



COLORADO

Division of Reclamation, Mining and Safety

Department of Natural Resources
1313 Sherman Street, Room 215
Denver, CO 80203

November 2, 2021

Brian Briggs
Ouray Silver Mines, Inc.
PO Box 564
Ouray, CO 81427

RE: Revenue Mine, Permit No. M-2012-032, Technical Revision (TR-14), Alternative Reagent Chemical-Approval

Dear Mr. Briggs:

On October 29, 2021 the Division of Reclamation, Mining and Safety (Division) received a request to use Floquat FL 2949 as the primary flocculant in the Revenue Mill. The Division is **approving** your request for the use of this reagent at the Revenue Mine site.

If you have any questions please don't hesitate to contact me.

Sincerely,

Amy Yeldell

Environmental Protection Specialist
Division of Reclamation, Mining and Safety

Enclosure: Approved Reagent List with alternatives

Ec: Travis Marshall, Senior EPS, DRMS
Lucas West, DRMS
Todd Jesse, OSMI
Poppy Staub, OSMI
Michelle Robbins, OSMI



Reagent	Manufacturer	Purpose of use	Alt Names	Human Health §2: SDS HCS 2012 (29CFR 1910.1200)	Environmental Impacts §12: SDS	PPE §8: SDS	NFPA - Classification §16 SDS	EPA List of Lists §12 SDS	Corrosivity	Incompatible Materials		
AeroFloat 242 Promoter	Solvay (distributor for Cytec Industries Inc.)	This is the ammonium salt of AEROFLOAT 31 promoter. Widely used for flotation of Pb from Pb/Zn ores and Cu/Pb from Cu/Pb/Zn ores. Improves Ag recovery from these ores.	NA	Acute toxicity, Category 4 Acute toxicity, Category 3 Skin Corrosion, Category 1B Serious eye damage, Category 1 Skin Sensitization, Category 1 Reproductive toxicity, Category 2 H373: May cause damage to organs through prolonged or repeated exposure. Specific target organ toxicity - repeated exposure, Category 2	H302: Harmful if swallowed H311: Toxic in contact with skin H314: Causes severe skin burns and eye damage H315: Causes serious eye damage H317: May cause an allergic skin reaction H361: Suspected of damaging fertility or the unborn child H373: May cause damage to organs through prolonged or repeated exposure. Toxicity to terrestrial plants Toxicity to above ground organisms	Acute toxicity to fish LC50 - 96 h: ca.66mg/L Rainbow trout Not tested Acute toxicity to daphnia and other aquatic invertebrates Toxicity to aquatic plants Toxicity to microorganisms M-Factor Ammonium hydroxide Acute aquatic toxicity = 1 Biodegradability: 70% - 28 Days Toxicity to benthic organisms Toxicity to soil dwelling organisms Toxicity to terrestrial plants Toxicity to above ground organisms	Health - 3 Serious Flammability - 1 Slight Instability or Reactivity - 0 Minimal	Ammonium HydroxideCAS - No. 1336-21-6 1000lb	Not classified re: corrosion of metals	Oxidizing agents, strong acids or bases, and amines		
Danafloat 067 (alternative to AeroFloat 242)	Quadra Chemicals Inc.	Flotation Agent	NA	Acute toxicity, Category 4 Acute toxicity, Category 3 Skin Corrosion, Category 1 Serious eye damage, Category 1	H302: Harmful if swallowed H311: Toxic in contact with skin H314: Causes severe skin burns and eye damage H318: Causes serious eye damage	Acute EC50 5 to 10ppm Marine Water - Species: Algae - macrocystic pyellera - young Acute EC50 7000 µg/l fresh water - Crustaceans - Grammarus fasciatus Acute LC50 10000 µg/l fresh water - Fish - leporinus macrochirus	Exposure 4 days 48 Hours 96 Hours	Health - 3 Flammability - 0 Physical Hazards - 0	Ammonium O, O-bis(methylphenyl) dithiophosphate 49-51 % CAS- No. 587373-83-4 mix-cresol 0-7% CAS No. 1319-77-3 ammonia 0-7% CAS No. 1336-21-6	Corrosive to the respiratory system and digestive tract	Acids	
Aerophine 3418 Promoter	Solvay (distributor for Cytec Industries Inc.)	AEROPHINE 3418A has application in flotation of copper- and lead-sulfide minerals, particularly where these are found in complex sulfide ores containing sphalerite zinc mineralization, and ores with high levels of pyrite and/or pyrrhotite.	NA	Serious eye damage, Category 1 Skin sensitization, Sub-Category 1B Health hazards not otherwise classified, Category 1	H318: Causes serious eye damage H317: May cause an allergic skin reaction Contact with acids liberates toxic gases	Acute toxicity to fish Not harmful (LC LL50>100mg/L) Acute toxicity to daphnia and other aquatic invertebrates Not harmful (EC/EL50>100mg/L) Toxicity to aquatic plants Toxicity to microorganisms Chronic toxicity to fish Chronic to daphnia and other aquatic invertebrates Toxicity to benthic organisms Toxicity to soil dwelling organisms Toxicity to terrestrial plants Toxicity to above ground organisms	Health - 3 Serious Flammability - 1 Slight Instability or Reactivity - 0 Minimal	N/A	Not corrosive to metals	Mineral acids, strong oxidizing agents, strong acids or bases		
Copper Sulfate Pentahydrate	Quadra Chemicals LTD.	Used in Zinc flotation as an activator of sphalerite	cupric sulfate, blue vitriol, bluestone	Acute Toxicity - Oral Category 4 Skin Corrosion/Irritation Category 2 Eye damage/Irritation Category 2	Harmful if swallowed Harmful in contact with skin Eye damage/Irritation	Ecotoxicity Persistence and degradability Bioaccumulation Mobility Other Adverse Effects Not Determined	Very toxic to aquatic life with long lasting effects Not determined Not determined May be mobile due to water solubility Not Determined	Health - 3 Serious Flammability - 0 Instability or Reactivity - 0 Minimal	CAS/313 Category Codes N100 & (CERCLA) 313	Mildly corrosive to steel	Aluminum powder, acetylene gas, hydroxylamine, magnesium and moisture	
Floquat FL 2949	SNF, Inc.	Used as a settling agent. A flocculant causes the suspended mineral to form into small masses. This will make the thickener load settle.		No known hazards to humans Aqueous solutions or powders that become wet render surfaces extremely slippery	Acute toxicity to fish LC50/Danio rerio/96 hours > 10-100mg/L (OECD 203) Acute toxicity to invertebrates LC50/Fathead minnow/96 hours > 10-100mg/L (OECD 203) Acute toxicity to algae No Data Chronic toxicity to fish No Data Chronic toxicity to invertebrates No Data Toxicity to microorganisms No Data Effects on terrestrial organisms No known effects Sediment toxicity No Data	Safety glasses with side shields PPE or other plastic material gloves Coverall and/or chemical apron and rubber footwear where physical contact can occur. No personal respiratory protective equipment normally required Wash hands before breaks and immediately after handling the product.	Health - 0 Flammability - 0 Instability - 0	N/A	Not classified re: corrosion of metals	None known		
Hyperfloc AF 309 (alternative to Floquat)	SNF, Inc.	Used as a settling agent. A flocculant causes the suspended mineral to form into small masses. This will make the thickener load settle.	NA	No known hazards to humans Aqueous solutions or powders that become wet render surfaces extremely slippery	Acute toxicity to fish LC50/Danio rerio/96 hours > 100mg/L (OECD 203) Acute toxicity to invertebrates LC50/Fathead minnow/96 hours > 100mg/L (OECD 203) Acute toxicity to algae LC50/Scenedesmus subspicatus/72 hours > 100mg/L (OECD 201) Chronic toxicity to fish No Data Chronic toxicity to invertebrates No Data Toxicity to microorganisms No Data Effects on terrestrial organisms No known effects Sediment toxicity No Data	Safety glasses with side shields Plastic material gloves Work clothes protecting arms, legs and body Dust safety masks recommended where working powder concentration is more than 10 mg/m3. Wash hands before breaks and immediately after handling the product.	Health - 0 Flammability - 0 Instability - 0	CERCLA - Hazardous substances list (40 CFR 302.4) - RQ - Not concerned	Not classified re: corrosion of metals	Strong bases, oxidizing agents		
Hydrated Lime	Lhoist North America	Lime is used to adjust the pH to aid in the collector adsorption by controlling the pulp chemistry. It also aids in the depression of certain minerals	NA	Eye damage Category 1 Carcinogen Category 1 Skin Irritation Category 2 Specific Target Organ Toxicity Single Exposure Category 3 Specific Target Organ Toxicity Repeat Exposure Category 1 Hydrated lime is not listed as a carcinogen, however this product contains crystalline silica, which is classified as carcinogenic to humans when inhaled.	Serious eye damage Skin irritation Respiratory irritation Damage to lungs through prolonged or repeated exposure when inhaled Cancer potential through inhalation Hydrated lime is not listed as a carcinogen, however this product contains crystalline silica, which is classified as carcinogenic to humans when inhaled.	Reacts with atmospheric CO2 overtime to form calcium carbonate No bioaccumulation effect or food chain concentration toxicity Minimal mobility in soil. Reacts with clay portion of soil to form calcium silicates and calcium aluminates This material is alkaline and if released into water or moist soil will cause an increase in pH Crystalline Silica 14808-60-7 OSHA PEL: 0.050mg/m3 as an 8 hr. TWA (respirable) ACGIH TLV: 0.025 mg/m3 (respirable)	NIOSH Approved respirators if airborne concentration exceeds PEL Safety Glasses with side shields or safety goggles. Contact lenses should not be worn when working with the lime products. Wear appropriate clothing and gloves to prevent contact Eye wash fountain and emergency showers close to work station location	N/A	N/A	Not classified re: corrosion of metals	Acids, reactive fluorinated or brominated compounds, reactive powdered metals, organic acid anhydrides, nitro-organic compounds, reactive phosphorus compounds, interhalogenated compounds	
Oreprep F-549 Frother	Solvay (distributor for Cytec Canada Inc.)	A frothing agent used to create a stable surface for sulfide mineral to adhere.	NA	Skin Irritation Category 2 Eye Irritation Category 2A	H315: Causes skin irritation H319: Causes serious eye irritation	Acute toxicity to fish No Data Acute toxicity to daphnia and other aquatic invertebrates No Data Toxicity to aquatic plants No Data Toxicity to microorganisms No Data Chronic toxicity to fish No Data Chronic toxicity to daphnia and other aquatic invertebrates No Data Abiotic degradation No Data physical and photo-chemical elimination No Data Biodegradation No Data Adsorption potential No Data Known distribution to environmental compartments No Data Results of PBT and vPvB assessment No Data Other adverse effects No Data	Store in a well ventilated area Chemical resistant goggles tightly fitting Impervious clothing Change work clothes after each work shift Contaminated work clothing should not be allowed out of the workplace Handle in accordance with good industrial hygiene and safety practice Wash hands before breaks and at end of workday Do not eat, drink or smoke while using this product.	Health - 2 Moderate Flammability - 1 Instability or reactivity - 0 or Minimal	N/A	Not corrosive to metals	Strong oxidizing agents	
Polyfloh W20 (Alternative to Oreprep)	Quadra Chemicals Inc.	A frothing agent used to create a stable surface for sulfide mineral to adhere.	NA	While this material is not considered hazardous by the OSHA Hazard Communication Standard (29 CFR 1910.1200), this SDS contains valuable information critical to the safe handling and proper use of the product. This SDS should be retained and available for employee's and other users of this product. No known significant effects or critical hazards.	No known significant effects or critical hazards. Ecotoxicity - Not available Persistence and degradability - Not available.	Chemical resistat, impervious gloves, complying with an approved standard should be worn at tall times when handling chemical products if a risk assessment indicates this is necessary	Health - 0 Flammability - 0 Instability - 0	NA	NA	No specific test data related to reactivity available for this product or it's ingredients. The product is stable Under normal conditions of storage and use, hazardous reactions will not occur.		
Sodium Isopropyl Xanthate Flottec SPX Collector	Charles Tennant & Copmany	Xanthate is commonly used in the flotation process of sulfide minerals. Xanthate is a combination of alcohol, sodium hydroxide and carbon dioxide, which is an anionic collector.	NA	Sodium Isopropylxanthate Self heating substances and mixtures Category 1 Acute toxicity (oral) Category 4 Acute toxicity (dermal) Category 4 Skin irritation Category 2 Eye irritation Category 2A Catches Fire spontaneously if exposed to air Harmful if swallowed or in contact with skin Causes skin irritation	Proxan Sodium (Synonym) H251: Self-Heating; may catch fire H302: Harmful if swallowed H315: Causes skin Irritation	Acute Aquatic Toxicity Category 2 Chronic Aquatic Toxicity Category 2 Do not allow to enter soil, water ways or waste water This product may be harmful to aquatic life Biodegradability All waste from this product including all empty containers must be disposed of in accordance with municipal, provincial and federal regulations.	H411: Toxic to aquatic life long lasting effects H412: Harmful to aquatic life with long lasting effects H413: Causes serious skin irritation H414: Causes serious skin contact H415: Causes serious skin contact H416: Causes serious skin contact H417: Causes serious skin contact H418: Causes serious skin contact H419: Causes serious skin contact	Wear impervious gloves when there is greater exposure risk If respiratory protection is required institute a complete respiratory protection program including selection, fit testing, training, maintenance and inspection. NIOSH or MSHA approved respirator for acidic vapors Face shield, safety glasses with side shields. Safety Boots Adequate protective clothing An eye wash station/safety shower should be near the work station Explosion proof mechanical ventilation to limit vapor concentration below T.L.V.	Health - 2 Flammability - 0 Instability - 2	CAS/313 Category Codes 7440-23-5 CERCLA RQ 10	Not classified re: corrosion of metals	Strong oxidizing agents, strong acids, strong bases, flammable liquids, heat, moisture
NAX 31 (Sodium isopropyl Xanthate alternative)	Prospec Chemicals (Charles Tennant & CO 3rd party supplier of Xanthate. Cascade columbia is a Distributor for Charles Tennant).	Xanthate is commonly used in the flotation process of sulfide minerals. Xanthate is a combination of alcohol, sodium hydroxide and carbon dioxide, which is an anionic collector.	NA	Acute Toxicity Oral Category 1 Acute Toxicity Dermal Category 4 Acute Toxicity Skin Irritation Eye Irritation Category 2 Eye Irritation Category 2A Eye Irritation Category 2B Eye Irritation Category 2C Eye Irritation Category 2D Eye Irritation Category 2E Eye Irritation Category 2F Eye Irritation Category 2G Eye Irritation Category 2H Eye Irritation Category 2I Eye Irritation Category 2J Eye Irritation Category 2K Eye Irritation Category 2L Eye Irritation Category 2M Eye Irritation Category 2N Eye Irritation Category 2O Eye Irritation Category 2P Eye Irritation Category 2Q Eye Irritation Category 2R Eye Irritation Category 2S Eye Irritation Category 2T Eye Irritation Category 2U Eye Irritation Category 2V Eye Irritation Category 2W Eye Irritation Category 2X Eye Irritation Category 2Y Eye Irritation Category 2Z	Harmful if swallowed Harmful in contact with skin Wash with plenty of soap and water Eye damage/Irritation NA	NA	NA	Health - 2 Flammability - 0 Instability - 0	NA	Not classified re: corrosion of metals	Strong oxidizing agents, strong acids, strong bases, flammable liquids, heat, moisture	
Sodium Metabisulfite	Quadra Chemicals LTD (Prospect Chemicals 2nd/3rd party distributor/supplier)	Sodium Metabisulfite aka MES is used for pH control in float flotation to control Pyrite depression. ... It is also used to prevent flotation of sphalerite by copper activation in the presence of Tennantite/Covellite in the ore.	Sodium Pyrosulfite, Disodium Pyrosulfite, Pyrosulfurous Acid, Disodium Salt, Sodium Disulfite.	Acute Toxicity Oral Category 4 Acute Toxicity Dermal Category 5 Serious Eye Irritant Category 1	Harmful if swallowed Harmful in contact with skin Eye damage/Irritation	Ecotoxicity: Sodium Metabisulfite is a non hazardous solid commonly used as a waste water dechlorination agent. High concentrations will contribute to elevated chemical oxygen demand in aquatic environments.	General and local exhaust ventilation systems to maintain airborne concentrations If necessary, wear and MSHA/NIOSH approved respirator. Protective boots, gloves, and clothing to prevent excessive skin contact. Protective eye glasses, safety glasses with side shields, or goggles. Emergency eye wash stations, showers, and washing facilities available in the work area. Remove this material from PPE as needed. Do not eat, drink or smoke in work areas.	Health - 2 Serious Flammability - 0 Instability or Reactivity - 0 Minimal	Hazardous Substance (40 CFR 302.4) RQ N/A	Not classified re: corrosion of metals	Acid and water produce sulfur oxides, Powdered potassium, sodium metal, alkali agents, oxidizing agents, and chlorates.	
Zinc Sulphate Monohydrate	Zinc Nacional	The established lead-zinc ore flotation processing scheme is to add zinc sulphate (ZnSO4) to the grind to control metal ion activation (sphalerite depression) ... Sphalerite that is rejected into the lead flotation tails is then floated in a second flotation step after activation with copper sulphate.	White vitriol, Goslarite	Acute aquatic toxicity Category 2 Skin corrosion/irritation Category 2 Serious eye damage Category 1 Specific target organ toxicity, single exposure, Respiratory tract irritation Category 3 Hazardous to the aquatic environment, long-term hazard Category 1	H302: Harmful if swallowed H315: Causes skin irritation H318: Causes serious eye damage H335: May cause respiratory irritation H410: Very toxic to aquatic life with long lasting effects	LC50 24 Hours fish (rainbow trout) 1.24 mg/L LC50 48 Hours fish (rainbow trout) 2.4 - 5mg/L LC50 96 Hours fish (rainbow trout) 24 - 83 mg/L LC50 96 Hours Daphnia 7.4 mg/L Organic carbon levels being regulating factors.	Zinc Sulphate has a high water solubility and its zinc and manganese contents are directly bio available. The zinc may be toxic to aquatic organism, especially fish, with water hardness, pH and dissolved organic carbon levels being regulating factors.	Gloves and long-sleeved work clothes or disposable coveralls may be necessary. Eye protection should be worn where dust is generated and there is a potential that eye contact may occur. Use adequate local or general ventilation where necessary to maintain the concentrations of dust well below the recommended occupational exposure limits for general Particulates, not otherwise specified. Where dust fumes are generated and cannot be controlled to within acceptable levels by engineering means, use appropriate NIOSH approved respiratory protection equipment.	Does not burn or support combustion § 5 Fire Fighting Measures SDS	CERCLA RQ 1000 Section 313c	Not classified re: corrosion of metals	Strong oxidizers, acids, strong bases

* highlighted items are primary reagent chemicals. Non-highlighted are alternatives