Europe: a changing landscape for end-of-life mattresses

Europe’s flexible polyurethane foam industry could find itself having to produce more sustainable mattresses in the future. Visitors to the EuroPUR meeting in Lisbon heard from the experts whether they should consider it a threat – or an opportunity.

Sustainability means more than merely including a few percent of biopolyl in a flexible polyurethane formulation. Increasingly, it means that products should be designed at the outset for disassembly, with formulations kept simple to facilitate recycling. Perhaps the most important issue facing European mattress makers is to be ready for extended producer responsibility (EPR) in the EU.

Changing market demands and EU time limits for sustainability improvements will hit the mattress industry, according to Frederik Lauwaert, managing director of the European Bedding Industry Association (EBIA). ‘It will change the world for the bedding industry quite significantly,’ he said. ‘The EU is imposing increased recycling rates, and landfill will fall.’

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There is enormous political pressure in the current e-waste legislation. ‘The EC has put a lot of focus on EPR schemes,’ he said. ‘While only one country, France, has such a scheme up and running already, discussions are ongoing in the UK, the Netherlands and Belgium, he added. ‘Like it or not, political pressure is rising, and industry will not be able to delay discussions.’

Conflicting regulations

Tempur Sealy, for one, welcomes the changes. ‘They force us to rethink the way we use raw materials,’ claimed Tom Mikkelsen, the company’s global senior category manager for chemicals. ‘We want to promote PU as a sustainable material.’

But, he warned, there are no easy answers. ‘We also see that the movement, particularly on thermoplastics, forces politicians to find solutions which may not be fully sustainable,’ he said. ‘Is it really the best way to ship our trim waste across the ocean? If there is a combined effort in the industry with foam, as mattress producers and material suppliers, we will be able to adapt and prevail.’

France has set up a mattress and furniture collection and recycling process in place, called Eco-Mobilier. Remi Beulque, the programme’s advisor for development of innovative sectors, told the meeting: ‘It is important for industry to say that our products are well managed at the end of their life.’

He explained that France has set up about 5,000 collection points, which feed materials to dismantling centres. They then had to develop the markets. ‘They were small, and they still are small, but we anticipate that through R&D with the foam makers they will enable us to achieve our regulatory goals,’ Beulque said. ‘The French system relies on an organiser to link together a value chain, from collection to separators and companies who can create new materials and applications and find new markets.’

Band together

Ingrid Honfis, advisor environment and energy, Fedustria, said that it was clear that the industry cannot handle extended producer responsibility on its own. ‘As mattress producers, we need the entire value chain to help us,’ she said. ‘We need our suppliers and the waste operators. We want to bring them together in a working group on designing for circularity. This is a very important way to approach the value chain.’

This view was reflected by Eco-Mobilier’s Beulque, as he believes regulations and substances are always changing. ‘It would help if industry could collaborate with others over substances, and it will be helpful to have an approach which anticipated changes,’ he said. ‘The answer lies in production processes.’

He stressed that clarity of design for disassembly will be key. ‘It’s not just the mattress producers: the value chain needs to cooperate. We believe that EPR schemes and criteria can help guide companies and the materials they choose to use.’

Antonio Vasconcelos, managing partner at recycling consultant New Next, reiterated that products must be made for easy disassembly. Furthermore, action to find processes that can cope with traditionally designed mattresses must run in parallel with simplifying the number of elements and materials used to make them. ‘We have to work on both all the market will impose change,’ he said.

Look out for snowballs

Tempur Sealy’s Mikkelsen added that there has been a real push towards renewables among customers for many products. ‘They expect a certain level of renewable or recyclables but, at the moment, it is not so much the case in the bedding industry,’ he said.

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Certainly, the mindset needs to change. I believe the end of life is going to be very beneficial, and allow us to take those mattresses back and turn them into something useful. It is clear that, at the moment, consumers are not prepared to pay more for mattresses made with more expensive products that are more environmentally friendly. Several years ago, all raw material companies had natural oil polyols, that cost a little bit more,” Mikkelsen said. “They are acceptable for manufacturing, but consumers were not willing to pay.”

EBIA’s Lauweert said that while some people are prepared to pay, others are not. “It is important to explain to consumers why there is an increase in price,” he explained. “There is no room today for higher prices but, in the future, consumers could be ready to pay more for products.”

Across the pond
Lee Salamone, senior director at the Centre for the Polyurethane Industry in the US, said that the country does not have extended producer responsibility schemes. There are formal programmes in some states, notably the Bye Bye Mattress Scheme in California, Connecticut and Rhode Island, where a fee is imposed to facilitate the collection, processing and disassembly of mattresses.

“It’s not mandatory,” Salamone said. “There are 50 or so mattress recyclers, who have collected and recycled 4.5m mattresses, about 3m of them in California. The fee is mandatory, but the recycling is not: it’s a take-back promotional opportunity. EPR is generally considered to be a code for tax in the US.”
Squaring the recycling circle

Across the polyurethane industry, extended producer responsibility will become more important in the future. What can we do to reduce the impact that end-of-life products have on the environment? There were some suggestions at the recent EuroPUR meeting including chemical recovery and easier-to-dismantle mattresses

We make it, they buy it, they wear it out, they throw it away. We make a new one, they buy it, they wear it out, they throw it away. And so on, ad infinitum. That is the model behind conventional consumption.

How close is the flexible polyurethane industry to a circular model where 'we make it' uses materials from the 'they throw it away' part of the conventional model? What strategies might be able to close the materials loop?

As Marcel Moeller, EMEA marketing director at Dow Polyurethanes, told the Lisbon meeting: 'The pressure that we face comes from end of life. We have the markets; we have the consumers pushing in that direction. I am not saying that it is negative at all. We must work on this, and time is not a luxury.'

He said that there are a number of ways of reducing waste and starting to close the loop. The simplest approach would be to reuse products, but that may not be the easiest to achieve. 'Think about a 10-year-old mattress,' he said. 'Who wants to take that mattress and sleep another 10 years on it? We have to be creative.'

Larger wins
Mechanical recycling of waste polyurethane from production is well established. But the larger wins, he said, will come from using polyurethane to help other industries, such as rubber and wood, with their mechanical recycling.

Chemical recovery and carbon utilisation might also be possible. 'We have to be as close as possible to the end use,' he said. 'That's where we have the greatest positive sustainability. And, of course, there are renewable raw materials.

But, Moeller stressed, there is no silver bullet. 'We need all these approaches to be successful as we move from the linear to the circular chain,' he said.

If foam makers and recyclers start making raw materials from waste polyurethane, will there be competition along the value chain? Moeller doesn't believe so. 'It is not about us competing with our competitors,' he said. 'It is about us as an industry and our right to exist tomorrow.'

But the widespread use of small volumes of polyurethane in combination with other materials makes recycling complex.

'A very diverse group of downstream industries is coming back asking for help,' Moeller said. 'Polyurethane is a thermoset product; it is not that easy to recycle. And, for many of these industries, PU is a fraction of the final product.'

It is down to the polyurethane sector to find solutions for individual industries, and take these to them. 'Otherwise, the complexity will kill us,' he said. 'There is plenty of space to be innovative and extract value.'

Beware snowballs
It is also important for the polyurethane industry to address two issues: legacy chemicals and its thermoset nature. The industry needs to stand up and talk about this,' Moeller claimed. 'Some groups are talking negatively about thermoset products and recommending thermoplastics instead. We need to make sure that this snowball doesn’t get bigger, to the point that it hits us like a truck.'

Dow Polyurethanes is developing a polyol from old mattresses. 'We can make new mattresses successfully with 25% polyol in the formulation,' he said. 'We can also bring this into insulation material at 50%, with no reduction in output. The material can run on standard equipment, and the performance of the final product is unchanged. The product we have developed is also Reach compliant.'

Several flexible foam manufacturers outlined what they are doing to move from a linear to a circular business model, including Recticel. Bart Haelterman, the company's corporate manager for sustainable innovation & HSE, said they are exploring new

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chemistry and designing technologies for end-of-life foam. We are also exploring renewables to become independent of fossil fuels," he said. "We are heavily involved in mechanical recycling and sorting. This is key because end-of-life materials will have to go into the right solutions and outlets.

Different technologies
Many product manufacturers are already looking to make their products easier to recycle. IKEA is one. According to Michal Soltyński, head of foam production at major IKEA supplier Ikano Industry, they are increasingly designing mattresses with IKEA to ensure easy disassembly and possible textile recycling. Ikano has also been chemically recycling in-process waste into standard, visco and HR foam for several years, he said.

Herbert Bettinger, Eurofoam's group manager for foam recycling, outlined a process he claimed is designed to work with all kinds of foam. "The process works with materials which are wet or contaminated with bacteria," he said. "It doesn't matter."

"Repsol is already using chemical recycling for plastics. We expect to have the same success with polyurethane," Manuela Fernandez, Repsol.

In the first step, developed by Eurofoam in collaboration with scientists at the University of Würzburg in Germany, 2cm cubes of foam are heated to 250°C in an aqueous solution to degrade the material. Eventually, he said, the foam turns into "coal-like particles" which feed the second step.

After the foam is converted, the residue is dried and heated to 600-700°C in a chamber with very even heat distribution. After heating, the reactor contains approximately 22% gas, 52% oil, and 26% char," Bettinger said. "The char is very clean with no VOC, and so might be used as a material in foam formulations."

He added that polyurethane additives are also broken down by the heat of the process and are not found in the output. The oil could be further processed by the petrochemical industry using crude oil chemistry. Bettinger said. It should be possible to blend it with crude.

Energy balance
"The gas goes directly to generate electrical power for both processes," he added. "In principle, the process only needs energy to start up, and is self-sufficient afterwards."

"This means that, in energy terms, the process should be self-sustaining once it has been initiated."

It also has a low carbon footprint. "You can use all kinds of foam when it is running," Bettinger said. "The carbon footprint of this technology should not be much larger than the carbon footprint of the foam."

Manuela Fernandez, senior manager of circular economy at Repsol explained her company's participation in the Aspire European Project. This includes 22 companies, and Repsol is leading the chemical recycling part of the project.

"Repsol sees mechanical and material valorisation as its main activity," she said. "Chemical recycling could help reduce the impact of CO2 by 30-40%. The project has €10m of funding, €8m of which was provided by the EU."

Repsol would happily sell polyols from crude oil or from recycled sources, she said. There are plenty of opportunities, but it is not clear yet which technology will be the most appropriate.

"Repsol is already using chemical recycling for plastics, and we have been doing this since 2015 in our sites," Fernandez added. "We expect to have the same success with polyurethane."