

https://dspace.org/

# Removal of toxic metals and recovery of acid from acid mine drainage using acid retardation and adsorption processes

**Nleya, Yvonne**

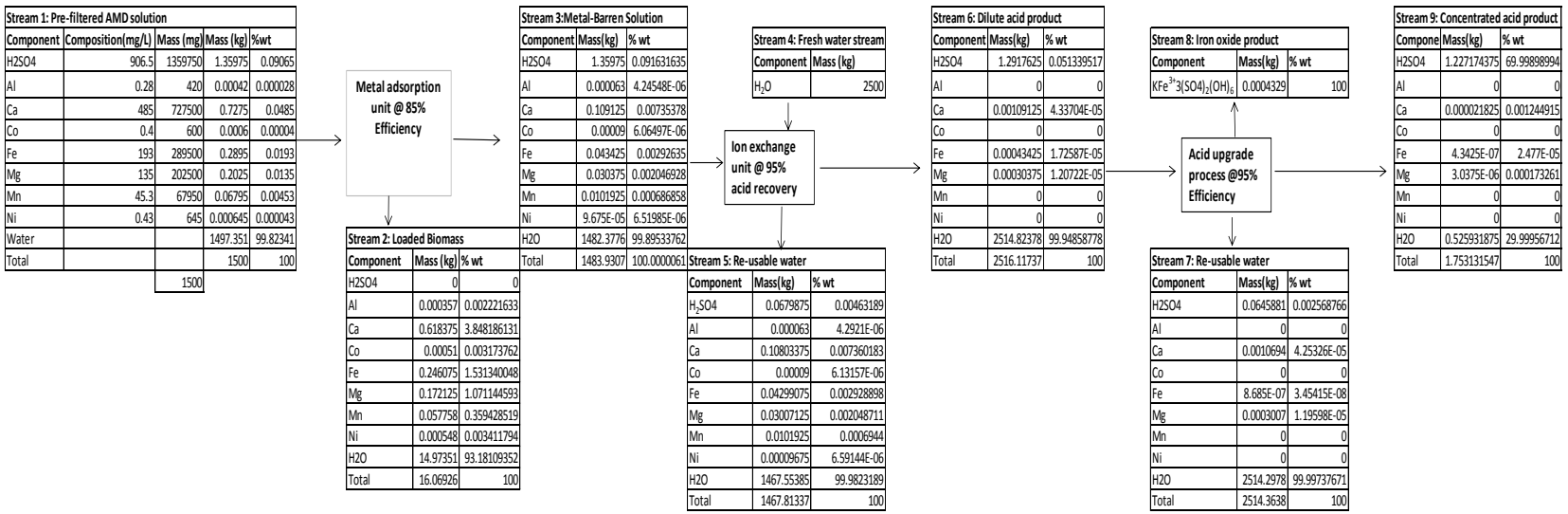
**2016**

http://hdl.handle.net/10539/21051

Nleya, Yvonne (2016) Removal of toxic metals and recovery of acid from acid mine drainage using acid retardation and adsorption processes University of Witwatersrand, Johannesburg, <http://wiredspace.wits.ac.za/handle/10539/21051>

Downloaded from a DSpace repository. https://dspace.org/

Basis 1500L/hr, 7680hrs of operation per year,
Density of waste water 1kg/L




**Stream 1: Pre-filtered AMD solution**

| Component | Composition(mg/L) | Mass (mg) | Mass (kg) | %wt |
|---|---|---|---|---|
| H2SO4 | 906.5 | 1359750 | 1.35975 | 0.09065 |
| Al | 0.28 | 420 | 0.00042 | 0.000028 |
| Ca | 485 | 727500 | 0.7275 | 0.0485 |
| Co | 0.4 | 600 | 0.0006 | 0.00004 |
| Fe | 193 | 289500 | 0.2895 | 0.0193 |
| Mg | 135 | 202500 | 0.2025 | 0.0135 |
| Mn | 45.3 | 67950 | 0.06795 | 0.00453 |
| Ni | 0.43 | 645 | 0.000645 | 0.000043 |
| Water | | | 1497.351 | 99.82341 |
| Total | | | 1500 | 100 |
| | | 1500 | | |

**Stream 2: Loaded Biomass**

| Component | Mass (kg) | % wt |
|---|---|---|
| H2SO4 | 0 | 0 |
| Al | 0.000357 | 0.002221633 |
| Ca | 0.618375 | 3.848186131 |
| Co | 0.00051 | 0.003173762 |
| Fe | 0.246075 | 1.531340048 |
| Mg | 0.172125 | 1.071144593 |
| Mn | 0.057758 | 0.359428519 |
| Ni | 0.000548 | 0.003411794 |
| H2O | 14.97351 | 93.18109352 |
| Total | 16.06926 | 100 |

**Stream 3:Metal-Barren Solution**

| Component | Mass(kg) | % wt |
|---|---|---|
| H2SO4 | 1.35975 | 0.091631635 |
| Al | 0.000063 | 4.24548E-06 |
| Ca | 0.109125 | 0.00735378 |
| Co | 0.00009 | 6.06497E-06 |
| Fe | 0.043425 | 0.00292635 |
| Mg | 0.030375 | 0.002046928 |
| Mn | 0.0101925 | 0.000686858 |
| Ni | 9.675E-05 | 6.51985E-06 |
| H2O | 1482.3776 | 99.89533762 |
| Total | 1483.9307 | 100.0000061 |

**Stream 4: Fresh water stream**

| Component | Mass (kg) |
|---|---|
| $H_2O$ | 2500 |

**Stream 5: Re-usable water**

| Component | Mass(kg) | % wt |
|---|---|---|
| $H_2SO4$ | 0.0679875 | 0.00463189 |
| Al | 0.000063 | 4.2921E-06 |
| Ca | 0.10803375 | 0.007360183 |
| Co | 0.00009 | 6.13157E-06 |
| Fe | 0.04299075 | 0.002928898 |
| Mg | 0.03007125 | 0.002048711 |
| Mn | 0.0101925 | 0.0006944 |
| Ni | 0.00009675 | 6.59144E-06 |
| H2O | 1467.55385 | 99.9823189 |
| Total | 1467.81337 | 100 |

**Stream 6: Dilute acid product**

| Component | Mass(kg) | % wt |
|---|---|---|
| H2SO4 | 1.2917625 | 0.051339517 |
| Al | 0 | 0 |
| Ca | 0.00109125 | 4.33704E-05 |
| Co | 0 | 0 |
| Fe | 0.00043425 | 1.72587E-05 |
| Mg | 0.00030375 | 1.20722E-05 |
| Mn | 0 | 0 |
| Ni | 0 | 0 |
| H2O | 2514.82378 | 99.94858778 |
| Total | 2516.11737 | 100 |

**Stream 7: Re-usable water**

| Component | Mass(kg) | % wt |
|---|---|---|
| H2SO4 | 0.0645881 | 0.002568766 |
| Al | 0 | 0 |
| Ca | 0.0010694 | 4.25326E-05 |
| Co | 0 | 0 |
| Fe | 8.685E-07 | 3.45415E-08 |
| Mg | 0.0003007 | 1.19598E-05 |
| Mn | 0 | 0 |
| Ni | 0 | 0 |
| H2O | 2514.2978 | 99.99737671 |
| Total | 2514.3638 | 100 |

**Stream 8: Iron oxide product**

| Component | Mass(kg) | % wt |
|---|---|---|
| $KFe^{3+}3(SO4)_2(OH)_6$ | 0.0004329 | 100 |

**Stream 9: Concentrated acid product**

| Compone | Mass(kg) | % wt |
|---|---|---|
| H2SO4 | 1.227174375 | 69.99898994 |
| Al | 0 | 0 |
| Ca | 0.000021825 | 0.001244915 |
| Co | 0 | 0 |
| Fe | 4.3425E-07 | 2.477E-05 |
| Mg | 3.0375E-06 | 0.000173261 |
| Mn | 0 | 0 |
| Ni | 0 | 0 |
| H2O | 0.525931875 | 29.99956712 |
| Total | 1.753131547 | 100 |

**Figure C2: Mass balance of proposed process**