



Top 10: ELASTOMERS FOR SUSTAINABILITY

First ever ranking of projects contributing most to raising the environmental profile of the elastomers/rubber industry

The top entries for the inaugural staging of ERJ's new Elastomers for Sustainability initiative has now been decided by our judging panel* led by experts in the field of polymer science & technology.

E4S is an industry-first sustainability initiative, designed to highlight significant advances for end-user sectors including tires, automotive components, construction, consumer, industrial and medical.

1 Asahi Kasei / New-generation styrene-butadiene rubber

The company's sixth generation functionalised SBR is said to show 20% lower rolling resistance than previous versions and reduced wear. For this, Asahi developed a special functional group to enhance filler-polymer interaction – to improve wear resistance and rolling resistance – and a new polymerisation technology to optimise the polymer structure for advanced abrasion resistance while maintaining processability. The advanced SBR is currently being tested by customers worldwide, with plans to commercialise some grades in 2021. Next target is to improve the wear resistance by a further 20% and to increase the stability of the polymer in the compound.

JUDGING REMARKS:

- Top marks for rolling-resistance and wear reduction through functionalisation of SBR to stick to rubber molecules.
- Market-oriented development. What is positive is the progress being made in this vital area.

2 ETB / Bio-butadiene for tire production

The project targets the construction of standalone bioethanol-to-butadiene plants and those integrated into fossil-based butadiene production sites. To deliver this, the team developed a new catalyst system to increase the energy-efficiency and bio-butadiene yield of the Lebedev process. The result could be a significant enhancement of sustainability indices across the synthetic rubber

production chain – with clear benefits also for the ethanol industry. Commercialisation steps include a demo plant in The Netherlands, with first commercial scale batches expected within three years.

JUDGING REMARKS:

- Ethanol-to-butadiene via updated, lower-energy Lebedev process – with a more efficient catalyst than before.
- A process development based on very good chemistry. With large-scale application could be beneficial for industry.

Trinseo / Highly-functionalised SSBR grade

Functionalised SSBR with enhanced filler-polymer interaction is now the way to go for tire tread rubber. New grade Sprintan 918S featuring Trinseo's proprietary functionalisation technology is at the leading-edge: offering advanced wet-grip and rolling-resistance properties in tires, including those for electric vehicles (EVs). With Sprintan 918S, the optimised styrene/vinyl-group microstructure – in combination with functionalisation – is said to enhance wet braking performance at a relatively low glass transition temperature. This, in turn, im-

proves wear performance. Since its recent introduction to the market, the material is said to be generating strong interest for EVs, UUHP/UHP summer, all-season and even winter tread applications.



JUDGING REMARKS:

- With a view to electric mobility, this product definitely has significant market potential.
- Innovative product that could have a significant effect on fuel reduction, which is important.
- Similar to Asahi entry, but the mechanism of better filler-dispersion and polymer-filler interaction is less clearly detailed.

3 Tyromer / Tire-to-tire recycling

PR: While devulcanisation has long been the 'holy grail' for rubber recycling, it remains a challenge to achieve properties anywhere close to those of virgin polymer. This project uses twin-screw extrusion to carefully process ELT rubber crumb and other waste rubber – with encouraging results. Since 2016, a facility within AirBoss Rubber Solutions has supplied 'tire-derived polymer' (TDP) to KAL Tire. The client has used it in an OTR retread compound with 20% content, as well as OTR, truck and passenger tires with 15-20% TDP. Products are currently on road trials in N. America and Europe while a car tire maker is optimising compound with 30% TDP. A second TDP facility is nearing completion in Windsor, Ontario to supply a top American brand. With financial support from the Dutch government, a third TDP plant is being built in The Netherlands to supply a top brand in the EU. Further plants are planned worldwide.

JUDGING REMARKS:

- If it really works the way it is presented, the innovative power is very high.
- Project using simple process. Some

Position	COMPANY	PROJECT	SCORE
1	Asahi Kasei	New-generation SBR technology	528
2	ETB	Bio-butadiene from ethanol for tire production	525
	Trinseo	Highly-functionalized S-SBR grade	525
3	Tyromer	Tire-to-tire recycling	521
4	Continental	Eco-rubber hose	510
5	Covestro	Sports flooring based on CO2	494
6	Behn Meyer Europe	Epoxidised natural rubber filler technology	459
7	Cabot Corp.	Engineered elastomer composites	447
8	Flinders University	Self-repairing rubber	440
9	Mitsubishi Chemical – MCPP	Incorporating renewable carbon in TPEs	430
10	Kraton Corp.	IMSS technology	424

questions in the applications area and about the next development steps

4 Continental / Eco-rubber garden hose

The strength of this project-entry is that it has delivered a pipeline taking a bio-ethylene monomer from sugar cane to a fully commercial product. The R&D work involved led to Arlanxco's development of an optimised bio-EPDM compounds able to match the performance of conventional petroleum-derived polymer. The garden-hose project is linked a broader programme at Continental; targeting similar products containing up to 95% of renewable and reclaimed/recycled feedstock and materials – including that from end-of-life tires and other rubber products.

JUDGING REMARKS:

- Commercialisation is key to achievements in sustainability. This project seems to succeed in this point
- Sugar cane to EPDM rubber is really an Arlanxco innovation. I like the potential in many other applications.

5 Covestro / Sports flooring based on CO2

This project stems from Covestro's development – with partner RWTH Aachen – of a process for CO2 utilisation in polymers, which is said to save up to 20% of crude oil in production.



Here, a CO2-based polyol enabled sport surfacing maker Polytan to create a sustainable binder for hockey pitches. This replaced an oil-based binder for the artificial turf, which typically contains an elastic underfloor comprising recycled styrene-butadiene rubber granules. The first successful installation was at the CHTC hockey club in Krefeld, Germany, a venue for international matches. Polytan's sports flooring employing the CO2-based binder is now sold and installed globally. The next goal is to apply the CO2 technology to the artificial turf backing, thereby making the entire flooring system even more sustainable.

JUDGING REMARKS:

- A smart project, about using less crude oil and integrates CO2 into the production process. Extension beyond binders would be a good achievement
- Covers a complete value chain, plus the innovative use of CO2 as a polymer feedstock.

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ABOUT THE TOP 10 TABLE

Since early 2020, companies and individuals have been invited to supply E4S entries via an online link on the ERJ website. From the strongest 20 contenders, the expert judging panel assessed each project on the basis of: Quality of the presentation; level of innovation; USP; Commercial potential; and Contribution to sustainability. Along with ratings for overall strength and weakness, the system allowed for a maximum score of 700 points.



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E4S JUDGING

The expert panel comprised:

Prof James Busfield, professor of materials & national teaching fellow director of industrial engagement & head of the soft matter group, Queen Mary University of London.

Dr. Christoph Sokolowski, lead on 'sustainability' issues within the German rubber industry association the WDK (Wirtschaftsverband der deutschen Kautschukindustrie), based in Frankfurt am Main, Germany.

Martyn Bennett, who has recently founded UK-based consultancy Midsomer Science, after a career spanning over 30 years at Avon Rubber plc, most recently as chief scientist and head of its ARTIS consultancy service.

Jiří Brejcha, head of Brejcha Rubber Consulting, and former materials development specialist at Trelleborg Wheel Systems, and before that Mitas, Prague, Czech Republic.

CAN YOUR PROJECT CHART HIGHER?

As the E4S rankings will be updated on a regular basis, companies and individuals are invited to enter for review new projects throughout the year. The next Top 10 is scheduled to be published in the Nov/Dec issue of European Rubber Journal magazine. Please visit the ERJ website for details of how to enter your company's project for review.

6 Behn Meyer / Epoxidised NR filler technology

This project addresses two important aspects of sustainability: the replacement of fossil-based materials in tires and rubber products; and reducing abrasion and, thereby, the potential contribution of tires to 'microplastics' pollution. This is achieved via a process technology that overcomes the challenges of incorporating silica-silane systems in epoxidised natural rubber compounds. While work to commercialise the technology is still ongoing, the R&D effort and findings to date represent a potentially significant step towards that important goal.

JUDGING REMARKS:

- Part of their long-term development around extending the use of sustainable materials. Background of the project is very well prepared. Good combination of materials and processes.
- ENR incorporating silica – an older story than other submissions.

7 Cabot Corp. / Engineered elastomer composites

Cabot has applied some significantly innovative mixing technology to provide rubber compounds for tire and non-tire rubber applications. The patented mixing process results in three times less undispersed carbon black in rubber compounds than conventional mixing methods. The enhanced levels of filler dispersion are said to improve the performance, safety and lifespan of tires, while reducing the environmental impact of production. Stated improvements

in rubber properties include: 20% lower hysteresis, 25% higher reinforcement, delayed crack initiation and 70% slower crack growth. Off-road tires – already being commercially used in the mining industry – are a particular focus with potential for fuel-efficient on-road tires also being explored.

JUDGING REMARKS:

- Very good process, using experience of previous work and patents. Clear strategy, clear impact.

8 Flinders University / Self-repairing rubber

Tapping the ability of certain rubber materials to self-repair is an intriguing area of polymer research, with particular implications for reuse and recycling. This Australian research team has focused in on a specially developed polymer based on sulphur, canola oil and dicyclopentadiene. Their findings show how polysulphide groups on the polymer surface react in the presence of pyridine catalyst at room temperature to undergo S-S metathesis that joins together polymer pieces into a new shape. The new rubber could, they say, be used to make products including car tires, which can be fully repaired and restored to original strength in minutes at room temperature.

JUDGING REMARKS:

- If the project can bring its power to tires, the contribution to sustainability could be high
- Self-healing chemistry is still a long way from commercialisation

9 MITSUBISHI CHEMICAL - MCPP / Incorporating renewable carbon in a range of applications



Mitsubishi Chemical's TPE compounds utilise 'renewable' carbon derived from PCR/PIR streams, biomass or carbon capture. They are said to overcome barriers to using bio-based or recycle materials in TPEs for applications requiring high levels of technical performance, regulatory compliance and quality-consistency. Formulations can include 40% of bio-based carbon, or up to 70% of recycle, for a wide hardness range – both options available in natural colour. Early applications include over-moulded grips, sanitary parts and industrial seals, with MCPP also expecting commercialisation in the automotive industry, especially of bio-based solutions for interior parts.

JUDGING REMARKS:

- Interesting approach, though the commercialisation path is unclear
- Even many minor achievements can add up to a significant advance in sustainability

10 Kraton Corp. / IMSS technology



Kraton has put in some serious work in developing a challenger to slush-moulded PVC in automotive instrument panel skin applications. As well as matching the fine-gauge processability and physical properties of the established polymer, the new HSBC also offers benefits in terms of lower part weight, reprocessability, non-fogging and lower energy-consumption during transformation. Excitement mounts as the first (of several) commercial car model with the Kraton IMSS technology is scheduled to start production in Q4 2020.

JUDGING REMARKS:

- The potential is indeed high if the material can outsmart PVC

Further details of all the Top 10 projects will be published on the ERJ website.