

# Good things come in small packages

Is there a way to make cardboard as robust as plastic? Of course, SustainPack's **Kennert Johansson** tells Jim Banks, you simply manipulate its structure. He explains how nanotechnology is shaping the future of environmentally sensitive packaging.

**The packaging** market is changing rapidly in response to growing pressure to meet environmental standards and stricter regulations. The drive to deliver high-performance, cost-effective and sustainable packaging has never been greater.

One solution involves using nanotechnology to make fibre-based packaging from renewable resources. This is the central tenet of the SustainPack project, developed in response to a fixed framework research proposal backed by the EU.

Based in Sweden, SustainPack was conceived in 2002 to support the development of the Swedish forestry industry, which is closely linked to the packaging sector.

Kennert Johansson, SustainPack's coordinator, explains: 'Around 50% of the paper products from Swedish forestry go to the packaging industry, which is maybe slightly higher than in other European countries, so it was a very interesting project for us. We looked at the market and from our statistics we concluded that plastic was growing faster than paper-based packaging in both flexible and rigid forms. That led us to discussions on fibre-based packaging and renewable resources.'

The project's backers recognise that fibre-based packaging has huge potential, but accept that to realise this potential there are key goals it must achieve (see box, above).

In response, SustainPack is launching a number of sub-projects that look to extend the limits of fibre-based packaging materials through the application of nanotechnologies.

Johansson says: 'We looked at renewable resources such as paper, but recognised that in consumer packaging it is always used with barriers, either aluminium or plastics, especially in the food industry, though also in electronics packaging. So we wanted to see if we could achieve packaging based completely on renewable resources.'

## MANIPULATING MATTER

One of the key achievements of the project, which concludes in May 2008, will be proving nanotechnology's potential in developing truly innovative packaging materials.

Nanotechnology involves applying science and scientific knowledge at the nanoscale for industrial or commercial objectives. Although not actually the smallest unit of measurement, the nanoscale is the smallest scale at which matter can be manipulated.

### Realising nanotechnology's potential

Fibre-based packaging must:

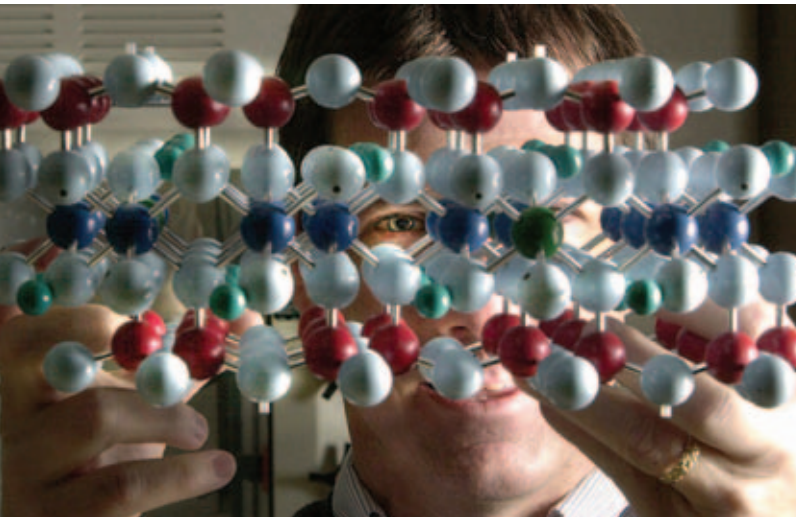
- Perform better with fewer fibres
- Have built-in barrier properties
- Be both active and interactive
- Provide new opportunities for structural design

'Twenty years ago people were talking about moving to RFID, but it hasn't happened yet. The price needs to come down first.'



SustainPack is working on communicative packaging, which uses temperature sensors to help reduce shrinkage of fresh products during storage and transportation.

## FOLDING CARTONS & CARTONBOARD



Nanoparticles, shown here as a molecular model, could provide a solution to the challenge of providing sustainable packaging.

When the technology is fully mature, it will significantly impact virtually all industries and areas of society. Fibre-based composite films, which mix nanofibrils and nanoclays, have already shown good progress in many areas of packaging. Similarly, the use of renewable polymer mattresses using different composites shows great potential.

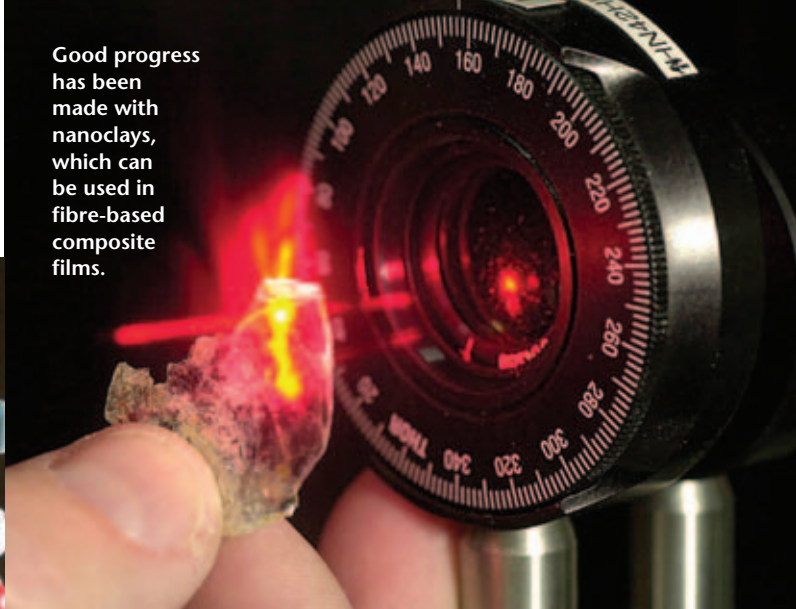
The ability to manipulate matter at the nanoscale means materials that are easy to recycle, such as paper and cardboard, can be given the properties of more robust and practical packaging materials, such as plastics. For example, nanofibrils – 20–200nm diameter chains of cellulose molecules that form the cellulose fibres found in paper – can be blended with other materials to give enhanced properties.

In addition, nanoclay – a ~1nm-thick sheet-like mineral, which naturally forms in stacks and can be split apart into individual platelets – can be blended with renewable polymers to produce improved plastic materials.

### Seven examples of SustainPack's success

1. A corrugated box offering performance equivalent to standard products but using lightweight material and incorporating fibre-based cushioning and an RH indicator/logger
2. A carton with attributes similar to existing products using lightweight material and incorporating a 2D barcode
3. A carton comparable to current products, but with lighter material, a laminated barrier film and a 2D barcode
4. A barrier-coated tray for chilled ready meals, sealed with a bio-based nano-composite film lid and incorporating a temperature logger
5. A flexible packaging film for frozen food incorporating barrier coatings and a temperature logger
6. A flexible packaging film for snack products, incorporating barrier coatings and an RH indicator
7. A carton or micro-flute box for luxury goods incorporating a biodegradable polymer window, moving image imprint and anticounterfeiting technology

Good progress has been made with nanoclays, which can be used in fibre-based composite films.



'We wanted to see if we could achieve packaging based completely on renewable resources.'

### BUILDING A FUTURE

The SustainPack initiative consists of six sub-projects, all designed to establish fibre-based materials as the future for the packaging industry (see box, right).

The 35 partners working on these projects include research organisations and universities. Crucially, industry partners, including Ahlstrom Research and Services, Kappa Packaging Development Ltd, Supermarkets Ltd and Smurfit WW Research, are also on board.

Johansson notes: 'This needs to be a value chain project, so we have to consider the big packaging retailers' requirements.

We will launch seven demonstrators later this year to show what we have done [see box, left], which will then inspire the industry to go further along the line of renewable packaging. We want people to fully understand the outcome of the project.'

Johansson adds: 'Each demonstrator has an element from three or four of the different sub-projects. In some of those sub-projects we have only proof of principle, so there is still a lot of development work to do. For liner boards in corrugated boxes, for example, there are problems in a cyclical climate in which they easily lose their properties, so we are taking a research-based approach to learning

### The SustainPack sub-projects

**Sub-project 1.** Determine what the market needs to direct the applied research projects towards delivering commercially and technically viable nanotechnology packaging solutions

**Sub-project 2.** Establish a nanofacility to produce cellulose and mineral-based nanostructures and deliver lean and effective fibre-based materials

**Sub-project 3.** Develop renewable composite films, incorporating fibres materials and renewable plastics, to compete with synthetic polymers

**Sub-project 4.** Develop coating and printing technologies

**Sub-project 5.** Develop fibre-based 3D composite packaging solutions

**Sub-project 6.** Develop one and two-way communicative packaging

more about such problems and solving them using different methods. We have certainly provided a good foundation for future research.'

### A PLATFORM FOR DEVELOPMENT

There are also areas where the SustainPack project has made significant advances without producing a demonstrator product. For instance, its work on printing active elements directly onto packaging has laid the groundwork for a process that could ultimately make tagging individual items more affordable, particularly if its research is linked to that of other organisations developing RFID technologies.

Johansson says: 'There has been a lot of discussion about tags on packaging. Twenty years ago people were talking about moving to RFID, but it hasn't happened yet. If we have a reusable tray we could have a reusable tag, but the price needs to come down first. Our work in that area, which includes printing sensors onto materials, has been very good.'

The teams working on communicative packaging, which eventually could provide useful visual signals through moving images, have also made great strides, as they have in making

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barcodes, humidity and temperature monitors part of the design of fibre-based packaging.

The project's partners have realised that paper packaging is more restrictive than plastic in terms of design, hence the focus of a sub-project on 3D design. Though there is not yet a product prototype, the team has gone a long way towards developing the materials research necessary to progress the use of nanofibres in a wider range of shapes for packaging.

Johansson says: 'It is good that we decided to involve the whole value chain in the project, as it has taken the research forward more rapidly. Besides new and interesting technologies, the objective is to have more academic researchers realise that packaging is a very important business.'

Given the progress so far, it seems likely that this objective – and many others – will be achieved by the time SustainPack concludes its efforts next year. **pci**



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