

GLOBAL PACKAGING RESEARCH

The international packaging research and education newsletter

Biomaterials' cushioning performance under scrutiny

Packaging developers are increasingly looking to renewable resources as the raw materials for next-generation transit cushioning. But do the environmental and media friendliness of these materials mask a less convincing sometimes even untested performance profile?

One well-publicised example originating in the US is Ecovative's Mushroom Packaging, made from fast-growing mushroom mycelium. The company's prospects have grown just as quickly, with the story of 'disruptive' invention and entrepreneurship leading to a Du Pont Packaging Innovation Award, World Economic Forum Tech Pioneer Award and, last year, licensing of North American and European production and sales to Sealed Air Corporation.

Ecovative says the material "matches the cost and performance of existing plastic packaging parts". At the European launch, president of Sealed Air's Protective Packaging business Ryan Flanagan talked about "helping our customers achieve their sustainability objectives ... without sacrificing performance or cost competitiveness."

But elsewhere it has been described as "expensive" and a lack of any published performance data has been noted.



Ecovative's Mushroom Packaging

Others have been more encouraging. Rochester Institute of Technology (RIT) has been carrying out preliminary impact and vibration tests on the material. Dan Goodwin of RIT reports that the shock performance data looks 'normal' and "would probably allow use in protective design applications." He adds: "We are continuing tests to see if we can find techniques to get more consistent vibration results, as the preliminary results were inconclusive."

He concludes: "Sealed Air has an excellent reputation for providing customers with valid data, and this will hopefully be forthcoming in the near future." See also pp4-5.

www.ecovatedesign.com

Improved IAPRI website

The IAPRI Board has approved a new logo for the association and a fresh redesign for the website and this newsletter.

As well as an improved design, the website will benefit from more regular updating of association and member activities. Members are encouraged to keep general secretary Marie Rushton informed about news and supply photos for a picture gallery. They are

requested to contact her for new login information for the member pages: marierushtoniapri@gmail.com

She says: "We wanted to give the website a more contemporary and visually clear and appealing design, with easier access to information – and we think this is what we've achieved."

www.iapriweb.org

This issue:

News

1 'Sustainable' cushioning
IAPRI website

2 Comment
Solving recycling puzzles

Melbourne 2014 programme

3 Developments in mineral oil barriers

Putting the case for packaging in the UK

IAPRI seeks new Board members

Technology spotlight

4 Cushioning: protecting the environment and the product

Members profile

6 ESIReims: Engineered in France

Comment

'Containing' food waste

Food waste has been identified as a major problem in the United States, and has led to the development of partnerships including the Food Waste Reduction Alliance (FWRA). Founded in 2011, the FWRA has launched a three-year initiative to reduce food waste to landfill. It estimates that some 60 million tons of food waste was generated in the US in 2010, with around two thirds of that ending up in landfill.

Food waste issues are global, as reflected by the latest figures from WRAP (Waste and Resources Action Programme) in the UK. Here, annual avoidable household food waste amounts to some £12 billion. Around 60% of household food waste could have been eaten. Phase III of WRAP's Courtauld Commitment, involving over 40 supply chain partners, includes a target to cut food and drink waste by 5% from 2012 levels by 2015.

Incpen (see p3) continues to make a strong case for packaging's role in lengthening the useful life of products.

At the same time, many waste problems can be traced back to conservative labelling on the part of producers, compounded by poor consumer understanding of shelf life information. Packaging and labelling technology can provide consumers with easy-to-understand indicators for product freshness and safety. Active labels that change colour with the passage of time, or through monitoring CO₂ levels, are now commercially available.

Innovations in active packaging can and should play a major role in reducing global food waste.

Dan Goodwin, Rochester Institute of Technology



Melbourne skyline

Solving recycling puzzles

The forthcoming K2013 plastics show (Düsseldorf, 16-23 October) will see Germany's Fraunhofer IVV (Institute for Process Engineering and Packaging) presenting its solvent-based CreaSolv technology for recycling plastics, including expanded polystyrene (EPS), polylactide (PLA) and metal-plastic composites.

In fact, according to deputy head of Fraunhofer's process development of polymer recycling department Martin Schlummer, the process has been successfully tested with all the major packaging polymers.

With regard to EPS, he says: "There are other EPS recycling activities, but most of them end up with general purpose PS, since the thermo-oxidative stress causes a loss in molecular weight. In contrast, CreaSolv safeguards the molecular weight of the waste EPS, and therefore it can be recycled in a closed loop into more EPS."

Fraunhofer is also talking about a "new logistical plan for collecting EPS waste at low cost".

When it comes to PLA, Schlummer admits that amounts of post-consumer waste remain low. But he contrasts the CreaSolv process with the Loopla system from Galactic, Belgium, launched some four years ago. "Our process retains the molecular weight of the PLA, and therefore saves the tremendous amount of energy applied to produce PLA from monomers," he says. "It is intended to be much more resource-efficient than the Galactic process."

"CreaSolv safeguards the molecular weight of the waste EPS, so it can be recycled in a closed loop into more EPS"

CreaSolv can also be used with construction waste EPS, where flame retardants may be present, and with plastic-covered metals or galvanised plastics used in the automotive and construction industries, for example. www.ivv.fraunhofer.de

Melbourne 2014 programme

IAPRI's 2014 Conference (June 15-18) in Melbourne, Australia, will serve up a pot-pourri of social engagements on top of high-quality keynote, oral and poster presentations.

The board meeting and lunch on Sunday June 15 will be followed by a "welcome cocktail function" at host Victoria University's City Convention Centre. Monday will see the official Conference opening followed by a "national" keynote speaker. Later the same day there will be an evening social dinner and spit roast at the City of Melbourne Bowls Club.

www.vu.edu.au/19th-iapri-world-conference-on-packaging

Tuesday's sessions will open with an "international" keynote and conclude with the formal conference dinner at the Melbourne Aquarium. The third and final keynote will come on Wednesday. The day's proceedings will be followed by the IAPRI Scholarship presentations, award ceremony and Working Group meetings.

For those wishing to prolong their stay, there will be post-Conference workshops on Thursday June 19 followed by a choice of social trips on the Friday.

Developments in mineral oil barriers

Sappi Fine Paper Europe headlined its appearance at the September FachPack trade show in Germany with the launch of mineral oil barrier (MOB) coated papers, demonstrating this is still a problem in search of solutions.

The Kraft and Gravure-grade papers, for inner and primary-pack bags, were the result of over a year's development work with coating supplier BASF and the Eurofins testing lab.

According to Sappi, this is the first directly-applied coating (as opposed to a separate inner bag) to have demonstrated sufficient MOB quality to comply with German regulatory standards for migration levels.

“The methods to measure mineral hydrocarbons are not simple, and cannot be viewed as fully quantitative”

Achieving a uniform coating layer was of critical importance, but also challenging, stated senior product specialist at Sappi Central R&D Jos Lycops. “This requires, first of all an extremely smooth and low-porosity base paper, followed by a low-porosity pre-coat with good coverage,” he said in a launch statement.

For BASF, the challenge was to develop an aqueous dispersion polymer system offering a defect-free film which did not block on the reels.

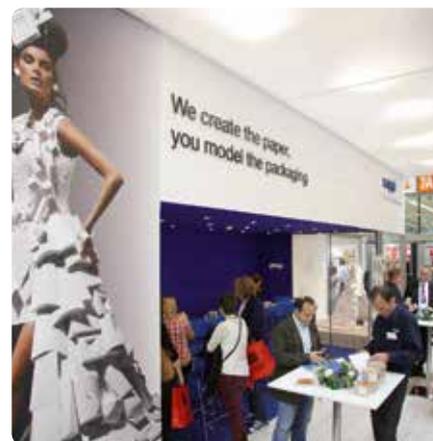
According to food contact compliance manager at Smithers Pira in the UK Alistair Irvine, there are still questions about the source of any contamination in foodstuffs. This issue was reviewed very fully in the European Food Safety Authority (EFSA) report on mineral oils in foods published around a year ago.

“EFSA estimated that just over a third of the hydrocarbons in foods originated from recycled paper and board,” he recalls. “The methods to measure mineral hydrocarbons are not simple, and cannot be viewed as fully quantitative. But even allowing for the uncertainty, that still means that EFSA estimated at least half of the hydrocarbons present were entering food from other sources.”

Nonetheless, Irvine emphasises, there is still pressure on the supply chain to reduce levels of mineral oils, particularly the aromatic variety. “There was an industry initiative announced in December 2011 to remove inks containing hydrocarbons from use in the printing of packaging, but of course, that doesn't take account of the underlying contamination in recycled feedstock,” he says.

Barrier layers are another alternative, says Irvine, though clearly a challenge in an industry with such tight margins. “I haven't seen the data on how effective they are,” he adds.

www.sappi.com



Sappi models MOB papers at FachPack

Putting the case for packaging in the UK

The UK's Industry Council for Packaging and the Environment (Incpen) has been arguing that EU recycling targets should remain at their current level, while also explaining packaging's positive role in sustainability.

Contributing to the consultation on EU waste management targets, director Jane Bickerstaffe explained that “leakage” at different stages in the collection and recycling process set an effective limit on targets.

“If 95% of households have collection facilities, 95% of those households use them and contribute 90% of their recyclables, and there is only 10% contamination, then the maximum proportion of

material that can be recycled is 73%,” she stated, stressing that this was an unlikely, best-case scenario.

Bickerstaffe has also had her voice heard in the national media. In the Guardian, she was quoted saying: “What people don't realise is that packaging has a job to do – ensuring that the product doesn't get overheated on the dock, or in the lorry, or to deliver the goods in a good condition.” She then wove in data on the shelf life of shrink-wrapped cucumbers, and added: “[People] don't realise that the vegetable wouldn't have got to the shop without plastic.”

www.incpen.org

IAPRI seeks new Board members

IAPRI is keen to recruit three new Board members to fill positions which will become vacant in June 2014.

The Board currently consists of 10 members. Individuals are normally elected for a term of three years and can be re-elected once. They

must represent an organisation which is a Full Member of IAPRI. Anyone interested in finding out more about the role and selection process should please contact general secretary Marie Rushton: marierushtoniapri@gmail.com

Cushioning: protecting the environment and the product

How well do renewable and biodegradable cushioning materials perform in comparison with petroleum-derived polymers? Are there barriers other than cost to their wider introduction?

When it comes to factoring in environmental impact, the focus for many – if not most – of those involved in packaging design and engineering has been on primary retail packaging: the kind that the supermarket shopper holds in his or her hand every day.

But many of the same calculations, cost-efficiency evaluations and substitutions are being made every day in the world of business-to-business transit packaging. And in fact, as the debate about home delivery packaging for online purchases demonstrates, protective packaging for transit is a consumer-facing issue, too.

It should come as no surprise, then, that packaging research is increasingly being asked to explore new options when it comes to cushioning materials. Typically, this involves the production, adaptation and testing of materials deemed to be more sustainable than petroleum-based products such as expanded polystyrene (EPS) and polyethylene (EPE), especially those derived from renewable resources.

For instance, since 2009, IAPRI members Celabor in Belgium and



ESIREims' cushioning

ESIREims in northern France have collaborated on the Agrocalage (Agro-cushioning) project, part of the Interreg IV programme of cross-border co-operation funded by the EU's European Regional Development Fund. Agrocalage is applying R&D to cushioning materials derived from agricultural products.

Packaging department manager at Celabor Sébastien Cajot explains: "Our material choice was focused on starch (extracted from wheat or from potato, typically) as the main constituent of the cushioning material, and on by-products from hemp and flax as a fibrous reinforcement."



Starch-based material from Celabor

He talks about a "fruitful collaboration" in the way that the strengths of the two institutes have proved to be complementary. He says: "While Celabor has been in charge of the preparation and characterisation of the fibres, the characterisation of the materials, their static behaviour and finally the study of their disintegration, ESIREims has been in charge of the formulation and implementation of the materials, their characterisation and dynamic behaviour."

According to Cajot, results to date have been encouraging. "The performance of the cushioning materials obtained at lab scale is really good, and as efficient as EPE of a similar thickness," he says. "They could be particularly effective in the protection of rather heavy objects."

ESIREims adds that, though the shock absorption of starch-based foams was comparable with EPE, they were slightly heavier. This can be a significant issue in transit packaging.

As Celabor points out, there are opportunities to tailor the resulting materials to specific needs. "Different formulations have been studied in the project in order to control the extrusion parameters of the materials (including nucleating, blowing agents and plasticisers), and also the eventual addition of fibres," Cajot explains.

Technical specialist at ESIREims Marie Le Baillif emphasises the project's focus on materials and additives which are from renewable resources and are biodegradable. She was a part of the team behind a paper at the June 2013 IAPRI Symposium which looked at the effects of three additives – gluten, glycerol and sodium bicarbonate – on extruded starch structures as part of Agrocalage.

"We found that formulations clearly affected the size of the cell and its density," says Le Baillif. "We're still investigating and mapping the specific and synergistic effects of different combinations." The 'starch' itself is not a homogeneous material, she notes, with different proportions of amylopectin and amylose affecting the final properties.

Currently, the aim is to extrude sheets of expanded starch tailored to offer different types of cushioning performance. "If this is successful, then the next stage would be to move on to injection moulding," she says.

Today, in France, there are examples of companies using starch-based loose fill in transport packaging, says Le Baillif. But the challenge is to produce and commercialise moulded components. "It's a bit early yet to find starch-based transit packaging of this sort," she says. "We haven't shown yet how long the materials can be stored before use without loss of quality." This shelf life would need to be measured in months for it to be commercially acceptable.

But she is optimistic that, once key properties have been demonstrated, industry will be eager to embrace these new-generation materials. After all, EPS is widely viewed as being difficult and costly to recycle. "Companies know that changing to more eco-friendly packaging is good for their image," she says.

At Celabor, Cajot believes that prices of starch-based cushioning will remain higher than for petroleum-derived plastics. Then again, the issues of fluctuating oil prices and limited fossil fuel resources are likely to grow in importance. "Companies may be ready to change their current cushioning for a 'greener' alternative, but it will depend on the price and on the certainty that it will provide similar – or better – properties."

Even where a product based on renewable resources has been commercialised by a packaging supplier, this does not always mean that the material's properties are well documented. In May this year, Sealed Air Corporation announced that it was going to extend sales of Ecovative's Mushroom Packaging from North America into Europe (see p1). This is a material based on mycelium or mushroom roots, first launched by Sealed Air as Restore last October.

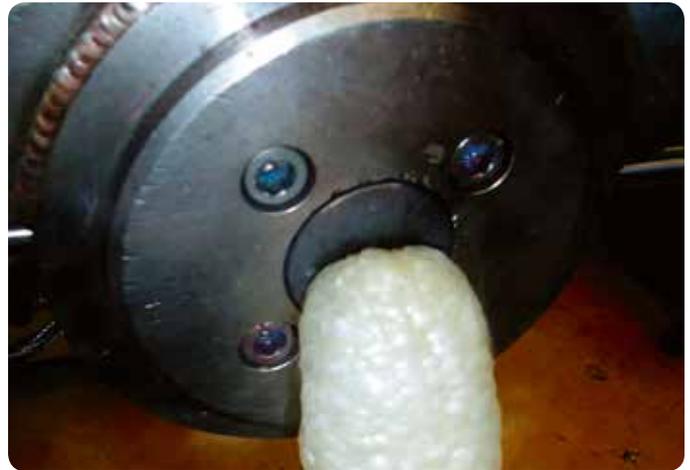
"We haven't shown yet how long the materials can be stored before use without loss of quality"

IAPRI's June Symposium heard a paper from Rochester Institute of Technology (RIT) in the US, which has been conducting preliminary shock and vibration tests on the new material. But according to RIT's Dan Goodwin, there are still plenty of questions surrounding what Sealed Air characterises as a "rapidly renewable and environmentally responsible" alternative to EPS.

RIT plans to move on to transport simulation assessments of the material.

Where an alternative material does compete with EPS, for instance, on shock and vibration performance, there may be other limitations on its use. Goodwin cites the example of the fibre-based cushioning from Corrupad in France, which is cost-competitive and offers good performance, but which is not moulded into shape, and therefore provides less design flexibility.

RIT has also been looking at opportunities with foamed polylactic acid (PLA), which was the subject of another Symposium paper in Helsinki, this time from Carlos Diaz. His particular focus was on microcellular foaming, which uses inert gases in a supercritical state in injection moulding. "Microcellular PLA and PLA/wood fibre



Extruding starch foam at ESIReims

composites are of research interest right now, but I'm not aware of any commercial production," he says.

As detailed in the July 2013 IAPRI newsletter, as part of the Biopolymer Network, Scion in New Zealand has been working on applications of Zealafoam EPLA. So far, the emphasis has been on complete moulded packs such as fish boxes rather than inserts for transit packaging.

Meanwhile, cost, performance, versatility and shelf life are not the only challenges standing in the way of the commercialisation of renewable resource-based cushioning materials. In more general terms, the bioplastics industry is in the middle of a heated debate about the use of primary food crops for the creation of packaging.

According to industry organisation European Bioplastics, so long as there is enough food to go round, questions about the use of crops as feedstock are often driven by emotion rather than logic. Says MD Hasso von Pogrell: "If you agree that using biomass for industrial purposes makes sense and is morally acceptable, then the question should focus on land-use efficiency, and how more bioplastics can be produced using less land." He points to a report from Germany's nova-Institut renewables consultancy which supports this view.

The industry talks about 'first generation' feedstock based on crops and the 'second generation' based on bio-waste. Although the brands which use these biomaterials are eager to move on to the second option, with all the good publicity it brings, it remains to be seen whether the functionality of the end product and efficiency in production will allow this to happen.

www.celabor.be
www.univ-reims.fr
www.rit.edu
www.scionresearch.com

ESIREIMS: Engineered in France

When in 1989, ESIEC (Ecole Supérieure en Emballage et Conditionnement) was created at the Université de Reims Champagne-Ardenne in northern France, there was a clear 'gap' in packaging engineering education which needed addressing.

Today, there are not only other institutes in France offering similar expertise, but there has been an expansion in the areas covered by the school to include thermal and energy engineering. As a result, two years ago, it took the new, broader-based name of Ecole Supérieure d'Ingénieurs de Reims (ESIREIMS).

ESIREIMS professor Serge Odof explains: "When ESIEC was set up, there were fewer than 10 students and four or five teachers. Originally, it also had no dedicated site. Today, there are around 25 university professors at ESIREIMS, some 15 industry-associated teachers and five technicians. The number of students is around 250, comprising 75 in each year of study." These student numbers are split between 50 for packaging and 25 for thermal engineering.

The engineering diploma (see box-out) offered by ESIREIMS is, he says, equivalent to a master's degree, but with more hours of teaching in the course.

Those who successfully complete the diploma are much in demand. All find a job within six months of leaving the institute, around 30% of them outside France. The majority end up in the cosmetics industry, food and drink or the industrial packaging sector.



The ESIREIMS site

Currently, there are five PhD theses underway in areas such as package testing and biomaterials. Longer-term, the school is

planning to increase the number of PhD students researching both the mechanical and material sides of packaging.

External collaboration includes work with Danone, and with Celabor, Belgium, on starch-based biocushioning as part of the Interreg IV programme (see p4). There has also been close co-operation with Metropak, a pack testing business set up by two ex-students. "Metropak has sponsored two PhD theses on non-Gaussian characterisation of random vibration during transportation, and we are currently starting new research with them dealing with time reduction in the vibration test," says Odof.

"At the end of the third year, students have to take part in an industry-funded study"

In fact, the focus on practical research starts during the diploma itself. He explains: "At the end of the third year, students have to take part in an industry-funded study. Companies give the school 4,000 euros to employ a student and school equipment in solving a particular problem, typically a cost-saving study or an R&D test."

When it comes to investment, ESIREIMS is planning to buy a new random vibration system, a new differential scanning calorimeter and, for plastics, a system for thermogravimetric analysis, extrusion equipment for making bio-cushioning materials and a shock-test machine.

Clearly, the school has ambitious plans for the future.

www.univ-reims.fr

ESIREIMS' Diploma

The first year of the packaging engineering diploma at ESIREIMS is based on fundamental maths, physics and chemistry, with a focus on the main classes of material: fibre, plastics, metal and glass. There is also an introduction to design.

The emphasis in the second year is far more clearly on the role of 'packaging engineer', including the details of packaging machinery, printing processes, the interaction between packaging and product (migration and stress cracking, for instance) and project management. "It's still relatively new for us, but for the last two years, we've also run a new course on the environment, including lifecycle analysis, eco-design, and so on," says school professor Serge Odof.

"Unlike many other engineering courses which offer packaging as an option, with the exception of thermal engineering, we focus exclusively on packaging," he adds.

www.iapriweb.org International Association of Packaging Research Institutes

IAPRI was established in 1971 as an international membership association to promote packaging research. It is a unique global network which allows organisations to communicate and develop ideas, exchange experiences and in many cases reduce duplication of effort.

For more information please contact: IAPRI Secretary General, Marie Rushton e marierushtoniapri@gmail.com

To contribute to the next issue of 'global packaging research', please contact Editor Paul Gander e paul@gander123.plus.com

Published by Whitmar Publications on behalf of IAPRI