RSC INTEREST GROUP
CONSULTANCY

Bulletin – November 2022

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The Consultancy Group

The Group is one of the Royal Society of Chemistry's many Interest Groups. The Interest Groups are member-driven groups which exist to benefit RSC members, and the wider chemical science community, in line with the RSC's strategy and charter.

The Group provides a forum for RSC members who are consultants. Members may be self-employed, in partnerships or employed by commercial organisations or academia. Many of the members of the Consultancy Group also act as Expert Witnesses in criminal and/or civil litigation.

The Group arranges meetings and workshops to provide networking opportunities and training in aspects of setting up and running a consultancy business.

Annual General Meeting

The AGM took place on 27th September 2022 in Burlington House, London, as part of the *Sustainability in Industry* meeting.

Theme: Sustainability in Industry

State of Battery Recycling – A. Fox, Ever Resource, Cambridge, UK

Athan Fox at Burlington House

The Lead-Acid Battery (LAB) and Recycling

The LAB is the world's most successfully recycled product with an anticipated turnover in excess of $85 billion in 2026. However, recycling the battery is highly polluting. It is energy and carbon intensive as well as wasteful and polluting.

The LAB is made up of about 70% lead/lead compounds, up to 20% electrolyte (sulphuric acid) and 10% plastic (casing and separators). The lead/lead compounds are a mixture of about 35% lead metal or alloy and about 65% "leady" oxide.

The "traditional" method of recycling the batteries is to crush them in order to separate the plastics, clean them and produce moulded plastic products. Meanwhile, the lead burden, which includes lead sulphate from the spent battery-

active materials, is refined into ingots. The ingots are used to manufacture the lead components of the battery, including the grid and leady oxide. Crucially, the processing of waste active material (lead sulphate) in a furnace is energy intensive and polluting.

An "alternative" (*Regenerate*) method is to convert lead sulphate into a battery-grade leady oxide without having to produce an intermediate lead ingot. This can be achieved by separating the solid metallics from the waste battery-active materials, and then desulphurising the lead sulphate to produce intermediate lead oxide, followed by conversion into metal organic framework (MOF). The MOF is calcined to produce a battery-grade leady oxide. This has the benefit of being more benign due to the use of water rather than fire as well as saving money and improving battery performance.

The simplicity of the lead-acid battery in terms of physical-mechanical separation at end-of-life has allowed recycling to become a huge success in this industry. Indeed, the lead battery is the most successfully recycled commodity item. This is because the separation of plastic, lead and electrolyte is simple. With lithium batteries, however, the separation of components is very difficult. This is because there are multiple types of battery chemistries, multiple ways to build cells, modules and packs, and considerably more complex battery architectures. This makes lithium battery recycling more complex to achieve at a low cost. In general, expensive batteries lead to economically sensible recycling, but low-cost batteries (which are arguably good for market penetration) using non-critical metals can lead to low margins or losses in the recycling business.

By 2027, battery producers must declare the amount of recycled cobalt, lead, lithium and nickel in their products. By 2035 the European Union has a target for lithium-ion batteries of being 70% recycled. The demand for 4% of lithium to be from recycled sources would require the equivalent of over 87,000 Tesla Model 3 battery packs to be recycled annually.

Fibre, pulp and paper - Tony Eley, Pulp Tech

Pulp is the raw material used for paper manufacture containing vegetable, mineral, or man-made fibres. It forms a matted or felted sheet on a screen when the moisture is removed and this is paper or board.

There are five sources of "natural" fibres for paper making pulps. These are:

1. Stem-Trees (hardwood, the lowest price pulp & softwood);
2. Seed (cotton, the highest price pulp);
3. Bast (flax, hemp, kenaf, jute);
4. Gramineous: grasses (esparto, bamboo, straw, bagasse, reed);
5. Leaf (abaca, sisal).

Non-wood fibres are referred to as annual fibre or pulps. The mechanical properties of fibres depend on the architecture of the secondary cell walls. Cellulose fibres have high strength, durability and are hygroscopic. Chemically cellulose is a polysaccharide consisting of chains of glucose monomers.

The method used to produce the pulp is determined by the fibre type to be produced and the purpose of the pulp. Mechanical production is the cheapest process and is used for newspapers and magazines that are not intended to have a long life. Chemical processes give a lower yield than mechanical methods but produce pulps with longer and stronger fibres. Chemical processes allow for the production of high-quality white papers. A hybrid processing method, which is often more expensive than chemical processing but can give a higher yield, is used for the production of various high-quality papers.

- The demand for Paper & Board is still high & forecast to increase
- Recycled fibre demand is still increasing but the quality can be poor

- North America, China & Brazil dominate pulp production
- There is an increasing customer voice for less de-forestation

The paper makers are looking more at using Agro-residue rather than traditional wood pulps.

Non-wood fibres can be a fast annual growing fibre resource, and have a smaller content of lignin than wood. They can be sourced locally, giving reduction in transportation and provide benefit for local economy. The non-wood pulp can be produced at low temperatures with a lower dosage of chemicals. Compared to wood pulp mills a smaller site can be feasible in manufacturing processes, giving a simplified production process. The beating (mechanical treatment) of non-wood pulp fibres can also be easier to implement than traditional wood pulps.

In conclusion, the demand for paper (and therefore pulp) is likely to increase as population increases. There is consumer pressure to move away from traditional wood pulp-based paper is increasing while pulp capacity for non-wood pulp is still relatively low. Consequently, there is a requirement for an eco-friendly, sustainable & economically alternative to wood pulps.

Ecopulping - Florence Miremadi NAFICI Environmental Research

A sustainability-focused company developing and licensing *EcoPulping*, an innovative patented process which transforms agricultural wastes into paper pulp. EcoPulp can be used to produce unbleached paper packaging or moulded products.

Currently there are two EcoPulping pilot plants: Horsham, UK with 100kg input capacity and; Linqing, Shandong Province, China with 1 tonne input capacity. A commercial EcoPulping plant in Linqing, China (operational Q4- 2022) will process reed, wheat straw and corn to produce 50TPD of unbleached dewatered pulp for paper. A commercial EcoPulping plant for the UK & European market will be operational in 2023 producing food grade and unbleached wheat straw pulp.

By processing a large variety of agricultural wastes using EcoPulping will produce unbleached pulp (cereal straw, maize stover, reed, date palm leaves, miscanthus and more). A wide range of economically viable plant capacities (20 to 400 TPD) with stand-alone units or retrofitting to an existing mill producing wet or dry EcoPulp can be manufactured. EcoPulping can be used to manufacture paperboard packaging or moulded products. It is intended to target similar or lower price pulps equivalent to wood pulp grades.

Ecopulping compared to more traditional methods:

- Low heat, no pressure → Up to 50% less energy;
- Closed loop → Up to 95% less water;
- Valuable by-products and minimal wastes;
- Economic at small- or large-scale capacity;
- Can be built as an independent unit or retrofitted to existing mills.

By-products and potential applications include:

- Soil Conditioner / Fertiliser;
- Moulded Fibre products;
- Insulation boards;
- Animal feed;
- Animal Bedding.

In conclusion, EcoPulping ticks several Sustainable Development Goals.

- Hundreds of millions of tonnes of wheat straw or other agricultural residues are burnt or left to rot in many countries every year, emitting greenhouse gases (GHG): EcoPulping helps to reduce GHG emissions to air;
- EcoPulping means avoiding tree felling - agricultural wastes are an alternative to wood for paper pulp for packaging products;

- EcoPulping uses up to 50% less energy than traditional pulping and consumes up to 95% less water;
- EcoPulping helps farming communities by using their surplus agri-wastes which creates new income (and improves their soil when using the EcoPulping by-products as soil conditioner or fertiliser);
- Packaging products made from EcoPulp can replace food or non-food plastic products.

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Chocolate Tasting Meeting

Thursday 15 December 2022 11am – 4 pm

Burlington House, London

If you would like to attend, please sign up by going to:
https://www.rsc.org/events/detail/75020/chocolate-and-elephants-at-christmas

In addition, if you did not see this first time around, the "Secret World of" series has programme on Sweets which includes a piece on pastilles, presented by Bill Edwards.
https://www.channel4.com/programmes/the-secret-world-of/on-demand/73427-003

Directory of Consultants

The Royal Society of Chemistry has a list of consultants that are registered with them. It can be found at:

https://www.rsc.org/membership-and-community/directory-of-consultants/

The Directory is a service provided by the Royal Society of Chemistry to members, professionals and the public. The information supplied in this directory, and the services offered and delivered, are entirely the responsibility of the consultants themselves, and not the Royal Society of Chemistry.

The consulting experts listed in this directory are all full members of the Royal Society of Chemistry and are bound by the RSC Code of Conduct.

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The consultants' profiles are organised into separate pages by area of expertise;

Manufacturing; Marketing & business development; People development; Regulation; Health & safety; Science; Engineering & technology; Strategy & policy; Legal & expert witness services.

If you wish to be added to the Directory, please complete the application forms found on the RSC webpage above.