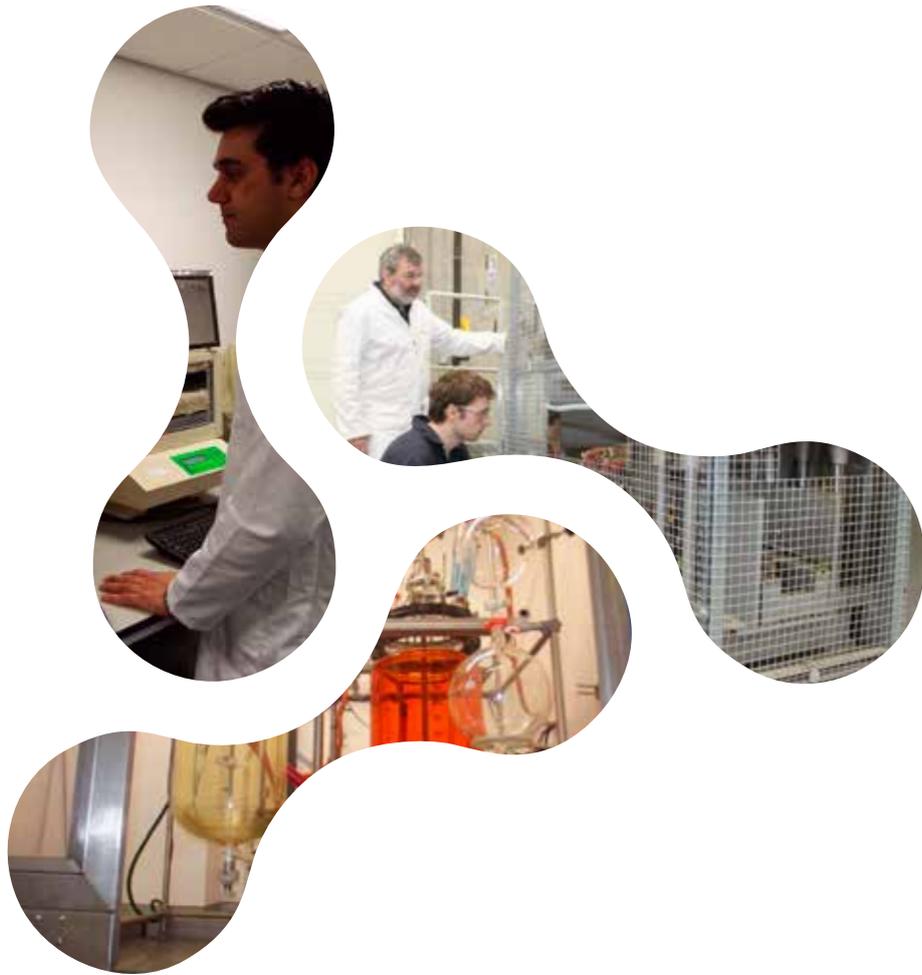


# The BioComposites Centre ANNUAL REPORT 2014



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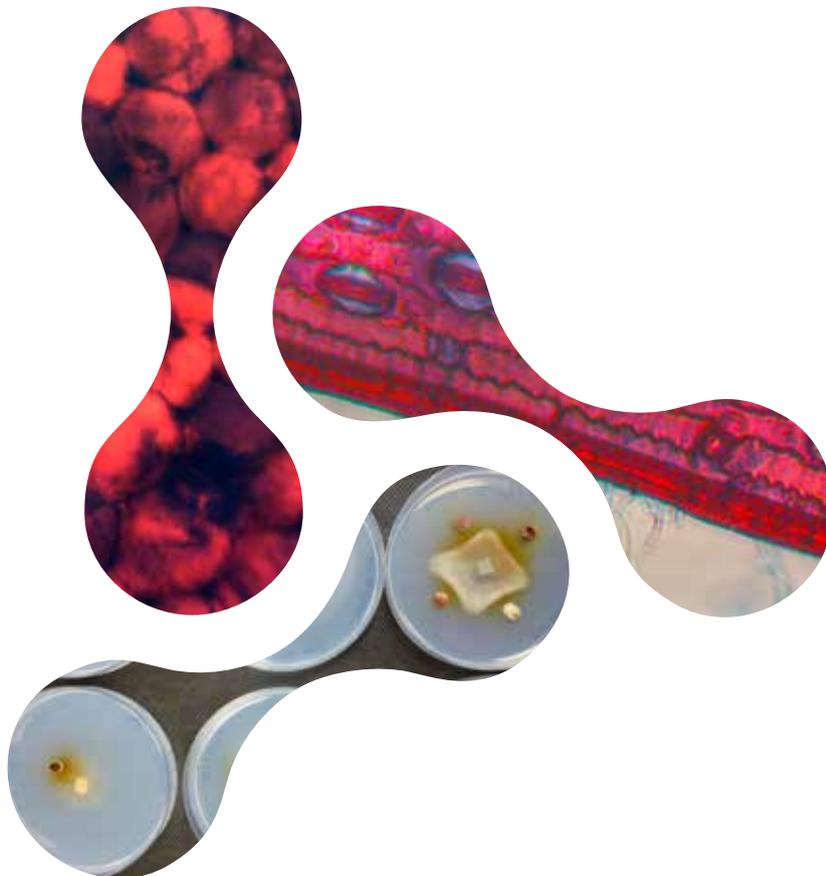


Llywodraeth Cymru  
Welsh Government



# Index

1. Welcome	2
2. Introduction to the BioComposites Centre	2
3. European Research Collaboration	4
4. National and UK Funding	6
5. Investment in Infrastructure	8
6. People and Awards	10
7. Networks	12
8. Events	14
9. Publications	15
10. Staff List	16



# Executive Summary

## Welcome

In 2010 I took over as Director for The BioComposites Centre (BC) and the last four years have been really exciting with innovative research projects, new networks as well as investment in people and equipment. The bio-based economy is very active and BC has consolidated its position as a leading research centre in the UK. This year marks our silver anniversary and after 25 years we have finally managed to publish our first annual report.

This report highlights some of the more significant achievements in 2013/14 and we have made a commitment to publish a report every year to ensure that all our stakeholders are kept aware of our future successes. Compiling this report has provided me with a real insight as it is only when we have time to step back and reflect that it is possible see what has been accomplished.

## Introduction to the BioComposites Centre

### Research Theme and Impact

The BioComposites Centre was established in 1989 at Bangor University with the support of the Welsh Development Agency. The creation of BC was in response to the need to develop better links between Universities and industry and since 1989 BC has continued to achieve this aim. Now part of the College of Natural Sciences it has a strategic role in linking research with impact at Bangor.

BC focusses on the utilisation, conversion and development of bio-based feedstocks as an alternative to oil based products. The demand for these alternatives is driven by improved environmental standards, a growing consumer concern for greener products and concerns about the security of supply of fossil resources in the 21<sup>st</sup> Century. Companies in the fine chemical, plastic, transport, food, forest products and polymer industries are increasingly seeking new bio-derived ingredients that can improve the technical and environmental performance of their products. To help them achieve these aims, BC works closely with industry to demonstrate feasibility, both by applying know-how that is underpinned by scientific excellence and by offering access to state of the art pilot scale facilities.



*Dr Rob Elias: Director*

Thank you to all staff members past and present for all their efforts and achievements and a big thank you to all our project collaborators and funders.

This close collaboration with companies enhances the future potential commercial impact of research here in Bangor. Through this approach BC is helping Wales develop new collaborative projects with micro enterprises, SMEs and large companies.

### Key performance indicators

We have consistently developed strong networks with companies and key stakeholders such as UK and Welsh Governments and are recognised as a leading EU Centre of excellence in applied industrial research. A key to this success is the capacity to deliver projects through our staff and facilities. In 2013/14 we have 38 staff members that include scientists, technicians, administrative support and PhD students (Table 1). We encourage multi-disciplinary teams of scientists to work on ground-breaking research projects and we have continued to invest in state of the art facilities and pilot scale equipment to ensure that they are able to get the job done.

Table 1. Staff numbers for 2013/14

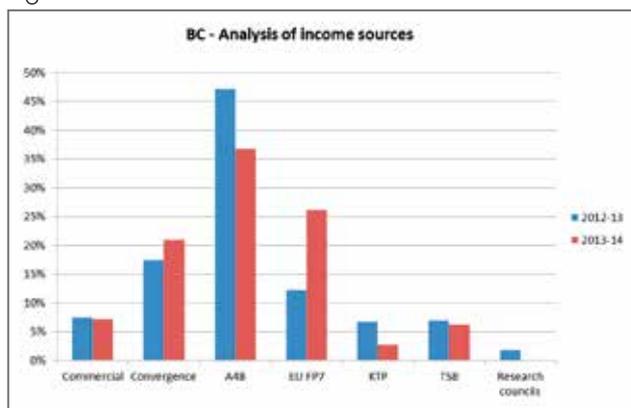
Research Staff	20
Technical	9
Administrative and project support	4
PhD students	4
KTP Associates	1
Total	38
Student internships	7
Visiting academics	1

Funding is secured from a number of sources, through competitively won bids to Welsh, UK and EU Governments along with commercial income (Figure 1).

In 2012/13 BC took a strategic decision to concentrate efforts on capturing more EU FP7 funds in preparation for the new H2020 funding round. Using our European networks and hard effort we have secured 2 new EU FP7 projects bringing the total number won to 3. These projects are highlighted in this report.

Other successes include 7 A4Bs, 4 TSBs and 1 sKTP. This helps to bring in a total of £2.3M of research funding for Bangor University. Over the last couple of years BC has also invested over £700,000 in new capital equipment.

Figure 1. Research income



Challenges in 2014/15 will be to build on this success, develop new capacity and alliances using convergence funding and secure H2020 projects. I look forward to working on these challenges and can see many future opportunities for the BioComposites Centre.

Dr Rob Elias, Director.



# European Research Collaboration

## NEW EU funded Research

Winning EU funding is very competitive and this year the Centre is successfully collaborating in three new EU FP7 projects. The projects cover applications of biobased materials in the construction, biopolymer and chemical sectors. "These projects are funded by the last of the money available through the old FP7 framework" explains Dr Rob Elias. "New projects are in the pipeline and we hope to build on our success with the EU Horizon 2020. The bio-based economy is a significant area for future research and through our strategic partners within the EU we hope to be successful with new projects" added Dr Elias.

## Improving air quality and energy efficiency in buildings – Project: ECO-SEE

2013/14 has seen the launch of a new Framework 7 project, ECO-SEE (Eco-Innovative Safe and Energy Efficient Materials). The project aims to address an emerging health problem associated with modern low carbon buildings. Modern buildings have been developed to be very airtight, thus improving their energy efficiency and reducing their carbon footprint. However, these sealed environments have created unexpected side effects, with research showing that a build-up of potentially harmful chemicals (VOCs) in the air is possibly causing negative impacts on occupants health.

The ECO-SEE project studies the use of innovative eco-building materials that will address poor air quality, while also radically improving the energy efficiency of buildings.

Through the project researchers will develop highly insulated wall panels treated using novel chemical processes to enhance the capacity of building materials to capture VOCs. The team will also develop highly novel photocatalytic coatings using nanoparticle technology,

which will decompose harmful chemicals when exposed to sunlight, preventing them from being released into the air.

The objective of the project is to deliver products with at least 15 per cent lower embodied energy than traditional construction materials, with at least 20 per cent longer expected lifespan, and for at least 20 per cent lower build costs. By making better products at a lower price the research group can create a cost effective solution with the potential for real market impact.

The BioComposites Centre team leader is Dr Graham Ormondroyd. Graham is leading the work package on innovative materials, which includes the development of new insulation materials, additives for the panel industry and lime and clay renders.

## Will Micro algae be the next black gold? – Project: BISIGODOS

BISIGODOS aims to address the production of valuable chemicals derived from an algae biomass that is grown in reactors fed with CO<sub>2</sub> emissions from industrial processes. This approach is based on technology developed by Biofuel Systems (BFS). The company based in Spain is the lead partner in a new EU funded project and their aim is to produce a bio-oil feedstock for industrial applications, a new source of oil that is sustainable.

"The BioComposites Centre is work-package leader in the project" explains Innovation Manager Dr Radek Braganca, who joined the Centre in 2003. "Microalgae are cultivated in photo-bioreactors and only need sunlight and carbon dioxide (CO<sub>2</sub>) to grow rapidly. The biomass is then harvested and pyrolysed to produce an oil and we are looking at extracting valuable chemicals from this oil."

Radek started his career working as a chemical engineer in the oil industry, so putting his old skills to use is an exciting challenge. "We have set up a new team of scientists here at Bangor and we are working in close



collaboration with Dr Juma Al-Dulayymi in the Chemistry Department to help isolate these complex molecules and develop them with our industrial partners". The team of scientists at Bangor will be working on the project to look at the separation and functionalisation of new molecules for use as surfactants, personal care products and coatings.

### **Trains, planes and automobiles - will benefit from new composites materials – Project: BRIGIT**

Planes, trains and automobiles use a lot of composite materials that are made from a sandwich structure of thermoset adhesives reinforced with glass fibre. These glass filled products are difficult to recycle, heavy and take time to produce. In a novel approach Project Manager Dr Olga Tverezovskaya is working with an EU consortium to develop a new bio based resin system that can be used to bind layers of natural fibres to produce a 3D composite product. "The aim of the project is to produce a recyclable and lighter product that can be easily made using a high capacity production process" explains Olga who has over 12 years of research experience with BC.

The European R&D project BRIGIT, which started in August 2012 and will last for 48 months, is funded by the European Commission within the Seventh Framework Programme. The project is coordinated by The Technological Institute of Plastics (AIMPLAS), and the consortium is made up of a total of 16 partners. The BRIGIT project aims to develop fire resistant bioplastics for the passenger transport sector.

BC is leading the work package that focuses on the production of polybutelene succinate (PBS) using a bio based succinic acid that is made from waste pulping chemicals. Olga's work is to synthesise the PBS based copolymers in the laboratory using enzymatic and chemical catalysis approaches. The reaction conditions

are now being optimised to obtain polymers that are within target specification. Partners will now start to evaluate the new polymers in a range of applications such as door cover panels in cars.

### **Biodegradable film from bread waste - Project: Bread4PLA**

Now in its final year, this EU LIFE+ project has been looking at the potential of synthesising Polylactic Acid (PLA) from waste products of the bakery industry and using the PLA produced to make a 100% biodegradable film to be used in the packaging of bakery products (closed life cycle).

High purity lactic acid, the starting material for PLA manufacture, was produced using fermented bread waste. "It is imperative to get pure lactic acid in order to obtain high molecular weight PLA with good rheological properties" commented Dr Viacheslav Tverezovskiy, Head of the BC Chemistry Research, who has been collaborating on the project.

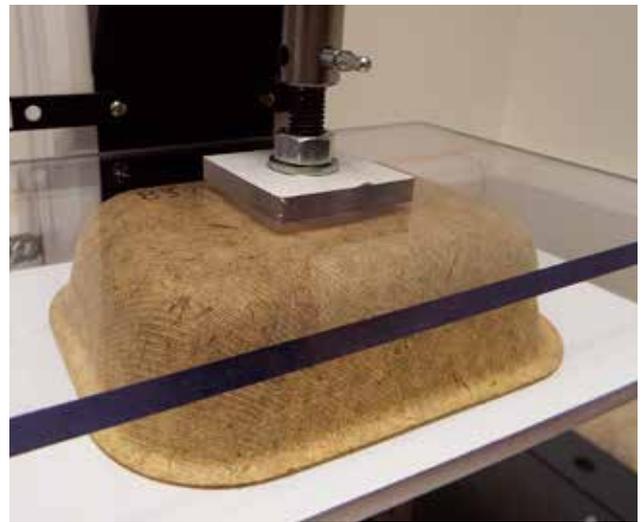
The production process was scaled up and 10kg of PLA was prepared by catalytic ring opening polymerisation of lactide in a stainless steel reactor under nitrogen. The resulting polymer had properties comparable with commercially available PLA. This project shows that technically the closed loop process of industrial production of PLA from bread waste is achievable.

# National and UK Funding

## Slate dust makes good looking slates – Project: ECOTILE

In this Academic Expertise for Business (A4B), Welsh Government funded project we have been working closely with partners Ecobond Cymru to develop a process to make roofing tiles from slate waste.

Products currently on the market use 40-50% of polymers and are formed by extrusion of solids with plastics at elevated temperatures. Through the ECOTILE project, BC has developed a new technology to produce tiles from slate powder with a low solid content of polymers (10-15%). The finished tiles look similar to natural slate which is a huge advantage as customers do not like the glossy look of the tiles made from slate waste which are currently sold in the UK. "Using three times less resin makes our technology much more resource efficient and will provide a cheaper product" commented Dr Viacheslav Tverezovskiy, who has led the team in developing the process. He added "Millions of tons of slate waste is available in Wales and we are able to mix this with mica sand, another large waste resource from the porcelain industry, to produce good looking 'slate like' tiles".



## Ryegrass for sustainable packaging - Project: STARS

Collaborative multi-disciplined projects are a key aspect to the innovative research at BC. The STARS (Sustainable Ryegrass Products) project is a classic example of a collaborative project that brings together industry and researchers from across Wales and the UK. Dr Adam Charlton leads the project for the Centre which is in partnership with the Institute of Biological Environmental and Rural Sciences at Aberystwyth University.

"Through funding from the Welsh Government's A4B programme we are developing a biorefining process that will isolate and extract sugars and other components from ryegrass and convert them into low carbon products" explains Adam.

Trials are underway at BC's Biorefining Technology Transfer Centre (BTTC) facility using a new pilot scale pulp moulding line to make new food packaging products using the grass fibres. Chief technician at BTTC, Nick Laffin runs the pilot plant and explains "Developing a new product like this is great fun as we are always learning new ways to set up and run our trials."

The project brings together a team of companies that are working closely to help develop a range of applications. Bangor is tasked with developing a novel packaging product for one of the key partners in the project, Waitrose, a leading food retailer in the UK.

BC is already seeing the benefits of working with Waitrose as it is engaging with its customers through a series of on-line surveys and customer focus groups. Quentin Clarke, Head of Sustainability at Waitrose, said: "Waitrose is working hard to use easy to recycle, sustainable materials for its packaging, so there is a natural synergy between this project and Waitrose's approach to "Trading Lightly" and reducing its environmental footprint."

## **Project: Upgrading Welsh Timber to fulfil Future Market Potentials**

A Welsh Government funded A4B project has drawn together nine timber users and associated companies to work with BC in product development. One of the key aims is to engage carpenters, joinery manufactures and furniture makers to test and feedback on the thermally modified timber produced by two of the project partners.

Thermal modification of wood is gaining widespread acceptance in Europe, and a unique thermal treatment system developed in Wales shows great potential for production of an attractive, joinery quality, high value timber based on softwoods such as Western hemlock which are rarely sought for commercial production. The opportunity to add value to these timbers will support the forestry sector in Wales, but also the UK wood processing industry, with a novel and competitive product which will excite architects and designers.

The products were recently showcased at Venturefest in Cardiff, and at the Royal Welsh Show. One aim was to engage with future timber users to try out the material. Project Manager Morwenna Spear said "This is an attractive product which has real potential to add value to timber. We are really keen to get people to try this timber to see for themselves, and help establish a supply chain in Wales."

## **NISE Project achieves a first for UK**

The Novel Ingredients from Seaweed Extracts (NISE) project aims to develop a sustainable supply chain that exploits Welsh seaweed as a natural source of ingredients for a range of applications from cosmetics to foods.

The joint project led by the BioComposites Centre (BC) is in collaboration with the Bangor's Centre for Applied Marine Sciences (CAMS).

Welsh Government's A4B funds have allowed BC and CAMS to collaborate. Dr Radek Braganca and Dr Lewis

LeVay (CAMS) have set up a joint team to look at the cultivation and fractionation of seaweed. "We have looked at a range of seaweeds and have collected samples from the wild for Radek's team to analyse" explains Lewis. "We now have over 18 months of seasonal data and have a very interesting picture of cyclic changes in their chemical composition".

Radek's role is working with companies to establish their product needs. "Seaweed is full of antioxidants that are used in lots of products such as sun-creams. We are now producing samples using a new fractionation process and supplying them to the company partners for evaluation".

A key stage in the process is demonstrating that seaweed can be cultivated off-shore so that supplies can be easily harvested in the future. To show that this is possible the project has deployed the first ever off-shore structure from which seaweed will grow on ropes. This UK first was achieved with help from James Wilson of Deepdock Ltd. The teams will now monitor and compare growth rates and chemical composition to the data collected from the wild.

## **New researcher to help with biopolymers work**

Biopolymers and their applications is a relatively new area of research at BC. Dr Qiuyun Liu, a Project Manager who has been with BC since 2003, is looking at the use of biopolymers in packaging and medical applications. "Adapting the polymers to make them easier to process is the main driver for our work here" explains Qiuyun. Current polymers being studied include polylactic acid (PLA) and polyhydroxyalkanoate (PHAs) and the use of additives to improve their barrier and thermal properties.

Many of the end-uses for biopolymers are in packaging but a new 12 month Knowledge Transfer Partnership (KTP) is looking at the use of these polymers in medical products such micro-needles. Chris Williams CEO of Innoture, based in Swansea, explains "Microneedles are patches of tiny pillars which deliver therapies via the dermis of the skin. They are very effective and can speed up drug delivery and often avoid many of the side effects of intravenous injections." To help with the research, recent mature graduate Alan Hughes has joined the team. Funding through KTP has given Alan his first real science job following his graduation this year (2014) with a PhD in Chemistry from Bangor University. Alan originally had a career in the civil service, but was interested in science. An opportunity for full time education arose and Alan chose to study chemistry at Bangor. Following a successful degree he embarked upon a PhD and now is working for the Centre. "The chance to put into practice the skills I have learnt during my studies is fantastic and also very challenging" explained Dr Alan Hughes.

# Investment in Infrastructure

## NEW EQUIPMENT

This year has seen the Centre upgrade and invest in new equipment with the help and partial support of the WISE Network programme. This has resulted in some exciting developments that will assist the work undertaken by the Materials Group.

A thermal testing suite has been added to the Centre's extensive analytical capabilities and will aid in the analysis of the change in properties of materials due to heat and humidity. "The ability to study thermal changes in materials is critical when developing a fundamental understanding of how these materials may behave in use" explained Dr Graham Ormondroyd who manages the Materials Group. New facilities for assessing weathering performance using both outdoor and accelerated weathering tests are available, including; an in-ground timber test facility located at Bangor University's Henfaes research farm and a new Atlas SUNTEST XLS+ for QUV testing (with options of water spray and submersion)



used for accelerated weathering. The analysis of the interaction of materials with moisture during changes in relative humidity has continued to be predominant throughout 2012/14. To further enhance our capability in this area we have upgraded our analysis suite with a new DVS Advantage, allowing us to analyse not only the interactions of materials with water vapour but also organic solvents.

## New CO<sub>2</sub> Lab goes from strength to strength

In 2010 Prof. Ray Marriott, an industrial expert in CO<sub>2</sub> extraction, joined the Centre to take up the opportunity to develop supercritical extraction working on a Welsh Government funded project managed by Dr Adam Charlton. "At that time the Centre had one small CO<sub>2</sub> extractor/reactor and a basic understanding of the benefits of using CO<sub>2</sub> as a solvent extraction process" said Adam "but with Ray's help and additional investment in pilot plant equipment we have rapidly grown to become





a leading facility for CO<sub>2</sub> research in the UK". The CO<sub>2</sub> team now includes two postdoctoral researchers, one technician and two PhD students.

Liquid or supercritical CO<sub>2</sub> provides a clean alternative to petrochemical derived solvents such as hexane and it is universally accepted as an organically-certified solvent.

The CO<sub>2</sub> laboratory provides facilities to develop processes from a gram to tens of kilogram scale. It is equipped with two extraction plants: a laboratory-scale Thar rig (1 Litre) and a pilot-scale Separex (2 x 16 Litre). This enables the CO<sub>2</sub> group to carry out optimisation trials at small scale before transferring to larger scale for product development and formulation.

All of the equipment has full energy monitoring of component parts that allows both process optimisation and energy minimisation to be achieved. The process development is supported by a comprehensive analytical laboratory that is equipped with GC, GC-MS, LC and LC-MS so that trials can be monitored in real time and products fully characterised.

### **New pilot scale production facilities**

In 2006 the Centre relocated its pilot scale equipment to Mona on the Island of Anglesey and created the Biorefining Technology Transfer Centre (BTTC). This involved considerable investment in equipment and in 2014, two additional pilot scale lines were installed with funding from BEACON.

Dr Adam Charlton, who manages the BTTC facilities, explains "Our new wet fractionation plant has a capacity of 300 litres and uses enzymes in an aqueous medium to process and separate biomass into a range of fractions including polysaccharides (e.g. beta glucans) and soluble/ insoluble fibres. The system is chemical and solvent-free so is a great example of our green processing capability". The technology was developed initially to produce materials for the food industry from

oats and bran. "We will hopefully use the line for a wide range of feedstocks including seaweeds, food waste and forestry residues".

Adam continued "Our second new line is the pulp moulder. This is used to convert plant fibres into a range of pulp moulded products, including soft fruit and vegetable packaging trays. The equipment uses a thermoforming (in-mould drying) process which reduces the footprint of the equipment and reduces drying times."



# People and Awards

## New Staff

As well as investment in equipment and laboratories BC has grown in staff numbers to 38. The BioComposites Centre continues to offer placements for early career scientists and internships for EU research students wishing to gain research experience in a work environment.

## New PhD Students

Bronia Stefanowski and Elie Mansour are our new PhD students. Their research work will focus on modifying wood based panels and natural fibres to sequester VOC's with the aim of improving indoor air quality. The work is part of the FP7 project ECO-SEE.

Bronia, a graduate from Bangor University, with a degree in Conservation and Forest Ecosystems, looked at waste paper and cardboard sources as a substrate for cultivating mushrooms for her undergraduate thesis. She then joined BC as a technician for three years working on resins, biomaterials, wood preservatives and fibre analysis. She has always had an interest in biology and was inspired by her teachers to follow a route into science.

Elie Mansour has a degree in chemistry from Université Libanaise and completed an MSc in Green Chemistry and Sustainable Industrial Technology at the University of York. In his research project he used reductive hydrogenation of lignin to produce monomers and phenolic aldehydes for use as flavouring agents. Elie has just completed a two year Knowledge Transfer Partnership, funded by the Technology Strategy Board, as a production technologist at Black Mountain Insulation. His work there involved reviewing, evaluating and improving production processes and launching new insulation products.

Elie and Bronia have joined Bangor University Anthea SWAN group. This group recognises commitment to advancing women's careers in science, technology, engineering, maths and medicine (STEMM) employment in academia.

## Life Cycle Assessment

Understanding the environmental impact of technologies developed in the BioComposites Centre using Life Cycle Assessment (LCA), is the role of Campbell Skinner. Campbell joined BC in 2012, having previously worked on lifecycle assessments of food crops for the late Prof Gareth Edwards-Jones in School of Environment Natural Resources and Geography (SENRGy). "As part of the BEACON project my role is to develop a comprehensive set of tools so that we can undertake LCA and lifecycle costing. We have fitted individual energy monitoring devices to all pilot-scale equipment in BC, and to a number of the lab-scale facilities to collect process specific data".

BC also has access to Ecoinvent, the world's largest licensed database of peer-reviewed lifecycle inventory datasets. This along with SimaPro, a market-leading LCA software package, allows Campbell to carry out analyses ranging from small-scale scoping studies (ideal as an initial business engagement tool and for hotspot identification work) to full cradle-to-grave research-based analyses. Getting companies more involved is a key task and we have already delivered a series of LCA seminars which were well attended and received by business, academics and researchers.

"I have been amazingly busy working on many projects including a contribution to the Bangor-Aberystwyth distance-learning MSc in Sustainable & Efficient Food Production. We have hosted an LCA-based short-term scientific mission from CIRAD / Montpellier University and also have an ongoing collaboration with the US Department of Energy's National Renewable Energy Laboratory (NREL) in Colorado. They have developed a new land-use change model called BioLUC, for which we received a special thanks" added Campbell.

## Major Award for The BioComposites Centre



BC picked up a major award for its flagship BEACON project, the prestigious European Commission RegioStars Award for 2014. Project Manager Dr Adam Charlton attended the event. "This is fantastic recognition of the great achievement and impact of the project" acknowledged Adam.



Initially 19 finalists were chosen from 80 projects supported by EU Cohesion Policy funds on the basis of four key criteria: innovation, impact, sustainability and partnership. The project is led by Aberystwyth University's Institute of Biological, Environmental and Rural Sciences (IBERS) and BEACON was one of four projects to be shortlisted in the "Sustainable growth: Green growth and jobs through Bio-economy" category. Researchers at BEACON work with industry, including small and medium sized enterprises, to develop renewable materials, fuels and chemicals as well as modified and new environmental and economically sustainable processes. Welsh Finance Minister, Jane Hutt, who also attended the ceremony in Brussels on 31st March 2014 said: "This is an excellent example of how EU projects are delivering in Wales through ground-breaking research and innovation which is helping to drive our economy and global competitiveness. This also demonstrates the importance of EU membership to Wales and the benefits of EU Funds to people across the region."

## RESEARCH AND ENTERPRISE IMPACT AWARD

Bangor University held its second annual Impact and Innovation Awards in July. These Awards recognise outstanding research and enterprise activities from across Bangor University, which have succeeded in benefiting the wider economy and society.



Last year The BioComposites Centre were runners up in the category "Improvement in Business Performance and/or Outstanding Innovation" for work with Apollo Scientific during which over 150 commercially important chemical intermediates were developed for the fine chemical sector. This year saw BC scoop the top prize in the business impact category for a collaborative project to develop novel packaging materials with Valueform Ltd.

The award went to work funded by Technology Strategy Board that developed a novel food packaging product made from waste straw that will replace polystyrene discs used for chilled pizzas. The size of the current UK market for chilled pizza bases is 200 million per year and ValueForm are now commercialising the packaging with the UK's largest manufacture of pizzas.

Dr. Simon Curling, Project Manager co-ordinated the research and tested the products: "The chance to work on a challenging collaborative project like this was great. We ran lots of trials using the pilot scale pulp moulding line and made thousands of discs. Nick Laflin and the team at the BTTC ran and optimised the production process to ensure we could make the discs to the correct specifications" added Simon.

Prakash Korde, Managing Director of ValueForm commented: "Creating a technology platform for the use of annually renewable materials like straw as substitute to paper and plastic in packaging and creating a high value processing regime is ValueForm's 21st century sustainable goal."

The UK expandable polystyrene (EPS) market is around 65,000 tons per annum and has a value of £90 million pounds, 55% of which is imported. EPS products are not recycled and are disposed of in landfill sites, thereby contributing towards climate change. Replacement by an agri-fibre product that can be composted will reduce greenhouse gas emissions and bring environmental benefits to the UK.

# Networks

## **COST Actions and other networks/ partnering awards**

This year has seen the BioComposites Centre host the first training school and workshop for COST action FP1205 'Innovative applications of regenerated wood cellulose fibres'. The workshop, run by the Materials Group, led by Dr Graham Ormondroyd, saw 15 students join BC staff to explore the use of regenerated cellulose in film applications. The students worked with staff to produce films at a pilot scale at the Bio refining Technology Transfer Centre and assess the effects of cellulose addition to the films using the facilities at the BioComposites Centre.

"I found the meeting very interesting and productive and I also found the city impressive and enjoyed my stay" commented Emília Csiszár from the Department of Physical Chemistry and Materials Science, Budapest University of Technology and Economics. Cost actions (Cooperation in Science and Technology) are funding streams accessed through the European Government to network and disseminate research activities and ideas on specific research topics. The BioComposites Centre has continued its involvement in the COST action program with involvement in the following five actions:

FP1205 - Innovative applications of regenerated wood cellulose fibres

FP1006 - Bringing new functions to wood through surface modification

FP1003 - Impact of renewable materials in packaging for sustainability - development of renewable fibre and bio-based materials for new packaging applications

FP1303 - Performance of bio-based building materials

FP1306 - Valorisation of lignocellulosic biomass side streams for sustainable production of chemicals, materials and fuels using low environmental impact technologies

The BioComposites Centre sits on the management committees of each of these COST actions and are



actively involved in the running of the COST actions with roles including vice-work package chairs (FP1006) and financial rapporteur (FP1205).

The BioComposites Centre is also participating in the following networks and partnering awards funded through the BBSRC (Biotechnology and Biological Sciences Research Council):

- BBSRC Networks in Industrial Biotechnology: A Network of Integrated Technologies: Plants to Products and Food Processing Waste and By-Products Utilisation Network (FoodWasteNet)
- Partnering awards with Taiwan and the United States (National Renewable Energy Laboratory, Colorado)

## **Synthetic Biology Platform**

Dr Viacheslav Tverezovskiy was involved in supporting the IKC Synthetic Biology bid. This is a five year £30M program led by Imperial College London involving 15 UK universities. The bid was successful and a consortium of universities will get £10M from the UK Government for research in the Synthetic Biology field led by commercial partners. BC's input towards the consortium's success was considerable as we provided four of the thirteen commercial partners included in the bid.

Prof. Richard Kitney, co-director of IKC at ICL said "The aim of this IKC is to bring together expert scientific groups from UK universities with companies who are looking to develop products, tools and services using Synthetic Biology to help grow the UK industry". He added "Bangor University through the School of Biology and the BioComposites Centre played a significant role in bringing dynamic UK companies on board as well as working on research projects to be funded through SynBio IKC". The lead scientist for the Synthetic Biology Platform from Bangor University, Prof. Peter Golyshin explained "the IKC is a significant national enterprise of

international importance which will act as a springboard for the world-leading research by UK universities and create a significant industry that uses the benefits of Synthetic Biology.

### **LIMNet Low Impact Materials Network**

The development of low impact materials faces complex and varied challenges and increasingly now requires a multidisciplinary approach to solve these challenges. Through LIMNet, an A4B Knowledge Exchange Partnership funded by the Welsh Government and led by the BioComposites Centre, key industrial and academic partners in Wales across a range of disciplines are being brought together. LIMNet is a partnership of three academic institutes; the BioComposites Centre at Bangor University, Swansea University and the University of South Wales (USW). The network is addressing the following different sectors with each institute leading in one area: smart and biomimetic materials (Bangor), 3D printing and fabrication (Swansea) and building and construction (USW).



The overall objective of LIMNet is to provide the necessary information to develop an effective strategy to support future research in Wales that will eventually assist Welsh companies seeking innovation in this area. Ceri Loxton, Project Manager for BC said "The project will help to identify opportunities for growth and collaboration within and between these sectors both for academic institutes and companies within Wales." The network aims to build capacity by forming collaborations and seeks to identify project partners for research through Technology Strategy Board calls and Horizon 20/20 bids.

So far through LIMNet a series of workshops, seminars and lunchtime briefings have been organised by the various partners. Additionally the academic partners have been able to offer one-to-one assistance to companies to help them develop their R&D and help build collaborative research proposals. The use of smart materials in the textile and medical sectors are just two areas where initial workshops have resulted in further activity and the building of collaborative research projects.

# Events



## Public Open Days

BC always has a strong presence at Bangor Universities public open days. This year we had displays and demonstrations at the Menai Bridge Seafood Festival (31st August, 2013), Bangor Science Festival (14-23 March, 2014) and Universities Week (9-15 June, 2014). On show were many different bio-based products that we have been developing together with some of the current plant based research projects such as NISE, WISE, STARS.

## Diary of future events

In July 2014 the BioComposites Centre will host the 2<sup>nd</sup> UK Supercritical Fluids Conference. It is ten years since the first UK conference on supercritical fluids was held at Birmingham University and this conference will bring together both academic researchers and industry to promote the application of supercritical fluids and to identify new opportunities to replace traditional solvent based processes with cleaner and greener technologies. The proceedings of the conference will be published as a thematic series (edited by Prof Ray Marriott) in Sustainable Chemical Processes (Springer) which is an open access journal.

## BC IPPS Master Class and 25th Anniversary Dinner

We will be hosting a Master Class in Bangor on 16<sup>th</sup> & 17<sup>th</sup> September 2014. This will be combined with a gala dinner to celebrate 25 years of BC.

Dr Martin Ohlmeyer of the Thünen Institute of Wood Research in Hamburg will be talking about VOCs, the latest regulatory issues, relevant emissions from wood based panels and future strategies that could be considered. The talk will be combined with practical demonstration of some of the new techniques being developed to measure VOCs.

## Information dissemination

Our website has more details about the Centre and its facilities, our work and expertise and the current projects that we are involved with, together with the latest news. Why not take a look at <http://www.bc.bangor.ac.uk>



# Publications

## Journal papers

Mustafa H.H., Baird M.S., Al Dulayymi J.R., Tverezovskiy, V.V. (2014) A nine carbon homologating system for skip-conjugated polyenes. *Chemistry and Physics of Lipids*. 183C: 34-42.

Mackenzie C.L., Ormondroyd G.A., Curling S.F., Ball R.J., Whiteley N.M., et al. (2014) Ocean warming, more than acidification, reduces shell strength in a commercial shellfish species during food limitation. *PLoS ONE* 9(1)

Mustafa H.H., Baird M.S., Al Dulayymi J.R., Tverezovskiy V.V. (2014) Tandem rearrangements of a cyclic bis-allene. *Tetrahedron* 70(7): 1502–1507.

Popescu C, Hill, C.A.S., Curling, S.F. Ormondroyd, G.A., Xie Y. (2014) The Water vapour behavior of acetylated birch wood: how acetylation affects the sorption isotherm and accessible hydroxyl content. *Journal of Materials Science* 49(5) 2362-2371

Laine, K. Segerholm, K. Wälinder, M. Rautkari, L. Ormondroyd, G. Hughes, M. Jones, D. (2014) Micromorphological studies of surface densified wood. *Journal of Materials Science* 49(5) 2027-2034

Rautkari L., Hill C.A.S, Curling S, Jalaludin Z, Ormondroyd G. (2013) What is the role of the accessibility of wood hydroxyl groups in controlling moisture content? *Journal of Materials Science*, 48 (18): 6352-6356

Mustafa H.H., Baird M.S., Al Dulayymi J.R., Tverezovskiy V.V. (2013) Diastereomeric cyclic tris-allenes. *Chemical Communications* 49(25): 2497-9.

Mohammed M.H., Williams P.A., Tverezovskaya O. (2013) Extraction of chitin from prawn shells and conversion to low molecular mass Chitosan. *Food Hydrocolloids* 31: 166-171.

## Conference Proceedings

Martin L., Skinner C., Marriott R.J. Supercritical Extraction of Oil Seed Rape: Energetic Evaluation of Process Scale. 14th European Meeting on Supercritical Fluids. May 2014. Marseilles, France.

Spear M., Binding T., Jenkins D., Nicholls J. and Ormondroyd G. Mild thermal modification to enhance the machinability of larch. In: Proceedings of the 7th European Conference on Wood Modification 2014. 10-12th March 2014, Lisbon, Portugal.

Hill C, Popescu C.M, Rautkari L, Curling S, Ormondroyd G, Xie Y, Jalaludin Z. The role of hydroxyl groups in determining the sorption properties of modified wood. European Conference on Wood Modification 2014. 10-12th March 2014, Lisbon, Portugal.

Loxton C, Mansour E, Elias R. Research into natural bio-based insulation for mainstream construction. In: SB13 Oct 30 – Nov 1 2013. Guimarães, Portugal. p. 631-638

Loxton C, Mansour E, Elias R. Research into natural bio-based insulation for mainstream construction. World SB14 Oct 28 – 30 2013. Barcelona, Spain.

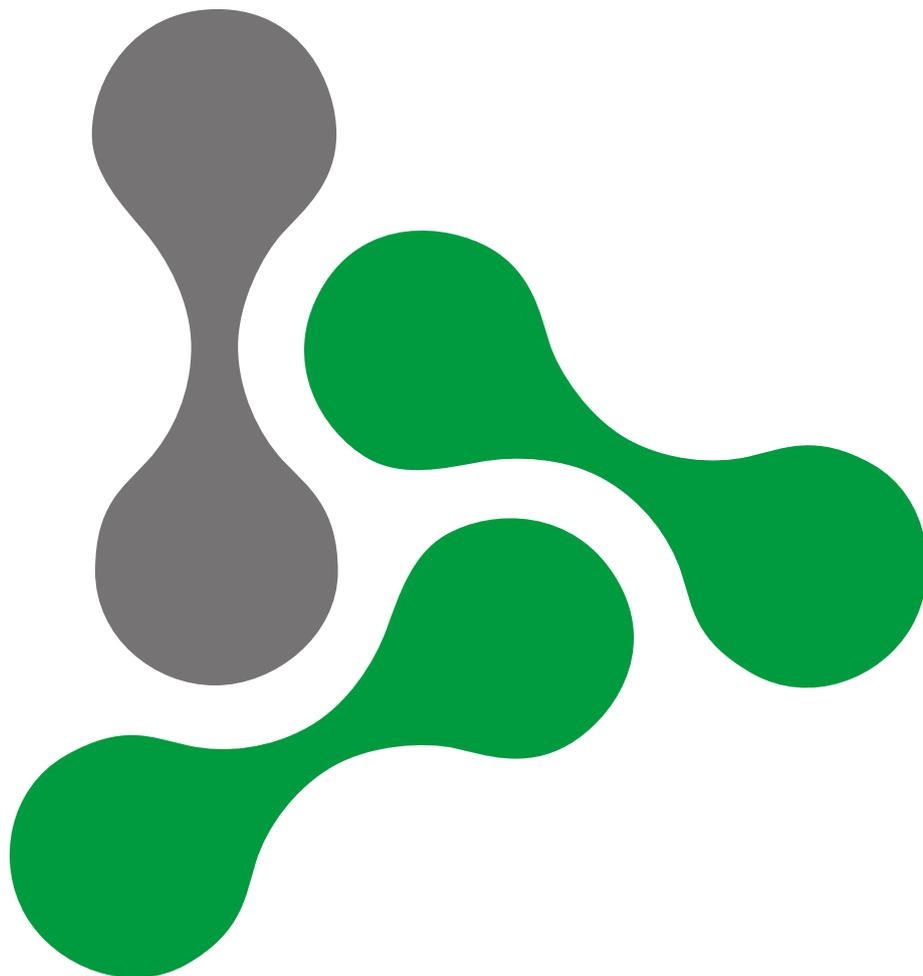
Curling, S. Stefanowski, B. Laflin, N. Davies, G. Ormondroyd G. Effects on panel properties following incorporation of reject paper fibre into MDF. In: Proceedings International Panel Products Symposium 2013. 9-10th October 2013.

Ashaduzzaman, M Hale, M.D. Tverezovskiy, V.V. Ormondroyd, G.A. (2013) Effect of bio-resin from cashew nut shell liquid (CNSL) on wood decay resistance. IRG/WP 13-40649

# Staff List

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