Natural business in New New Zealand

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Unitec Sustainability Cluster.

BioChair - Natural Business in new New Zealand.

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Where does New Zealand design come from? It is debatable whether there is something that you can definitely call New Zealand Design. There is design from New Zealand; things that have been designed in New Zealand, made by New Zealanders or manufactured by New Zealand companies. It could be argued that there is not point in trying to distinguish between design from different countries; does all design that has been created in the last half century belong to an international style? Most companies sell their products in a global market and therefore cannot afford to design just for a home market.
Many New Zealanders would say that there is something special about New Zealand design: that a product from New Zealand can be identified as such, that a building has a certain 'New Zealandness' about it - but what is it that makes up this New Zealand feeling, aesthetic and sense of place?

In his book 'Looking at art in New Zealand', Peter Tomory suggests that:

'the New Zealand aesthetic was different to that elsewhere. This statement is based on the premise that aesthetic appreciation is determined by visual experience: that as we go through day-to-day life, we acquire a visual vocabulary of the natural and man-made forms that surround us'

Tomory used the term 'totem' to describe these visual contacts in New Zealand:

with its few cities and fewer architectural landmarks, the land still provided a great number of the 'totems' by which New Zealanders developed their aesthetic measurements. The lack of European masterpieces, and the impress of the landscape, he concluded, produced a unique New Zealand aesthetic. (1)

Travel around New Zealand and you will see kilometre upon kilometre of green landscape, pastures, rolling hills, volcanic terrain, trees, islands and sea. It is probably this landscape and life within it that has, over anything else, contributed more to forming the New Zealand national mind and New Zealand design. It could be said that New Zealand design come from the landscape.

In 1999 leveraging of the landscape and its natural beauty, Tourism New Zealand branded the country as "100% Pure". In its award winning advertising Tourism New Zealand uses images of the landscape to reinforce the brand story. But is this the kind of image contemporary New Zealand should be portraying?

In January 2007, New Zealand design, innovation and business magazine 'Idealog' published an article called 'New Zealand Meet the New You'. In this article author Jake Pearce argues that New Zealand needs to portray itself in a far more innovative and contemporary manner:
'the '100% pure' campaign plays to this stereotype. Its panoramic spreads of white mountains and whiter beaches reinforce the perception that we do little more that raise cattle and run up mountains for kicks' (2)
New Zealand is struggling to live up to the '100% Pure' image economically, environmentally and socially. Business pundit Rod Oram states:

'economically: we're fast loosing our competitiveness in the commodities that dominate our exports; our current account deficit equals ten percent of GDP.
environmentally: our urban lifestyles and rural farming practices are putting unprecedented pressure on out natural resources' (3)

Jude Hooson director of market strategist The Providence Report believes that '*the defining issue for New Zealand's economic future is our ability to apply our best minds and creative talents to our environment'* Hooson suggests:

'we have a deep biological economy with 70% of our exports traceable back to our industries of land-based innovation. The bottom line driver of our wellbeing and competitive advantage is our ability to make nature work for us and land-based innovation is our version of Finland's Nokia story'

'Brands with global interest will carry the New Zealand value of sophisticated simplicity' (4)

Undoubtedly if New Zealand is to remain competitive in the global market place and not allow the '100% Pure' image become its Achilles heel, it must manoeuvre itself into a position to fully realise and truthfully capitalise on it's brand built upon the purity of its businesses, land and conscience.

BioChair - Out Of The Landscape.

The BioChair project began in early 2009 and is collaboration between Unitec and the Crown Research Institute Scion. The idea of combing wood with polymers in the design of a piece of exportable commercial furniture was seen to offer the opportunity to bring together the 'naturalness' of New Zealand with industrial design to create an innovative and original product that could express the new contemporary country brand those such as Pearce and Hooson argue is needed. Furthermore, the BioChair project aims to create and commercialise the first product made entirely from New Zealand formulated biopolymer in a 'sophisticated-simple' design. New Zealand, like most other countries, is beginning to see a growing introduction of bioplastic and biodegradable plastic materials within the plastics industry. The market penetration of bioplastics in the global plastics industry is expected to grow from less than 100,000 tonnes a few years ago to a level approaching 1 million tonnes by 2010. (5)

From the researchers perspective, the area of commercial furniture production provided an excellent application to development new biomaterials as it is a specific example, yet material characteristics required are common to many other applications.
Wood is a natural resource with qualities that are in demand by an environmentally aware society. It is renewable, biodegradable and has a green image not enjoyed by other materials (such as metals, concrete and plastics).
The challenge is to enhance the value of wood by providing uniform performance without compromising its green image. Increasingly polymers will fill this role. Polymers are compounds made up of simple, identical repeated units. They are uniform, predictable and can be designed to form structures with specific properties. By combining wood or wood fibres with polymers, the renewability and biodegrability can be retained while improving the variability and stability in service. (6)

From experience gained in the furniture industry, the researchers were able to define the initial focus of the chair project. It was decided that the target product would be a fixed height, 4-leg 'visitor chair' which is traditionally used in waiting rooms, conference rooms, chairs to be brought out for special functions or a more basic meeting room chair. The market is large and the requirement of visitors chairs, less demanding than that of task office seating.

The Market:

The US market for office furniture in 2008 was an estimated 12.9 billion. Worldwide, furniture manufacturers that have investigated eco sustainable furniture production have tended to focus on the recyclability of high-energy embodied technological materials rather than on the utilization of renewably sourced biopolymers that have a wider range of 'end of life' options, even including composting. (6)

Next:

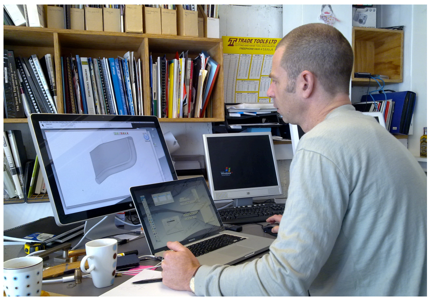
Design work undertaken between Unitec and Scion seeks to prove that commercial office furniture can be made using biopolymer material formulated in New Zealand.
Working with Scion, polymer developments have been laboratory tested for mechanical properties, commercial moulding possibilities and end of life options explored, such as recyclability or composting.

Design solutions are currently being refined and scale models produced for evaluation. In parallel to this a 50KG batch of Scion formulated biopolymer is currently being made. An injection moulded chair part made from biopolymer will then be tested for structural durability to NZ /AU commercial furniture standards.

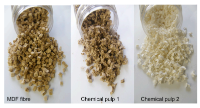
Solid modelling of the BioChair using Rhino.

1:1 scale models will be tested for manufacturing technologies and overall aesthetics.

Poster below was created byLCA specialist Daniel Kellenberger from SCION showing Life Cycle Analysis of biopolymer using Cradle to Gate method.



SCION
Next generation biomaterials



Environmental impact of novel biopolymers - a "laboratory to industrial scale" case study

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Introduction and Goal

Scion[1] and Unitec[2] are collaborating on the design of sustainable furniture using biopolymers. Various biopolymer formulations have been studied for desirable mechanical properties (i.e. a minimum tensile strength of 56MPa; Even et al. 2009). Three biopolymers combining polylactic acid (PLA) with different wood fibres meet these mechanical requirements. This study examines the environmental impact of their production. The environmental impact has been calculated on both laboratory and future industrial-scale production. Scenarios based on five current electricity options plus two future (average and marginal) options have been applied to determine the polymer/energy mix with the least environmental impact.

Materials

Three biopolymer formulations were studied:
- Chemical pulp 1 & PLA (CP1-PLA);
- Chemical pulp 2 & PLA (CP2-PLA); and
- MDF-based wood fibres & PLA (WF-PLA).

They were compared to a control of 20% glass fibres with 80% Polypropylene (GF-PP), Figure 1.

Figure 1: Tensile test specimens (from bottom to top): glass fibre-PP, PLA (not studied); chemical pulp 1-PLA, chemical pulp 2-PLA and wood fibre-PLA

The input materials/energy were grouped into ***polymers*** (either PP or PLA), ***reinforcements*** (chemical pulp or MDF wood pulp) and ***processing*** (drying of the fibres, extrusion and injection moulding).

Methods

The environmental impact was calculated using Life Cycle Assessment (LCA). The system chosen was ***cradle to gate***. The environmental impact from composting or landfilling was dealt with qualitatively due to lack of LCA data. The results are presented as Global Warming Potential (GWP in kg CO_2-eq.) for renewable and non-renewable Energy (MJ) as well as total Eco-Points based on the EcoIndicator 99 (H/A) methodology. The generation mixes of five existing electricity providers were used to calculate the **current provider** scenarios. The two **future** scenarios (**average** and **marginal**) used projected energy mixes [SOO 2008]. Applying **future marginal** electricity mixes means that a future industrial production of biopolymers will require additional electricity not covered by today's generation so these only take into account the difference between today's and the future electricity mix [SOO 2008].

Table 1 shows the **current provider** electricity mixes:

[%] Fuel type	Electricity Provider in NZ (2008): Meridian	Genesis	Contact	Mighty River	Trust Power	Others
Hydro	96	17	32	61	73	63
Geothermal			20	19		
Biomass (Wood)				1		
Wind	4				27	
Coal		37				
Gas		46	48	18		37

Table 2 shows the **future average** NZ electricity mixes:

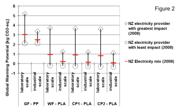
[%] Fuel type	Average Future Scenario (2015): 1	2	3	4	5
Biomass	1	1	1	1	1
Coal	4	3	3	9	3
Gas	18	19	19	18	24
Geothermal	16	12	16	12	12
Hydro	56	55	56	55	55
Other cogen.	1	1	1	1	1
Wind	4	10	4	5	4

Table 3 shows the **future marginal** NZ electricity mixes:

[%] Fuel type	Marginal Future Scenario (2015): S1	S2	S3	S4	S5
Biomass	0	0	0	0	0
Coal	-14	-27	-28	28	-28
Diesel	0.03	0.02	0.00	0.01	0.00
Gas	-19	-6	-5	-19	42
Geothermal	86	48	90	49	52
Hydro	28	12	24	19	17
Other cogen.	0	0	0	0	0
Wind	19	74	20	23	17

Results and Discussion

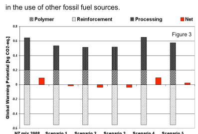
The Global Warming Potential for the three biopolymers based on **current providers** are shown in Figure 2:



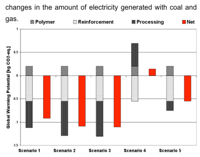
- The three biopolymers are all significantly better than the control on a laboratory scale. When up scaling the production to industrial scale, the production process will be more efficient so the environmental impact will be reduced further;
- By a slight margin, the best of the three biopolymers is the CP2-PLA; and
- For the biopolymers, GWP is negligible if using the most environmentally friendly NZ electricity mix.

The results for the best biopolymer (CP2-PLA) were then modelled with the **future average** and **marginal** electricity mix scenarios for GWP.

The results for CP2-PLA modelled with **future average** NZ electricity mixes (Figure 3) show that a large part of the existing non-renewable power sources are shifted to more renewable ones in Scenarios 1 to 3. Under Scenarios 4 and 5, changes in coal- or gas-generated power reflect changes in the use of other fossil fuel sources.



The results for CP2-PLA modelled with the **future marginal** electricity mixes for GWP (Figure 4) show that shifting some non-renewable energy (large negative GWP) to renewable energy (small positive GWP) energy reduces the environmental impact significantly in Scenarios 1 to 3. Scenarios 4 and 5 result in a net positive GWP due to small changes in the amount of electricity generated with coal and gas.



Conclusions / Recommendations

- Biopolymers have lower environmental impacts than plastics;
- Energy supply source strongly influences the environmental impact of polymers; and
- Increasing the proportion of renewable energy in the future will be critical for securing low environmental impact.

Acknowledgements

- Scion, specially support from Damien Even, Jeremy Warnes and Alan Fernyhough
- Clariant for providing industry data
- Roger Bateman from Unitec in Auckland, NZ for the good collaboration

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This poster was presented at the 5th International Conference on Industrial Ecology in Lisbon from 21st to 24th of June 2009

1. The trading name of the New Zealand Forest Research Institute
2. Unitec Institute of Technology, Auckland

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