



Biomass Waste to Chemical Base

Circa and Furacell™



A new technology from an Australian company is leading the way in using renewable biomass waste as an input to some chemicals. Could Circa's Furacell process be yet another herald of the transformation from hydrocarbons to carbohydrates?

Cellulose is the most abundant, easily accessible form of photosynthetically captured carbon on Earth. It forms the structural, non-food parts of all higher plants, including the vast majority of agricultural and silvicultural crops.

Australia is one of the world's largest producers of cellulose – with millions of tonnes of green “waste” available. Therefore the potential for a renewable biomass technology sector here is considerable. However, unlike Europe and the Americas, Australia's research and development has lagged and only a few demonstration projects are currently operational.

One company, Circa Pty Ltd, is developing technology to produce a platform chemical from renewable cellulose waste, with the potential to partially replace the millions of tonnes of fossil based products used in solvents, polymers and pesticides for example.



Keeping the Footprint Tight

To work within the limitations of a distributed and dry Australian feedstock landscape, the original Circa technology brief set strict parameters. These were:

- Conversion to an energy-dense liquid near source is essential since transporting bulky ‘raw cellulose’ in the form of biomass is not efficient
- Facilities must be profitable on a medium scale (typically 100 dry tonnes per day of biomass, or less) and be mobile or semi-mobile
- Operating conditions must be relatively benign, and the plant operable by local people
- There must be a minimal environmental footprint: energy self sufficient, low or no emissions, no nett water use
- Char is a useful by-product, but an uneconomic activity by itself
- Technology should be common to diverse cellulose feedstock (municipal solid waste, agriculture and forestry wastes, and energy crops in the medium term)
- Develop a range of market opportunities for the products
- Technology should have export potential to markets where decentralised, medium sized farming/forestry exists
- Benchmark maximum cost of AUD55 per barrel equivalent.

Several of these constraints rule out more traditional processes involving high pressures.

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Process Creates Range of 'Products'

The Circa process uses a catalytic thermochemical process to produce three primary products. These are:

- 1. Char** – suitable as a renewable fuel (via gasification), soil conditioner or carbon sequestration agent;
- 2. Water** – manufactured during the breakdown of the cellulose;
- 3. Biocrude** – an energy dense and chemically simple liquid product that can be readily converted into levulinic acid, a product recognised by the US Department of Energy as one of the top ten renewable platform chemicals of the future that can be used to produce many of the products currently derived from crude oil - liquid fuels being prominent among them.



Furacell™ Process Schematic:

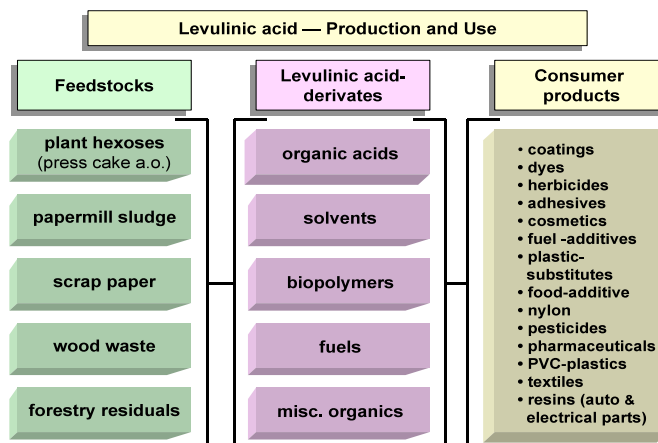
The lessons of recent ethanol investments linked to single source feedstock have been well documented, demonstrating that reliance on selling to a single fuel market is a weakness for any new player.

Energy companies are extremely efficient. For smaller and newer players, competing head-on is difficult, both in transport fuels and stationary energy.

While products from the Furacell™ process can be used in energy production, Circa's focus is further up the value chain and away from biomass derived commodities, towards biomass derived speciality chemicals.

Circa focuses on levulinic acid since a number of derivative products can be manufactured using well understood conversion processes. Natural Resources Canada estimate two products, methyltetrahydrofuran (MTHF), a gasoline extender, and delta-amino levulinic acid (DALA), a biopesticide, have the potential to increase the demand for levulinic acid to a CAD30-CAD50 billion market by 2020.

Options for this versatile platform chemical are outlined below:



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Circa Business Model and Strategy

The Circa business strategy is based on a hub and spoke model. This is for licensing the manufacturing, purchasing the biocrude for central refining and marketing the levulinic acid.

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For example, using Furacell™, regional contractors can process waste cellulose feedstock, then market the char locally, and on-sell the biocrude to Circa. Alternatively, Circa will work in joint venture arrangements where feedstock availability allows a permanent, stand alone facility.

This flexible strategy creates opportunities to export plant and technology to regions where sufficient waste feedstock is available (there are more than two billion tonnes of field and forestry residues in Asia). Technology exports will also be focussed on regions where an alternative and competitive source of levulinic acid is attractive to chemical companies.

After two years research, the Furacell™ process is at pilot stage, and achieving increasingly attractive yields.

A Patent Cooperation Treaty (PCT) Patent Application has been submitted, trademarks granted, and an early stage commercial focus is underway to develop joint ventures in three specific feedstock sectors. The next stage is to prove the system on a larger scale and to test commercial feasibility of the undertaking.

As market opportunities are being developed and sought both in Australia and overseas, Circa is seeking further grants in 2010 to maintain research and development momentum, as well as supporting staffing and capital requirements.

Circa's approach is to develop core proprietary intellectual property which is compatible with known downstream processes. It takes greater effort, but is considered to be a more sustainable opportunity for stakeholders.

However, a cautious approach is still appropriate and the advice of a colleague keeps the mind focussed. The rule of three for new ventures: it will take three times as long to get to market, cost three times the original budget, and the market will only be a third the size you thought.

But that does not mean it is not worth it.


"We can sit here and talk about China and India as much as we want and they're burning a lot of coal today.

But they're going to get better some day and I'd rather they get better with technologies I'm making and selling from here, than things we just delegate to them because we were too lazy to do it in the first place."

GE CEO Jeffrey Immelt (2008)

Modern Thinking Driving Novel Process and Outcomes

Circa's thinking is that a carbohydrate economy is likely to eventually replace much of the current hydrocarbon one, and Circa's Furacell™ technology provides a piece of the new jigsaw.

An ability to process cellulose directly, in simple, scalable equipment, without the need for high pressure, to form a mixture of a chemically simple liquid and char is a significant advance with good potential in current and future markets.  **CE**

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