OPERATING ASPECTS
Mark Vancas (Bateman Litwin)

The Power Point presentation which accompanied the keynote paper on Operating Aspects is shown following this section. Following the presentation, the following points were discussed:

1) As regards crud, the generation of crud is greater when the circuit is running aqueous continuous.

2) Often 1-person is dedicated to crud removal in a plant using mixer settlers.

3) In column operation, the crud generation is considerably less, and in one plant the amount of crud generated in a week that accumulated at the interface was about 10 litres.

4) Following a rain period, there is more crud generated from a heap leach operation due to the increase in fines. Clarification prior to the mixer settler plant is often not economically feasible. The aim is generally to achieve 20 ppm suspended solids in the feed PLS to solvent extraction.

5) In the presence of the PLS + diluent the corrosion can be greater than the single solutions in contact with the material (synthetics, metals) so the choice of materials can be site specific.

6) The use of polymeric concrete was discussed for application to ponds and settler construction.

7) Columns have ranged from up to 3 m diameter. Any solids in the system are discharged with the raffinate or may sit at the interface. The control of the phase continuity is easy. Columns have been used in many situations and industries, and in the metals area have been successfully applied to several metal recovery systems, including: U, Zr, Co, Ni. Construction materials vary and may be site specific. FRP and stainless steel columns have been used and the internals have included stainless steel and Teflon.

8) Solvent can be degraded in several situations, and these degradation products will adversely affect the solvent extraction process.
   i) when exposed to sunlight,
   ii) bacteria
   iii) concentrated H₂SO₄ in some reagents
   iv) high alkalinity in some reagents

All result in gradual degradation of the constituents.

9) Treatment of plant organic – pond organic and sump organic - requires treatment (clay is mostly used, although a caustic wash can be effective) before re-use to remove undesirable surfactants that would adversely affect the phase separation characteristics, the loading, discrimination and stripping.
OPERATING ASPECTS OF SX-EW
(How to screw up an SX-EW Plant)

Flowrates
Crud
Extractant Concentration
Organic Depth in the Settler
Crystallization
Launder Adjustments
Air
Organic Entrainment
Cobalt
Rectifier Adjustments
Mist Suppression
Details
Dealing with Management
SOLVENT LOSSES
Gordon Ritcey (G.M. Ritcey & Associates Inc.)

The Power Point presentation which accompanied the keynote paper on Solvent Losses is shown following this section. Following the presentation, the following points were discussed:

Constituent reagent losses are not equal, and the loss may be dependent on the molecular weights.

Fouling (poisoning) of the Solvent
- Fouling of the solvent by organic acids, e.g. humic and fulvic acids
- The poisoning may often be seasonal, particularly in the case where open pit operations exist and the runoff is high
- Prevention of loading the solvent of undesirable contaminants (organics as well as organic-metallic species) can be accomplished by a diluent wash of the aqueous phase to solvent extraction
- A caustic wash, at controlled alkaline pH, can be successful in the removal of the accumulated organic acids.
- Fouling is also due to the preferential loading and difficulty in stripping of some elements, such as the amphoteric elements. In such a case the control and removal from the solvent is usually accomplished by a caustic wash or a highly acidic wash.

Crud
- Some crud can be tolerated in certain circuits, otherwise a physical/mechanical problem results.
- The presence of large amounts of chloride ion (in a sulphate system) appears to inhibit interfacial problems
- Silica is a problem because of its many species of colloids and precipitates, due in part to the acidity and the amphoteric nature of the element. Can the use of zeta potential measurements on solids be of assistance in the management of a process that is generating crud?
- Treatment of crud may be accomplished by:
  a) 3-phase centrifuges (newer ones are superior)
  b) horizontal centrifuges appear to be excellent
  c) tricanters
  d) washing of the crud (e.g. raffinate)
- Can we design for crud in a plant?

Emulsions
- Emulsions are difficult because of the nature of the constituents and the type of formation (e.g. shear, surfactants)

Phase Continuity
- Control of phase continuity can minimize emulsions/cruds
- Recycle of the minor phase in the mixer, usually to maintain a desired phase continuity is accomplished at a ratio in the mix box of 1:1 of O:A. The control can be a problem. Can sufficient intimate mixing be achieved at high ratios (e.g. 1:10) in the mix box?
Misting
- Minimize the distance the solution has to drop, maintain a full launder, and the design of
  the discharge are all important in reducing mist formation.
- In addition to the loss of solvent and the adverse impact to the worker, the generation of
  mist becomes a flash point issue. The dielectric constants may be of use in prediction.
- With mist generation, there are visible signs appearing in the settler, such as “fish eggs”.
  These are often predominant in the extraction stage.

Recovery of Solvent from Raffinate
- Some of the methods & equipment that have been used with varying success are:
  - Coalescers
  - Activated carbon & filtration
  - Spintex filters
  - Flotation treatment of the raffinate before discharge
  - Flotation treatment in the pond
  - After settlers
  - Electrical coalescence has been used in pharmaceutical but not in mining because of the variation in PLS

    A value of 0.7 kg reagent/T Cu produced was stated as a reasonable amount of loss to expect.

One of the main problems of analysis and the design of recovery systems has been the
sampling of streams when a “grab” sample is taken. A composite sample gathered “over
time” would be preferable.
SOLVENT LOSSES

G.M. RITCEY

LOSSES DUE TO:
- SOLUBILITY
- ENTRAINMENT
- EVAPORATION
- MISTING
- DEGRADATION
- CRUD
- SAMPLING & SPILLAGE

SOLVENT LOSS

RELATED TO:
- REAGENT CHOICE
- EQUIPMENT SELECTION
- METHOD OF OPERATION
- NATURE OF FEED

SOLVENT LOSSES CAUSES

- HIGH SHEAR,
- DROPLET SIZE VS. COALESCEENCE
- EMULSIONS
- 3RD PHASE FORMATION
- DUAL CIRCUITS & CROSS-
  CONTAMINATION
SOLUBLE LOSSES

RECOVERY FROM RAFFINATE:
- RE-EXTRACTION WITH LOW BOILING SOLVENT
- STEAM STRIPPING
- ADSORPTION ON ACTIVATED CARBON

MISTING

- HIGH SOLVENT LOSSES OF ALL COMPONENTS + METAL
- POSSIBLY CAUSED BY:
  - SURFACTANTS,
  - ORGANIC DEGRADATION,
  - SOLVENT POISONING
  - OVER-MIX,
  - EXCESSIVE AIR

ENTRAINMENT

MINIMIZED BY:
- SKIMMERS
- CENTRIFUGES
- COALESCERS
- SETTLING (AFTER-SETTLERS)
- FLOTATION
- ACTIVATED CARBON
- IN-LINE FILTERS, ETC----
DEGRADATION

CAUSED BY:

- HIGH TEMPERATURE
- OXIDATION (METALS, AQUEOUS SOLUTION)
- EXCESSIVE ACIDITY / ALKALINITY
- BIODEGRADABILITY

RECYCLING SOLVENT

PROBLEMS THAT MAY OCCUR:

- ACCUMULATION OF NON-STRIPPABLE METAL
- EXTRACTION SITES OCCUPIED BY A "POISON" WHICH MAY REACT IN STRIPPING (HYDROLYSIS)
- DEGRADATION OF THE EXTRACTANT
- SOLUBILITY OF DEGRADATION PRODUCTS IN AQUEOUS (PROBLEMS)

CRUD

C. R. U. D.

Chalk River Unidentified Deposit
CRUD

CRUD IS THE SLIMY MATERIAL THAT ACCUMULATES IN SETTLERS DERIVED FROM:
- PARTICLES IN FEED
- DUST FROM THE AIR
- PRECIPITATES
- BACTERIAL ACTION

CRUD

COMPOSITION

- Si, Al, Fe, Mg, P, SO4, CLAY, GYPSUM, FINES

SOME CRUD SAMPLES MAJOR CONSTITUENTS

- URANIUM
  - Zr 8-10 %
  - Bi 35 %
  - Mo 5 %

- COPPER
  - Si 10-20, Cu 1-2, Fe 1, Pb 0.5 %

- COBALT
  - Si 10-25, Fe 15, Al 4 Mn 0.6, Mg 1.3 %

- NICKEL
  - Si 3.5, Ni 18
CRUD

FACTORS CAUSING CRUD
- SOLIDS
- HIGH SHEAR
- CARBOXYLIC ACIDS, HUMIC ACIDS
- SILICA
- PHOSPHORUS
- HYDROLYSIS OF EXTRACTED SPECIES
- BACTERIA, FUNGUS

SOME CRUD DESCRIPTIONS
- COTTON-LIKE WHITE / YELLOW
- PORRIGE-LIKE SLIMES
- THICK VISCOUS BROWN MUD
- BROWN, GUMMY MATERIAL
- YELLOWICH, PLASTIC-LIKE
- BLACK-BROWN MATERIAL

CONSEQUENCES OF CRUD
- LOSS OF SETTLER AREA AND INCREASED ENTRAINMENT LOSSES
- ADSORPTION LOSS SOLVENT ON CRUD SURFACES
- POOR EXTRACTION & STRIPPING
- WASH LIQUOR TO CCD INCREASES SOLUBLE METAL LOSSES
- IF EXTREME—MILL SHUT-DOWN REQUIRED
CRUD

- FORMATION
- TREATMENT
- PREVENTION
CRUD TREATMENT

TREAT CRUD FOR SOLVENT RECOVERY:

- WASH WITH RAFFINATE
- WASH WITH ACID, BASE, DILUENT
- CENTRIFUGE

CRUD PREVENTION

- IMPROVE FEED CLARIFICATION
- AVOID OVERGRINDING (SLIMES)
- REMOVAL OF ORGANIC CONTAMINANTS (HUMIC ACIDS, CARBOXYLIC ACIDS) BY ACT. C; OR DILUENT WASH OF AQUEOUS
- MINIMIZE OXIDANTS IN LEACHING
- AROMATIC DILUENT USE

CRUD PREVENTION

- CAREFUL SELECTION & USE OF FLOCCULENTS TO CCD (POLYACRYLAMIDES)
- O/A RATIOS & SATURATION IN EXTR’N TO SCRUB IMPURITIES
- WASH STAGE BETWEEN EXTRACTION AND STRIPPING
- SELECTION OF OTHER CONTACTORS

CRUD PREVENTION

- SCRUB LOADED SOLVENT (PARTICLES & AMPHOTERICICS)
- HIGH MOL. WT. AMINES (EG ALAMINE 304 FOR U CIRCUITS)
- CAREFUL DESIGN, WARNING DEVICES, EFF. CONTROLS, & CLOSE ATTENTION TO OPERATION

(CONTINUED)
### PARTICIPANTS LIST AND E-MAIL CONTACTS

<table>
<thead>
<tr>
<th>PARTICIPANTS</th>
<th>AFFILIATION</th>
<th>COUNTRY</th>
<th>E-MAIL ADDRESSES</th>
</tr>
</thead>
<tbody>
<tr>
<td>Alexander, Doug</td>
<td>Anglo Research</td>
<td>South Africa</td>
<td><a href="mailto:dalexander@angloresearch.com">dalexander@angloresearch.com</a></td>
</tr>
<tr>
<td>Álvarez, Gonzalo</td>
<td>Bateman-Litwin N.V.</td>
<td>Chile</td>
<td><a href="mailto:GonzaloA@bateman-litwin.com">GonzaloA@bateman-litwin.com</a></td>
</tr>
<tr>
<td>Angora, Marco</td>
<td>Votorantim Metais Niquel</td>
<td>Brazil</td>
<td><a href="mailto:marco.angora@vmetais.com.br">marco.angora@vmetais.com.br</a></td>
</tr>
<tr>
<td>Backham, Leslie</td>
<td>AREVA NC</td>
<td>Canada</td>
<td><a href="mailto:leslie.backham@hotmail.com">leslie.backham@hotmail.com</a></td>
</tr>
<tr>
<td>Bender, Jack</td>
<td>COGNIS</td>
<td>USA</td>
<td><a href="mailto:jack.bender@cognis.com">jack.bender@cognis.com</a></td>
</tr>
<tr>
<td>Bourget, Cyril</td>
<td>Cytec Industries</td>
<td>Canada</td>
<td><a href="mailto:cyril.bourget@cytec.com">cyril.bourget@cytec.com</a></td>
</tr>
<tr>
<td>Brueggemann, Martin</td>
<td>Freeport McMoRan Phelps Dodge</td>
<td>USA</td>
<td><a href="mailto:martin_brueggemann@fmi.com">martin_brueggemann@fmi.com</a></td>
</tr>
<tr>
<td>Cannoni, Rogerio</td>
<td>Votorantim Metais Niquel</td>
<td>Brazil</td>
<td><a href="mailto:rogerio.cannoni@vmetais.com.br">rogerio.cannoni@vmetais.com.br</a></td>
</tr>
<tr>
<td>Casas, Jesus</td>
<td>University of Chile</td>
<td>Chile</td>
<td><a href="mailto:jecasas@ing.uchile.cl">jecasas@ing.uchile.cl</a></td>
</tr>
<tr>
<td>Chagnes, Alexandre</td>
<td>ENSCP</td>
<td>France</td>
<td><a href="mailto:alexandre-chagnes@enscp.fr">alexandre-chagnes@enscp.fr</a></td>
</tr>
<tr>
<td>Collard, Joel</td>
<td>Curtin University</td>
<td>Australia</td>
<td><a href="mailto:collardj@kalg.curtin.edu.au">collardj@kalg.curtin.edu.au</a></td>
</tr>
<tr>
<td>Conkle, Nick</td>
<td>Battelle Memorial Institute</td>
<td>USA</td>
<td><a href="mailto:conkle@battelle.org">conkle@battelle.org</a></td>
</tr>
<tr>
<td>Courtaud, Bruno</td>
<td>AREVA NC</td>
<td>France</td>
<td><a href="mailto:bruno.courtaud@areva.com">bruno.courtaud@areva.com</a></td>
</tr>
<tr>
<td>Cramer, Keith</td>
<td>Cytec Industries</td>
<td>USA</td>
<td><a href="mailto:keith.cramer@cytec.com">keith.cramer@cytec.com</a></td>
</tr>
<tr>
<td>Defreyne, Jennifer</td>
<td>CESL</td>
<td>Canada</td>
<td><a href="mailto:jennifer.defreyne@teckcominco.com">jennifer.defreyne@teckcominco.com</a></td>
</tr>
<tr>
<td>Dickson, Peter</td>
<td>SNC-Lavalin E&amp;C</td>
<td>Canada</td>
<td><a href="mailto:peter.dickson@snc-lavalin.com">peter.dickson@snc-lavalin.com</a></td>
</tr>
<tr>
<td>Fei, Weiyang</td>
<td>Tsinghua University</td>
<td>China</td>
<td><a href="mailto:Fwy-dce@tsinghua.edu.cn">Fwy-dce@tsinghua.edu.cn</a></td>
</tr>
<tr>
<td>Firestein, Mark</td>
<td>Bateman-Litwin N.V.</td>
<td>Israel</td>
<td><a href="mailto:markf@bateman.co.il">markf@bateman.co.il</a></td>
</tr>
<tr>
<td>Grinbaum, Baruch</td>
<td>Bateman-Litwin N.V.</td>
<td>Israel</td>
<td><a href="mailto:BaruchGr@bateman.co.il">BaruchGr@bateman.co.il</a></td>
</tr>
<tr>
<td>Haig, Peter</td>
<td>Shell Chemicals</td>
<td>Australia</td>
<td><a href="mailto:peter.haig@shell.com">peter.haig@shell.com</a></td>
</tr>
<tr>
<td>Ibanez, Don</td>
<td>Curtin University</td>
<td>Australia</td>
<td><a href="mailto:d.ibanez@curtin.edu.au">d.ibanez@curtin.edu.au</a></td>
</tr>
<tr>
<td>Jakovljevic, Boban</td>
<td>Cytec Industries</td>
<td>Canada</td>
<td><a href="mailto:boban.jakovljevic@cytec.com">boban.jakovljevic@cytec.com</a></td>
</tr>
<tr>
<td>Koopmans, Lauren</td>
<td>CVRD-INCO</td>
<td>Canada</td>
<td><a href="mailto:koopmans@inco.com">koopmans@inco.com</a></td>
</tr>
<tr>
<td>Kordosky, Gary</td>
<td>COGNIS</td>
<td>USA</td>
<td><a href="mailto:gary.kordosky@cognis.com">gary.kordosky@cognis.com</a></td>
</tr>
<tr>
<td>Lakshmanan, Lucky</td>
<td>Process Research ORTEC Inc.</td>
<td>Canada</td>
<td><a href="mailto:flakshmanan@processortech.com">flakshmanan@processortech.com</a></td>
</tr>
<tr>
<td>Lam, Ed</td>
<td>Cameco Corporation</td>
<td>Canada</td>
<td><a href="mailto:ed_lam@cameco.com">ed_lam@cameco.com</a></td>
</tr>
<tr>
<td>Lerner, Oded</td>
<td>Bateman-Litwin N.V.</td>
<td>Israel</td>
<td><a href="mailto:OdedL@bateman.co.il">OdedL@bateman.co.il</a></td>
</tr>
<tr>
<td>Liu, Huizhou</td>
<td>Chinese Academy of Sciences</td>
<td>China</td>
<td><a href="mailto:hzliu@home.ipe.ac.cn">hzliu@home.ipe.ac.cn</a></td>
</tr>
<tr>
<td>Lommen, Jim</td>
<td>Lommen Consulting</td>
<td>USA</td>
<td><a href="mailto:jimommen@att.net">jimommen@att.net</a></td>
</tr>
<tr>
<td>Meze, Florian</td>
<td>AREVA NC</td>
<td>France</td>
<td><a href="mailto:florian.meze@areva.com">florian.meze@areva.com</a></td>
</tr>
<tr>
<td>Mihaylov, Indje</td>
<td>CVRD-INCO</td>
<td>Canada</td>
<td><a href="mailto:jimi@yahoo.com">jimi@yahoo.com</a></td>
</tr>
<tr>
<td>Moenting, Grant</td>
<td>CESL</td>
<td>Canada</td>
<td><a href="mailto:grant.moenting@teckcominco.com">grant.moenting@teckcominco.com</a></td>
</tr>
<tr>
<td>Molnar, Ron</td>
<td>MetNetH2O Inc.</td>
<td>Canada</td>
<td><a href="mailto:dejuro@gmail.com">dejuro@gmail.com</a></td>
</tr>
<tr>
<td>Monzyk, Bruce</td>
<td>Battelle Memorial Institute</td>
<td>USA</td>
<td><a href="mailto:monzyk@battelle.org">monzyk@battelle.org</a></td>
</tr>
<tr>
<td>Morgan, Jason</td>
<td>Freeport McMoRan Phelps Dodge</td>
<td>USA</td>
<td><a href="mailto:Jason_Morgan@FMI.com">Jason_Morgan@FMI.com</a></td>
</tr>
</tbody>
</table>
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