Treatment of process water from molybdenum flotation
Ikumapayi Fatai Kolawole¹, Jan-Eric Sundkvist² and Nils-Johan Bolin³

¹Division of Mineral Processing and Metallurgy, Luleå University of Technology, SE-971 87 Luleå, Sweden,
fatai.ikumapayi@ltu.se
²&³Division of Process Technology, Boliden Mineral AB, SE-936 81 Boliden, Sweden, jan-eric.sundkvist@boliden.com, nils-johan.bolin@boliden.com

Abstract
The Boliden copper mine in Aitik, north of Sweden is aiming to produce molybdenum as a new product. Due to the use of sodium hydrogen sulphide (NaHS) as a depressant of copper concentrate during the molybdenum flotation, it was a concern that the tailings pond cannot buffer the potential acid generation when free hydrogen sulphide ions (HS⁻) and degradation products such as thiosulphate ions (S₂O₃²⁻) are further oxidized downstream to sulphate ions (SO₄²⁻). There was also a concern regarding possible dissolution of heavy metals into the process water, for example mercury. Test work carried out aiming to generate data for the design of a suitable process for treatment of the process water before discharging it from the molybdenum flotation circuit into the tailings pond, demonstrates that: A significant portion of the Chemical Oxygen Demand (COD) can be removed by aeration of the pulp through oxidation of HS⁻ and polysulphides to elemental sulphur and thiosulphate. Subsequent flocculation test work on the oxidised pulp has shown that elemental sulphur as well as precipitated mercury or fine mercury minerals will go to the final copper concentrate by sedimentation. The thiosulphate content in the overflow from the solid-liquid separation of the oxidised pulp can be completely converted to sulphate using hydrogen peroxide based on the Fenton procedure. The overflow was finally neutralized using slaked lime. Acceptable water quality to the tailings pond could be accomplished.

Keywords: NaHS; conditioning; COD; flotation; thiosulphates; aeration; hydrogen peroxide; Fenton oxidation

1. Introduction
The predominant process employed to produce molybdenite from copper concentrate is to depress copper sulphides, capitalizing on the surface property of the easy floatability of molybdenite. The depressant agent commonly used is sodium hydrogen sulphide (NaHS). Addition of NaHS reagent to the pulp reduces the redox potential to a level where copper sulphides are un-floatable. Depression of copper sulphide starts at a Redox potential of about -250 mV. However, for an efficient depression, the Redox potential is maintained between -450 and -500 mV. The reaction mechanism is not completely understood, however, the addition of NaHS allows for obtaining sulphides with a fresh surface because it desorbs the collector, making depression easy (Equation 1; X signifies the collector). The surface of chalcopyrite is also modified from hydrophobic to hydrophilic (Equation 2) and there is high possibility of elemental sulphur desorption from the surface of the concentrates (Equation 3) (Ikumapayi, 2008).

\[
\begin{align*}
2\text{CuX}(s) + \text{HS}^- & \rightarrow \text{Cu}_2\text{S}(s) + 2\text{X}^- + \text{H}^+ & (1) \\
2\text{CuFeS}_2 + \text{HS}^- & \rightarrow \text{S}_2\text{O}_3^{2-} + \text{H}^+ + \text{Cu}_2\text{S}(s) + 2\text{FeS}(s) & (2) \\
\text{S}^0 + \text{HS}^- & \rightarrow \text{S}_2\text{O}_3^{2-} + \text{H}^+ & (3)
\end{align*}
\]

The proposed addition rate of NaHS at Aitik is in the range of 5-8 kg per ton of copper concentrate and it was a concern that the tailings pond cannot buffer the potential acid generation when free HS⁻ and degradation products, mainly thiosalts, are further oxidized downstream to SO₄²⁻ (Equations 4 and 5) (McGeer et al., 2000; Schwartz et al., 2006).

\[
\begin{align*}
\text{HS}^- + 2\text{O}_2 & \rightarrow \text{SO}_4^{2-} + \text{H}^+ & (4) \\
\text{H}_2\text{O} + \text{S}_2\text{O}_3^{2-} + 2\text{O}_2 & \rightarrow 2\text{SO}_4^{2-} + 2\text{H}^+ & (5)
\end{align*}
\]

At the nominal production rate of 343000 ton of copper concentrate, the expected addition of NaHS has a potential to produce 950-1500 ton of sulphuric acid per year. Another concern is possible dissolution of heavy metals into the process water (Bolin et al., 2007). For example mercury and
Antimony sulphides can dissolve in alkaline sulphide solution by forming stable metal-sulphide complexes. Table 1 is a thermodynamic calculations result of Hg-sulphide-water system based on an algorithm described by Ericsson (Ericsson, 1979). As can be seen from the results, the solubility of Hg is significant and depends strongly on pH at the expected NaHS concentration in process solution. A number of testwork carried out on the concentrate for this work have indicated that there is minor dissolution of mercury in the process water from the molybdenum flotation circuit, the mercury concentration is enriched in the fine fractions of the copper concentrate suspended in the process water, the dissolution is slow and incomplete at low temperature compared to higher temperatures and in addition, the oxidation of the process water is a very slow process ending up with colloidal sulphur and thiosulphates (Ikumapayi et al., 2008).

Table 1 Calculated equilibrium concentrations of mercury species at 5.85 kg/m³ NaHS in solution

<table>
<thead>
<tr>
<th>pH</th>
<th>Solubility</th>
<th>Hg²⁺</th>
<th>Hg(HS)₂(aq)</th>
<th>HgS²−(aq)</th>
<th>HgS(s)</th>
</tr>
</thead>
<tbody>
<tr>
<td>13.00</td>
<td>576.7</td>
<td>-51.06</td>
<td>-12.74</td>
<td>-2.54</td>
<td>-2.15</td>
</tr>
<tr>
<td>12.75</td>
<td>418.7</td>
<td>-50.92</td>
<td>-12.38</td>
<td>-2.68</td>
<td>-2.10</td>
</tr>
<tr>
<td>12.50</td>
<td>281.6</td>
<td>-50.75</td>
<td>-12.05</td>
<td>-2.85</td>
<td>-2.07</td>
</tr>
<tr>
<td>12.25</td>
<td>177.9</td>
<td>-50.55</td>
<td>-11.75</td>
<td>-3.05</td>
<td>-2.04</td>
</tr>
<tr>
<td>12.00</td>
<td>107.5</td>
<td>-50.33</td>
<td>-11.47</td>
<td>-3.27</td>
<td>-2.02</td>
</tr>
<tr>
<td>11.75</td>
<td>63.1</td>
<td>-50.10</td>
<td>-11.20</td>
<td>-3.50</td>
<td>-2.01</td>
</tr>
<tr>
<td>11.50</td>
<td>36.4</td>
<td>-49.86</td>
<td>-10.94</td>
<td>-3.74</td>
<td>-2.01</td>
</tr>
</tbody>
</table>

1.1. Literature review

A number of attempts have been made to remove thiosalts from mining effluents, most of which are either site/effluent specific, uneconomical or ineffective (Wasserlauf et al., 1982; CANMET, 1998; Dinardo et al., 1998; Li et al., 1999; Riveros et al., 2000; Sridhar, 2001; Gould et al., 2004): Co-precipitation with ferric salts as well as natural degradation in which the thiosalts concentration is expected to be oxidised naturally by dissolved oxygen in the effluents was ineffective due to factors such as temperature, nutrients, oxygen concentration and bacterial populations in the effluents (Riveros et al., 2000; Gould et al., 2004). Direct photolytic process (DPP), which involves the destruction of thiosalts by direct absorption of ultraviolet (UV) irradiation by the thiosalts and their progeny, and subsequent chemical interactions in the aqueous phase was effective but uneconomical (Sridhar, 2001). SO₂/air oxidation process in the presence of iron is a viable process for thiosalt destruction but site/effluent specific, each effluent has to be characterized individually in order to identify the catalysts/elements present in solution and their effect on the oxidation kinetics (CANMET, 1998). Chlorination, ozonation, hydrogen peroxide, chalcopyrite catalysis, alkaline pressure oxidation, bicarbonate addition and reduction by iron achieved complete thiosalts removal, and almost complete removal in the case of biological oxidation; these methods are technically feasible, however, there is a high degree of uncertainty regarding the effectiveness of these technologies to treat large volumes of effluent on a continuous basis (Dinardo et al., 1998; Li et al., 1999).
2. Materials and methods

2.1. Materials
The copper concentrates used as feed were obtained fresh at the Boliden concentrator in Aitik, Sweden. Technical grade NaHS flakes (~70% NaHS) were used as depressant of copper sulphide. Nitrogen gas was used to create inert atmosphere when necessary. The flocculant used is known as Magnafloc 351, hydrogen peroxide, (H₂O₂, 35%) was used as oxidising agent, ferrous sulphate pentahydrate, (FeSO₄ .7H₂O, green vitriol or melanterite) was used as catalyst during effluent oxidation, technical grade sodium hydroxide (NaOH), sulphuric acid (H₂SO₄) and slaked lime (Ca(OH)₂) were used as pH regulators. All chemicals and reagents were collected from Concentrator’s laboratory in Boliden.

2.2. Analytical methods
The COD reflects the maximum oxygen uptake requirement of the process water. It is measured with the aid of Hach-Lange spectrophotometer DR 2800 (oxidizable substances present in the water sample react with sulphuric acid-potassium dichromate solution in the presence of silver sulphate as a catalyst, potassium dichromate is reduced forming Cr³⁺. The amount of green coloration of Cr³⁺ is evaluated in the spectrophotometer and is used as an indirect measure of the oxidizable contents of the water sample (Clair et al., 2003). The elemental sulphur (S⁰) and tetrathionate (S₄O₆²⁻) concentrations were determined by cyanalysis followed by spectrophotometric determination of formed thiocyanate (SCN⁻) (Mizoguchi et al., 1975). Thiosulphate (S₂O₃²⁻) and sulphite (SO₃²⁻) concentration were analyzed by iodometric titration (Koh, 1990). The sulphate concentration was analyzed by spectrophotometric turbidity measurement of precipitated barium sulphate (BaSO₄) (Meneses et al., 2005). The sulphide, (HS⁻) concentration in solution was analyzed by calculation of COD difference before and after eliminating sulphide as H₂S from the solution by blowing nitrogen through the solution. The ammonia/ammonium concentration in the final solution from the testwork with ammonium sulphide conditioning was determined by the Hach/Lange method. An attempt to detect any desorbed xanthate present in the solution was done by addition of copper (II) sulphate and Cu(I)-chloride. The presence of xanthates is indicated by precipitation of yellow copper xanthate. The dissolved oxygen in the pulp and solutions was measured by inserting the probe of a Hach-HQ 30d flexi oxygen meter directly into the pulp or solution. The Redox potential was measured against Ag, AgCl reference electrode with the aid of an Orion 230A+ Redox meter. The pH was measured with the aid of an Orion 210A pH meter.

2.3. Method
This is a number of flotation-oxidation test works based on a concept where the sulphur species are removed from the solution step wisely figure 1. The tests were carried out in a lab scale flotation cell, in order to simulate real process conditions, including conditioning, flotation, subsequent oxidation of the pulp, solid liquid separation as well as oxidation and neutralization of the final solution. The formation and destruction of thiosalts in solution was followed throughout the tests. A 3-liter WEMCO flotation cell was used throughout the experiment. During the low temperature experiment, the cell was placed in a water bath, which is cooled with the aid of a cooling bar.
2.4. Procedure

Pulp of fresh copper concentrate, 30% solids was conditioned with 8 kg NaHS/ton concentrate for approximately 10 minutes in a nitrogen atmosphere. The pH was maintained at approximately 11, using sodium hydroxide. A single test was carried out in which the pulp was initially conditioned for 24 hours using ammonium sulphide. Flotation was carried out for approximately 30 minutes after conditioning using nitrogen gas. The remaining pulp was oxidized with air or oxygen until a tendency of unmanageable foaming was observed. Aeration was carried out at high (11 to 12) and low (7 to 8) pH as well as ambient (16 to 19 °C) and low (5 to 7 °C) temperatures. The final pulp was further oxidized by addition of hydrogen peroxide when pulp-oxidation was carried out at high pH, in order to completely remove the polysulphides and thereby ensuring the precipitation of heavy metals. The end-point was indicated by the disappearance of the yellow coloration of the solution and the smell of H2S. A solution of 0.92-g/l Magnafloc 351 was subsequently added to the pulp in order to speed up the settling rate and obtain a clear overflow. The process water was decanted and analyzed for dissolved species.

2.4.1. Final oxidation by means of the Fenton procedure

The clear solution was analysed for thiosalts concentration via COD and iodometric titration for calculation of the stoichiometric H2O2 demand to subsequently oxidize the thiosalt content completely to sulphate based on Fenton’s reagent procedure (Reference library-Fenton). The Fenton testwork was carried out batchwise. The pH of the solution was controlled between 3.5 and 5. Iron II catalyst was added as a solution of FeSO4 to a concentration of approximately 60 mg Fe/l and the H2O2 solution was added slowly, while the pH was maintained within the above-mentioned range. Faster addition rates of the H2O2 solution inhibit the catalyst (Reference library-Fenton). The acidic solution was finally neutralized to approximately pH 9 by addition of powdered slaked lime, Ca(OH)2. The variable factors in performed test work are summarized in Table 2.
### Table 2 Summary of variable factors.

<table>
<thead>
<tr>
<th>Test no.</th>
<th>Temp (°C)</th>
<th>(NH₄)₂S conditioning</th>
<th>Pulp oxidation</th>
<th>pH</th>
<th>Gas</th>
</tr>
</thead>
<tbody>
<tr>
<td>a</td>
<td>16</td>
<td>-</td>
<td>-</td>
<td>11.0-12.5</td>
<td>Air and O₂</td>
</tr>
<tr>
<td>b</td>
<td>16</td>
<td>-</td>
<td>-</td>
<td>11.0-12.5</td>
<td>Air</td>
</tr>
<tr>
<td>c</td>
<td>16</td>
<td>-</td>
<td>-</td>
<td>11.0-12.5</td>
<td>Air</td>
</tr>
<tr>
<td>d</td>
<td>16</td>
<td>-</td>
<td>-</td>
<td>7.5-8.5</td>
<td>Air</td>
</tr>
<tr>
<td>e</td>
<td>16</td>
<td>24</td>
<td>1.7</td>
<td>7.5-8.5</td>
<td>Air</td>
</tr>
<tr>
<td>f</td>
<td>16</td>
<td>-</td>
<td>-</td>
<td>7.5-8.5</td>
<td>Air</td>
</tr>
<tr>
<td>g</td>
<td>16</td>
<td>-</td>
<td>-</td>
<td>7.5-8.5</td>
<td>Air and N₂</td>
</tr>
<tr>
<td>h</td>
<td>5</td>
<td>-</td>
<td>-</td>
<td>7.5-8.5</td>
<td>Air</td>
</tr>
<tr>
<td>i</td>
<td>16</td>
<td>-</td>
<td>-</td>
<td>7.5-8.5</td>
<td>Air</td>
</tr>
<tr>
<td>j</td>
<td>5</td>
<td>-</td>
<td>-</td>
<td>11.0-12.5</td>
<td>Air</td>
</tr>
<tr>
<td>k</td>
<td>5</td>
<td>-</td>
<td>-</td>
<td>11.0-12.5</td>
<td>Air</td>
</tr>
<tr>
<td>l</td>
<td>5</td>
<td>-</td>
<td>-</td>
<td>7.5-8.5</td>
<td>Air</td>
</tr>
</tbody>
</table>

### 3. Results and discussion

A sequence of COD concentration from flotation-oxidation tests sampled solutions is summarized in figure 2. The figure shows available results of analyzed COD concentrations present in the solution at each stage of the test work carried out at different test conditions as shown in the legend. Full data of each test stage are not available in all the experiment due to laboratory circumstances and aim of each experiment.

The most probable main chemical reactions at different process stages are outlined as follows:

**Initial mixing with NaHS**

Reaction with dissolved oxygen in the process water:

\[ 2\text{HS}^- + 2 \text{O}_2 \rightarrow \text{S}_2\text{O}_3^{2-} + \text{H}_2\text{O} \]  \hspace{1cm} (6)

**Conditioning with NaHS**

![Figure 2 Solution COD concentrations at different test stages](image-url)
The following reactions give a COD net increase and consume alkali:

Dissolution of elemental sulphur:
\[ \text{HS}^- + S^0 \rightarrow H^+ + S_2^{2-} \]  \hspace{1cm} (7)

Collector desorption:
\[ 2\text{CuX} + \text{HS}^- \rightarrow \text{Cu}_2\text{S} + 2\text{X}^- + H^+ \]  \hspace{1cm} (8)

(1 mmol of HS\(^-\) gives about 64 mg COD, while 1 mmol of amyl xanthate gives 312 mg COD as per measurement)

Elemental sulphur may also be disproportionated by the action of the high alkalinity:
\[ 4\text{So}^0 + 4\text{OH}^- \rightarrow 2\text{HS}^- + \text{S}_2\text{O}_3^{2-} + \text{H}_2\text{O} \]  \hspace{1cm} (9)

The following reaction gives a COD decrease contribution:

Sulphidation of metal hydroxides:
\[ \text{HS}^- + \text{Me(OH)}_2 \rightarrow \text{MeS} + \text{H}_2\text{O} + \text{OH}^- \]  \hspace{1cm} (10)

Oxygen addition by minor air introduction to pulp may also contribute to COD decrease:
\[ 2\text{HS}^- + 2\text{O}_2 \rightarrow \text{S}_2\text{O}_3^{2-} + \text{H}_2\text{O} \]  \hspace{1cm} (11)
\[ \text{HS}^- + 2\text{O}_2 \rightarrow \text{SO}_4^{2-} + \text{H}^+ \]  \hspace{1cm} (12)
\[ 2\text{HS}^- + 0.5\text{O}_2 \rightarrow \text{S}_2^{2-} + \text{H}_2\text{O} \]  \hspace{1cm} (13)

The observed net increase of COD as well as the slight decrease of pH during conditioning indicates that COD generating reactions are dominating. Analysis of the feed concentrate shows that it contains about 0.4% \text{So} and the indicated \text{So} concentration in the solution was estimated to correspond to about 7.9% of the sulphur from the concentrate.

\text{N}_2 \text{ flotation}

During flotation with nitrogen it can be anticipated that the same type of reactions occur as during conditioning. However, it was observed during testwork that only minor changes in pH, redox and COD occurred during flotation provided that introduction of air was minimised. Possible anaerobic reactions seem to go to the end already during conditioning.

\text{Aeration}

\[ \text{H}_2\text{O}_2 \rightarrow 0.5\text{O}_2 + \text{H}_2\text{O} \]  \hspace{1cm} (20)

\[ 2\text{HS}^- + 4\text{H}_2\text{O}_2 \rightarrow \text{S}_2\text{O}_3^{2-} + 5\text{H}_2\text{O} \]  \hspace{1cm} (21)
\[ 2\text{HS}^- + 2\text{O}_2 \rightarrow \text{S}_2\text{O}_3^{2-} + \text{H}_2\text{O} \]  \hspace{1cm} (22)
\[ \text{S}_2^{2-} + \text{H}_2\text{O} + 0.5 \text{ O}_2 \rightarrow 2\text{S}^0 + 2\text{OH}^- \]  \hspace{1cm} (16)

(probable cause of pH increase)
\[ \text{S}_2^{2-} + \text{H}_2\text{O} \leftrightarrow \text{HS}^- + \text{S}^0 + \text{OH}^- \]  \hspace{1cm} (17)
\[ \text{HS}^- + 2\text{O}_2 \rightarrow \text{H}^+ + \text{SO}_4^{2-} \]  \hspace{1cm} (18)

The formation of more \text{S}^0 will diminish the concentration of \text{HS}^- and \text{S}_2^{2-} in solution. When the concentration of free \text{HS}^- and \text{S}_2^{2-} became very low; any dissolved mercury will precipitate:
\[ \text{HgS}_2^{2-} + \text{H}_2\text{O} \rightarrow \text{HgS(s)} + \text{OH}^- + \text{HS}^- \text{(further oxidised)} \]  \hspace{1cm} (19)

\text{H}_2\text{O}_2 \text{ oxidation}

Peroxide was used as oxidant both as a pulp polisher and in the subsequent solution oxidation stage:

The following reaction may describe the polishing stage, which is carried out without pH control:
\[ \text{H}_2\text{O}_2 \rightarrow 0.5\text{O}_2 + \text{H}_2\text{O} \]  \hspace{1cm} (20)
\[ 2\text{HS}^- + 4\text{H}_2\text{O}_2 \rightarrow \text{S}_2\text{O}_3^{2-} + 5\text{H}_2\text{O} \]  \hspace{1cm} (21)
\[ 2\text{HS}^- + 2\text{O}_2 \rightarrow \text{S}_2\text{O}_3^{2-} + \text{H}_2\text{O} \]  \hspace{1cm} (22)
\[ \text{S}_2^{2-} + \text{H}_2\text{O} + 0.5 \text{ O}_2 \rightarrow 2\text{S}^0 + 2\text{OH}^- \]  \hspace{1cm} (23)
\[ \text{HS}^- + 2\text{O}_2 \rightarrow \text{H}^+ + \text{SO}_4^{2-} \]  \hspace{1cm} (24)

The solution from the pulp polishing stage mainly contains thiosulphate, which is further oxidised completely to sulphate by means of the Fenton procedure. The following equation describes the overall reaction:
\[
\text{S}_2\text{O}_3^{2-} + 4\text{H}_2\text{O}_2 \rightarrow 2\text{SO}_4^{2-} + 2\text{H}^+ + 3\text{H}_2\text{O}
\]  \hspace{1cm} (27)

Iron (II) sulphate is used as a catalyst in the Fenton procedure in order to generate reactive hydroxyl radicals for stochiometric usage of added peroxide (Michael et al., 2003; Reference library-Fenton).

\[
\text{Fe}^{2+} + \text{H}_2\text{O}_2 \leftrightarrow \text{Fe}^{3+} + \text{OH}^- + \cdot \text{OH} \hspace{1cm} (28)
\]

\[
\text{Fe}^{3+} + \text{H}_2\text{O}_2 \rightarrow \text{Fe}^{2+} + \cdot \text{OOH} + \text{H}^+ \hspace{1cm} (29)
\]

**Recycling/Stripping of NaHS**

Free sulphide and sulphide occurring as polysulphides in the solution can be recovered or stripped by acidification with e.g. sulphuric acid (Equations 30 and 31) followed by scrubbing of the stripped H\_2S with a caustic soda solution which produces NaHS (Equation 32).

**Stripping**

\[
\text{H}^+_{aq} + \text{HS}^-_{aq} \rightarrow \text{H}_2\text{S}_g \hspace{1cm} (30)
\]

\[
2\text{H}^+_{aq} + \text{S}_2^{2-}_{aq} \rightarrow \text{H}_2\text{S}_g + \text{S}^0_s \hspace{1cm} (31)
\]

**Scrubbing**

\[
\text{NaOH}_{aq} + \text{H}_2\text{S}_g \rightarrow \text{NaHS}_{aq} + \text{H}_2\text{O} \hspace{1cm} (32)
\]

Table 3 shows a summary of result of process interest.

Table 3 Summary of important test results: Approximate reagent consumption and final COD

<table>
<thead>
<tr>
<th>Process stages</th>
<th>Pulp oxidation by air</th>
<th>Polishing</th>
<th>H_2S stripping</th>
<th>Settling</th>
<th>Fenton</th>
<th>Overall</th>
<th>Final assay</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Total O_2 uptake mg/l</td>
<td>H_2O_2 kg/t</td>
<td>H_2SO_4 kg/t</td>
<td>Magnafloc g/t</td>
<td>H_2O_2 kg/t</td>
<td>H_2O_2 kg/t</td>
<td>COD mg/l</td>
</tr>
<tr>
<td>Ambient temperature, low pH</td>
<td>42</td>
<td>3,24</td>
<td>40</td>
<td>2,29</td>
<td>2,29</td>
<td>38,8</td>
<td>0</td>
</tr>
<tr>
<td>Ambient temperature, high pH</td>
<td>134</td>
<td>0,905</td>
<td>50</td>
<td>5,20</td>
<td>6,11</td>
<td>69,2</td>
<td>0</td>
</tr>
<tr>
<td>Low temperature, low pH</td>
<td>46</td>
<td>0,835</td>
<td>40</td>
<td>1,64</td>
<td>1,64</td>
<td>66,6</td>
<td>0</td>
</tr>
<tr>
<td>Low temperature, high pH</td>
<td>46</td>
<td>0,835</td>
<td>40</td>
<td>1,64</td>
<td>1,64</td>
<td>66,6</td>
<td>0</td>
</tr>
</tbody>
</table>

4. Conclusion

1. The testwork has shown that in-situ oxidation of the process solution is the preferred route.
2. The thiosulphate content in the overflow from the solid-liquid separation of the oxidised pulp was completely converted to sulphate by hydrogen peroxide based on Fenton procedure, which was finally neutralized using slaked lime.
3. Flocculation of oxidised pulp has shown that elemental sulphur and precipitated mercury or fine mercury minerals will go to the final copper concentrate by sedimentation. This will ensure acceptable quality of the bleed water to the tailings pond.
4. Elemental sulphur present on the surface of the concentrate is dissolved by NaHS forming polysulphides, which gives rise to an increase in COD during conditioning.
5. The testwork has also indicated a possible route for recycling of a significant portion of added NaHS.

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http://www.h2o2.com/applications/industrialwastewater/fentonsreagent.html


