

CEReS -Co-processing of Coal Mine & Electronic Wastes: Novel Resources for a Sustainable Future

Christopher G. Bryan, B J Williamson, J Calus-Moszko, Q van Haute, Anne-Gwenaelle Guezennec, S Gaydardzhiev, P Wavrer, R Frączek

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International Biohydrometallurgy Symposium

23rd October, 2019 Fukuoka, Japan

CEReS: Co-processing of Coal Mine and Electronic Wastes

Dr Chris BRYAN

Geomicrobiology and Environmental Monitoring unit (GME), BRGM, France



709868 Research Fund for Coal & Steel



Geoscience for a sustainable Earth













Concept

Industrial Ecology & Symbiosis









Concept

Integrated Process







Key Details

- Received funding from the Research Fund for Coal and Steel (RFCS)
- Three-year R&D project from June 2016; project budget ~3.2M€
- Eight partners from five countries
 - University of Exeter (Coordinator)
 BRGM; <u>Caspeo</u>
 - Université de Liège; <u>Comet Traitements</u>
 - GIG; <u>TAURON Wydobycie</u>
 - University of Cape Town



UK

FR

BF

PL

RSA



Key Details

- Use Poland as case study region
- Prove technical feasibility of individual unit processes
 At (mini) pilot-scale
- Integrate through modelling and simulation
 - Demonstrate viability of concept
 - Include economic assessment
- Evaluate environmental benefit vs "do nothing" scenario

 LCA



Raw Materials

CEReS

- Analysed four coal waste streams
 - Selected Janina Spiral Tails (~12% Py)
 - Detailed mineralogical characterisation
- Bioprospecting
 - Two bioleaching consortia (30°C & 48°C)
 - Microbial ecology of Janina waste dump (NGS)
- Characterised AMD-generating potential
 - "Missing Acid" question...









Raw Materials

- Analysed WEEE processing in Poland
 - Three PCB categories; selected low-grade
- Not as required; ~35% PCB
 use Comet own stock
- Detailed characterisation & analysis
 - Metal/value breakdown
 - Au and PM highest values; Cu significant.
- Produced database and cross-map.







Catalytic Cracking

- Adaption of Comet's pyrolysis process to PCB
 - Initial orientative bench-scale tests
 - Pilot scale tests Phoenix reactor



- Produced and characterised char and hydrocarbon outputs
 - Hydrocarbon 18% original mass; requires removal of Si prior to use in co-generation engine
 - Char four size categories: +8 mm; 2-8 mm; 75 μm-2 mm;
 -75 μm
 - Bromine 74% recovered in quench water
- >90% Ag, Au and Cu concentrated in two fractions
 - ~47% input; concentration factor ~2







Coal Waste & Char Leaching

- Selection of bioleaching consortia
 - Two enriched from Janina waste, two existing bioleaching consortia
 - Selected 48°C "TW48" consortium from Janina waste
- Biolixiviant capable of leaching char
- Huge problem with corrosion
 caused by CI content of waste...
- Decide on appropriate strategy
 - washing or using different waste?











Non-AMD



Improved environmental stability of bioleached coal waste



- Geochemical modelling + Quantitative iii mineralogy to investigate "missing acid" phenomenon Biokinetic AMD test provides useful additional information
- Potential issue of latent acidity...





Non-AMD generating solids

Coal Waste & Char Leaching

 Possible reuse of fine-grained waste in production of ceramic products, granulates, concrete products







Coal Waste & Char Leaching

- Char leaching options tested
 - Reactor type, design, operating conditions
 - Char pre-processing
- Char leaching can result in 100% Cu dissolution
 - Colonisation of char leaching reactor possibly beneficial
 - Bi-phasic...



Non-AMD generating solids





Refining of Products

- Selected Acorga for SX due to high selectivity
- Iron management possible via precipitation of jarosite and conversion to hematite



Only able to valorise Cu within the scope of the project
 Work required to recover PM









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Process Integration

 CEReS does not make money *if*...



- Cost of PCBs based on market value (Umicore)
- Coal waste cost-neutral
- Stabilised (bioleached) coal waste has no value

BUT...

 LCA analysis shows significant benefit of CEReS process over the do nothing (business as usual) scenario (for majority of impact categories)





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ありがとう Thank You, Merci, Dziękuję, Dankie

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