International Specialised Skills Institute

Environmental Graphics: Sustainable Materials for the Built Environment

Mary Miceli

Skills Victoria (TAFE)/Italy (Veneto) ISS Institute Fellowship

Fellowship funded by Skills Victoria, Department of Innovation, Industry and Regional Development, Victorian Government

Victoria
The Place To Be

ISS Institute Inc
AUGUST 2011

International Specialised Skills Institute

ISS Institute
Level 1
189 Faraday Street
Carlton Vic
AUSTRALIA 3053

T 03 9347 4583
F 03 9348 1474
E info@issinstitute.org.au
W www.issinstitute.org.au

Cover image: Via Mazzini, Verona, Italy. This Shopping strip is an excellent example of how EG is used in keeping with the architectural beauty of the streetscape. Retail outlets are branded in and visually suitable manner without overpowering each other. Image courtesy of Walter Collalto.

Published by International Specialised Skills Institute, Melbourne

Extract published on http://www.issinstitute.org.au

Executive Summary

Sustainable material solutions in the broader design industry have been heralded in the mainstream consciousness since the 1970s. Initially scientists, designers and manufacturers concentrated on avoiding materials such as glues and paints that were highly toxic. The 1970s also saw environmental awareness being the main impetus for paper recycling, shortly followed by the introduction of mainstream plastic recycling.

Although plastic recycling is undoubtedly beneficial, it is not in itself a solution to plastic waste. Many of the plastic products produced are made from varying polymers that are not all suitable for the recycling processes, or alternatively are assembled with non-recyclable parts or toxic glues. These products inevitably become landfill. Even if a product goes through the recycling process it is generally down-cycled into an inferior product, such as wheelie bins or outdoor furniture, rather than being recycled into its original or equivalent use.

While a significant amount of plastics are being recycled, the current linear model of product to landfill remains the outcome for most plastic products. The problem with this model is twofold: first, the continued reliance on fossil fuels to produce petrochemical polymers, that are both energy intensive to source and deplete scarce resources; second, the landfill problems that occur as a result of the fact that plastic does not fully degrade in the environment. In fact, the outcome of some degradation of petrochemical plastic is worse than no degradation as the small particles of plastic are hazardous in much of the environment. Of particular concern is the impact in our oceans where marine life and birdlife swallow small pieces of plastic, blocking their digestive system and ultimately killing them.[1]

Petroleum base produced plastics have a significant presence in the design industry. Plastic is convenient, it is cheap, flexible and strong. It comes in a plethora of colours and can be processed through a range of manufacturing methods.

Many manufacturers recognise that the current reliance on fossil fuels in the plastics industry is unsustainable and are investing considerable time and money into research and development to produce renewable products that are a closed loop, ‘cradle-to-cradle’ process.

Society is currently going through a vision of change when it comes to sustainable solutions. Consumers are asking more questions about sustainability and Life Cycle Thinking (LCT) is gaining momentum. Designers are in the optimum position to be at the forefront of this technology and unfold the innovative potential of bioplastics.

This Fellowship concentrates on an analysis of the production and usage of bioplastics in Italy, investigating the use of bioplastics as potential materials for use in Environmental Graphics (EG) in Australia. The report examines the quantity and production of EG in Australia, promoting the use of interdisciplinary design to create a more effective EG that has more impact and generates less visual pollution encouraging a better outcome for the built environment.

There are a number of International standards that a material must meet to be referred to as biodegradable or fully compostable. These standards are referred to throughout the report purely by their name and number. Full details of these standards can be obtained at varying costs at: http://www.iso.org/iso/home.htm.

Bioplastics, made primarily from starches, range from completely compostable to 90% biodegradable under aerobic conditions. They are either completely or largely agriculturally produced, reducing reliance on fossil fuels. There are numerous benefits to using agricultural raw material. It is more energy efficient to produce than sourcing and attaining fossil fuels, consequently, bioplastics do not deplete valuable resources and are often cheaper to produce; most biodegradable bioplastics form the fully sustainable closed loop process producing less waste. It should be noted that not all bioplastics are biodegradable and that these should be recycled as per specification of material.

Executive Summary

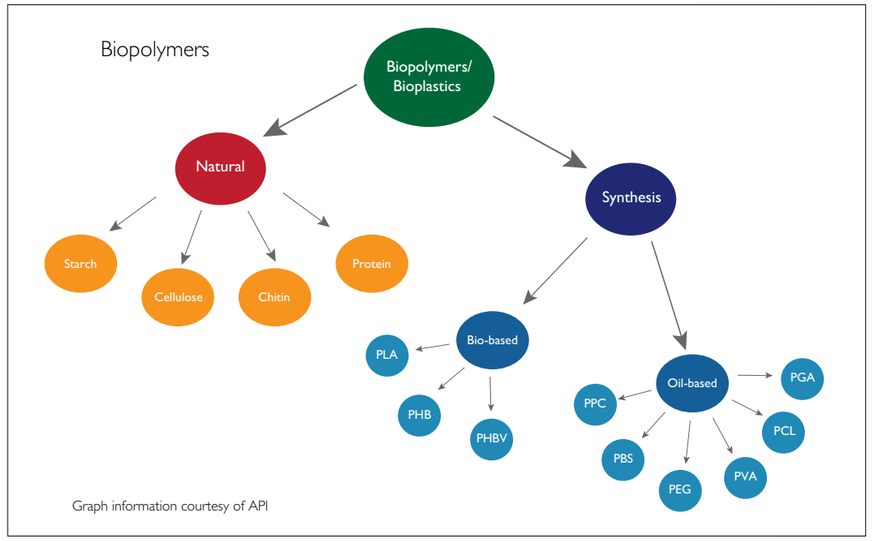


Figure 1 – this graph shows the range of bioplastics that are produced both naturally or through the process of synthesis

Italy is recognised as a leader in bioplastics, with companies such as Novamont being at the forefront of fully compostable bioplastics. Their main product line is Mater-Bi® and this product is currently distributed in Australia. Much research and innovation within traditional plastics industries is now focused on bioplastics, such as that found at API (Applicazioni Plastiche Industriali SpA) who have produced the biodegradable product, Apinat®. This product has both a soft and rigid application significantly extending its usage possibilities.

The Fellow met with representatives of both the Novamont and API companies as well as representatives of recycling plants and designers to investigate whether a bioplastics material could be produced in a thickness and strength that would be suitable for EG.

For the material to be suitable it needed to have the strength to be extruded between 3–6 mm in depth. It needed to be suitable for processing in the existing manufacturing machines available in Australia, be heat resistant and have the capacity to be coloured to meet the client's requirements.

This Fellowship report resolves that there is great potential for a revision of material use in EG in Australia. Industries both in Italy and Australia are interested in the extended possibilities of such growth and believe that any shortcomings in current materials could be resolved to meet this application.

Potentially, there is also the possibility of growth in the Australia agricultural sector to produce the raw material that is increasing in popularity. According to European Bioplastics Associations, bioplastics have seen a significant market growth since 2003 with a global average growth of 38% until 2007 and are expected to increase by a similar amount by 2013.[2]

The market for and application of bioplastics is still in its infancy, many companies particularly in Europe and the United States are investing a great many resources to extend the application of bioplastics as an alternative to conventional plastic. Australia's market share, although significantly smaller, does exist. Increased community and business interest would provide incentive for further investment in this market.

Table of Contents

Abbreviations/Acronyms

AGDA	Australian Graphic Design Association
API	Applicazioni Plastiche Industriali SpA
DEED	Department of Education and Early Childhood Development, State Government of Victoria
DIA	Design Institute of Australia
DIIRD	Department of Innovation, Industry and Regional Development, State Government of Victoria
DIISR	Department of Innovation, Industry, Science and Research
DSE	Department of Sustainability and Environment
EFS	Education for Sustainability
EG	Environmental Graphics
EU	European Union
IBSA	Innovation and Business Skills Australia
ISO	International Organization for Standardization
ISS Institute	International Specialised Skills Institute
LCA	Life Cycle Assessment
LCT	Life Cycle thinking
LED	Light-emitting diode
LEED®	Leadership in Energy and Environmental Design
NCS	National Centre for Sustainability, Swinburne University of Technology
PACIA	Plastics and Chemicals Industries Association
PBS	Polybutylene succinate
PCL	Polycaprolactone
PHB	Polyhydroxybutyrate
PHBV	Polyhydroxybutyrate-valerate
PLA	Polylactic acid
POPAI	Point of Purchase Advertising International (Australia and New Zealand)
PU	Polyurethane

Abbreviations/Acronyms

PVA	Polyvinyl alcohol
PVC	Polyvinyl chloride
RMIT	Royal Melbourne Institute of Technology
TAFE	Technical and Further Education
TPE	Thermoplastic elastomes
TPU	Thermoplastic polyurethane
VECCI	Victorian Employers' Chamber of Commerce and Industry
VET	Vocational Education and Training
VISA	Visual Industries Suppliers Association

Definitions

Applicazioni Plastiche Industriali SpA

Applicazioni Plastiche Industriali SpA (API) is an Italian chemical company producing specialty plastics.

Bioplastics

Two different concepts underlie the term 'bioplastics':

a) Compostable plastics certified according to EN13432 and based on renewable (bio-based) and/or non-renewable (fossil) resources

The focus of this concept is on functionality and 'compostability'.

Industrial users, consumers and waste management operators need to be able to identify products and assign them to composting where appropriate. The compostability of plastics, therefore, must be proven by recognised testing standards (Europe: EN 13432, the legally binding standard for the compostability of plastics in all EU [European Union] member states or EN 14995, USA: ASTM D-6400, other countries: ISO 17088).

Products made thereof should be certified by independent third party certifiers and labeled with the trademarked 'seedling' logo.

A large proportion of certified compostable plastic products available on the market today contain a high proportion of renewable raw materials. There are also synthetic polymers (based on fossil raw materials) that are compostable according to the above-mentioned standards and certification.

b) Bio-based plastics produced on the basis of renewable resources

The focus of this concept is the raw materials basis.

Rather than using fossil carbon in manufacturing conventional plastics, bio-based polymers use carbon from renewable resources such as sugar, starch, vegetable oils or cellulose in production. Corn, potatoes, cereals, sugar cane and wood are the most commonly used feedstocks. The proportion of renewable carbon used in the product can be determined using analytical methods e.g. ASTM D-6866. Bio-based polymers are not in all cases biodegradable and compostable.[3]

Biodegradable plastic

If a plastic material claims to be biodegradable and compostable in Australia, it must comply with Australian standard AS 4736-2006. This standard provides assessment criteria for plastic materials that are to be biodegraded in municipal and industrial aerobic composting facilities. This Australian standard is similar to the widely known European EN 13432 standard, but has an additional requirement of a worm test. In order to comply with the AS 4736-2006, plastic materials need to meet the following requirements:

- minimum of 90% biodegradation of plastic materials within 180 days in compost
- minimum of 90% of plastic materials should disintegrate into less than 2 mm pieces in compost within 12 weeks
- no toxic effect of the resulting compost on plants and earthworms
- hazardous substances such as heavy metals should not be present above the maximum allowed levels
- plastic materials should contain more than 50% organic materials.

This standard was prepared by Standards Australia (http://www.standards.org.au) to assist authorities regulate polymeric materials entering into the Australian market. In turn, the Australian Bioplastics Association (ABA) leverages a third-party verification system to assist manufacturers, distributors and retailers to communicate their compliance to this standard, hence verify product quality with respect to biodegradability claims.[4]

Closed loop process

This is another term for the cradle-to-cradle process in the life cycle of bioplastics. Image available at http://www.european-bioplastics.org/index.php?id=182

Compostability

For a material to be fully compostable it must meet Standards EN 13432 and EN 14995. Plastic products can provide proof of their compostability by successfully meeting the European standards, EN 13432 or EN 14995. The European Packaging Directive 94/62 EC makes reference hereto with regard to compliance with the EN 13432.

Cradle-to-cradle

For the purpose of this report the term 'cradle-to-cradle' is used to describe the life cycle of a product that mimics a natural process. It refers to a closed loop circular process that begins and ends in nature. The principle of this model is that there is little to no waste in the life of a product, for example a material that starts as an agricultural product, such as a starch, cycles through the manufacturing process into the product. When the product is disposed of it is either fully compostable or biodegradable, therefore, returning the material back to the earth and nothing is wasted.

Design

Design is problem setting and problem solving. Design is a fundamental economic and business tool. It is embedded in every aspect of commerce and industry and adds high value to any service or product—in business, government, education and training, and the community in general.[5]

EG

Environmental Graphics refers to a broad range of person-made internal and external signs, varying from information signs to branding a vast area encompassing many design disciplines.

Elastomer

An elastomer is a polymer with the property of visco-elasticity (colloquially 'elasticity').

Innovation

Creating and meeting new needs with new technical and design styles. (New realities of lifestyle).[6]

LEED®

Leadership in Energy and Environmental Design, Green Building Rating System.

LCA

Life Cycle Assessment, by strict definition of International Organization for Standardization (ISO) 14040 and 14044.

Life Cycle Thinking

Life Cycle Thinking (LCT) seeks to identify possible improvements to goods and services in the form of lower environmental impacts and reduced use of resources across all life cycle stages. This begins with raw material extraction and conversion, then manufacture and distribution, through to use and/or consumption. It ends with re-use, recycling of materials, energy recovery and ultimate disposal.[7]

MPa

Refers to flexural modulus and strength in polymers.

Scope of testing under EN 13432/EN 14995

- Chemical test: Disclosure of all constituents, threshold values for heavy metals are to be adhered to.
- Biodegradability in watery medium (oxygen consumption and production of CO_2): Proof must be made that at least 90% of the organic material is converted into CO_2 within 6 months.
- Disintegration in compost: After 3 months composting and subsequent sifting through a 2 mm sieve, no more than 10% residue may remain, as compared to the original mass.
- Practical test of compostability in a semi-industrial (or industrial) composting facility: No negative influence on the composting process is permitted.
- Compost application: Examination of the effect of resultant compost on plant growth (agronomic test), ecotoxicity test.

The maximum material gauge of a plastic is determined by its compostability in standard practice composting operations. All tests must be passed with the same material. Success in individual tests will not be sufficient. The EN standard test methods are based on the scientific definitions of the ISO standards 14851, 14852 (aerobic degradability in water), 14853 (anaerobic degradability in water) und 14855 (aerobic composting). The tests must be conducted by recognised test laboratories.[8]

ShA

Shore Hardness Durometer – Scale A refers to soft plastics, Scale D refers to harder polymers.

Skill deficiency

A skill deficiency is where a demand for labour has not been recognised and training is unavailable in Australian education institutions. This arises where skills are acquired on-the-job, gleaned from published material or from working and/or studying overseas.[9]

There may be individuals or individual firms that have these capabilities. However, individuals in the main do not share their capabilities, but rather keep the intellectual property to themselves. Over time these individuals retire and pass away. Firms likewise come and go.

Sustainability

The ISS Institute follows the United Nations for Non-Governmental Organisations' definition on sustainability: *"Sustainable Development is development that meets the needs of the present without compromising the ability of future generations to meet their own needs".*[10]

Ultimate Biodegradability

The breakdown of an organic compound by microorganisms in the presence of oxygen into carbon dioxide, water and mineral salts of any other elements present (mineralization) plus new biomass.[11]

Acknowledgements

Mary Miceli would like to thank the following individuals and organisations who gave generously of their time and their expertise to assist, advise and guide her throughout the Fellowship program.

Awarding Body – International Specialised Skills Institute (ISS Institute)

The International Specialised Skills Institute Inc is an independent, national organisation that for over two decades has worked with Australian governments, industry and education institutions to enable individuals to gain enhanced skills and experience in traditional trades, professions and leading-edge technologies.

At the heart of the ISS Institute are our Fellows. Under the **Overseas Applied Research Fellowship Program** the Fellows travel overseas. Upon their return, they are required to pass on what they have learnt by:

1. Preparing a detailed report for distribution to government departments, industry and educational institutions.
2. Recommending improvements to accredited educational courses.
3. Delivering training activities including workshops, conferences and forums.

Over 180 Australians have received Fellowships, across many industry sectors. In addition, recognised experts from overseas conduct training activities and events. To date, 22 leaders in their field have shared their expertise in Australia.

According to Skills Australia's 'Australian Workforce Futures: A National Workforce Development Strategy 2010':

> Australia requires a highly skilled population to maintain and improve our economic position in the face of increasing global competition, and to have the skills to adapt to the introduction of new technology and rapid change.
>
> International and Australian research indicates we need a deeper level of skills than currently exists in the Australian labour market to lift productivity. We need a workforce in which more people have skills, but also multiple and higher level skills and qualifications. Deepening skills across all occupations is crucial to achieving long-term productivity growth. It also reflects the recent trend for jobs to become more complex and the consequent increased demand for higher level skills. This trend is projected to continue regardless of whether we experience strong or weak economic growth in the future. Future environmental challenges will also create demand for more sustainability related skills across a range of industries and occupations.[12]

In this context, the ISS Institute works with Fellows, industry and government to identify specific skills in Australia that require enhancing, where accredited courses are not available through Australian higher education institutions or other Registered Training Organisations. The Fellows' overseas experience sees them broadening and deepening their own professional practice, which they then share with their peers, industry and government upon their return. This is the focus of the ISS Institute's work.

For further information on our Fellows and our work see http://www.issinstitute.org.au.

The Fellow would like to thank the following ISS Institute staff members for their advice and support throughout the Fellowship:

- Carolynne Bourne AM, Former CEO
- Ken Greenhill, Fellowship Report Co-ordinator
- Jeremy Irvine, CEO
- Paul Sumner, Former Fellowship Co-ordinator

Fellowship Sponsor

The Victorian Government, Skills Victoria is responsible for the administration and coordination of programs for the provision of training and further education, adult community education and employment services in Victoria and is a valued sponsor of the ISS Institute. Miceli would like to thank them for providing funding support for this Fellowship.

Supporters

In Australia

- Linda Arnold, Industry Manager, Innovation and Business Skills Australia (IBSA)
- Michele Azzopardi, Director, Design Victoria
- Walter Collalto, Photographer, Walter Collalto Photography
- John Craddock, Program Manager, Sign Industry, Victoria University
- Professor Frank Fisher, Faculty of Design & Convenor, Graduate Programs, National Centre for Sustainability, Swinburne University of Technology
- Geoff Fitzpatrick, Director – National Strategy, Design Institute of Australia (DIA)
- Iain Gartley, Chairperson Victorian Sub-Committee, Australian Sign & Graphics Association
- Warwick Hall, Divisional Manager, Specialty Polymers and Bioplastics Plastral Pty Ltd
- Werner Hammerstingl, ISS Institute Fellow 2008, Coordinator Multimedia, Swinburne University of Technology
- Simon Lockrey, Research Fellow, Centre for Design, Royal Melbourne Institute of Technology (RMIT) University
- Lucy Miceli, Lecturer, Communication Design, Swinburne University of Technology
- Professor Per Mollerup, Professor of Communication Design, Swinburne University of Technology
- Simon Mundy, Co-president, Australian Graphic Design Association (AGDA)

In Italy

- Ilaria Abrami, Communication Officer, VEGA Parco Scientifico Tecnologico di Venezia
- Carlo Brunetti, Vice President Innovation, API SpA, Mussolente, Vicenza
- Ing. Paolo Groppi, Managing Director, Vinyloop® Ferrara SpA, Solvay, Ferrara
- Jonathan Koupermann, Account Executive, Material Connexion, Milano
- Paolo Lucchetta, Architect, RetailDesign founder, RetailDesign srl, VEGA Parco Scientifico Tecnologico di Venezia
- Marco Meneghetti, Laboratory Manager, API SpA, Mussolente, Vicenza
- Stefano Palmieri, Area Manager, Novamont SpA, Novara
- Ing. Francesco Tarantino, Plant Manager, Vinyloop® Ferrera SpA, Solvay Ferrara
- Omar Vulpinari, Fabrica – Benetton Research Center, Head of Visual Communication, Program Director

Acknowledgements

Employer Support

- William Winford, Manager, Arts Department, School of Creative and Service Industries, Swinburne University of Technology, Technical and Further Education (TAFE)
- Ingrid Wittman, Executive Director, School of Creative and Service Industries, Swinburne University of Technology, TAFE

Organisations That May Benefit From This Report

Government

- Australian Government, Department of Environment, Water, Heritage and the Arts
- Australian Government, Department of Innovation, Industry, Science and Research (DIISR)
- IBSA
- Local Government, Planning and Building Departments
- State Government, Department of Education and Early Childhood Development (DEED)
- State Government, Department of Innovation, Industry and Regional Development (DIIRD)
- State Government, Department of Planning and Community Development (DPCD)
- State Government, Department of Sustainability and Environment (DSE)
- Sustainability Victoria

Industry

Individuals and organisations in the following industries:

- Architecture
- Graphic Design
- Industrial Design
- Interior Design
- Plastics Manufacturing
- Sign Writing
- Urban Design
- Urban Planning

Professional Associations

- AGDA
- Australian Sign & Graphics Association
- Bioplastics Association of Australia
- DIA
- Design Victoria
- Green Building Council Australia
- Plastics and Chemicals Industries Association (PACIA)
- Point of Purchase Advertising International, Australia and New Zealand (POPAI)
- Visual Industries Suppliers Association (VISA)

Education and Training

- Centre for Design, RMIT
- NCS, Swinburne University of Technology
- Universities and TAFEs that offer courses in Design, Architecture, Urban Planning and Sign Writing
- Victorian Employers' Chamber of Commerce and Industry (VECCI)
- Other relevant RTOs

About the Fellow

Name: Mary Miceli

Employment

- Course Coordinator/Teacher, Graphic Design, Swinburne University of Technology

Education

- Vocational Graduate Certificate in Education for Sustainability, Swinburne University of Technology, 2011
- Certificate IV in Workplace Assessment and Training, 2005
- Bachelor of Education (Visual Arts), Melbourne University, 1993

Professional Memberships

- Member of AGDA
- Member of Design Victoria
- Member of DIA
- Member of International Council of Graphic Design Associations

Brief Biography

Mary Miceli is currently employed as Course Coordinator/Teacher of Graphic Design, Swinburne University of Technology, TAFE, and as a sessional teacher within the Faculty of Design, Contemporary Design Issues, Swinburne University of Technology. She initiated and developed the introduction of the Diploma of Graphic Design at the Wantirna campus through her conviction that there was a vocational gap in Graphic Design for students in the Eastern demographic.

Miceli has had extensive experience in vocational teaching in the areas of graphic design, visual merchandising and visual arts. She has a strong interest in promoting education through external assignments that promote social responsibility in design. She implements this passion in her program by providing assignments where students work directly with non-government organisations as part of their industry training.

She sees vocational education as an alliance between curriculum content and industry needs. Her objective is to work closely with industry to ensure she is able to provide a program that is relevant and current.

Her experience in the design industry spans over 15 years, where she has worked as a graphic designer and studio manager, and designed a broad range of projects for a diverse clientele. Her interest in the area of Environmental Graphics (EG) stems from her involvement in the production of EG for both private and government bodies. She has worked with designers from different disciplines on an ad hoc basis and believes the industry would benefit from a greater focus on interdisciplinary projects. She would also like to see the implementation of opportunities in interdisciplinary design within educational institutions.

Miceli is interested in promoting the idea of considered streetscapes that take into account the visual appeal and suitability for the built environment they are contained in as well as their commercial or descriptive intent.

She believes that designers and design educators have a responsibility to promote a sustainable future in the area of design by providing clients with sustainable options and encouraging behavioural change. She aims to develop resources that will promote the use of sustainable materials in both educational and industry arenas.

Aims of the Fellowship Program

Australian businesses are increasing their acknowledgement of the value of design as an essential part of their company's growth. Building company brand and identity is an important component of the design strategy and the area of EG has become an intrinsic element of a company's identity.

In the current environment, design practitioners, educators and fabricators need to be well versed in the area of sustainability and be able to provide EG for businesses using best practice in sustainability.

The aim of this Fellowship was to expand the knowledge and skills to improve sustainable practices and promote eco-efficiency in EG. The following points were considered:

- Sourcing sustainable materials that would be suitable for the application of EG consequently, enabling the Fellow to act as a useful source of information to the design industry, industry bodies, government bodies, design educators and students.
- Life Cycle Assessment (LCA) of materials and the practical use of existing recycled materials for EG.
- Cost factors and availability of these materials in Australia.
- Incorporating techniques and methodology for using leading-edge technologies in existing training packages and curriculum.
- Exploring approaches to visual consideration, such as size and materials, of the built environment. The Veneto region is an excellent example of how EG is used in keeping with the historical nature of the streetscape.
- Meeting with industry leaders in Italy in the area of bioplastics and it's suitability to EG.
- Establishing overseas links with key design centres, educational institutions and industry bodies.
- Identifying and comparing international approaches in interdisciplinary design.
- Developing a teaching unit based on the findings, that specifically looks at the area of sustainable materials in EG.

The Australian Context

A Brief Description of the Industry

In Australia the concentration of eco-design has been predominately in paper, print and packaging, considerations into expanding the knowledge of sustainability into the EG sector has been limited.

Although the application of EG is broad, the signs themselves can be categorised into three main areas:

1) Statutory signs, such as road signs
2) Directional or information signs, also known as way-finding signs, as found in hospitals or airports
3) Commercial signs that predominately serve the function of branding for a company.

Within each of these categories there are generally two types of signs: the static sign that provides non-changing information, and the temporary sign where information is either updated or completely altered on an ongoing basis.

The materials used for EG are extensive, with the most commonly used materials in Australia including:

- Plastics – acrylics, resins and polyvinyl chloride (PVC)
- Metals – aluminium and composite materials, stainless steel
- Illuminated signs – neon and light-emitting diode (LED)
- Vinyls, timber and glass.

Australia has vast streetscapes, commonly accommodating equally vast distribution of EG. This unfortunately often results in the creating of little more than visual pollution and confusion. Excessive signage is most common in retail strips and shopping hubs, where the shopper is often greeted with a barrage of signs. Many retail outlets promote their business at any given time with a number of sign applications such as light boxes, metal awning signs, vinyl lettering or banners and possibly LED screens. Further to this there are often point-of-purchase stands within the retail outlet.

Left and below: Vast distribution of EG in Swan Street, Richmond, Victoria. Images courtesy of Walter Collalto.

It appears that little consideration is given to the unity of the overall design, how it works in relation to the existing environment and what might be the best possible sustainable option for the purpose of the sign.

Currently, a large proportion of the materials used in the retail environment are plastics. This means that not only is there an excessive approach to EG but also that the environmental impact could be significantly reduced through effective design where one sign that has greater impact is produced.

Project production is another area that requires greater collaboration between stakeholders. Whether the project is simply a one-off sign, that involves only the client and sign writer, to a much larger and complex project, encompassing design disciplines such as architecture, industrial design, graphic design, urban design, engineering and urban planning. Individually each of these disciplines problem solve a single area, collaboratively they could provide a sustainable design solution.

This Fellowship primarily investigated commercials signs, with a manifold focus as follows:

1) Plastic materials, analysing the bioplastic and recycled plastics products in order to evaluate best materials available to the industry. Current practices in Australia show little evidence of exploring the possibilities of alternative materials in this industry.
2) Promote the use of interdisciplinary design for EG in the future, to encourage a better outcome for the built environment.
3) Consider the use of more effective EG creating more impact and less visual pollution.
4) Investigate the use of LED technologies as a viable, sustainable solution to EG.

As the general public continues to become environmentally conscious they look for and demand sustainable alternatives. Not investigating these options for the development of EG in Australia leaves a gap in a large section of the market.

Traditional methods of material production for plastics and the overuse of such materials are not sustainable. While we look for greener building options, energy saving devices and ways to minimise our paper and packaging waste the EG section of the market has not been fully explored. The fact that companies in this sector are looking for sustainable options suggests that there would be support for greater investigation into this area.

SWOT Analysis

Strengths

- Public interest in sustainable options
- Less depletion of fossil fuels
- Increase in bioplastic industry
- Designers like to be at the forefront of technology and are keen to explore leading-edge technologies
- EG industry can promote itself as using green technologies
- Extend the possibilities for green design
- Designers working as part of a larger creative think tank to provide innovative solutions
- Visual improvement of the built environment
- Interest from the education sector to provide training in sustainable technology
- Interest from the education sector to provide new courses.

Weaknesses

- Identifying the materials
- Difficulty in assessing sustainable value
- Manufacturer reluctance to introduce new materials
- Difficulty of changing client perceptions of ‘bigger is better’
- Accessibility to various materials
- Production methodology
- Possibility of having to learn new assemblage techniques
- Bioplastics could encourage an agricultural monoculture.

Opportunities

- Creation of new markets and jobs
- Cutting-edge training programs in new technologies
- Interdisciplinary qualifications
- Interdisciplinary alliances in the employment sector
- Establishment of an employment/network hub for designers
- Catalyst for change in industry

Threats

- Perception by existing manufacturing industries that sustainable technologies might be a threat to their bottom line
- Lack of interest from industry

Identifying the Skills Deficiencies

Identifying and Defining the Deficiencies

1) Identify and differentiate between sustainable materials for EG, and investigate the application of graphics to these materials and assemblage of materials.

- Identify current materials used for EG in Australian and compare sustainable options.
- Establish links with the main stakeholders in the sign fabrication, graphic design, architectural, industrial and urban design areas in Australia to promote the idea of sustainable EG.
- Conduct interviews with academics and regulatory bodies in the area of sustainable design.
- Meet with key research groups, manufacturers and recycling plants in Italy that are at the forefront of new technologies in bioplastics and recycled PVC.
- Investigate the methods of product manufacture such as whether traditional processes be used on existing machines used for petrochemical plastics.
- Discuss methods used for colourisation of bioplastic and biodegradation of pigments.
- Investigate methods of assemblage, looking into products available for construction, that do not corrupt the degradability of the primary material.

Aim: Provide a knowledge bank of possible sustainable materials in EG. This list would encompass LCA and the cradle-to-cradle supply chain with consideration to cost factors and availability of material in Australia.

2) Encourage an attitude of social responsibility in design and provide the opportunity for interdisciplinary design within the VET sector.

Increasingly designers and students want to know how their designs will impact the environment. The educational environment should be a catalyst for change researching and embracing greener technologies at every opportunity.

- Establishing overseas links with key design centres and universities by interviewing practitioners and academics at such places as Fabrica in Treviso.
- Compare overseas approaches to interdisciplinary design in industry and the tertiary sector.
- Visit architecture and design companies for whom sustainable design is a key factor in their projects.

Aim: Identify directions and possible new courses for interdisciplinary design in the VET sector. This direction could focus on innovative approaches that are socially and sustainably responsible.

3) Gain skills in the use of LED technologies for EG.

The growth of electronic billboards and interactive walls as both internal an external signage is becoming increasingly popular. These technologies should be explored for suitability as a viable alternative to the static plastic sign. Many businesses, in particular in the retail environment, utilise vinyl and similar materials for short-life promotions. This is a particularly wasteful approach.

This component of the Fellowship will determine the sustainable feasibility and cost of utilising LED technologies as an alternative form of promotion etc.

- Attend conferences and trade shows on LED technologies
- Visit Vega Park in Venice in particular the areas of ICT Digital Media and Environment and Sustainable development

Aim: Compare the advantages of using LED technologies EG as opposed to or in conjunction with static materials.

The Fellow's initial intention was to investigate point 3) as a viable, sustainable option for EG. As a result of the overseas experience the Fellow realised that for LED technologies to be considered as an alternative, a completely unique and independent study of a number of variables would need to be investigated in depth to adequately formulate a comparison.

Nationally Accredited Courses

There are a great number of courses that would benefit from this information. In Victoria alone, there are over 25 institutions and private RTOs that provide numerous courses in the extensive area of design, including but not limited to:

- Australian Academy of Design
- Australian Catholic University
- Bendigo Institute of TAFE
- Box Hill Institute of TAFE
- Chisholm Institute of TAFE
- Deakin University
- Gippsland Institute of TAFE
- Gordon Institute of TAFE
- Goulburn Ovens Institute of TAFE
- Holmesglen Institute of TAFE
- Institute for Design
- La Trobe University
- Monash University
- Northern Melbourne Institute of TAFE
- Oceania Polytechnic Institute of Education
- RMIT
- RMIT TAFE, South West Institute of TAFE
- Sunraysia Institute of TAFE
- Swinburne University
- Swinburne TAFE
- University of Ballarat
- University of Ballarat TAFE
- University of Melbourne
- Victoria University
- Wodonga Institute of TAFE.

The International Experience

Visit One: API SpA

Location

Mussolente, Italy

Contacts

- Carlo Brunetti, Vice President Innovation
- Marco Meneghetti, Laboratory Manager

Objective

The aim of the visit was to examine the range of biodegradable thermoplastics currently being produced by API SpA. The intention was to identify the raw materials used, then to investigate the properties of these bioplastics, such as their strength and density and consider the processing methods required to take the granules into a commercially viable product, such a sheet extrusion suitable for EG.

Outcomes

API is an Italian company situated in Mussolente, Vicenza, Italy, that produces polymer-based granules. API has been operating since 1956 and is committed to researching and developing products that meet the extensive commercial need for polymer products in a range of applications and environmental concerns. API produces a range of products under the umbrella of thermoplastic polyurethane (TPU), thermoplastic elastomes (TPE), polyurethane (PU). They also have dedicated testing departments that allow them to produce client specific master batches of coloured granules.

Conscious of the sustainable concerns related to plastic API have made significant inroads in the research and development of producing a thermoplastic elastomer that is biodegradable. The first of these biodegradable products is Apinat®. Although Apinat® is not 100% agriculturally produced, it reaches 90% biodegradation under aerobic conditions in accordance with EN13432, EN14995 and ASTM D6400, after approximately 6 months. This meets the global standard defining biodegradability.

The following graphs show the biodegradability phase of Apinat®. Figure 2 shows biodegradation stage via degree of biodegradability and days required. Figure 3 shows the biodegradability of Apinat® by comparison to a fully cellulose material. Although there is a lag stage of biodegrability in the first stage, by 80 days the difference in the two materials capacity to biodegrade is negligible.

Although Apinat® is biodegradable under aerobic conditions it does not degrade simply in air or water, giving the material a similar lifespan to other thermoplastic elastomers, this means that it could be suitable for both indoor and outdoor applications.

Apinat® is available as both a soft and rigid material providing extensive usage possibilities. The soft material is usually produced from a mix of renewable resources and synthetic materials. The renewable content can be up to 82% of the raw material.

*"The **SOFT** grades have hardness ratings between 50–90 ShA (ASTM D2240) and flexural modulus in the range 35–110 MPa (ASTM D790). The **HARD** grades have hardness ratings between 35–85 ShD (ASTM D2240) and flexural modulus in the range 70–3000 MPa (ASTM D790)."* [13]

Apinat® is neutral in colour; however, API also specialise in the mixing of master batch colours for clients. These colours are non-toxic and biodegradable.

In some areas of EG Apinat® would also need to be heat resistant. The heat resistance of rigid Apinat® is in the range of 60–100 degrees Celsius depending on the specific grade. In general, when it comes to Apinat® the greater the renewable content the lesser the heat resistance.

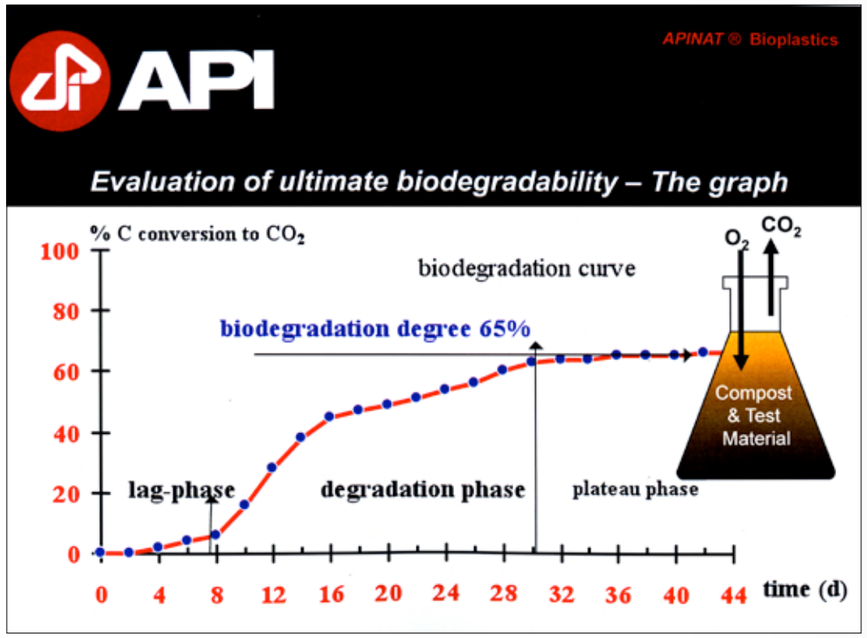


Figure 2 – Ultimate Biodegradation via degree of biodegradability and days required for biodegradability. Image courtesy of API.

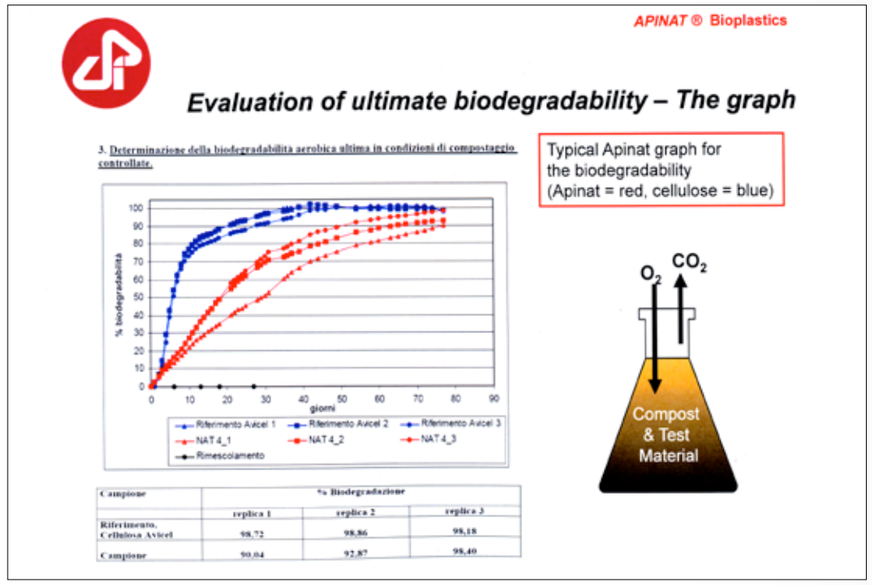


Figure 3 – Shows the biodegradability of Apinat® by comparison to a fully cellulose material. Image courtesy of API.

Apinat® degradation profile in different conditions. Image courtesy of API.

API has also considered the assembly requirements of manufacturing products to ensure ultimate biodegradability by introducing fixtures that are also made from bioplastics.

Importantly, Apinat® does not require special methods for manufacturing. Its manufacture can be processed through injection moulding, extrusion and calendaring, all of which may be used in the production of EG. This ensures the viability of importing this material to Australia as a possible alternative to traditional thermoplastics elastomers.

Current applications for Apinat® are in areas as widespread as the automotive, foot ware and medical industries. The following images show current applications.

Left and middle: Products currently in production using bioplastics. Right: API promotional key rings clearly show the materials capacity to be moulded into specific forms.

The Fellow held discussions with both Carlo Brunetti, Vice President Innovation, and Marco Meneghetti, Laboratory Manager, about the suitability of Apinat® for the EG industry. These discussions proved positive. The Fellow showed the following examples to clarify her intended use and although Apinat® is yet to be used in this area they could see no reason for not doing so.

API indicated that they would be extremely interested in communicating with a Plastics distributor in Australia to discuss the prospect of importing their granules to Australia.

The Fellow provided these examples to API to clarify Fellow's intended use. Images courtesy of Walter Collalto.

Visit Two: Solvay Plastics – Vinyloop® Ferrara SpA

Location

Ferrara, Italy

Contacts

- Ing. Paolo Groppi, Managing Director, Vinyloop® Ferrara SpA, Business Manager VC/Vac Copolymers, Solvin, Italy, Executive Committee member of ASSOPLAST
- Ing. Francesco Tarantino, Plant Manager, Vinyloop® Ferrara SpA

Objective

The purpose was to investigate the possibility of recycled post-consumer PVC materials produced by Vinyloop® as a potential material that could be utilised for EG.

Outcomes

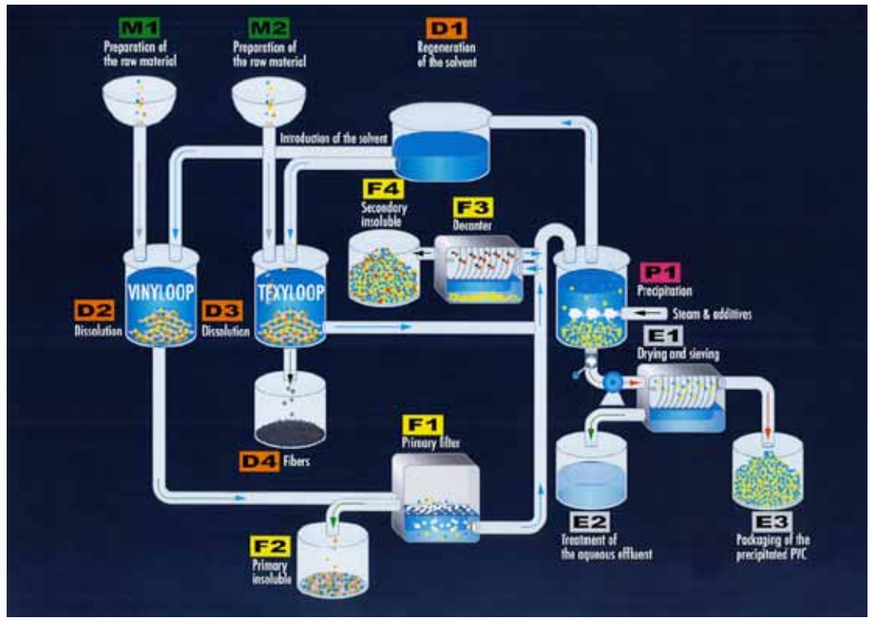
Vinyloop® Ferrara SpA, is a joint venture of four companies, SolVin Italia, Adriaplast, Tecnometal and Vulcaflex. Vinyloop® is the recycling process that is being used at the Solvay's Ferrara site in Italy.

The Vinyloop® process was developed by Solvay's Research and Development centre in Brussels, and was patented in 1998. Solvay is an international chemicals and pharmaceuticals group with headquarters in Brussels.

This site is a recycling plant that uses the Vinyloop® process to recycle post-consumer PVC by separating the PVC from other components allowing it to be recycled into a new consumerable product.

The recycled waste materials are primarily PVC insulation material from post-consumer electric cables. The process of recycling this type of material is complicated as the raw material is not homogeneous; therefore, it must be separated. The material from cables is often a mixture of PVC, rubber, polyester fibres, metals, natural textiles and many others. It may also contain chemical compounds such as lead so an extraction process is required to remove any of these toxic compounds.

The Vinyloop® process separates the PVC compound from the other materials, this is done by a method of dissolution, filtration and precipitation. To achieve this a solvent is added to the raw material, this acts to breakdown the PVC. The material then goes through a filtering system where the other polymers that have not broken down are filtered out and the PVC compound continues into the decanting stage. Additional separation then occurs where centrifugal force is used to eliminate any small contaminates. The precipitation stage that follows allows for additives such as plasticiser to be used so that the material remains soft and flexible. Steam is also injected and any remaining solvent is evaporated. The remaining material goes through a process of sieving and drying. The excess aqueous effluent is treated until it reaches an appropriate level for discharge and the separated PVC is dried and packaged for reuse.



The Vinyloop® decontamination procedure. Image courtesy of Vinyloop®

It is important to note that over 99% of solvent used is recovered and reused in this closed circuit method. A more detailed explanation and graph can be viewing the Vinyloop® – Innovation in PVC recycling borchure at: http://www.solvayplastics.com/sites/solvayplastics/EN/Companies/Pages/Vinyloop.aspx

At present the regenerated PVC colour is either black or grey. It is primarily recycled into mudguards, shoe soles and the inner rubber of hosing material. While these products are made through the same converting processes used for EG, such as extrusion, calendaring and injection moulding, the resulting product is not of a high enough grade to be considered for EG.

The Fellow acknowledges that PVC manufacture, its high level of emissions in production and the complexity of separating materials in end of life management, makes PVC a more complex material than other plastics. However, an analysis of these complexities and, more specifically, the alternatives in recycling options are outside the purview of this Fellowship. Green Building Council of Australia recently published a detailed report of PVC best practise guidelines that references some of the concerns. A copy of this report has been included in the 'Attachments' Chapter of this report.

Visit Three: Fabrica (Benetton Group, Research Centre)

Location

Treviso, Italy

Contact

Omar Vulpinari, Head of Visual Communication

Objectives

The purpose was to visit a communications research centre that is know globally for communicating social issues with an emphasis on issues in the developing world. The intention was to investigate how this philanthropic centre was established, what makes it so successful and if something similar could be achieved with a focus on sustainability.

Another objective was to explore the idea of a greater move towards interdisciplinary design at an educational level.

Outcomes

Fabrica was initiated by Luciano Benetton and Oliviero Toscani in 1994. The idea stemmed from a long-term passion by the Benetton family for recognising the extent by which design and communication can be utilised within a socially responsible environment. They wanted to combine creativity, social concern, youth and design in a non-commercial environment that was not stifled by an economic outcome.

Fabrica is imposing and inspirational from the moment you enter the grounds. Housed in a 17th century Palladio-style villa that has been restored and modernised by Japanese architect, Tadao Ando. The structure of the activity at Fabrica is unique and also inspirational. It is a hybrid of education, experience and research. It does not operate as either a university or a studio; rather, it could be considered an incubator of ideas.

At any given time there are approximately 40–50 graduates under 25 years of age from all over the world who have been selected through a vigorous selection process. Participants are residents for one year. During this time they work on external projects for organisations such as UNESCO and WHO. These projects vary in both audience and issue. They could be global issues, such as climate change, where they would target a global audience or more localised issues. The focus is intercultural dialogue through visual communication. The projects are not funded so there is a significant amount of creative freedom often producing distinctive and challenging designs.

Fabrica is also involved in workshops that bring to light socially relevant issues. They place an emphasis on knowledge sharing through online lectures and workshops.

Fabrica provides an environment of collaboration between disciplines. Interdisciplinary design is fluid at Fabrica; projects are not forced together, rather, they work to naturally support each other. This is not unusual in the workplace but is limited in the vocational education arena.

Fabrica encompasses the 'bigger picture' of sustainability; its focus is not primarily on sustainable design through the use of greener materials but, instead, on communication and cultural change. Having said that, sustainable approaches still play a significant part in the design outcome. Predominately much of the print media produced here is distributed electronically. As the designs are used globally this allows for each location to modify language; this encourages a print-on-demand environment and avoids unnecessary transportation costs and surplus print.

Fabrica does have a commercial arm producing design for Benetton among other companies/organisations. Benetton have a significant number of stores globally, consequently retail signage is a significant sustainability issue. Benetton has recently worked with the Rochester University of Technology on a project called the Future of Retail examining the technological possibilities, platforms, languages and interactivity for screen-based retail communications.

The outcome of this project is that a number of Benetton stores now have digital screens called live windows as their window displays.

Digital media as an option for EG has many advantages; it creates adaptability and flexibility while enhancing the users experience through greater engagement. But, is it more sustainable? There is significant environmental waste from the current practises when changing a shop window. Much of the materials used: print, vinyl, plastic and other installation materials, plus transport, make for a significant amount of waste.

Screens, on the other hand, are installed once and the imagery can be changed a number of times from one central location. However, the screens consume energy and will need to be replaced regularly increasing e-waste.

The energy savings of a digital screen and how this compares to the energy used in making the screen means that it is questionable as a sustainable alternative. It is difficult to measure what is the better alternative as this would require a completely independent study. However, the concept of replacing traditional materials with digital materials is not necessarily the more sustainable option.

Visit Four: RetailDesign Srl, VEGA – Parco Scientifico Tecnologico (Venice Gateway for Science and Technology)

Location

Venezia Marghera, Italy

Contact

Paolo Lucchetta, Designer

Objective

The purpose of this visit was to discuss the application of green design into retail spaces with a focus on EG. This was an opportunity to speak with a designer at the forefront of sustainable design and discuss new materials he had used as well as advantages and disadvantages he had encountered.

Outcomes

RetailDesign is primarily an architectural company that specialises in retail design with a focus on sustainability. They are members of the Green Building Council Italia, a professional association that is recognised by LEED®-Accredited Professionals.

RetailDesign's vision is centred on the spatial and social context of a retail area with equal consideration to the ethics and aesthetics of a space. Underpinning these ideas is a focus on sustainability. In the ideal situation sustainable considerations occur at the outset of a project rather than as a component of the design. In this situation the designer is involved in the project from conception, often before the site is located as the actual site is important to the sustainable outcome.

To achieve this RetailDesign emphasise collaboration on projects rather than individualism. This way of thinking promotes unity between design disciplines while still encouraging diversity. As in nature, there is recognition of being part of a holistic system and that each area comes to the project as part of a process. This philosophy of relational design should be encouraged in universities. If students were encouraged to see their work as part of a whole this would lead towards greater interdisciplinary design that is both vocationally realistic and could promote significantly more sustainable outcomes.

It was acknowledged that not all projects are provided to the designer from the outset of the concept or at the initiation of a building. Many projects are restorations or replacements particularly in the EG area. In this instance the capacity for the designer to be holistically sustainable is reduced so material selection is of the utmost importance.

Material selection by designers at RetailDesign is often drawn from products accredited by Green Building Council, Italia, however, new materials and technologies are always considered. The Materials ConneXion database is often used as a resource by this company providing a bank of possible materials to adequately inform product research.

RetailDesign do not currently use bioplastics as a sustainable material, however, they felt that there was significant potential in this area and were enthusiastic about the possibilities of using such materials in the future.

Visit Five: Novamont

Location

Milan, Italy

Contact

Stefano Palmieri, Milano Area Manager

Objective

Novamont SpA (Novamont) currently exports granules of Mater-Bi®, a family of bioplastics that is not only biodegradable but also 100% compostable, to Australia. These granules are used primarily in the manufacture of compostable plastic bags. The purpose of the Fellow's visit was to explore the possibilities of new applications for this material.

Outcomes

Novamont was founded in 1990 as a research centre. They have been integrating chemical and agricultural knowledge endeavouring to resolve environmental pollution issues through the ongoing development of products and technologies that use renewable raw materials of agricultural origin.

In 2002 Novamont started a collaboration with Coldiretti, an organisation of farmers that represent agricultural enterprises launched their bio-refinery in Terni, Umbria, Italy. This collaboration has extended Novamont's aim in assisting to forge a 'truly sustainable development' where the economic, social and environmental issues are integrated as an important part of their business model. This Life Cycle Thinking approach includes the primary producers as an integral part of the solution.

This means that non-food crops can be grown for the specific intention of exploring and analysing agricultural processes, such as the amount of water and nitrogen the plants require, crop rotation and production from waste.[14]

The production of these non-food crops does not affect the food bowl as, *"In Italy, more than 800.000 hectares of agricultural land are left uncultivated (set aside) due to EU decisions; the European Union gives some contributions to farmers for this purpose: thanks to the Novamont biorefinery system, theoretically, it is possible to produce approximately 2 million tons of bioplastics, by re-converting these hectares of land into maize and oleaginous plants cultures".*[15]

Novamont's Mater-Bi®, is manufactured at their bio-refinery in Terni, using vegetable components such as cornstarch and vegetable oils. The biopolymer is created by, *"using process of 'complexing' starch with variable quantities of complexing agents (natural, from renewable sources, synthetic), different supra-molecular structures are constructed, characterised by a series of different properties".*[16]

The production of Mater-Bi® is also more energy efficient than traditional plastic with traditional plastic outputting 2.1 CO_2 levels per kilo to the Mater-Bi®, 1.3 CO_2 level per kilo.

Novamont only handles the production of the raw material not the manufacture of the consumer product. It is the raw material produced by Novamont that meets global standards of a fully compostable material.[17] Products made using this material may introduce foreign particles that render it not fully compostable.

The manufacture from granules into a bio-plastic product uses common technologies similar to those used in traditional plastics. Mater-Bi® can be coloured with biodegradable master batches using natural non-toxic pigments. Mater-Bi® can also be heated or glued for the purposes of laminating to other fibres, however, these additional raw materials may not be biodegradable or compostable.

Mater-Bi® is most commonly used for mulching film in farming, shopping bags, food cling film, catering products and food packaging—from thermoformed trays to extruded nets for fruit and vegetables, personal hygiene products and pet chewing products. It can also be thermoformed for the production of pot plant holders that are compostable.

Left: Plastic bags made using Mater-Bi®. Image courtesy of Walter Collalto.

Discussions indicated that this product was not suitable for the purposes of EG if it was to retain its current range of environmental standards. If the manufacturing process is extrusion then the extruded material must not be any thicker than 0.15 mm if it is to remain fully compostable. If the material was being processed via injection moulding it could be as thick as .8 mm and still be compostable. However, neither of these thicknesses are close to the 3–6 mm thickness required for EG. Therefore, it would seem that to produce a thickness suitable for EG this material could not remain in its both biodegradable and compostable virgin form. This is not to suggest that Mater-Bi® could not be used as a base product together with another product to produce a more rigid outcome.

Visit Six: Materials Connexion

Location

Milan, Italy

Contact

Jonathan Koupermann, Account Executive

Objective

The aim of this visit was to see how a material resource library operated and to investigate new materials or directions in sustainable materials.

Outcomes

Materials ConneXion Milano is a resource centre for new and innovative materials. There are currently five offices around the world in New York, Milan, Cologne, Bangkok and Daegu.

Materials ConneXion showroom and library. Image courtesy of Walter Collalto.

Materials ConneXion works primarily as a virtual global database providing over 4,000 materials for a range of industries. Access is also available on site where you can browse through the actual samples. These samples are categorised into one of seven categories: polymers, metals, glass, ceramics, carbon and cement-based materials, natural materials, and natural derivative material. The database is accessible via an annual membership. Members sourcing a material are provided with the technical description, commercial information, images of the material and the manufacturers details. The intention of Materials ConneXion is to act as a virtual library linking manufacturers with users. They do not sell or promote any material in particular. Library access includes access to staff well versed in the materials on the database. Lectures and workshops on new materials and their usage are also available.

Manufacturers submissions are added to the database via selection by a jury, made up of industry professionals. Selection is based on considerations of suitability and innovation of the new material. The manufacturers do not pay to have their materials added to the database, which ensures neutrality. Entry for each manufacturer is standardised and manufacturers cannot buy additional space.

Materials ConneXion also operates as a research centre where a company looking for a specific material solution can request a staff member to actually research a number of materials and source the appropriate one based on specific issues.

Other features of Materials ConneXion are innovation alerts for members on subjects such as sustainability, access to reports and consultations on products.

On return to Australia the Fellow made recommendations to the Swinburne University of Technology library to consider becoming members of this database as Swinburne has many design courses that may benefit from the information in a database such as this one.

Concluding Remarks

The overseas component of the Fellowship provided the Fellow with an insight into the European (Italian) bioplastic market. It identified the complexities of what are referred to as sustainable materials and the plethora of information that can lead to some misguided directions and ‘greenwashing’ of products. The Fellow found the optimism of interviewees toward a sustainable future impressive as well as their willingness to embrace ideas and directions suggested by the Fellow as opportunities that could provide new business directions.

This Fellowship provided the impetus for a new direction for the Fellow, recognising that taking a sustainable direction in EG requires not only valuing and understanding the science of sustainability but the necessity to embrace and foster behavioural and cultural change.

Educational institutions are optimum places for change to be initiated. Educators are in the privileged position of having an engaged audience who are there to learn; the challenge is how to best prepare students to help create a better future through new ways of thinking.

The knowledge gained and outlined in this report from the perspective of both sustainable and collaborative design could lead to a number of new opportunities for courses both within educational institutions and industry seminars. The sharing of this information to a range of stakeholders may further identify the gap that currently exists between manufacturers and designers.

Australia with an already existing, albeit small, presence in the bioplastics market may be well placed to invest in the research and implementation of emerging technologies in bioplastics. This may be the impetus required to encourage the application of sustainable materials into the area of EG.

The Fellow acknowledges that the bioplastics market has continued to expand since her investigation in 2010, producing new products that may be suitable for the applications discussed. The Fellow also recognises that Australia is among the countries that are advancing in bioplastics. However, an investigation into the detail and future of the Australian industry was outside the purview of this Fellowship.

On her return the Fellow has continued to investigate and explore bioplastics and other sustainable materials. She has recently completed a Vocational Graduate Certificate in Education for Sustainability, Swinburne University of Technology, that promotes embedding sustainability into teaching programs through supporting behavioural change. She was selected to be part Swinburne’s pilot program and at completion will champion Education for Sustainability (EFS) implementation in training packages across the TAFE. The program intention is to provide teachers with the ability to create awareness and innovative solutions for sustainable practice within their programs this in turn will provide the students with the tools to research and implement sustainable solutions when they complete their course.

Knowledge Transfer: Applying the Outcomes

On her return to Australia the Fellow provided information regarding API SpA to Plastral Pty Ltd in Victoria. The Fellow chose Plastral Pty Ltd as the point of contact as they are already distributors of other bioplastics from Italy. Communications are currently underway regarding importing this material.

The following activities will be investigated to transfer the knowledge gained throughout the Fellowship:

Industry Conference or Seminar

A conference or seminar focused solely on sustainable design bringing together all stakeholders in the business of EG. This would include speaker representatives from the plastics industry, sign fabricators, designers, educators, design associations and government representatives associated with these industries. Discussions with industry leaders during my visits indicated that there was broad interest in coming to Australia to be part of such a conference.

The aim of this activity is to provide opportunities for better communication and collaboration between stakeholders; this, in turn, would provide an improved understanding of the possibilities and complexities in sustainable design. This activity would differ from existing design conferences where the focus tends to be on the actual design or the business of design. This conference would focus primarily on collaboration within design. The target audience is the same as the stakeholder group.

The location of the conference and the timeframe would be dependent on stakeholder interest. Organisations such as the ISS institute or design industry bodies such as Design Victoria, DIA, AGDA or IBSA should consider supporting such an event.

Workshop or Forum

This activity would focus on emerging materials in bioplastics, their advantages and shortcomings. The aim of this workshop would be to facilitate an environment of open dialogue where participants could raise issues of concern and share success stories in the implementation of sustainable design. It could also be an opportunity for resources to be shared. The target audience will be design professionals.

Such an activity could be held in conjunction other events held by design industry bodies such as Design Victoria, DIA, AGDA. Alternatively, it could be held at an educational institution such as Swinburne University of Technology.

Embedding the Transfer of Knowledge Within Existing Design Courses

The Fellow has a number of opportunities to transfer this information within existing design courses. At Swinburne TAFE the transfer of knowledge will be facilitated through the implementation of EFS into the training packages. The Fellow will be able to directly impart her Fellowship findings to fellow teachers and students through the establishment of this initiative. Her involvement in teaching within the Faculty of Design, Contemporary Design Issues, also provides the basis for informal transfer of knowledge within her class sessions.

Additionally, the Faculty of Design holds regular lunchtime Sustainability Lectures, there may be potential to be involved in a lecture on the use of biopalstics within the design industry.

See the ‘Recommendations’ Chapter for more information on the transfer of knowledge into the broader, formal design courses.

Recommendations

Government – Federal, State, Local

1) Both Federal and State Governments should allocate funding to a Sustainable Design and Materials Innovation Centre. This might be a joint venture between educational and government organisations together with professional industry bodies.

   Relevant parties that would benefit from such an arrangement would be Schools of Creative Services; Faculties of Design organisations, such as the NCS, Swinburne University of Technology; Sustainability Victoria; Australian Governments, including the Department of Innovation, Industry, Science and Research; State Governments, such as the Department of Innovation, Industry and Regional Development, the Department of Planning and Community Development, and the Department of Sustainability and Environment.

   This venture could be a postgraduate interdisciplinary facility focusing on effective and innovative design that would promote cultural change. This facility could function in a similar way to Fabrica, Treviso, Italy, as an incubator of sustainable innovation in design.

2) Provide incentives for businesses to use bioplastics or recycled materials.

Industry

1) Instigate the use of sustainable materials when providing design options to clients.

2) Create an industry group that keeps designers up to date with new directions in sustainable materials and technologies.

3) Encourage educational institutions to include sustainability, a key element of design education.

Professional Associations

1) Access to a vast database such as Materials ConneXion would be beneficial to industry and educational institutions as this already operates as a bank of knowledge. One of the reasons Materials ConneXion may not have a presence in Australia is that access to an actual library, where the viewer can have a tactile experience of the materials, does not exist. Investigate the possibility of opening an office in Melbourne. Memberships to Materials ConneXion would be provided by this office, possibly making the set up of such an office commercially viable.

2) Form a working party that becomes a hub for sustainable activity, discussing new ideas and materials. This could be a branch of a professional association. This could either become a branch of existing work groups or a stand-alone design sustainability group.

3) Organise a design sustainability forum, where international and local experts speak about current projects and directions.

Education and Training – University, TAFE, Schools

1) Introduce an Associate or Advanced Diploma in Design Sustainability. This should be a graduate course as the intention is not to teach the fundamentals of design rather the social and environmental impact of design, promoting greener practices that will ultimately be beneficial to industry. The projects that students undertake could be actual industry projects or government projects. The design component would be part of the program and, consequently, the client would not incur an expense; however, they would pay for any expenses incurred outside the design.

2) Embed sustainability into all competencies in design programs. This could be an assessed element that would encourage students to investigate new directions and provide them with a network of relevant companies to work with once they have graduated.

3) This information would be relevant to a wide range of courses including those at Swinburne University of Technology:
   - 21874VIC Diploma of Graphic Design
   - 21873VIC Advanced Diploma of Graphic Design
   - 21869VIC Diploma of Product Design
   - SIR50207 Diploma of Visual Merchandising
   - CPC32108 Certificate III in Signage

   The course content would then be similar to the workshop for emerging materials in bioplastics (highlighted in the 'Knowledge Transfer: Applying the Outcomes' Chapter), but directed at students. In the first instance the students would be provided with specific information on what is current, how important it is to stay at the forefront of sustainable design and how to go about researching new information.

Community

1) Community and businesses requiring the services of a designer should ask for the designer to provide a sustainable option.
2) Rally government support for tax incentives to counter any increase in price to use sustainable materials.

ISS Institute

1) The ISS Institute to consider follow-up Fellowships, available to existing or past Fellows to extend on skills and knowledge deficiencies in their area of study. In the instance that the area of study is vast, such as bioplastics, the Fellow would have the capacity to extend their research into the ongoing explorations of varying materials and technologies in other international areas.
2) ISS Institute to identify and manage a recognised overseas expert to visit Australia to run lectures, seminars and workshops as appropriate to the expert's specialisation and expertise in bioplastics.

Further Skills Deficiencies

EG uses a vast array of materials and technologies. The Fellow's initial intention was to investigate digital technologies as a viable, sustainable option for EG. As a result of the overseas experience the Fellow realised that for LED technologies to be considered as an alternative a complete independent study of a number of variables would need to be investigated in depth to adequately formulate a comparison.

This could form the basis of another Fellowship where the cost factors and LCA of digital technology would be compared to that of a range of other sustainable options such as bioplastics.

References

Endnotes

[1] Addicted to Plastic, 2008 [DVD], Connacher I, Cryptic Moth Productions

[2] Product overview and market projection of emerging bio-based plastics, PRO-BIP 2009, PDF, http://en.european-bioplastics.org/multimedia/

[3] *Bioplastics Frequently Asked Questions (FAQs) June 2008*, European Bioplastics, page 3 of PDF, http://www.truegreen.ae/Libraries/Scientific_archives/Bioplastics_FAQ.sflb.ashx

[4] *Australian Bioplastics Association*, viewed Oct 2010, http://www.bioplastics.org.au/faq/what-is-the-as4736-standard-for-biodegradable-plastics

[5] *Sustainable Policies for a Dynamic Future,* Carolynne Bourne AM, ISS Institute 2007.

[6] Ibid.

[7] *Life Cycle Thinking and Assessment*, European Joint Research Centre, Institute for the Environment and Sustainability, viewed Oct 2010, http://lct.jrc.ec.europa.eu/

[8] *Standards, European Bioplastics*, Viewed Oct 2010, http://en.european-bioplastics.org/standards/standardisation/

[9] *Directory of Opportunities. Specialised Courses with Italy. Part 1: Veneto Region,* ISS Institute, 1991.

[10] http://www.unngosustainability.org/CSD_Definitions%20SD.htm

[11] *Australian Standard™ Plastic materials—Determination of the ultimate aerobic biodegradability and disintegration under controlled composting conditions—Method by analysis of evolved carbon dioxide*, Standards Australia, viewed Oct 2010, http://www.standards.org.au/Default.aspx

[12] Skills Australia's *Australian Workforce Futures: A National Workforce Development Strategy 2010,* pp. 1-2. http://www.skillsaustralia.gov.au/PDFs_RTFs/WWF_strategy.pdf

[13] *API Back to Nature* brochure published by API SpA

[14] ECOMONDO 2009: The bioplastics answer to the crisis, Novamont press release, 2009, [PDF], http://www.novamont.com/detail.asp?c=16&p=1&id=1090

[15] Novamont biorefinery: a new model of sustainable development integrated with the territory, Novamont press release, 2006, [PDF], http://www.novamont.com/detail.asp?c=16&p=1&id=952

[16] *'Sustainable development is a reality, Living Chemistry for Quality of Life'* – Novamont company profile

[17] The legally binding standard for the compostability of plastics in all EU member states are Europe: EN 13432 or EN 14995, USA: ASTM D-6400, other countries: ISO 17088.

Bibliography

Books

- Fisher F, Response Ability – *Environment, Health and Everyday Transcendence*, Vista Publications, Melbourne, 2006
- McDonough W, Braungart M, *Cradle to Cradle: Remaking the Way We Make Things*, North Point Press, New York, 2002
- Mollerup P, *Wayshowing – A Guide to Environmental Signage Principles and Practices*, Lars Muller Publications, 2005

References

- Orr D.W, *The Nature of Design – Ecology, Culture and Human Intention*, Oxford University Press, New York, 2002
- Weisman A, *The world without us*, Thomas Dunne Books/St Martin's Press, New York, 2007

DVDs

- *Addicted to Plastic*, 2008 [DVD], Connacher I, Cryptic Moth Productions

Articles and Papers

- *Back to Nature & Biodegradable TPE – Apinat®*, API SpA
- *Degradable polymers and product design. Design for sustainability with plastics*, Sustainability Victoria and PACIA, 2008, http://www.pacia.org.au/DownFile.Aspx?fileid=586
- *ECOMONDO 2009: The bioplastics answer to the crisis*, Novamont press release, 2009, [PDF], http://www.novamont.com/detail.asp?c=16&p=1&id=1090
- *Fact Sheet – Anaerobic Digestion*, European Bioplastics, 2010, http://en.european-bioplastics.org/multimedia/
- *Frequently Asked Questions report*, European Bioplastics, 2008
- Green Building Council of Australia, *Literature Review and Best Practice Guidelines for the Life Cycle of PVC Building Products*, 2010
- *Information on standards*, European Bioplastics, http://www.european-bioplastics.org/index.php?id=158
- *Life Cycle Assessment of Bioplastics*, European Bioplastics, 2008 [PDF], http://en.european-bioplastics.org/standards/
- *Life Cycle Thinking and assessment,* European Commission – Joint Research centre, Institute for the Environment and Sustainability, http://lct.jrc.ec.europa.eu/
- *Novamont biorefinery: a new model of sustainable development integrated with the territory*, Novamont press release, 2006, [PDF], http://www.novamont.com/detail.asp?c=16&p=1&id=952
- Shen L, Patel M.K, Haufe J, *Product review and market projection of emerging bio-based plastics, PRO-BIP 2009*, Group Science, Technology and Society (STS), Copernicus Institute for Sustainable Development and Innovation, Utrecht University, commissioned by European Polysaccharide Network of Excellence and European Bioplastics, http://en.european-bioplastics.org/multimedia/
- *Sustainable development is a reality*, Novamont SpA, (company brochure supplied by Novamont)
- *Sustainability Leadership Framework*, Plastics and Chemicals Industries Association Incorporated, 2008, http://www.pacia.org.au/DisplayFile.aspx?FileID=44
- *Vinyloop®, production process*, http://www.solvayplastics.com/sites/solvayplastics/EN/Companies/Pages/Vinyloop.aspx

Attachments

The attachments can be downloaded from the ISS Institute website as follows:

1. API SpA, *Back to Nature*
   http://www.issinstitute.org.au/pdfs/Miceli/01_API_Back_to_Nature.pdf
2. API SpA, *Biodegradable TPE – Apinat®*
   http://www.issinstitute.org.au/pdfs/Miceli/02_Apinat_Biodegradable_TPE.pdf
3. European Bioplastics, *Life Cycle Assessment of Bioplastics*, 2008
   http://www.issinstitute.org.au/pdfs/Miceli/03_European_Bioplastics_Life_Cycle.pdf
4. European Bioplastics, *Frequently Asked Questions report*, 2008
   http://www.issinstitute.org.au/pdfs/Miceli/04_European_Bioplastics_FAQ.pdf
5. Novamont SpA, *Sustainable development is a reality*
   http://www.issinstitute.org.au/pdfs/Miceli/05_Novamont_SpA_SDR.pdf
6. Novamont SpA, *ECOMONDO 2009: The bioplastics answer to the crisis*
   http://www.issinstitute.org.au/pdfs/Miceli/06_Novamont_SpA_ECOMONDO.pdf
7. Novamont SpA, *Novamont biorefinery: a new model of sustainable development integrated with the territory*, 2006
   http://www.issinstitute.org.au/pdfs/Miceli/07_Novamont_SpA_Biorefinery.pdf
8. Vinyloop®, *Innovation in PVC recycling, A step further towards Sustainable Development*
   http://www.issinstitute.org.au/pdfs/Miceli/08_Vinyloop_Innovation.pdf
9. Green Building Council of Australia, *Literature Review and Best Practice Guidelines for the Life Cycle of PVC Building Products*, 2010
   http://www.issinstitute.org.au/pdfs/Miceli/09_GBCA_Literature_Review.pdf