

Clariant Mining Solutions

BENEFICIATION OF FREQUENTLY OCCURRING MINERALS

| ELEMENT | MINERAL | FORMULA | GRADE WEIGHT% | HARDNESS | DENSITY | COLLECTOR | FROTHER | CO-COLLECTOR | SUPPORT REAGENT | MODIFIER | DEPRESSANT | ACTIVATOR | PH-VALUE | FLOATABILITY* | |
|-----------|--------------------|--|---|--------------------------------|-------------|--|--|--|---|--|--|---|-------------------------|---------------|------|
| A | Ag | Argentite | Ag ₂ S | 87.1 % Ag | 2.0 - 2.5 | 7.2 - 7.4 | HOSTAFLOT grades | FLOTANOL grades | Xanthate | | | | | ◆◆◆◆ | |
| | | Chlorargyrite (Cerargyrite) | AgCl | 75.3 % Ag | 1.0 - 1.5 | 5.6 | HOSTAFLOT grades | FLOTANOL grades | Xanthate | | | | 9.0 - 12.0 | ◆◆◆ | |
| | | Native silver | Ag | 90 - 100 % Ag | 2.5 - 3.0 | 9.6 - 12 | HOSTAFLOT M 91 | FLOTANOL C 07 | Xanthate | | | | | ◆◆◆◆ | |
| Al | Alumite | KAl ₃ (SO ₄) ₂ (OH) ₆ | 36.9 % Al ₂ O ₃ , 11.4 % K ₂ O | 3.5 - 4.0 | 2.7 - 2.8 | FLOTINOR FS-2, FLOTINOR FS-100 | FLOTANOL grades | | | Na ₂ SiO ₃ | Na ₂ SiO ₃ (excess) | | 7.0 - 10.0 | ◆ | |
| | Andalusite | Al ₂ (SiO ₅)O | 62.9 % Al ₂ O ₃ | 7 - 7.5 | 3.1 - 3.2 | FLOTIGAM 4343, FLOTIGAM 2835 or FLOTINOR FS-2, FLOTINOR FS-100 | | | | H ₂ SO ₄ , NaOH | Na ₂ SiO ₃ | NaF | 3.0 - 4.0 or 8 | | |
| | Bauxite | Al ₂ O ₃ ·H ₂ O | 50 - 70 % Al ₂ O ₃ | 2.5 - 3.0 | 2.4 - 3.4 | FLOTIGAM 7034 | FLOTANOL grades | Fuel oil | | H ₂ SO ₄ | NaOH, (NaPO ₃) _n | | 8.0 - 9.0 | ◆◆ | |
| | Cryolite | Na ₃ [AlF ₆] | 54.3 % F, 12.9 % Al, 32.9 % Na | 2.5 - 3.0 | 3 | FLOTINOR FS-2, FLOTINOR FS-100 | FLOTANOL C 07 | | | | Orthotoluidine, NaOH | CuSO ₄ | 7.0 - 10.0 | ◆◆ | |
| | Feldspar | [Na,K](Al Si ₃ O ₈), CaAl ₂ Si ₂ O ₈ | 11.8 % Na ₂ O, 16.9 % K ₂ O, 20.2 % CaO | 6.0 | 2.5 - 2.8 | FLOTIGAM 4343, FLOTIGAM 2835 | FLOTANOL 7026 | | | | H ₂ SO ₄ | Na ₂ SiF ₆ , Na ₂ SiO ₃ | HF, NaF | 2.0 - 2.5 | |
| | Kaolinite | Al ₂ Si ₂ O ₅ (OH) ₄ | 39.5 % Al ₂ O ₃ , 46.5 % SiO ₂ | 2.0 - 2.5 | 2.6 - 2.7 | FLOTIGAM 7034 | | | Al ₂ (SO ₄) ₃ | H ₂ SO ₄ | Na ₂ SiO ₃ | HF, NaF | 2.0 - 2.5 | | |
| | Korundum | Al ₂ O ₃ | 52.9 % Al | 9.0 | 3.9 - 4.1 | FLOTINOR FS-2, FLOTINOR FS-100 | FLOTANOL grades | | | | NaOH | Excess acid | | natural | |
| | Kyanite (Disthene) | Al ₂ SiO ₅ | 62.9 % Al ₂ O ₃ , 37.1 % SiO ₂ | 4.5 - 6.5 | 3.6 - 3.7 | FLOTINOR FS-2, FLOTINOR FS-100, FLOTINOR 3635 | FLOTANOL grades | | | | NaOH | | | 7.0 - 7.6 | |
| | Arsenopyrite | FeAsS | 46 % As, 34 % Fe, 20 % S | 5.5 - 6.0 | 5.9 - 6.2 | HOSTAFLOT M-91 | FLOTANOL grades | Xanthate | | | Na ₂ CO ₃ | Lime, NaCN | CuSO ₄ | 9.5 - 10.5 | ◆◆◆ |
| | Realgar | As ₂ S ₃ | 70 % As | 1.5 - 2.0 | 3.5 - 3.6 | HOSTAFLOT M-91 | FLOTANOL grades | Xanthate | | | Na ₂ SiO ₃ | Dextrine | Heavy metal salts | 9.5 - 10.5 | |
| | Skorodite | Fe ³⁺ [AsO ₄] ⁻ ·2H ₂ O | 33% As | 3.5 - 4.0 | 3.1 - 3.4 | | | | | | | | | | |
| | Sperryllite | PtAs ₂ | 56.6% Pt | 6.0 - 7.0 | 10.6 | | | | | | | | | | |
| Au | Calaverite | AuTe ₂ | 43.6 % Au | 2.5 - 3.0 | 9.2 | HOSTAFLOT M-91 | FLOTANOL grades | HOSTAFLOT LSB | | NaOH | NaCN | CuSO ₄ | | ◆◆◆ | |
| | Krennerite | (Au,Ag) ₂ Te ₂ | 40 % Au | 2.0 - 3.0 | 8.6 | HOSTAFLOT M-91 | FLOTANOL grades | HOSTAFLOT LSB | | | NaCN | CuSO ₄ | | ◆◆◆ | |
| | Native gold | Au | 70 - 99 % Au | 2.5 - 3.0 | 15.5 - 19.3 | HOSTAFLOT M-91 | FLOTANOL grades | HOSTAFLOT LSB | | | Na ₂ CO ₃ | NaCN | CuSO ₄ | | ◆◆◆◆ |
| | Petzite | Ag ₂ AuTe ₂ | 25.4 % Au, 41.7 % Ag, 32.9 % Te | 2.5 - 3.0 | 8.7 - 9.1 | HOSTAFLOT M-91 | FLOTANOL grades | HOSTAFLOT LSB | | | | NaCN | CuSO ₄ | | ◆◆◆ |
| | Sylvanite | (AuAg) ₂ Te ₂ | 34.4 % Au, 6.3 % Ag, 59.4 % Te | 1.5 - 2.0 | 7.9 - 8.3 | HOSTAFLOT M-91 | FLOTANOL grades | HOSTAFLOT LSB | | | | NaCN | CuSO ₄ | | ◆◆◆ |
| | | | | | | | | | | | | | | | |
| B | Borax | Na ₂ [B ₄ O ₇ (OH) ₄] ⁻ ·8H ₂ O | 16.3 % Na ₂ O, 36.5 % B ₂ O ₃ | 2.0 - 2.5 | 1.7 | FLOTINOR FS-2, FLOTINOR FS-100, FLOTINOR 3635 | | | | Starch, Dextrin Quebracho | | | 7.0 | | |
| | | | | | | | | | | Na ₂ CO ₃ , Na ₂ SiO ₃ , citric acid | AlCl ₃ , FeCl ₃ , F-Ions, K ₂ Cr ₂ O ₇ | BaCl ₂ , Pb-salts | 9.5 - 10.5 | ◆◆◆ | |
| Ba | Barite | BaSO ₄ | 58.8 % Ba, 13.7 % S | 3.0 - 3.5 | 4.3 - 4.7 | FLOTINOR FS-2, FLOTINOR FS-100 | FLOTANOL grades | | | | | | | | |
| | Witherite | Ba[CO ₃] | | 3.5 | 4.3 - 4.4 | | | | | | | | | | |
| Be | Beryl | Be ₃ Al ₂ Si ₆ O ₁₈ | 13.95 % BeO, 18.95 % Al ₂ O ₃ , 67.1 % SiO ₂ | 7.5 - 8.0 | 2.6 - 2.9 | FLOTINOR FS-2, FLOTINOR FS-100 | | | | Na ₂ SiO ₃ , NaOH | | | 7.0 - 8.0 | | |
| Bi | Bismuthinite | Bi ₂ S ₃ | 81.3 % Bi, 18.7 % S | 2.0 | 6.8 - 7.2 | HOSTAFLOT M-91 | FLOTANOL grades | Xanthate | | Na ₂ CO ₃ , NaHS | | Pb(NO ₃) ₂ | 6.0 | ◆ | |
| | Coal | C | | 1.4 | 1.3 - 1.6 | MONTANOL grades | FLOTANOL 7026, MONTANOL grades | Fuel oil, kerosene | | | | | natural | ◆◆◆ | |
| C | Graphite | C | 100 % C | 1.0 - 2.0 | 2.1 - 2.2 | Gas oil, kerosene | FLOTANOL 7026, MONTANOL grades | | | NaOH | Quebracho, tannic acid | | 7.5 - 8.5 | ◆◆◆◆ | |
| | | | | | | | | | | | excess Na ₂ SiO ₃ , K ₂ Cr ₂ O ₇ , Quebracho, caustic starch, Arkopal N 040 | | natural | | |
| Ca | Calcite | CaCO ₃ | 56 % CaO, 44 % CO ₂ | 3.0 | 2.6 - 2.8 | FLOTINOR SM-15, FLOTINOR V 2711, FLOTINOR FS-2, FLOTINOR FS-100 | | Fuel oil | | H ₂ SO ₄ , Na ₂ SiO ₃ | | | natural | | |
| | Diopside | CaMg[Si ₂ O ₆] | 25.9 % CaO, 18.6 % MgO, 55.5 % SiO ₂ | 5.0 - 6.0 | 3.2 - 3.5 | FLOTIGAM K2C | FLOTANOL 7026, MONTANOL 88, MONTANOL 800 | | | | | | natural | | |
| | Dolomite | CaMg[CO ₃] ₂ | 30.4 % CaO, 21.9 % MgO | 3.5 - 4.0 | 2.9 - 3.0 | FLOTINOR SM-15, FLOTINOR FS-2, FLOTINOR FS-100 | FLOTANOL grades | | | Na ₂ CO ₃ , Na ₂ SiO ₃ | excess Na ₂ SiO ₃ , Quebracho, caustic starch, Arkopal N 040 | Hot pulp | natural | | |
| | Gypsum | CaSO ₄ ·2H ₂ O | 32.6 % CaO | 1.5 - 2.0 | 2.2 - 2.4 | FLOTINOR 3635, FLOTINOR FS-2, FLOTINOR FS-100, FLOTINOR 7011 | FLOTANOL grades | | | Na ₂ CO ₃ | Lime, quebracho, ligninsulfonate | | | ◆◆◆ | |
| Ce | Wollastonite | Ca ₃ [Si ₃ O ₉] | 48.3 % CaO, 51.7 % SiO ₂ | 4.5 - 5.0 | 2.9 - 3.1 | FLOTIGAM K2C | | | | | H ₂ SO ₄ , tannic acid | | natural | | |
| | Monacite | (Ce, La, Nd, Th)[PO ₄] | 34.2 % Ce ₂ O ₃ , 29.6 % P ₂ O ₅ | 5.0 - 5.5 | 4.8 - 5.5 | FLOTINOR FS-2, FLOTINOR FS-100 | FLOTANOL grades | | | Na ₂ CO ₃ , Na ₂ SiO ₃ | strong acids | | natural | | |
| Co | Chalcocite | CoAsS | 35.5 % Co, 45.2 % As | 5.5 | 6.0 - 6.4 | HOSTAFLOT grades | FLOTANOL grades | Xanthate | | | | | | | |
| | Heterogenite | CoO(OH) | 64.1 % Co | | | Xanthate | FLOTANOL 7026 | | | Na ₂ SiO ₃ | | Erwärmte Trübe | 9 | | |
| Cr | Limmaite | Co ³⁺ Co ²⁺ 2S ₄ | 58 % Co, 42 % S | 4.5 - 5.5 | 4.8 - 5.8 | HOSTAFLOT grades | FLOTANOL M | Xanthate | | Na ₂ CO ₃ , Na ₂ SiO ₃ | | Polysulphides, hot pulp | 9 | | |
| | Chromite | FeCr ₂ O ₄ | 67.9 % Cr ₂ O ₃ , 32.1 % FeO | 5.5 | 4.5 - 5.1 | FLOTINOR 3635, FLOTINOR FS-2, FLOTINOR FS-100, FLOTINOR SM-15, FLOTINOR V 2711 | FLOTANOL 7026 | Fuel oil | | NaOH, Na ₂ CO ₃ , H ₂ SiF ₆ | | Phosphomolybdic acid, Phosphotungstic acid | 7 - 10 | ◆◆ | |
| Cu | Azurite | Cu ₃ (CO ₃) ₂ (OH) ₂ | 55.3 % Cu | 3.5 - 4 | 3.8 | HOSTAFLOT grades, FLOTINOR FS-2, FLOTINOR FS-100 | FLOTANOL 7026 | Xanthate | Fuel oil | Na ₂ CO ₃ , Na ₂ SiO ₃ , Na ₂ S | Quebracho | Polysulphides | 8.0 - 9.0 | ◆◆◆ | |
| | Bornite | Cu ₅ FeS ₄ | 63.3 % Cu, 11.1 % Fe, 25.6 % S | 3 | 4.9 - 5.3 | HOSTAFLOT grades | FLOTANOL grades | Xanthate | | Na ₂ SiO ₃ , lime | NaCN | CuSO ₄ | 9.0 - 12.0 | ◆◆◆◆ | |
| | Chalcocopyrite | Cu ₂ FeS ₂ | 34.6 % Cu, 30.4 % Fe, 34.9 % S | 3.5 - 4.0 | 4.1 - 4.3 | HOSTAFLOT grades | FLOTANOL grades | Xanthate | | Na ₂ SiO ₃ | NaCN | CuSO ₄ | 9.0 - 12.0 | ◆◆◆◆ | |
| | Chalcocite | Cu ₂ S | 79.9 % Cu | 2.5 - 3.0 | 5.5 - 5.8 | HOSTAFLOT grades | FLOTANOL grades | Xanthate | | Na ₂ SiO ₃ , lime | NaCN | CuSO ₄ | 9.0 - 12.0 | ◆◆◆◆ | |
| | Chrysocolla | Cu ₂ [SiO ₃] ⁿ ·n H ₂ O | 32.5 - 42.2 % CuO | 2.0 - 4.0 | 1.9 - 2.3 | HOSTAFLOT grades | FLOTANOL grades | Xanthate, FLOTINOR FS-2, FLOTINOR FS-100 | | CaO | | | 9.0 - 12.0 | ◆ | |
| | Covellite | CuS | 66.5 % Cu | 1.5 - 2.5 | 4.6 - 4.8 | HOSTAFLOT grades | FLOTANOL grades | Xanthate | | CaO | NaCN | CuSO ₄ | 9.0 - 12.0 | ◆◆◆◆ | |
| | Cuprite | Cu ₂ O | 88.8 % Cu | 3.5 - 4.0 | 5.9 - 6.2 | HOSTAFLOT grades | FLOTANOL grades | Xanthate | Fuel oil | Na ₂ S | Quebracho | Polysulphides | 9.0 | ◆◆◆ | |
| | Enargite | Cu ₃ As ₂ S ₇ | 48.4 % Cu, 19.0 % As, 32.6 % S | 3 | 4.4 - 4.5 | HOSTAFLOT grades | FLOTANOL grades | Xanthate | Na ₂ S | CaO | NaCN | CuSO ₄ | 9.0 - 12.0 | ◆◆◆◆ | |
| | Malachite | Cu ₂ (CO ₃) ₂ (OH) ₂ | 57.5 % Cu | 3.5 - 4.0 | 3.8 | HOSTAFLOT grades, FLOTINOR FS-2, FLOTINOR FS-100 | FLOTANOL 7026 | Xanthate | Fuel oil | Na ₂ CO ₃ , Na ₂ SiO ₃ , Na ₂ S | Quebracho, tannic acid | Polysulphides | 8.0 - 9.0 | ◆◆◆ | |
| | Tennantite | Cu ₁₂ As ₄ S ₁₃ | 51.5 % Cu, 20.4 % As | 3.0 - 4.0 | 4.6 - 5.2 | HOSTAFLOT grades | FLOTANOL grades | Xanthate | | CaO | NaCN | CuSO ₄ | 9.0 - 12.0 | ◆◆◆◆ | |
| | Tetrahedrite | Cu ₈ Sb ₄ S ₁₆ | 38.1 % Cu, 29.2 % Sb | 3.5 - 4.5 | 4.6 - 5.2 | HOSTAFLOT grades | FLOTANOL grades | Xanthate | | CaO | NaCN | CuSO ₄ | 9.0 - 12.0 | ◆◆◆◆ | |
| | F | Cryolite | Na ₃ [AlF ₆] | 54.3 % F, 32.9 % Na, 12.8 % Al | 2.5 - 3.0 | 3.0 | FLOTINOR FS-2, FLOTINOR FS-100 | FLOTANOL C 07 | | Fuel oil | | | | 7.0 - 10.0 | |
| Fluorspar | | CaF ₂ | 48.7 % F, 51.3 % Ca | 4.0 | 3.1 - 3.2 | FLOTINOR FS-2, FLOTINOR FS-100 | FLOTANOL grades | | FLOTINOR SM-15, FLOTINOR V 2711, FLOTINOR 2818 | Na ₂ CO ₃ , Na ₂ SiO ₃ , Quebracho | K ₂ Cr ₂ O ₇ , BaCl ₂ , Na ₂ SiF ₆ , citric acid, AP ⁻ -salts | Hot pulp | 8.0 - 10.5 | | |
| Fe | Goethite | FeO(OH) | 62.9 % Fe | 5.0 - 5.5 | 4.3 | FLOTINOR 3635, FLOTIGAM 7034 | | | | | | | 3.0 - 6.0 8.0 - 12.0 | ◆◆◆ | |
| | Hematite | Fe ₂ O ₃ | 69.9 % Fe | 5.5 - 6.5 | 4.9 - 5.3 | FLOTINOR FS-2, FLOTINOR FS-100, FLOTINOR SM-15, FLOTINOR 3635 | | FLOTINOR SM-15, FLOTINOR V 2711 | Fuel oil | H ₂ SO ₄ | Caustic starch, tannic acid | Desliming | 3.0 - 6.0 | ◆◆◆ | |
| | Jarosite | KFe ³⁺ 3(OH) ₆ (OH) ₂ | 7.8 % K, 33.5 % Fe, 12.8 % S | 2.5 - 3.5 | 2.9 - 3.3 | HOSTAFLOT grades | FLOTANOL 7026 | Xanthate (long chained) | | Na ₂ CO ₃ | | Na ₂ S | 8.0 - 10.0 | | |
| | Magnetite | Fe ₃ O ₄ | 72.4 % Fe | 5.5 - 6.0 | 4.9 - 5.2 | FLOTINOR FS-2, FLOTINOR FS-100, FLOTINOR SM-15, FLOTINOR 3635 | | | | H ₂ SO ₄ | Tannic acid | | 3.0 - 6.0 | ◆◆◆ | |
| | Marcasite | FeS ₂ | 46.6 % Fe | 6.0 - 6.5 | 4.8 - 4.9 | HOSTAFLOT grades | FLOTANOL grades | Xanthate | | H ₂ SO ₄ | Lime, NaCN | CuSO ₄ | 4.0 - 7.0 | ◆◆◆ | |
| | Pyrite | FeS ₂ | 46.6 % Fe | 6.0 - 6.5 | 5.0 - 5.2 | HOSTAFLOT grades | FLOTANOL grades | Xanthate | | H ₂ SO ₄ , SO ₂ - gas | Lime, NaCN | CuSO ₄ | 4.0 - 7.0 | ◆◆◆◆ | |
| | Pyrrhotite | Fe(1-x)S | 62.3 % Fe | 4.0 | 4.6 - 4.8 | HOSTAFLOT grades | FLOTANOL grades | Xanthate | | H ₂ SO ₄ | Lime, NaCN | CuSO ₄ | 4.0 - 7.0 | ◆◆◆ | |
| | Siderite | FeCO ₃ | 48.2 % Fe | 4.0 - 4.5 | 3.7 - 3.9 | FLOTINOR FS-2, FLOTINOR FS-100, FLOTINOR SM-15, FLOTINOR 3635 | FLOTANOL grades | | Fuel oil | NaOH | | | 8.0 - 10.0 | ◆◆◆ | |
| | | | | | | | | | | | | | | | |
| | | | | | | | | | | | | | | | |
| H | Hg | Cinnabar | HgS | 86.2 % Hg | 2.0 - 2.5 | 8.0 - 8.2 | HOSTAFLOT grades | FLOTANOL grades | Xanthate | | Na ₂ SiO ₃ | CuSO ₄ | 8 | ◆◆◆◆ | |
| | | | | | | | | | | | | | | | |
| K | Sylvite | KCl | 52 % K, 63.2 % K ₂ O | 2.5 | 1.9 - 2.0 | FLOTIGAM S, FLOTIGAM V 5070 | FLOTANOL F, MONTANOL 800, FLOTANOL C 07 | Extender oil | Dextrin, Guar starch | | | | natural | ◆◆◆ | |
| Li | Lepidolite | KLiAl(AlSi ₃) ₃ O ₁₀ (F,OH) | 7.7 % Li ₂ O, 61.9 % SiO ₂ , 12.1 % K ₂ O | 2.5 | 2.8 - 2.9 | FLOTIGAM 4343, FLOTINOR FS-2, FLOTINOR FS-100 | FLOTANOL grades | | Fuel oil | H ₂ SO ₄ | Lactic acid | | 3.5 - 4.0 7.5 - 8.5 | ◆◆◆ | |
| | Spodumene | LiAl[Si ₃ O ₆] | 8.0 % Li ₂ O, 27.4 % Al ₂ O ₃ , | | | | | | | | | | | | |