Australia’s Newest Galvanizing Technology
Zero-Waste Spent Pickle Liquor Recycling

GALVANIZING INDUSTRY ACID WASTES
Zinc, HCl and iron from Spent Pickle Liquor

47th Annual Galvanizing Association of Australian Conference 2011
Port Stephens, 17 October 2011
Company Overview

Intec is an Australian company with patented hydrometallurgical technology plus a range of know-how and infrastructure for the recovery of base and precious metals from a wide range of mineral and industrial resources.

As a world leader in the field of chloride hydrometallurgy, Intec is successfully applying its technology to the recycling of heavy metals from industrial wastes in Australia.
Galvanizing Industry Wastes

Batch hot-dip galvanizing line – typical international processing

- Degreasing Bath
- HCl Strip/Pickle
- Fluxing Bath
- Zinc Galvanizing Bath
- Steel preparation

Steel → Degreasing Bath → HCl Strip/Pickle → Fluxing Bath → Zinc Galvanizing Bath → Galvanized Steel

- Paint & oil
- Alkaline waste
- Spent Pickle Liquor
- Zn/Fe Dross (for low-value sale)

- Zinc ash / Zinc skimmings
‘Spent Pickle Liquor’ (SPL) as Waste

- Steel is dipped in hydrochloric acid prior to hot-dip galvanizing
- Over time, the acid strength decreases, and the acid builds up with iron, zinc and other contaminants
- Internationally, approximately 20kg of SPL is produced per tonne of steel galvanized
  - 50-100 g/L Zn$^{2+}$ (5-10%)
  - 100-150 g/L Fe$^{2+}$ (10-15%)
  - 2-3% HCl
- SPL is conventionally disposed of as a waste, by first precipitating the metals with alkali, then dumping the heavy metal waste in landfill

1t SPL  ➔  2.3t waste disposed
(Solid residue + liquid effluent)
Disposing of this Material is Truly Wasteful

Economic cost
- Treatment and stabilisation/immobilisation fees
- Fresh stabilisation/immobilisation reagents, ‘bulking out’ the waste
- Transport of ‘bulked out’ mass
- Landfill gate charges for ‘bulked out’ mass
- Government levies for ‘bulked out’ mass
- Permanent loss of contained economic value

Environmental cost
- No stabilisation technology is permanent
- At best, stabilisation/immobilisation simply slows the release of the metals
- Recurrent local community issues affect all landfills to some extent
Recover the Value

It is much better to recycle

- No environmental legacy
- Massively reduced quantity and hazard
- Zero waste options for some ‘waste’ types
- Offset the costs using the contained metal value
- Potentially valuable by-products
- Environmental, ethical, intellectual and economic benefit
Our Service

Intec recycles heavy metals and precious metals from industrial wastes – sludges, filter cakes, dusts or waste waters.

Instead of creating extra waste by trying to lock these metals up in cement then disposing of them to landfill, Intec extracts and recovers them as useful mineral products.
Intec Process SPL Recycling

SPL → Iron Oxidation → Zinc Electrowinning → Acid Regeneration → Fresh HCl

- Hematite By-product
- Zn Metal
- Calcium Sulphate By-product
Intec Process SPL Recycling Stoichiometry

**Inputs**
- SPL: 1.0 t
- H₂SO₄: 0.3 t
- Alkali: 0.3 t
- Water: 0.7 t

**Outputs**
- Zn metal: 60 kg
- Iron oxide: 140 kg-dry
- CaSO₄: 0.4 t-dry
- 20% HCl: 1.0 t
- Airborne emissions: Nil
- Liquid effluents: Nil
- Solid wastes: Nil
SPL Recycling Project: Collaboration and Support

• This project is a direct result of an introduction made at EPA Victoria’s HazWaste Expo in November 2008
• A typical industrial company with a waste disposal issue: GB Galvanizing Service Pty Ltd (GBG), one of Victoria’s largest galvanising companies
• A company with a technology solution: Intec Ltd
• Intec is working with GBG as our Victorian project partner to deliver an SPL recycling plant at GBG’s Dandenong site
• EPA Victoria is contributing $780,000 from the HazWaste fund to GBG
• Total project cost estimated at ~$2.85 million
• The project is being implemented through three stages:
  • Phase 1: Pilot plant trials
  • Phase 2: Semi-commercial demonstration plant trials
  • Phase 3: Commercial plant construction and operation in Victoria
SPL Recycling Project: Stage 1

- Continuous pilot plant trials: November 2009 to February 2010
- Provisional patent lodged
- Key outcomes:
  - Tested a range of operating variables in order to frame the key operating parameters for the technology.
  - 175 hours of operation, during which 289 litres of spent pickle acid were recycled.
  - Successfully demonstrated both the recovery and electrowinning of zinc metal product, and also iron separation and recovery.
SPL Recycling Project: Stage 2

• First semi-commercial trials November to December 2010
  • These trials proved the technology at the commercial scale
  • Engineering data generated for materials of construction and process optimisation
  • New equipment ordered and installed
• Second trials February to April 2011 to demonstrate the reliability of the equipment
• Key outcomes:
  • Demonstrated equipment robustness and reliability
  • Achieved key performance criteria
  • Steady state operations achieved for mass balance calculations
SPL Recycling Project: Stage 2 Key Performance Criteria

Iron removal efficiency ✓
Iron precipitation kinetics on spec. ✓
Zinc EW current density >200A/m² ✓
Zinc EW product morphology on spec. ✓
EW Power consumption ✓
EW cathode stripping ✓
>100kg of representative sample ✓
Alkali utilisation efficiency ✓
Simultaneous, continuous operation ✓
Financial viability Provisional
Product assessment Underway
Life cycle assessment Underway
SPL Recycling Project: Stage 3

• The final phase of the project involves the construction of a full-scale commercial facility at GBG’s Dandenong site
• Recycle a minimum of 1,000,000 L per year of SPL
  • Avoid a minimum of 1,700 tonnes per year of liquid waste generation
  • Avoid a minimum of 600 tonnes per year of solid waste disposal to landfill
  • Generate a minimum of 70 tonnes of zinc metal per year for reuse by GBG
  • Generate fresh acid for reuse by GBG in the pickling bath
  • Generate iron and calcium by-products for industry use

Current Status
• Stage 2 Operations and primary reporting complete
• Q3 2011: Updated engineering and economic model, external analysis and project proposal
• Q4 2011: Commence Stage 3 development (design, approvals, contracts, et)
• 2012: Construction, commissioning and operation
SPL Recycling Project: Stage 3 Project Economics

• Economics:
  • Preliminary economic modelling is complete.
  • Detailed modelling is underway.
  • Based on the preliminary economic model
    • The plant is competitive at 1,000,000L per year vs current disposal costs
    • At 3,000,000L per year, modelling indicates that it would change the market. This is the maximum SPL available in Victoria.
  • All assumptions are based on Victorian market factors.

• The following data are estimates only
Net SPL Operating Costs (after product credits)

Current CFS treatment & landfill disposal cost (zero recycling)

Substantial Cost Savings

Intec SPL Recycling
Net SPL Operating Costs (after product credits)

Using zinc ash to utilise spare Zn EW capacity:
- Improves efficiency,
- Replaces some alkali usage, and
- Yields incremental economic improvements
Gross SPL Operating Costs Per Litre of SPL

- **Reagents**
- **Employee Costs**
- **Utilities**
- **Maintenance**

**1,000,000 L SPL pa**

**2,000,000 L SPL pa**
Gross Operating Cost

Intec Ltd
Superior and Sustainable Metals Production

![Gross Operating Cost Diagram](image)

- **Utilities**
- **Maintenance**
- **SPL & HCl Transport**
- **Employee Costs**
- **Reagents**

**Gross Operating Cost ($/L SPL)**

**Intec Process SPL Recycling Capacity (Lpa)**

1,000,000

2,000,000
Effect of the Carbon Tax

- Carbon Tax 2.7% of gross operex
- Carbon Tax 3.3% of gross operex

Gross Operating Cost ($/L SPL)

Intec Process SPL Recycling Capacity (Lpa)

Carbon Tax
Utilities
Maintenance
SPL & HCl Transport
Employee Costs
Reagents
Future Opportunities

• Spent Pickle Liquor is a waste that is common to the galvanizing industry, domestically and internationally
• Within Australia:
  • GBG has 117 m$^3$ of zinc bath capacity, and produces ~1 MLpa SPL
  • Victoria has ~286 m$^3$ of zinc bath capacity, and produces ~3 MLpa
  • Australia has a total of ~1,400 m$^3$ capacity
  • An estimate of total Australian SPL might be ~12-15 MLpa SPL
  • Are there opportunities in other states, particularly NSW & Queensland?
• Internationally:
  • European markets favour zero-waste technologies
  • Intec has already received international enquiries about the developing SPL recycling technology
  • Europe, USA and Asia (particularly the growing China & India galvanizing industries) might be huge potential markets
www.intec.com.au

**Head Office**
Dave Sammut
Corporate Development Manager
Level 3, 2 Elizabeth Plaza
North Sydney, NSW 2060
(ph): +61 2 9954 7888
(fax): +61 2 8904 0334
(email): dave@intec.com.au

**Projects**
Andrew Tong
Head of Technology
Level 3, 2 Elizabeth Plaza
North Sydney, NSW 2060
(ph): +61 2 9954 7888
(fax): +61 2 8904 0334
(email): andrew.tong@intec.com.au