SCRAP ALUMINIUM - AND THE NET-ZERO ECONOMY

A CASE STUDY IN CIRCULARITY

ALAN SMITH – WWW.NETZEROCHEM.COM

ALUMINIUM AND AL SCRAP - A SNAPSHOT.

- The total mass of aluminium in circulation is over 1Bn/t.
- Global production in 2020 was 65M/t with an annual growth rate of around 6%.
- 30M/t/y is used in packaging and manufacturing, which produce almost 0.7M tonnes of scrap as small or very small particles, hard to re-smelt so often exported or dumped.
- Around 90,000 tons of aluminium including this type of this type of waste is landfilled in the UK every year, the total landfilled in the EU and USA combined is over 4M tonnes.
- Small particle scrap can be processed CHEMICALLY in a rugged 'off grid' H2Pod system to into pure H2, and uniquely 'net zero' aluminium tri-hydride (ATH) without producing CO2 or toxins.
- 10 tonnes of scrap processed in an H2Pod produces 1.1 tonnes of pure green hydrogen, 29 tonnes of ATH and 4MWh of process heat.

TYPICAL 'NON-PREFERRED' ALUMINIUM SCRAP

THE LABORATORY VERSION OF THE H2POD

Fitted with a data-collection system this single reactor test-bed can produce up to 10Kg H2/week and has been run for over 400 hours.

HOW H2 POD FITS INTO THE CIRCULAR ECONOMY

- Challenging materials can be re-processed CHEMICALLY with net zero carbon impact in an H2Pod system to make:-
  - Unique 'net zero' ATH with **3 to 5 x the value of the scrap processed!!**
  - Pure H2– essentially free at the point of use due the gains in ATH value
  - Abundant process heat and COP of 50-100 dependent on scale.

- Creating profitable 'net zero' uses for non-preferred types of scrap aluminium has the following benefits:
  - Eliminates the need to mine bauxite ore just to manufacture aluminates
  - Cuts scrap exports to laxer jurisdictions and could eliminate the need for imports of ATH
  - Is truly green, grid-independent and can be located anywhere

H2 POD - HOW DOES IT WORK?

- The Pod system uses catalytic chemistry to promote the hydroxylation of aluminium in water- the water provides the hydrogen.

- The chemistry is green and reliable, and does not use caustic soda as others have – which means the hydroxide produced is clean, sodium free and the catalyst is re-usable

- Our '30 tonne' plant is designed to produce 100 times more energy than is required to sustain it. Hydrogen, Hydroxide and Heat are the products. Total energy out? 12 GW/yr, CO2 near-zero.

- No alchemical magic is involved – it's all in the literature.

Plant design (by RB Plant Ltd) to produce 150 t/y H2 and over 4,300t/y ATH from 1500 tonnes of Al scrap.

USING SCRAP TO POWER RE-SMELTING

A CASE STUDY IN CIRCULARTY

- To melt aluminum scrap back into useful ingots requires heating the metal to the pouring temperature of 720-740C. Theoretically this requires 330 Wh/kg, but real world thermal losses may add another 500Wh/kg, while poor firebox design can increase the energy required to as much as 1300 Wh/kg. Sadly only 25% of the combustion heat may be used for the intended purpose.

- Our model shows that depending on furnace efficiency, diverting between 15 - 25% of the Al scrap collected to make hydrogen using the H2Pod process provides all the pure hydrogen gas required to smelt the remaining 75-85%.

- A furnace operator using this system will see fuel and emissions costs fsll to zero and be immune to fluctuating fuel prices or unanticipated shortages.

- The hydrogen fuel created is essentially free at point of use, since the process creates valuable and useful co-products like process heat and aluminium tri-hydroxide (ATH) worth more than the input scrap metal.

COST COMPARISONS, H2 POD Vs ELECTROLYSER

- Plant build cost per kg/H2 are similar.
- H2Pod grid connection cost is negligible.
- Maintenance/plant life costs lower for H2Pod
- Energy cost of H2Pod <95% less.
- Direct/indirect jobs created 3-4x higher.
- ROI – 3 years for H2Pod, 6 for Electrolyser.
- Breakeven H2 price £3/kg – and always green.
- Total sales H2 Pod (ATH+ H2) =£ 2.5M/yr
- Electrolyser at same H2 price = £900k/yr.
- Not tied to grid – H2Pod works anywhere.

CONVENTIONAL ALUMINATE PRODUCTION
To Produce 1 Tonne ATH for the UK

1. Mine up to 6 tonnes of bauxite and overburden.
2. Truck to Bayer Process plant.
3. 'Slow-cook' bauxite with caustic soda.
4. Dump up to 5 tonnes of toxic 'red mud' spoil.
5. Filter, wash, and dry the ATH.
6. Truck and ship (possibly) 6000 mile
7. Total CO_2 Footprint < 3 tonnes per tonne.

UK ATH Imports CO_2 Footprint <300,000 tonnes.

Making ATH with the H_2 Pod cuts this by 99.7%

LOGICAL NEXT STEPS.

- Locate a potential H2Pod site (early talks under way) and seek funding for full FEED study.
- Further develop post-processing of ATH to raise purity of the current 'technical grade' 99.5% pure and worth around £350/t to 99.9%+ purity, worth around £3,500/t and in short supply.
- Finish task of signing input and offtake agreements.
- Investigate potential for CO2 credits if H2 Pod was deployed at scale.
- Add further patents to the current portfolio.

THANK YOU FOR YOUR TIME, AND THANKS TO OUR SUPPORTING PARTNERS, ESPECIALLY:-

RB Plant Group Ltd. UK

Alephzero.org, USA

Candlebark Farm, Australia

Christof Industries GmBh, Austria.

www.netzerochem.com : 07944847870