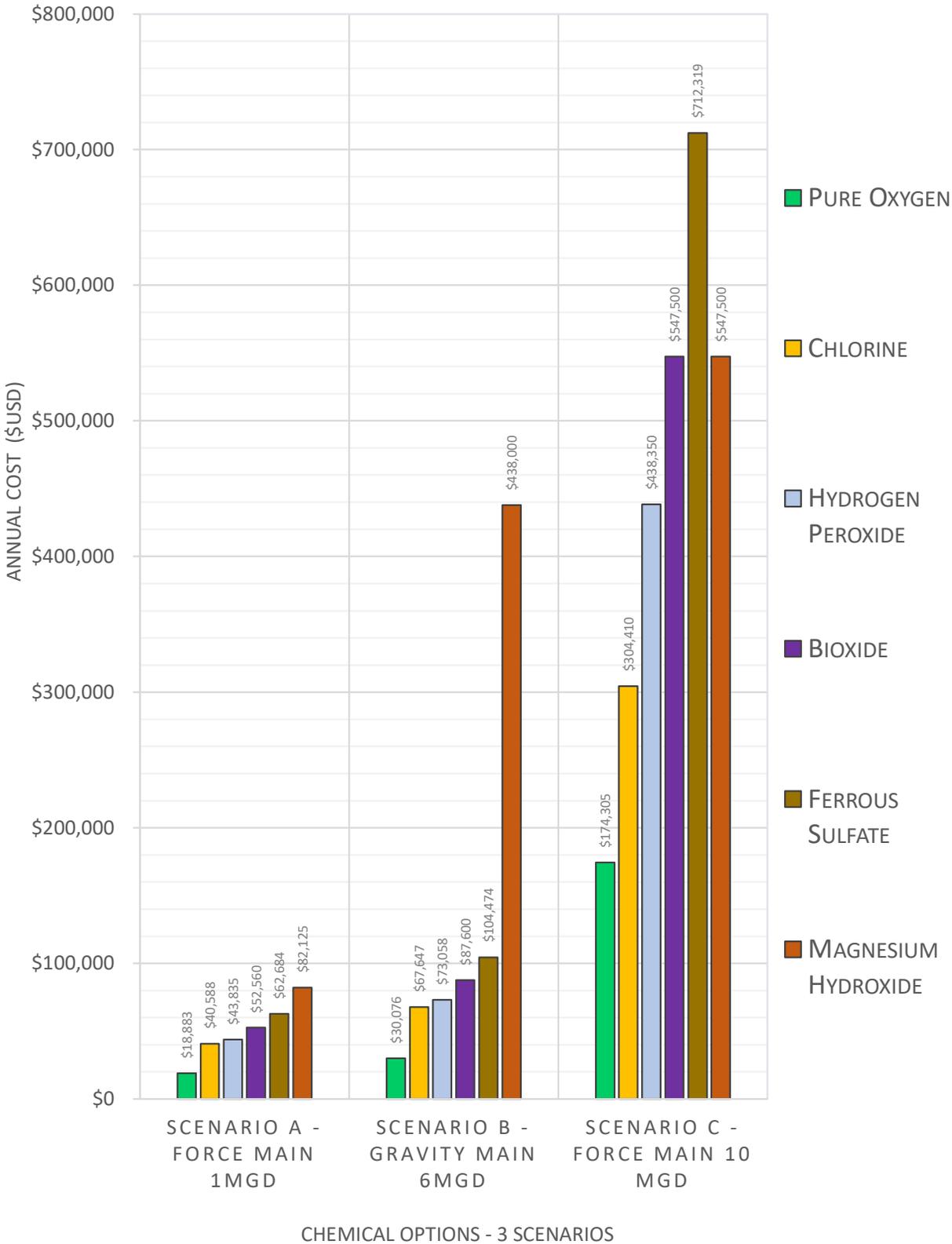


ANNUAL COST COMPARISON LIQUID PHASE SULFIDE CONTROL OPTIONS



Liquid Phase Methods of H₂S Control



Chemical	Application	Storage & Handling	Lowest H ₂ S Achievable	Dose Values	Dose Dependent	Product cost \$/gal	Pros	Cons
SuperOxygenation (Pure D.O.) High Purity Oxygen Oxygen Injection	Requires equipment for dissolving oxygen to high concentration without entrained gas/bubbles. Effective in preventing DS formation by preventing anaerobic conditions. Effective for oxidizing DS, requires 15-30 minutes.	Stored as liquid Non-hazardous Non-explosive Tank owned by O ₂ Supplier	DS~0 mg/L (H ₂ S~0 ppm)	Dose O ₂ = sum of (Remove=2 lbs/lb DS) (Prevent=OUR*HRT) [Ave. OUR = 10 ppm/hr] [Mult. by inefficiencies for oxygen gas purity and dissolution system]	Depends on Flow, HRT, OUR, and DS removed	\$0.48	+ Lowest Operating Cost + Effective for hotspots (HRT > 15-30 min) + Effective for force mains (HRT < 10 - 20 hrs) + Effective for gravity mains (HRT < 4 hrs) + Able to eliminate H ₂ S & Stop Corrosion + No byproducts are produced + Optimal for isolated lines	- Requires sidestream equipment to dissolve gas - Limited use for long lines (high pressure allows long HRT) - Not intended for lines with mult. flow inputs downstream
Chlorine (Cl₂) Hypochlorite/Bleach (NaOCl) Chlorine Gas Chlorine Tablets	Effective for rapid oxidation of DS	Hazardous Highly corrosive Requires secondary containment May off-gas and degrade	DS~0.5 mg/L (H ₂ S~20 ppm)	Dose NaOCl = 5-15 lbs/lb DS	Depends on Flow and DS removed	\$1.00	+ Inexpensive and easy to access + Familiar to operators, easy feed	- May reduce active biomass feeding WWTP processes - Reacts with DS and other compounds - May increase corrosion if fed incorrectly
Hydrogen Peroxide (H₂O₂)	Powerful Oxidant, reacts quickly, but will not carry for long HRT. Can be effective for short force mains (<2hrs HRT) Applicable for "hotspots", requires 15-20 minutes.	Hazardous Requires Secondary containment May require special training and security	DS~0.1 mg/L (H ₂ S~5-10 ppm)	Dose H ₂ O ₂ = 1 gal/lb DS	Depends on Flow and DS removed and prevented	\$3.00	+ Rapid reaction + No byproducts are produced + Can be used to regenerate Iron ("Pri-SC")	- Reacts with DS and other compounds - May require multiple feed points precautions - May require special operators, training, and safety
Calcium Nitrate (CaNO₃) ("Bioxide")	Requires 2-3 hrs min of contact time before effective. Can be used for long HRT. Can be dripped into wetwell. Can prevent Sulfide formation downstream. Can oxidize existing sulfides.	Non-hazardous	DS~0.1 mg/L (H ₂ S~5-10 ppm)	Dose NO ₃ = 12lbs/lb DS (Removal =2-5 lbs/lb DS) (Prevention =7-10 lbs/lb DS)	Depends on Flow and DS removed and prevented	\$2.50	+ Removes DS and Prevents H ₂ S + Efficient in long gravity lines	- Best possible results yeild DS = 0.5 mg/L (20 H ₂ S) - May increase scum in wetwell - Increased Nitrogen (as NO ₃) to WWTP
Iron Salts (Fe_x) Ferrous/Ferric Chloride / Sulfate	Can be effective for long lines (gravity and force mains) to precipitate and remove sulfides.	Hazardous Highly corrosive Requires secondary containment Requires freeze protection	DS~0.5 mg/L (H ₂ S~20 ppm)	Dose FeSO ₄ = 3.3 gal/lb of DS	Depends on Flow and DS removed	\$1.30	+ May help with settling and PO ₄ at WWTP + Can be regenerated with H ₂ O ₂ ("PRI-SC")	- Increased solids production at WWTP - May reduce biosolids quality at WWTP - May form deposits in low velocity lines - May cause iron film on pipe walls and equipment
Magnesium Hydroxide (MgO) ("ThioGuard")	Can be effective for high sulfide loading and low flows, both gravity and force mains. Elevates pH to keep Sulfides from becoming H ₂ S	Non-hazardous slurry Requires constant mixing Requires freeze protection Constant drip to avoid clogging feed lines	DS~0.5 mg/L (H ₂ S~20 ppm)	Dose MgO = MGD * 70-140 mg/L	Depends on Flow	\$2.50	+ Dose unaffected by Sulfide levels + Inhibits biogrowth in pipe + May increase alkalinity to benefit WWTP	- Not cost-effective for low H ₂ S targets, or turbulent zones - Does not remove S, only prevents release as H ₂ S - H ₂ S may re-release if flow is mixed with low pH water - May deposit in feed-lines, wet-wells, & low-velocity lines