Overview of the Regain Spent Potliner Solution

Presented at Knowledge Exchange Platform (KEP)
“Sustainable Processing and Utilization of Spent Pot Liners”

New Delhi
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The Chrysalis is symbolic of the beautiful butterfly in its transformational state.
From the Greek chrysos: gold
Spent Potlining Update

We are approaching a tipping point

- Regulatory practice
  - Landfill being banned
  - Costs of clean-up recognised
  - Re-Use and Recycling preferred

- Storage is costly

- Solutions can be risky
  - Transport & Handling of hazardous waste

- Solutions by aluminium companies have not met expectations
  - Capital intensive
  - High technical risk with complex processes
  - Not all of the SPL can be disposed of
  - Residual materials without disposal options
The Nature of SPL

To realise the potential value in SPL we must eliminate the hazards.

- Rich in alumina / carbon / fluorides / sodium
- Hazardous due to:
  - explosive gases
  - cyanide
  - leachable fluorides

Shipping container damaged by SPL gas explosion

Ship damaged by SPL gas explosion
Why Treat Spent Potlining?

- Regulatory practice
  - Landfill being banned – “true cost is far greater”
  - Legislation – smelters to deal with hazardous waste
  - Community & Regulatory concerns with SPL storage/transport
- Export is costly – plus safety, $ and reputation risk
- Industrial Ecology, Circular Economy principles
- E.g. - Aluminium Stewardship Initiative:
Success Factors

- Process technology and process plant
- Materials handling and plant operational capability
- Reliable, sustainable and transparent end-use of products
  - all output materials accounted for
  - comprehensive material tracking and product certification
  - quality controlled products as clinker plant additions
  - no residual risk for aluminium smelter
Overview

SPL Solution

Objectives
- Zero waste from smelter spent potliner (SPL)
- Positive impact on the environment
- Low cost of re-processing
- 100% beneficial use of waste material - no residue

Benefits for Aluminum Smelters
- Land filling of waste eliminated
- Accumulation of toxic waste in storage eliminated
- Cyanide and flammable gases risks eliminated
- Value from smelter derived products
- Advantage for smelter in relations with regulatory agencies and community stakeholders

Benefits for Industry and the Environment
- Lower energy consumption and greenhouse gas emissions for manufacturing products such as bricks and cement
- Positive impact on the environment

The Regain solution for SPL is based on valuable by-products rather than waste disposal.
SPL Process Technology & Plant

Regain process eliminates hazards in SPL and generates refined products

**Spent Pot Lining**

**PREPARATION**
- Recovery
- Crushing
- Classification

**TREATMENT**
- Cyanide destruction
- Neutralization of reactive materials

**BLENDING**
Manufacture of defined products by blending detoxified SPL

**Other By-products**
- Exhaust Gas
- Mineral Products

- large lumps to very dusty
- both first cut and second cut SPL
- robust chemical process to handle wide variations
An Industrial Ecosystem for SPL

Offtake risk is minimised through an integrated system of many smelters and many product users.
18 years of development by Regain and acceptance by Aluminum Smelter Clients, Regulatory Authorities and product Customers

SPL Solution Development Timeline

1997
- Anode carbon derived fuel product used in cement kiln
- Anode Carbon reprocessing at Portland Smelter

2000
- Demonstration SPL processing plant commissioned at Tomago Smelter
- Products derived from SPL established with cement & clay brick Industries

2005
- Hydro contract to process SPL at Kurri Kurri
- Alcoa contract to process SPL at Point Henry

2010
- Export Products to China
- Regulatory recognition that export Products are not hazardous waste

2015
- Export Products to Latin America and North Africa
- Export Products to South East Asia

Cumulative Product Shipments
SPL Derived Products in Cement Manufacture

- Refined products from transformation of SPL offer valuable minerals and chemicals without adverse effects.
- Valuable constituents in SPL for cement manufacture:
  - fluorides – mineralising properties help the clinker reaction
  - sodium – fluxing reduces firing temperatures + chemical balance
  - carbon – thermal energy
  - alumina and silica – raw materials
- Cement manufacture can use all SPL with no residual waste.
- Lifecycle Assessment shows that each tonne of SPL can save:
  - 4 tonnes of carbon dioxide equivalent (CO\textsubscript{2}e) greenhouse gas emission
  - 16 gigajoules of thermal energy
  - 350 kWh of electrical energy

Significant economic and environmental benefits for cement manufacturers.

**SPL** — **SPL Processing** — **Transport** — **Cement Clinkering** — **Cement Manufacture** — **Cement Products**
THANK YOU
To the Attendees at the KEP Roundtable

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Lifecycle Assessment (LCA)

- **Base case scenario:**
  - 1 million tpa clinker plant
  - 1.25 million tpa cement production

- **Optimised use of SPL scenario:**
  - 20,000 tpa refined SPL derived materials
  - extra 125,000 tpa cement

- **Each tonne of SPL can save:**
  - 4 tonnes of CO$_2$e
  - 16 gigajoules of thermal energy
  - 350kWh of electrical energy
Customer A - Trial without HiCal

Clinker Quality

Cement Compressive Strengths

3 days 17 MPa (min)  
7 days 22 MPa (min)  
28 days 32 MPa (min)
Potential business case for HiCAI

**Example:** 1 million ton per year clinker plant producing 1.16 million tonnes of cement with a cement clinker factor of 86%.

**Assumptions:** Low sulphur coal: Alkali 0.3 % Sulphur 0.4 %: Clinker alite level 60 %. 20,000 tpa HiCAI additions

Clinker mineralization increases alite level to 70 % and reduces clinker factor by 5 %. **Result:** increased cement output of 70,000 tonnes = ~ 5 million USD additional revenue.

Simultaneously the plant could double the sulphur input to the kiln system using 5% cheaper higher sulphur coal while maintaining its perfect alkali-sulphur balance. **Result:** Along with the thermal substitution of HiCAI, the plant’s thermal energy bill could be reduced by ~ 1.5 million USD.

Additionally an extra 1 % clinker factor reduction due to the higher content of soluble alkalis in clinker. **Result:** ~ 1 million USD in sales revenue could be achieved.

**TOTAL:** USD 7 million per 20,000 t HiCAI
HiCAL Product – a Performance System

HiCAL Product Line

HiCAL → Substitution of Fluorspar

HiCAL Delivery

Product Application Customer Support → Implementation of Mineralization

Feasibility Study

Industrial Trial Preparation

Industrial Trial & Evaluation

Safe and Sustainable Operations

Patented SPL Refinement Process

Regulatory Permits

Commercial Agreement

Economic Pre-Evaluation

Cement Standards and Market Requirement

Clinker Design

Industrial Trial Protocol

On-site Trial Support

Cement Product Performance

HiCAL Product Specification

Quality Assurance

Shipment to Port or Plant

Assistance during Unloading

Cement Manufacture Process Fitness

Feeding Options

Training Plant Personnel

XRF and Fluoride Analytics

Evaluation Trial Results

Economic Evaluation

Business Ecosystem

Regain

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