The BioComposites Centre
ANNUAL REPORT 2018

PRIFYSGOL
BANGOR
UNIVERSITY

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ANNUAL REPORT 2018

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BEACON
From plants to products
O blanhigion i gynhyrchion

Llywodraeth Cymru
Welsh Government

ERDF
Llywodraeth Cymru
Welsh Government
Ewrop & Chymru: Buddsoddi yn eich dyfodol
Cronfa Datblygu Rhanbarthol Ewrop
Europe & Wales: Investing in your future
European Regional Development Fund

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Annual Report 2018

Welcome *Dr Rob Elias: Director*

As you will see from this year's annual report we have had a busy year. The hard work of the team has ensured that we achieved our technical goals and this has helped win new projects. Our collaborative partners can clearly see the benefits of accessing our know-how, our technical expertise and our research facilities that assist them in innovating and developing their businesses.

This year we have had significant successes with two new EU funded projects. We are very pleased to be a partner in ProEnrich, a project funded by the BioBased Industries Joint Undertaking (BBI JU). The BBI JU is a €3.7 billion Public-Private Partnership led by industry. These projects have extra targets relating to impact of research in the biobased sector that are therefore very challenging, so to win a project with BBI funding is very prestigious.

We are also leading a new Interreg Atlantic Region project called NASPA. A low carbon economy for the Atlantic region is a key issue for territorial sustainable development in the Welsh, Irish, French, Spanish and Portuguese regions. The NASPA project is targeting green growth, eco-innovation and environmental efficiency by bringing together agritech companies seeking to develop alternative non-toxic treatments for improved plant/crop growth. Our collaborative partners also include our academic colleagues here within Bangor's College of Environmental Sciences and Engineering.

The high media interest in plastics and their impact on our environment has continued to shape our work on food packaging. Our Newton funded SafeBioPack project has attracted a lot of attention and is now successfully developing new prototype fibre-based trays. These trays can be made using a range of waste plant/crop fibres and the work is now looking at commercial opportunities with our UK and Malaysian partners.

We have also continued our success with Knowledge Transfer Projects (KTPs). KTPs enable the recruitment of qualified graduates to work with companies to develop new products and embed transformational changes within their businesses. The KTP programmes provide early career researchers with training and support to help them in this role. Using KTPs we are currently supporting two Welsh based companies to develop new manufacturing processes for innovative construction materials. Working with KTPs we can really see the benefits to companies and we also realise that this programme provides a mechanism for us to attract and retain future staff.

Dr Rob Elias: Director

As the competition for funding grows, demonstrating that we are delivering impact to our funders is increasingly important. To achieve this aim we are leading on a number of activities such as the Vanguard Initiative – this brings together EU regions that wish to develop smart specialisation strategies in the bioeconomy that will help boost entrepreneurial innovation and industrial renewal. The Welsh Government is backing Vanguard, and through our BEACON project we are able to represent the interests of our Welsh partners in Aberystwyth and Swansea Universities with a seat on the Vanguard Management Board. At National level we continue to support BioPilots UK - an alliance of open access biorefining centres that promotes pilot scale facilities to UK industry; and at a Welsh level we have set up a BioEconomy Steering Group, where we have helped bring together UK and Welsh Government to look at an integrated approach for the sector. Raising awareness takes time but it is now gathering momentum and we can already see some successes. We can positively contribute to future policy and help to develop funding strategies that will achieve the challenging goals for future clean green growth.

Table 1. Staff numbers for 2017/18

Staff Category	
Research Staff	16
Technicians	6
Administration & Finance	1
PhD Students	2
KTP Associates	2

National and International Funding

Welsh Minister visits our Anglesey pilot plant

Ken Skates AM, Cabinet Secretary for Economy and Transport, Welsh Government visited our pilot plant at Mona in July. The event was an opportunity for the Centre to showcase five collaborative projects linked to the circular economy in Wales and allowed the Minister to view the pilot-scale capabilities at BC and speak to the Welsh industrial partners linked to each project.

Also present at the event were key stakeholders including senior representatives from Bangor University and colleagues from Welsh Government, WRAP and the recently opened Menai Science Park (M-Sparc).

One of the five projects showcased was BEACON, which is a key project for the Centre. This £32 million initiative involving Bangor, Aberystwyth and Swansea Universities is supported by the European Regional Development Fund through the Welsh Government. The project, which was first funded in 2010, focuses on creating a bio-refining centre of excellence in Wales and enables the universities to collaborate with Welsh businesses in this sector on joint R&D initiatives. Since its launch, BEACON has worked with 360 companies in North / West Wales and the Valleys, created over 50 new jobs, and secured £7.4 million of additional funding.

Ken Skates AM talks with Paul Spencer, Dean of College of Physical and Applied Sciences

The other featured projects gave a sample of the range of funding vehicles successfully accessed by the Centre in recent years. Projects funded through Horizon 2020 and the Bio-Based Industries Joint Undertaking; the Small Business Research Initiative; Welsh Government SMART Partnership scheme; Innovate UK and the Newton Fund were all on display. Read more about these projects in the pages that follow…


The Minister inspects our biodegradable packaging samples

BEACON
From plants to products
O blanhigion i gynhyrchion

ERDF
Llywodraeth Cymru
Welsh Government
Europe & Wales: Investing in your future

National and International Funding

'Blue Planet effect' drives interest in our sustainable food packaging

This year we have seen a massive increase in interest in our work on biodegradable, biobased packaging. This is very pleasing when we have worked for so many years trying to raise the importance of using sustainable approaches to packaging. This interest was driven mostly by the ''Attenborough or Blue Planet Effect'' which stimulated a huge response from consumers, industry and the government to look at changes and consider alternative options for food packaging.

This is very timely for our SafeBioPack project. Working with our Malaysian partners, we have made significant progress in developing affordable and easy-to-use alternative materials. The biggest breakthrough has been in the development of fibre-based packaging. Working in close partnership with Amir Alzahari, MD of Eco Premium Packaging (a Malaysian pulp-based packaging manufacturer and exporter) has brought new insights into the technology and approaches to making high quality trays. One major advantage is the new tool made by Amir's team in Malaysia. The tool was fitted to our moulding machine in Mona and we have worked hard to optimise production, explains Dr Qiuyun Liu, BC's Co-project Lead: "We have now made some fantastic trays which we have supplied to our UK packaging company, Parkside. Parkside have worked successfully to apply lidding films using their compostable films and we can demonstrate that a pack can be made from biobased materials.''

The research team is also developing the concept of an active packaging system with incorporated active compounds from edible plants. In cooperation with Welsh SME Scitech and Malaysian partners, packaging films with antimicrobial properties have been produced. ''We aim to improve health and wellbeing of the population by reducing risk of communicable diseases transmitted by foodborne pathogens in meat or vegetables'' adds Olga Tverezovskaya.

Waste palm fibre

Pulp-moulding at Mona

Punnet drying

These developments are at an exciting time with the recent publication of WRAP's UK Plastic Pact. This is a collaborative initiative that aims to create a circular economy for plastics. It brings together businesses from across the entire plastics value chain with UK governments and NGOs to tackle the issues of plastic waste. The development of alternative materials with different disposal options is a critical part of this approach and the Centre is supporting the development of biobased and biodegradable approaches, as no one solution will fit all applications. A key area for exploiting biobased and biodegradable packaging is in the food-to-go sector. Here packaging tends to be solely single-use and can be heavily contaminated. These factors are often barriers to recycling so an alternative option should be considered. However the correct collection and processing facilities are needed and this needs to be standardised throughout the UK.

"Working with Welsh and UK Government to look at shaping the future of plastics is now a key priority area" explains Rob, "and this is a complex supply chain so novel approaches are needed – so there are some exciting and challenging times ahead!"

Olga Tverezovskaya and Paul Baker showing samples of novel antimicrobial films

Newton Fund

Innovate UK | UK Research and Innovation

E·S·R·C Economic & Social Research Council | UK Research and Innovation

The finished article!

National and International Funding

Coffee cup lids made from biobased plastics

The recent focus on coffee cup disposal has centred around the cups themselves but around ¾ of all cups will have lids that are mostly made from polystyrene. In fact, it is estimated that 3.9 million polystyrene coffee cup lids are used in the UK every day. And although these lids can be recycled, the reality is that this is rarely seen since they are lightweight, difficult to segregate and of low value. Working with Wells Plastics and Dragon Packaging, the Centre is helping to develop a biodegradable alternative.

Finding a replacement coffee cup lid that can biodegrade presented some significant technical and commercial challenges. One technical challenge is the thermal performance of the plastic. This is called the Heat Deflection Temperature (HDT). To test the HDT performance of a polymer, the sample is heated in an oil bath and its bending strength is measured. This gives an indication of the mechanical performance of the material when at elevated temperatures. In a coffee cup lid application HDT functionality is critical.

''The fit of a lid onto a cup with hot coffee is obviously very important. Some biobased polymers such as polylactic acid (PLA) have low HDTs that make them unsuitable for many end-uses. Current state-of-the-art achieves a temperature performance of 85°C but we are looking to achieve temperatures of above 89°C'' explains Dr Qiuyun Liu. ''We are looking at new grades and additives that will boost performance. Our early prototype tests are very sucessful and next year we plan to scale this up with some industrial trials.''

Good result!

Another key issue for the development of bioplastics is the engagement with stakeholders. In a recent workshop held in London the project team had chance to meet with MPs, academics and industry to debate some of the issues around plastic. Campbell Skinner gave an overview on how Life Cycle Assessment (LCA) can be used to look at the enviromental impacts of biobased plastics in comparistion to fossil fuel materials. The workshop also identified some of the major barriers to adoption of bioplastic, as in many regions there are no composting facilties. Local authorities need to agree on the same standards and consumers need to correctly separate different products. The insights from the workshop will now be used to help inform policy and strategy in the UK.

Production of our bio-based, biodegradable plastic at Mona…

First batch of compostable coffee cup lids

Innovate UK | UK Research and Innovation

Reducing childhood obesity using waste apple pomace

The diets of Welsh consumers typically have 11% more fat than the UK average and not enough fibre, and recent statistics show that more than a quarter of reception year school children in Wales are particularly at risk.

Wales, like the rest of the UK, generates thousands of tonnes of surplus fresh food resources such as apples and potatoes that never make it to the supermarket shelves. This may be because they are out-graded, surplus to requirements or only partly consumed, such as in fruit-based drink production.

These surplus fresh fruits and vegetables are rich in natural fibres with many beneficial nutritional properties. This SBRI project, jointly funded by Innovate UK and Welsh Government (Food and Drink Wales) is a collaboration between BC, Pennotec, Cybercolloids Ltd, and the Food Technology Centre at Coleg Menai in Llangefni. The project is developing new functional food ingredients from apple pomace resources in Wales to replace high calorie ingredients, particularly oils and fats, in the kinds of food that are particularly enjoyed by children.

The project is transferring technology developed with Bangor University to a food-grade facility at Coleg Menai and is working with manufacturers to investigate the use of the product in a range of foods, including cakes, sausages and sauces. The project hopes to make it possible for food manufacturers, school caterers and kitchens in our homes to create low fat versions of the types of food our children love to eat, without affecting taste or texture.

The functional food fibres will also bring additional nutritional benefits since they provide dietary fibre with no caloric value. They are also allergen free, GMO free and suitable for vegans. This unique approach to tackling childhood obesity will not only drive down cost but will also help to tackle the very pressing issue of unnecessary food waste in Wales and the wider UK.

Dr Adam Charlton with Jonathan Hughes of Pennotec

National and International Funding

Developing new biostimulants for greener agriculture

Developing new strategies for healthy crops and improved crop productivity is an important objective for the agriculture sector. Past agricultural practice has relied on the use of toxic chemicals that have had an impact on insect life and human health. Now a global concern, the industry is looking at new approaches that avoid these chemicals.

To help support this sector, Bangor is leading a new Interreg project (NASPA) that is helping companies develop a range of new products that are classed as plant biostimulants. Broadly speaking, biostimulants are substances or microorganisms that can be applied to plants with the aim of enhancing nutrition efficiency, improving the abiotic stress tolerance and/or increasing crop quality. These substances can be extracted from a range of biobased sources and the aim of this work is to develop a better understanding of how they work on a variety of important crops.

The project launch meeting was held in Bangor in January and EU partners from Spain, Portugal, France and Ireland attended. A key objective of the project is the exchange of best practice and partners gave presentations highlighting their expertise. Project partners include companies developing new biobased products, research institutes and test centres that are able to undertake glass house and field trials. A wide range of bioderived extracts from seaweed, plants and waste co-products will be formulated into products and tested using standardised protocols against current controls. Crops to be tested include tomatoes, potatoes, vines and carrots.

"Having this funding will help develop a series of test platforms across the EU to help SMEs and research institutions evaluate the efficacy of a range of novel biobased plant stimulants for crop protection and growth" explains Dr Radek Bragança, the project lead and manager. "We've set up monthly conference calls to help co-ordinate the planning of trials and have made some real progress and held our 6 month meeting, hosted by BioAtlantis in Ireland, in July.''

Growing trials at Henfaes, the University's research farm [photo: David Roberts]

Dr Radek Bragança NASPA project manager [R] with Ahmad Al-Dulayymi

BioAtlantis manufacture plant strengthener products that enhance crop tolerance to stress and increase yield. At the M6 meeting project partners discussed and agreed how materials will be transferred and tested. A key was reaching agreements on when samples could be sent for glass house and field trials. "Ensuring that the correct protocols are followed for testing is important and should be well documented" explains John O'Sullivan MD of BioAtlantis, "as we need to make sure that any claims we make regarding our products can be well backed up with some good science. Having access to this test platform will really help our company develop" added John.

The project is progressing extremely well and trials are already underway. The team are now looking forward to analysing test data at the next meeting to be held in Portugal in November. The project twitter handle is @BioNaspa so getting following us to find out more!

Lettuce showing signs of fungal infection

Interreg Atlantic Area
European Regional Development Fund

EUROPEAN UNION

Field trials in progress

National and International Funding

Functional proteins from fruit and vegetable processing waste

Rapidly rising global population is expected to create huge challenges in terms of providing affordable and readily available food in years to come. This is especially so for protein, where one of the big challenges for the food industry is the identification, production and utilisation of functionally useful plant proteins as an alternative to animal protein.

The current functional proteins market is dominated by dairy and egg protein derivatives and gelatine, but plant-derived proteins including soy, pea, potato, canola and rice are now important alternatives. However, there is still a need to identify new sources of functional, plant-derived proteins for a wide variety of applications in the food sector.

The Pro-Enrich project seeks to address this. It was funded in May 2018 and is supported by the Bio-Based Industries Joint Undertaking (BBI-JU). It aims to develop novel functional proteins and bioactive ingredients from rapeseed, olive, tomato and citrus fruit side streams for applications in food, cosmetics, pet food and adhesives.

The project consortium consists of sixteen partners from seven EU countries and is a mixture of SMEs, large enterprises and research & technology organisations, including BC / Bangor University. UK partners include Tate and Lyle, a regionally important company in NE Wales, with a facility in Mold, Flintshire.

BIO-BASED INDUSTRIES
Public-Private Partnership

Adam Charlton (far L) with project partners at launch meeting in Denmark

Relationship with Lignia Wood continues to grow

This year has seen the relationship with Lignia (formally Fibre 7 Ltd) go from strength to strength with two new projects being launched.

The first is a collaboration between BC, Lignia, Millennium Lasers and Coventry University. This project received £1.2 million of co-funding from Innovate UK in September 2017. The consortium brings together laser and wood specialists to improve permeability and processing of timbers during resin treatment. Treatment using resin is one of a growing platform of wood modification technologies that can alter the properties and service life of timber for use in demanding environments or to enhance aesthetics.

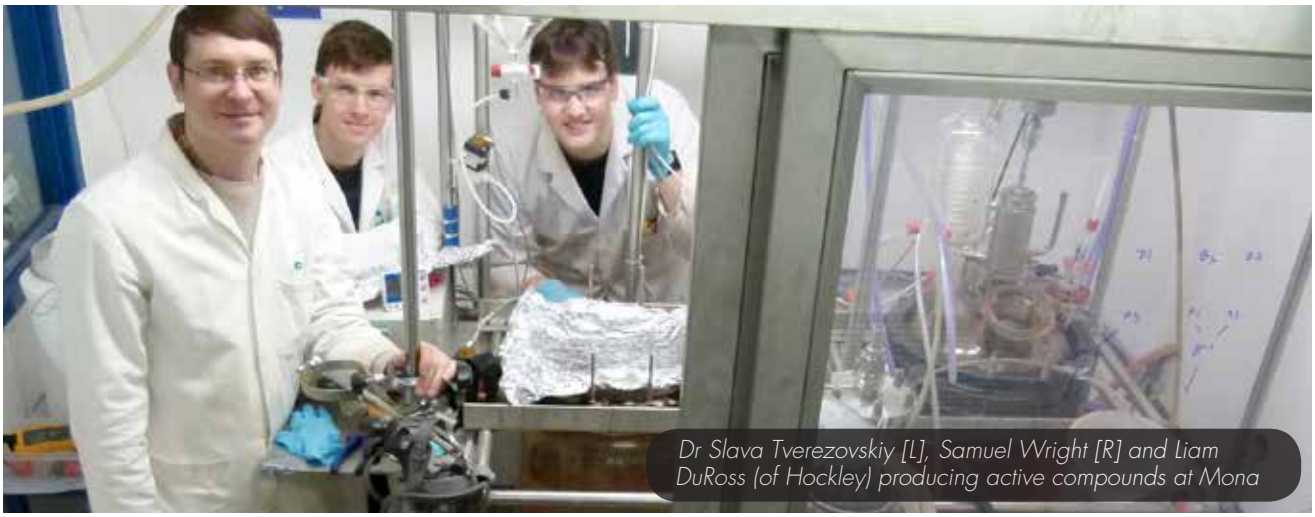
Patterns of micro-incisions will be made in the faces of wood prior to treatment to improve penetration of resin into the wood pieces. This will enable a greater range of timber species to be modified, including those currently grown in the UK. Establishing the optimum density and pattern of incisions, to achieve deep and consistent resin coverage, is one of the key areas of the research.

Andy Pitman, Lignia's Technical Director believes ''this laser-drilling offers significant benefits for our wood treatment process, increasing the range of timbers we can employ and the section sizes we can modify.'' Andy adds ''The technology offers others needing to impregnate timbers with fluids such as wood preservatives an additional tool, since far less damage will be caused using lasers compared with mechanical incising, meaning it can be used on joinery timbers.'' The project runs until March 2019.

Building on this, a second initiative with Lignia sees the Centre embark on a new KTP (Knowledge Transfer Partnership) project focused on optimizing the current treatment process. The aim is to enhance product consistency, develop a viable quality control regime, and develop new products with lower environmental footprints across the range. The KTP will welcome the return of our recent PhD graduate, Bronia Stefanowski, to the post of KTP associate.

Centre's first synthetic biology project yields results

Now in its final year, the Biotechnology for AntiWeeds project is BC's first to utilise a synthetic biology approach. This £1.25M four-year project is co-funded through BBSRC / Innovate UK and aims to bring to market a novel natural herbicide produced from abundant natural oil via an enzymatic / chemical route. The research is a collaboration between BC, the University's School of Biological Sciences and two commercial partners, Hockley International and The Almac Group.



Dr Slava Tverezovskiy [L], Samuel Wright [R] and Liam DuRoss (of Hockley) producing active compounds at Mona

National and International Funding

BC team hand first batch of novel natural herbicide candidate to partners at Hockley

Arable farming typically uses significant quantities of chemical herbicides to control weeds and improve yields. However, there is currently no green "nature identical" herbicide on the market, and major classes of commercially available products are already in the mature phase of their life-cycle, as illustrated by the fact that a major UK agricultural pest, black grass, is resistant to all seven classes of commercially available herbicides.

Viacheslav Tverezovskiy, BC's Head of Chemistry Research, commented "we achieved small-scale synthesis of desired active compounds and production technology is now under development. A first batch of the novel natural herbicide candidate was produced at the Centre this summer via a semi-optimised process. This enabled Hockley to prepare an active emulsion, formulated to current standards, and commence greenhouse trials.''

This year, Hockley International showcased their strategy to success in The Parliamentary Review under the Manufacturing & Services Section. In this paper, Hockley highlights the importance of R&D to the company. "We have worked in conjunction with scientists at various Universities over the years. Our primary focus in this regard has entailed a close partnership with the Biocomposites Centre at Bangor University, and involves chemical research towards a natural-equivalent herbicide. After six years of work, we are starting to make serious progress, and the project is undertaking greenhouse trials to prove efficacy. Toxicology tests are also underway."

BBSRC bioscience for the future | UK Research and Innovation

Centre to lead CCC bioenergy consortium

BC has been selected to lead a consortium to deliver a review on 'the potential for using bioenergy resources for construction and other non-energy uses' for the Committee on Climate Change (CCC). This review will feed into the updated Bioenergy Review 2018 which will be published by the CCC in the autumn.

The consortium has brought together leading experts in timber and bio-based materials (BC), life cycle assessment and Environmental Products Declarations (JCH Industrial Ecology, Renuables), and carbon accounting and discounting (Professor Colin Price). The team will deliver a review of biomass use and availability in the UK, and its potential role in greenhouse gas abatement strategies. The study will include a deep review of carbon accounting protocols with respect to sequestered carbon (timber) in construction.

Dr Graham Ormondroyd, BC's Head of Materials Research, commented ''through our links with the industry and industrial associations the team will be able to give an in-depth analysis of the sector and a robust evaluation of the environmental benefits of increased use of timber in construction. It is a fantastic opportunity for Bangor University to help shape policy around future building stock towards green building and the use of timber.''

Marketing a novel wound treatment based on an Anglesey family tradition

This year the Centre collaborated with Anglesey-based small business, Môn Naturals, to investigate the antimicrobial and antifungal properties of their natural remedy, Eliawen balm. The remedy has been developed by the family going back 200 years, and has been used locally to treat skin conditions including burns and wounds for generations.

In 2016, the family formed a company to market the remedy more widely. They then received innovation funding support under the Welsh Government SMART Partnerships scheme to assess the antimicrobial properties of the balm for the commercial market. This work was conducted in collaboration with BC over ten months, in order to investigate the functional properties of the balm. The project also facilitated registration of the product as a cosmetics ingredient and, through additional support from Pontio Innovation at the University, the company was assisted with brand identity, packaging development and trademarking of the Eliawen Balm.

Llywodraeth Cymru
Welsh Government

This year the company was voted runner-up in the 'Business Development and Innovation' category at the Federation of Small Business Awards. The balm was officially launched at the National Eisteddfod (Cardiff, August 2018), where the company was a key partner in the new 'traditional healing forum' held as part of this event. The SMART partnership collaboration also highlighted further exciting options for the company as it continues to expand.

Ianto Jones [R], Director of Môn Naturals at Mona with Ken Skates AM

North Wales furniture company seeks Centre's expertise

A new collaboration with North Wales company, Silverlining Furniture, has seen two new projects funded this year.

A Welsh Government-funded SMART Partnership project will see BC's Dr Simon Curling investigating environmentally friendly ways to bleach timber to give a uniform base colour. Following on from this, a Knowledge Transfer Partnership (KTP) project will look at the development of environmentally friendly colouring techniques with a view to advancing our ability to artificially age timber to achieve a desired effect.

The Centre will soon be advertising for a KTP associate to fill this position.

Spin Out Company

Suprex turns two

Our joint venture business, Suprex, was set up to exploit the utilisation of supercritical CO_2 as a green solvent for the extraction of a range of biomass sources with applications in medical, food and industrial sectors. The company was officially incorporated in April 2016 and now with two years of successful trading the company continues to move forward.

Suprex Director, Andy Beggin, explains that a key to the success of the business is having a diverse range of projects and being able to keep clients very happy. "The know-how we have through the expertise of lead scientist, Dr Gee-Sian Leung, and her operational skills have helped develop this customer base" explains Andy.

Dr Leung studied for her PhD whilst working at BC and transferred her skills to work with the spin out company from day 1. "Moving to a commercial operation was a challenge as timescales to get the job done are critical and balancing our customer demands can be a struggle, but I enjoy this as I can use all my organisational skills to best effect" explains Gee-Sian.

Looking forward, the strategy for the company is now to focus on moving their customer's R&D projects to commercial opportunities. Top of the priority list is to ensure that customers can be guaranteed a reliable and quality service, so gaining appropriate accreditations is very important for their new markets. And it is going well, the company is already planning for expansion…

Dr Gee-Sian Leung of Suprex

People & Awards

Dave Preskett – Scale-up and Development Chemist

My career in natural products started in Germany where I spent 10 years in forestry, returning to the UK to complete my second degree in Forestry and Forest Products at Bangor in 1998. I began working for BC in 1996, which although it has been somewhat of a revolving door, over the years has been a source of inspiration with my involvement in a wide diversity of projects. I gained my PhD in Chemistry in 2007 and returned to the Centre to take up my current role in 2011, where I work with industrial partners to develop innovative and novel solutions from sustainable and renewable sources. My research interests are principally focused on the chemistry of non-timber forest products as well as the substitution of petrochemicals with natural products and the identification and valorisation of waste streams.

Jon Holmberg – Materials Research Technician

I am currently working at BC as a materials research technician on the Lasercure project, where I am investigating how laser technology can be used to improve the uptake of resins and chemical preservatives during timber treatment and modification. I am responsible for assessing the viability of timber species using microscopy, vacuum chambers and pressure reactors, as well as collecting and processing data from experiments conducted on these timber species. I also assist BC's Materials group in fulfilling their commercial contracts by testing sample materials and compiling test data for reports.

I have a Biology degree from the University of Kansas and have also worked as a research technician at Bangor University on two previous research projects. These included the EU-funded LIFE – Environment project 'Treating Waste for Restoring Land Sustainability' and the NERC funded Uplands N2O project, which investigated the relationships between soil properties, grazing patterns and sheep behaviour on N_2O emissions in the Uplands.

Jonathan Nicholls – Research Technician

I am the Centre's operational Research Technician working at our pilot-scale facility at Mona on Anglesey. I joined BC in 2013 having trained as a carpenter and spent time in the construction industry. I was initially responsible for sample preparation and testing for the Centre's Materials Group, and then moved to the pilot plant under the BEACON project. Since then I have learnt to operate and manage all of the plants' processing machinery and work closely with the Centre's industrial and academic project partners during operational trials. The equipment at the site is varied and includes a twin screw extruder, daylight press, pulp moulder and both pressurised and atmospheric refiners. As a result I get to work on a wide variety of projects and commercial work - from making fibres for MDF boards, to testing new bioresins, or trying to turn feedstocks and waste materials into new packaging formats - no week is ever the same!

Paul Baker – Research Officer

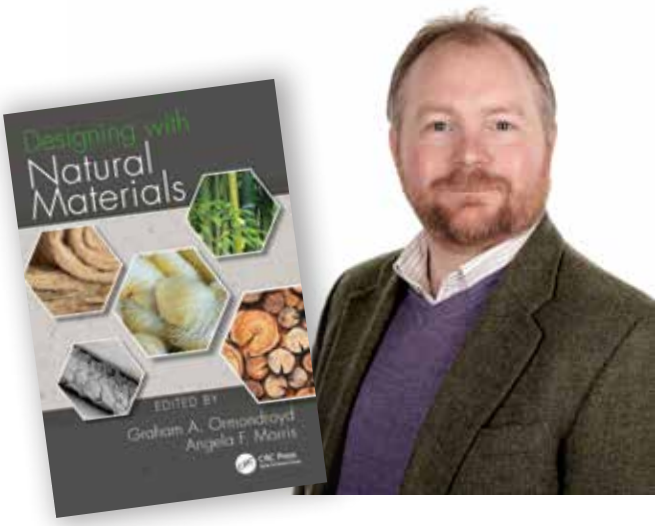
I graduated with a PhD from Warwick University and then spent time working around the world in Japan, USA and Ireland. I joined the Centre in 2011 to work on the BEACON project, exploring how wood rot fungi could help Welsh companies develop bio-based products and processes. More recently I completed a ten month Welsh Government-funded project aimed at evaluating the microbial efficacy of a 200-year old traditional balm from Anglesey. The balm, produced by Môn Naturals, is used in the treatment of burns and wounds. It is made up of locally sourced materials and my work was able to demonstrate the products' effectiveness in dramatically reducing most bacteria and fungi, especially Staphylococcus aureus.

New book from Centre's Head of Materials

BC's Graham Ormondroyd has published a new book entitled 'Designing with Natural Materials' as joint editor alongside Angela Morris of The Wool Packaging Company. The book covers the design process from a natural materials perspective and aims to bridge the gap between current scientific knowledge of the use of natural materials and product design.

Book chapters include case studies, research, and a historical perspective. They develop ideas of designing with natural materials in specific areas and look to the future of new biobased materials and how these will influence design. The work offers insight to designers of biobased materials across a range of different design disciplines while also providing insights to scientists on the process of design, production, and the needs of a material beyond those traditionally analyzed in the laboratory. The final chapters touch on the use of bioinspiration and biomimicry in the development and use of biobased materials and how these will influence product design in the future.

Other BC staff have contributed chapters to the book. Morwenna Spear wrote two chapters: 'Natural materials – composition and combinations' and 'Bio-inspired design – enhancing natural materials', while Campbell Skinner wrote a chapter called 'Designing with the life cycle in mind.'



PhD success for Bronia and Elie

This year saw our two PhD students, Bronia Stefanowski and Elie Mansour, both pass their viva voce examinations. Bronia Stefanowski completed research in the area of improving indoor air quality through the use of modified wood panels. Bronia was examined in late December by Dr Martin Ansell of the University of Bath and Dr Lone Ross Gobakken of NIBIO, Norway. Elie Mansour undertook research into the use of wool insulation as an absorber of volatile organic compounds (VOCs) and was examined in January 2018. Elie was examined by Prof. Pete Walker from University of Bath and Dr Andy Dengel of BRE. Both Bronia and Elie were praised for the quality of their theses by their examiners. They both graduated in July 2018.

Bronia on Graduation Day, with supervisors Simon Curling and Graham Ormondroyd

Dr Ana Maria Ferreira receiving her award, with judges Keith Godber and Chris Ryan

Harry Earl Memorial Award

At the IPPS 2017 Gala Dinner the 2nd Harry Earl Memorial Scholarship was awarded to a young Portuguese scientist, Dr Ana Maria Ferreira, for her work on bioresins. The Harry Earl Memorial fund was set up by Kronospan, CRC Chemicals and BC in the memory of Dr Harry Earl, a well-known and respected scientist who had a career in academia and industry.

"Harry always had time for younger colleagues and would help mentor and advise them on technical issues" explains Centre Director Rob Elias. The aim of the scholarship is to help early career individuals working in the wood-based panel sector to attend training events or travel to meetings. Judges Chris Ryan (Kronospan) and Keith Godber (CRC Chemicals) were on hand at the dinner to award the £500 grant to Ana for her work on low formaldehyde bioresin systems.

New applicants must complete a form and give a compelling justification on how the scholarship will help with their future career development. The awards are given out every 2nd year to coincide with the International Panel Products Symposium held in Llandudno. The next awards will be presented in October 2019. Application forms can be found on the Centre's website and for more information please contact Dr Rob Elias.

TTJ Awards recognise MDF recycling innovation

MDF Recovery Ltd was recognised at this year's TTJ Awards for its innovative MDF recycling process. Craig Bartlett, Managing Director, and Rob Elias both attended the prestigious annual event that is held in London and is well supported by the timber and wood-based panel industry.

"Getting this award has really helped raise the awareness of my technology in the sector" explained Craig. ''We have used an Innovate UK grant to build a small pilot plant but without support from BC and the BEACON project I would not have progressed as far or as quickly. Access to pilot-scale facilities at Mona have been a massive help for my company to demonstrate that this approach is feasible.'' Craig has now secured £400,000 of new investment from angel investors and is planning a full-scale plant with a major manufacturer.

Steph McGovern presents Craig with his award

Networks

Centre awarded EU 'KET' status for innovation in green economy

Key Enabling Technology centres (KETs) are those that can help small to medium sized enterprises speed up the commercialization of their innovation ideas by providing services such as help with prototyping, testing, upscaling, first production and product validation.

To achieve KET centre status, BC completed a questionnaire and provided background documents that demonstrated that it had the resources and the commitment to work with industry. All KET centres are added to a database that is accessible by SMEs and other stakeholders to identify technological service centres active in their fields. There are only eleven current KET centres in the UK and just two in Wales. This award will therefore help raise the profile of our services and facilities.

Expertise and equipment - key to gaining KET status

Close ties with Woodknowledge Wales continue to bear fruit

The positive relationship that was forged with Woodknowledge Wales in 2016 /17 continues with the secondment of BC's Ceri Loxton to WKW continuing into 2018/19. The success of this secondment has led to its extension and closer integration of activities between WKW and Bangor University.

WKW now sponsor two PhD candidates through the University's School of Natural Sciences, under the academic supervision of Professor John Healey and Dr David Styles. Estrella Yanguas-Fernández is funded through KESS and will be looking at developing sustainable forest value chains in Wales. Eilidh Forster is looking at the role that forest planting could play on marginal land. This is a very topical subject area at present as changes in the way that farmers receive subsidies after Brexit could profoundly alter land management choices for years to come.

One of Ceri's key roles within WKW is to organise WoodBUILD, an annual conference promoting greater

use of wood in the construction sector, and this year's event attracted well over 100 delegates. This year's theme was offsite manufacturing of timber-based housing solutions. ''Wales, like the rest of the UK, needs to build more homes and timber-based housing solutions offer lots of positive benefits, both in terms of build-ability and performance'' explained Ceri.

Gary Newman, Executive Director of WoodKnowledge Wales

Ceri has also provided valuable input into the Home Grown Homes Project. This project is funded through the Rural Development Programme and is being led by Powys County Council but delivered by WKW. Ceri is leading the work package on dissemination and providing input into other work packages which are looking at improving the quality of timber-based houses and the supply chain in Wales. 'I am particularly interested in the role that wood fibre insulation products can play in good quality and energy efficient housing. During my time at BC I have worked on several projects in this area so it will be exciting to see how that learning can be applied to real life building projects."

As a further sign of the relationship, WKW will be bringing WoodBUILD to Bangor in 2019. "We are looking forward to working with BC, the BEACON project, and the School of Natural Science at Bangor University to bring WoodBUILD to Bangor" said Gary Newman, Executive Director of WKW. The event will draw on the expertise at Bangor in terms of forestry and forest products, to look at how forests in Wales can deliver the products and services needed for a sustainable Welsh economy and environment.

Compound in mushroom waste could extend shelf life

FoodWasteNet

A long-term collaboration with Co-op Food, Monaghan Mushrooms and Welsh SME Pennotec, has evolved from two successful projects funded through the BBSRC network FoodWasteNet. Their aim was to reduce food supply chain waste by diverting a significant waste stream - mushroom trimmings - from landfill and to produce a fresh foods preservative from it.

The Proof of Concept project was completed in March 2018 and demonstrated that Industrial Biotechnology processes can produce higher yields of antimicrobial polysaccharide than are obtainable through less environmentally favourable chemical extraction. "Our key achievement was demonstration that a treatment with the active derived from mushroom waste discouraged Penicillium growth, effectively preventing spoilage of organic fresh produce and extending its shelf life" says BC Scientist Dr Olga Tverezovskaya.

The consortium is now preparing a proposal for Innovate UK funding to validate the initial results and expand food industry applications for a new bioactive.

Slava Tverezovskiy and Olga Tverezovskaya with project partners at Co-op HQ

Events

International Panel Products Symposium – IPPS 2017

The team from BC once again welcomed a large gathering of wood-based panel manufacturers and experts to the IPPS conference in Llandudno. The conference was held in October, and was dedicated to the memory of Prof. W.B. (Bart) Banks, who played a key role in establishing BC while serving as professor of Forest Science at Bangor University.

BC Director Rob Elias opened the event with some fitting words about the vision for academia supporting industry, which is central to the conference and to the ethos of the Centre. It is important that we continue to shorten the time lag between lab-scale development and the adoption of new ideas into industrial production and manufacture. The IPPS conference as ever seeks to accelerate this process, promoting networking and sharing of knowledge. Several exciting new products were presented, showcasing the emerging ideas from academia today, and progress in industrial development of MDF fibre recovery systems in particular.

A keynote talk on volatile organic compounds by Martin Ohlmeyer, of the Thünen Institute of Wood Research in Germany, posed the ongoing challenge to producers: that of maintaining panel performance while still meeting the requirements of eco-labelling schemes. Several researchers presented suggestions of bio-based scavengers and resin formulations to assist in this task.

Keynote speaker Martin Ohlmeyer addresses the delegates

As always, the conference was as much about the networking and discussions between delegates as the presentations in the main auditorium. Posters from students and researchers provided additional information on ongoing research, and trade stands from companies offered expert advice and product information.

1st International Conference on Safe Biodegradable Packaging

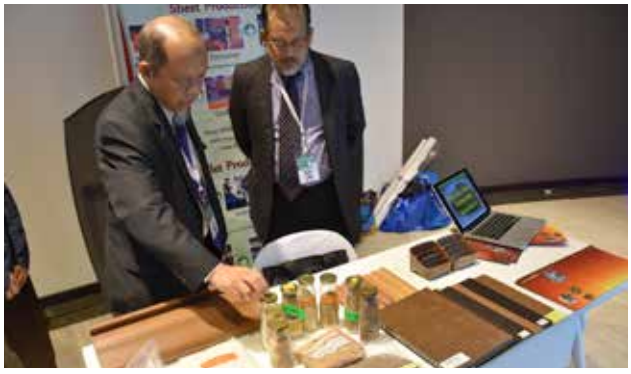
July saw two colleagues travel to Malaysia for a packed agenda of conference speeches, project meetings and industrial visits. Under our SafeBioPack project, Qiuyun Liu and Campbell Skinner travelled to meet partners from Malaysia, Australia and the UK for a packed ten-day agenda.

The main event was the 1st Conference on Safe Biodegradable Packaging, organized by the project consortium to promote the work of the project and build networks of packaging researchers, manufacturers and buyers. The two-day conference was hosted by MIGHT (the Malaysian Industry-Government Group for High Technology) in Kuala Lumpur and attracted around ninety delegates from around the world.

Campbell gave a keynote presentation on life cycle assessment (LCA) in relation to biodegradable packaging, while Qiuyun, who is co-project lead for Bangor, updated delegates on all the latest developments in the project.





Clockwise from top L: Safebiopack conference speakers and organisers; Mr Amir at the Eco Premium Packaging stand; Deputy Vice Chancellor of UPM (centre) with Dr Thariq and Dr Jawaid; Dr Khairul and Ramli Napiah of PolyComposites; project partners at UPM; Steve McCormick at the Parkside stand

Events

Opportunities for knowledge exchange and networking were plentiful, in particular at a beautiful conference dinner organised by our Malaysian hosts…all served up on our biodegradable plates and bowls of course!

Project meetings and industrial visits followed. These included a visit to ENER Worldwide, a pulp-moulded punnet manufacturer in the north of the country, who kindly allowed us to sample production data for use in the LCA component of the project.

Malaysia's palm oil industry produces a huge volume of under-utilised 'empty fruit bunch' biomass annually. This fibrous material is a waste product from the palm oil extraction process and much of it is currently burnt as waste. The project is using this waste material to develop biodegradable alternatives to some of the single-use plastic packaging items currently seen in use in our supermarkets.

UK partners include ourselves, manufacturers Parkside Flexibles and Scitech Adhesives (based in Flint, North Wales), Nextek consultants and Tesco supermarket.

Polycomposite's Malaysian production line

Campbell Skinner chairs an LCA meeting with project partners

Biodegradable plates and bowls in use during conference breaks

Exploring the use of plastics in Chinese agriculture

In May, Rob and Qiuyun visited China at the invitation of Professor Yan Changrong of the Chinese Academy of Agricultural Sciences (CAAS). The five-day trip consisted of lectures and meetings with staff and students at CAAS, as well as a visit to a Chinese biodegradable plastics manufacturer, Huasheng Ltd in Nantong.

While at CAAS, Rob gave a well-received lecture about bio-derived materials and their potential for application within the agricultural sector. The lecture covered some of the key research areas currently engaging our scientists at BC, and included the use of bioplastics for mulching, novel design of pest control devices, and the use of biomass for value added products. New research ideas were exchanged during a Q&A session and the group discussions that followed.

Huasheng Company is a leading manufacturer of mulching films in China. The visit started with a talk delivered by Rob on the biopolymers market and its applications, and was followed by a tour of the site. In a move to develop new technology, Husheng are now investing in the development of a range of new biopolymers. The tour therefore included a visit to look at the construction of their new biopolymer production factory. The building is specifically designed for their biopolymer reactor and is a major step in their investment in bioplastics for the Agritech sector.

The visit provided a good opportunity for knowledge exchange, networking and relationship building. There was much common ground between all three parties, with the development of biodegradable mulching films (to increase the crop yields while reducing residual plastic pollution in soil) being a key research interest for all - so watch this space!

Biopolymer production at Huasheng Co. factory

Qiuyun Liu and Rob Elias with Professor Yan Changrong

Rob about to present at Huasheng Co. headquarters, Nantong

Bangor Science Festival draws the crowds

In March the Centre took part in the Hidden Worlds Exhibition at Bangor University. This exhibition takes place during Bangor Science Festival, which is a nine day celebration of science, technology, engineering and maths and is aimed at entertaining and engaging people of all ages.

BC's Ceri Loxton has been helping Stevie Scanlan and Dr Rosanna Robinson of Bangor University organise the Hidden Worlds event for a number of years after first attending with her own children. "I just thought it was fantastic that the University opened it's doors and showed the public the depth and breadth of activity that was going on. People just love it" said Ceri.

This year at Hidden Worlds there was a cluster of displays around the theme of plastic pollution – the impact that plastic pollution in having in the oceans and on our beaches. The Centre participated by preparing a display on biobased compostable packaging. Biocompostable materials for single-use food packaging could significantly reduce plastic pollution in our environment. In addition to the display, we also had a hands-on activity for big and little kids – having a go at making a sheet of paper… a great way to engage and educate.

This year the event attracted over 1,000 members of the public through its doors and was a great opportunity to showcase potential new products and gain feedback.

GŴYL WYDDONIAETH BANGOR SCIENCE FESTIVAL

Ceri Loxton demonstrates paper-making

Dr Qiuyun Liu at our compostable packaging stand…before the crowds arrive!

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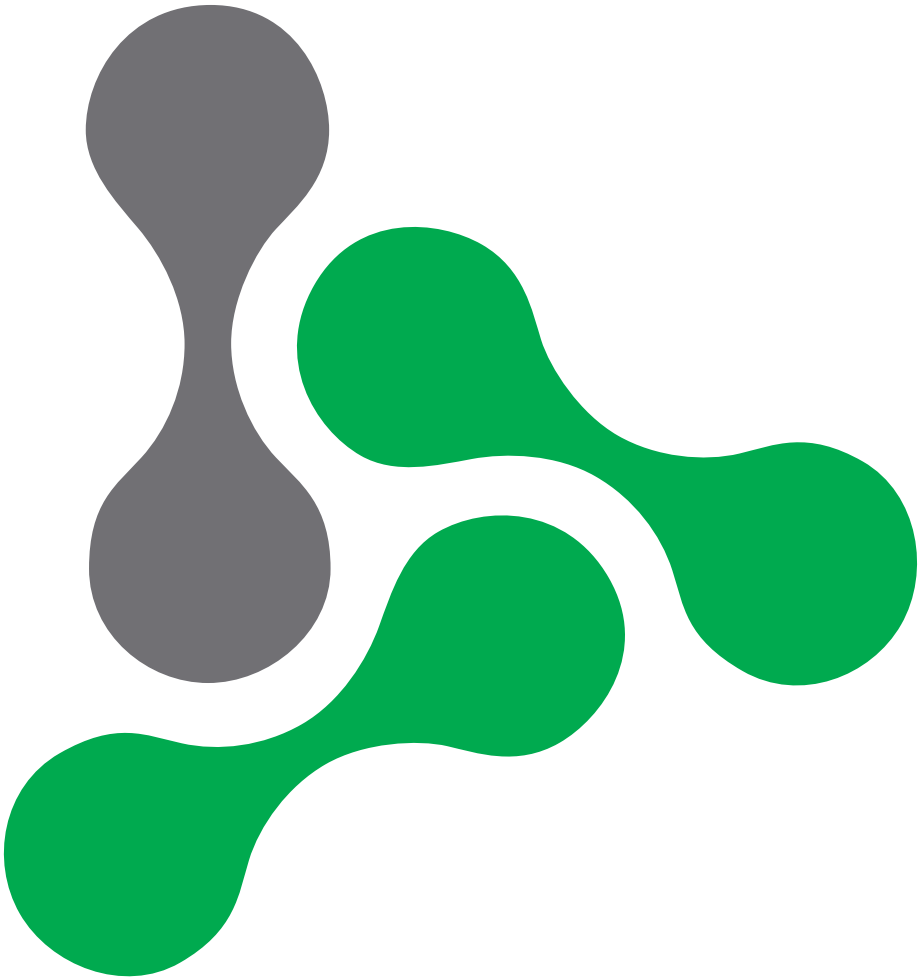

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