

Annual Report 2022

- Focusing on INNOVATION



Svensk
Däckåtervinning

Foreword

What is innovation? Innovation could be described as something that, in a new way, turns a challenge into an opportunity. The challenge could be to move faster between two places, and the solution could be an innovative new bicycle or a new type of vehicle. The challenge could also be to optimise resources in a way that is better, cheaper or has a smaller environmental footprint, and the innovation could be using recycled materials in a new way.

An innovation is particularly elegant if it solves multiple challenges at once. The Swedish Tyre Recycling Association (in Swedish, Svensk Däckåtervinning or SDAB) is currently working to encourage and support such innovation. Worn-out tyre material that is no longer useful as part of a wheel has inherent properties that can bring benefits in new applications, by offering at least the same functionality as is currently achieved with other materials, achieving cost-effectiveness and reducing the overall environmental footprint. Everyone who

takes tyres for recycling through the nationwide collection system established as part of extended producer responsibility (EPR) is also contributing to enabling innovation in the field. They are doing so in two ways: firstly, by making the material available again, and secondly, by funding the collection, processing and marketing of the material via the producers and the recycling fees.

The Swedish Tyre Recycling Association's ambitions are to provide new safe and secure benefits from recycled tyre material, to reduce exports of tyre material, to enable materials to be recycled a further one or more times before the material is chemically broken down or used for energy recovery, and to increase the material value so that, in the long run, recycling fees can be reduced. This annual report therefore looks at how the Swedish Tyre Recycling Association works to encourage innovation in order to achieve its high ambitions.

Happy reading!

Fredrik Ardefors, CEO

Contents

- Page 2** Foreword
- Page 4** What are the tyre materials and why can they add value after the tyre has ended its life on the road?
- Page 6** Which conditions support innovation, and what are the challenges?
- Page 8** What are the Swedish Tyre Recycling Association's requirements for good recycling of materials?
- Page 10** Which innovative areas are we working with?
- Page 15** How do we support opportunities for innovations?
- Page 16** Recycling facts
- Page 18** Key events in 2022
- Page 19** Contact details



What are the tyre materials and why can they add value after the tyre has ended its life on the road?

Tyre rubber has specific properties developed over more than a hundred years to offer **friction, withstand wear, be flexible, temperature insensitive, UV resistant, ageing resistant, vibration damping, sound absorbing, draining, durable, chemically stable and more.** The tyre is reinforced with steel and textiles. These properties remain when the tyre is cut into smaller pieces, but can also be developed further by processing and grading the material in

various ways. Tyre rubber can also be devulcanised or distilled in a process known as pyrolysis, both of which change its chemical structure to create new usable fractions. Finally, tyres have a large and stable inherent energy value as an additive or as fuel in combined heat and power plants and in the cement industry.

The various materials that the Swedish Tyre Recycling Association offers the market include:

Whole tyres

7 kg to 5 tonnes

Tyres in good condition that have been sent for recycling for various reasons and which, following examination, prove to be reusable. Whole tyres also are used in shipping, play areas and the cement industry.

Shreds

50-250 mm

Tyres are shredded and used as drainage material because their properties mean that the material does not freeze and does not let water through. Shreds of this size can also be used as a substitute material in aggregate.

Fine shreds

15-50 mm

Further shredding results in a finer fraction, which can be used in base courses for roads and in drain fields for water treatment as a substitute for natural gravel. With a special surface treatment the material can treat the wastewater by capturing phosphorus. Rubber concrete is a new material in which fine shreds are mixed with concrete and is particularly used in the equestrian world, for stables and riding surfaces and increasingly as building blocks.

Granulate

0-5 mm

A further step is to grind the shreds into granulate, i.e. tyre granules. Granulate has properties that are sought-after as filler in rubber asphalt and moulded products, e.g. building materials, fashion and interiors. These moulded products can be mixed with plastic to make a material that even works in 3D printers.

Powder

The finest granulate can be mixed into paint for sound absorption or as pigment, or can be used as a component for making new tyres and other moulded products.

Textile

Textiles are used in tyres as structural reinforcement. Textiles can be used in chipboard and to reinforce concrete, among other things

Steel

Steel is used in tyres as structural reinforcement and to keep the tyre on the rim. The steel is mainly returned to the steel industry or is used to reinforce concrete.

An energy resource with or without steel

Tyres consist of high quality oils and rubber as well as carbon black, all of which serve as beneficial additives or fuel for combustion in both power plants (to increase the temperature of waste incineration, thereby achieving more efficient and more environmentally friendly combustion) and the cement industry, where the steel in the tyres is also used in the process of converting limestone into cement.

Pyrolysis and devulcanisation feedstock

Pyrolysis involves heating tyres in the absence of oxygen to produce oil, carbon black and steel as separate fractions. The oil, carbon black and steel produced can be so pure that they are in demand on the global market as a more environmentally friendly alternative to virgin raw materials. Devulcanisation involves breaking the sulphur bonds in the tyre rubber and allows the rubber to be used as an admixture in new rubber applications, replacing virgin material.



Which conditions support innovation, and what are the challenges?

Innovators do not always have the wind behind them and the road from idea to a functioning product in the market is often long. Innovation is often costly and requires financing because expenses such as material development, sampling, product design, patent and trademark protection, marketing etc. need to be covered before any potential revenues can be generated. Important areas to consider are the laws and regulations that affect innovation and entrepreneurship. The worn-out tyre that can no longer fulfil its basic function is classified as waste, and all waste is subject to specific regulations. To utilise waste, a permit notification or application must be submitted to the municipality. Each of Sweden's 290 municipalities may make its own assessment, which complicates matters for an entrepreneur who often needs a national market in order to make investments. The EU, however, has a specific process for "end of waste" which reclassi-

fies waste as new raw material, and the Swedish Tyre Recycling Association is working to meet the requirements for reclassification for its materials. New products must comply with the European Chemicals Agency's (ECHA) REACH regulations and be registered. This is to ensure that the use of the material is safe for health and the environment in each application. There are also voluntary requirements and industry standards in many areas, such as Sweden's Byggarubedömningen

(BVB) for construction materials, and these may need to be met in order to access specific markets.

The Swedish Tyre Recycling Association actively works to support innovation and entrepreneurs using the knowledge that the organisation has built up in the field.

What are the Swedish Tyre Recycling Association's requirements for good recycling of materials?

Today's "linear" economy, which is not sustainable, is resulting in accelerating species extinction, unnatural climate change, ocean acidification, depletion of natural resources and destabilisation of ecosystems – the planet's life-supporting systems. This is symptomatic of a larger issue that revolves around how we manage the planet's resources and how we see nature. It is also about the present and the future, about not shying away from difficult questions and enabling circularity. An obvious conclusion from this reasoning is that we need to make the most of the products and materials we already have in circulation. This is where innovation comes in.

Recycling is not enough

Unfortunately, recycling is not enough. To meet the adaptation challenges of our time and shift consumption to a level that is within the planet's boundaries, we need to direct our efforts where they will have the greatest environmental benefit. Resource consumption and land use perspectives are the main drivers of ecosystem destabilisation, depletion and the imbalance in the carbon cycle that the Swedish Tyre Recycling Association can influence through our recycling solutions. For another company, it may be the phase-out of harmful chemicals. The systems perspective quite simply needs to be adapted. More information about how we have done this can be found in the Swedish Tyre

Industry's White Paper on sustainability (2019). In this White Paper we have defined a number of criteria for the recycling of tyre materials. These criteria are based on a systems perspective for sustainability and where the company can make the greatest impact. The criteria primarily apply to new applications for recycled tyre materials, but in the longer term apply to all types of materials recycling and materials usage – including biological materials.

Here are the Swedish Tyre Recycling Association's criteria for good materials recycling:

1 Is it of benefit to society?

The material is in demand based on a real need related to its properties, and on commercial terms. These terms assume that the material will provide real value where such properties are desired.

2 Does it reduce the planetary appetite?

The material provides unique value or replaces the use of virgin material in the application. In order to contribute to reducing the overconsumption of Earth's resources, virgin resources must be able to be replaced with tyre material.

3 Is the application safe?

The material is safe for health and the environment, and any risks can be managed. The application must comply with laws and regulations. If risks are identified, the application can still be accepted provided that the risks can be managed. This can be done by limiting use in time or space, using specific equipment or reducing exposure.

4 Effects on ecosystems and the carbon cycle?

The impact of the material on ecosystems and the carbon cycle must have been identified, and a conscious decision regarding its suitability based on this impact must be documented.

5 More suitable than other materials?

The material performs well in terms of overall environmental impact compared to alternatives. Life cycle assessments (LCAs) measure how the material performs in terms of overall environmental impact compared to other options within the same application. The recycled material must not perform significantly worse than other alternatives in order to be suitable for use.

6 Is this the best option for the material?

The material does not have significantly greater environmental benefits in another application. To avoid suboptimisation, alternative uses must be explored. Even if a material performs better than other alternatives in a specific application, the environmental benefits may be greater when used in other applications. This perspective is particularly relevant for limited resources, which can be the case with certain types of tyres.

7 Continued circularity?

The material can be recycled again. It is desirable for the material not to become unusable after being used in an application. The ability to sort, separate and reuse the material again must therefore always be assessed.

8 "Circle of care"

The material is covered by an identified and allocated chain of responsibility, a so-called "circle of care". To enable responsible use throughout the entire life cycle of all applications, the responsibility for the use and end-of-life of each life cycle must be clarified.

9 Certified?

Fulfilment of CERUB certification or equivalent, when applicable. CERUB is a sustainability label that guarantees traceability, documentation and transparency for recycled tyre materials.

Which innovative areas are we working with?

The Swedish Tyre Recycling Association actively works to establish collaborations with innovators and entrepreneurs. On the following pages a selection of the innovations that are currently being brought to market will be shown.

Rubber concrete

The company Rubber Concrete JL AB was started in Älvängen based on the need for a moderately firm and yielding, draining and moisture-retaining surface for horse competitions. A professor of equine anatomy and a concrete contractor mixed concrete with additives of tyre granulate and 20 mm fine shreds. Using different mixing ratios they have produced not only the surface they wanted, but also concrete mixtures for building houses, stable interiors and more. The rubberised concrete weighs only 45% of the weight of regular concrete and is easier to handle, cheaper to transport and has a lower environmental footprint.

3D printing

By mixing powder made from recycled tyre rubber and PE plastic with a so-called co-polymer, the company EcoRub in Hökmark has successfully developed a filament for 3D printing. Different blends result in materials of varying hardness and toughness and can also be coloured. The ability to 3D print components and products is an industry experiencing significant growth, as it can save long-distance transportation of finished goods. Spare parts, such as a handle for a refrigerator, can be produced locally as needed using this technology, rather than having to be kept in stock or ordered from manufacturers in Asia. EcoRub has already produced furniture, interior items, façade panels, and more using this material. It has great potential and the reduction in environmental footprint is substantial if local production can replace international transportation.

Moulded products

Various entrepreneurs have developed products based on moulded rubber granules. One new innovation is rubber impact protectors that are placed around road signs, poles etc. in traffic environments to reduce the risk of injury in the event of a collision. Katarina Segerberg created this solution as part of her thesis in Industrial Design at Lund University and is currently seeking a partner for its implementation.

Building façades

Bruns Architecture in the USA has innovatively developed a method of using a specific group of roof components as façade panels for vertical exterior cladding of buildings. The panels are cast or moulded from rubber or rubber blends. In Sweden the concept has attracted the interest of architects, and work is under way to implement it in homes, outbuildings and commercial buildings.

Rubber asphalt

The research institute RISE, together with researcher Christina Makoundou, has developed a rubber-based asphalt for footways and cycle paths. The advantage of this asphalt is that it is more forgiving than regular hard asphalt. Tests indicate a potential 40–50% reduction in fractures in the event of fall accidents. Within Sweden and the EU ambitious goals are continuously set for expanding bicycle lanes and cycle paths, with the number of cyclists expected to increase by 50% by 2030. At the same time there are currently 2,000 reported accidents in Sweden involving cyclists each year, but the actual number is likely to be higher. The rubber asphalt can be made with the same low rolling resistance as traditional asphalt, but it can also be given higher friction to slow down riders as they approach a junction, for example. The rubber asphalt can also be coloured.

Pyrolysis

The Swedish Tyre Recycling Association works with several innovators in the field of pyrolysis, for example by sorting the optimal size of material and mixtures of different types of tyres to ensure that the results of the pyrolysis processes are of the highest possible quality. Pyrolysis plants are expected to be able to be established on an industrial scale in Sweden in the coming years. Since pyrolysis plants require significant investments and long-term contracts for feedstock, the Swedish Tyre Recycling Association has developed innovative models for pricing over very long contract periods.

Water treatment

The Swedish Tyre Recycling Association has acquired the rights to a pretreatment of 40–70 mm tyre shreds that allows the material to bind phosphorus to the surface through an ion exchange process. Eutrophication

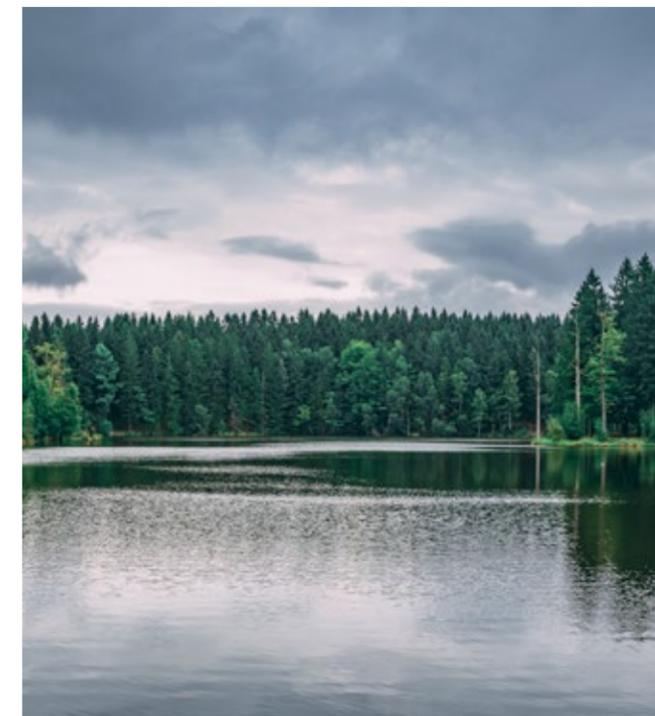
caused by leaking nitrogen and phosphorus is one of the problems arising from agriculture, animal husbandry, sewage and mining industries. Sweden currently has 500,000 to 600,000 non-approved individual sewage systems that treat the water by filtering it through gravel beds made of natural stone. Traditionally, the natural stone has been extracted from eskers where the stones have rubbed against each other for a long time, creating pores and conditions for the establishment of a biofilm for purification. There are now very strict restrictions on further extraction of natural stone because eskers are crucial for water levels (availability of clean water) in our country and provide unique habitats for plants and animals. Tyre shreds have been identified by the research institute RISE as a possible substitute material for the natural gravel.

Devulcanisation

Through international collaborations, the Swedish Tyre Recycling Association has established contact with actors wishing to establish operations in Sweden for selected tyres. The devulcanisation process currently requires a homogeneous feedstock of specific parts from certain tyres, something that can be accomplished at the new facility in Linköping.

Recycling of whole tyres in the cement industry

In partnership with Cementa (Heidelberg Materials Sweden AB), the Swedish Tyre Recycling Association has ensured through delivery agreements and innovative management that Cementa can continue to use whole tyres for fuel and steel supply in cement production following alteration of the feed system at the facility in Skövde.





How do we support market opportunities for innovations?

The ELTRP research portal

In 2023 the Swedish Tyre Recycling Association is launching an international research portal called the End-of-Life Tyre Research Portal (ELTRP), bringing together all the known and quality-assured information about tyre materials, content, performance and usability in various applications. The database includes published research on material usage, health and the environment, products and more in a searchable manner. Both innovators and regulators such as municipalities can search the database for information about tyre materials.

www.eltrp.org

CERUB

CERUB (Circular Economy Rubber) is a sustainability label for recovered tyre material and is currently a collaboration between Sweden, Finland, Norway and the Netherlands. CERUB certification ensures traceability of the material, documentation etc. and provides support for obtaining certifications or end-of-waste classification.

www.cerub.org

Rubber Hall & Showroom

Inspiration often serves as a trigger for innovation. The Swedish Tyre Recycling Association therefore showcases products that utilise recycled tyre materials, both physically in its showrooms at locations where the organisation is represented around the country and on the website www.rubberhall.com. Innovators, entrepreneurs, designers, architects, engineers, artists, students and others are welcome to showcase their products and creations through Rubber Hall.

www.rubberhall.com

SIS/CEN

The Swedish Tyre Recycling Association actively participates in the European efforts to establish standards for quality assurance of recycled materials through its work in SIS 422 and CEN 366. This work focuses on measurement methods for purity, sizes, steel content etc., and the use of these standards creates additional confidence in the trade and use of materials.

www.cenelec.eu

Health, environment and sustainability

In addition to the information in CERUB, the Swedish Tyre Recycling Association participates in various projects relating to how the recycled material affects health and the environment. The Swedish Tyre Industry's 2019 White Paper on sustainability lays the foundation for the operations from a broader perspective, and our annual reports for 2020 and 2021 focus on the interaction of the recycling with ecosystems and the carbon cycle respectively, for both products and operations. A recurring aspect of the Swedish Tyre Recycling Association's work is to consider the bigger picture and take a systems perspective, to avoid suboptimisation or even counterproductive measures. This work also supports innovators by providing guidance on sustainability issues that are important for them as well. The documents mentioned above can be found at www.sdab.se.

International cooperation

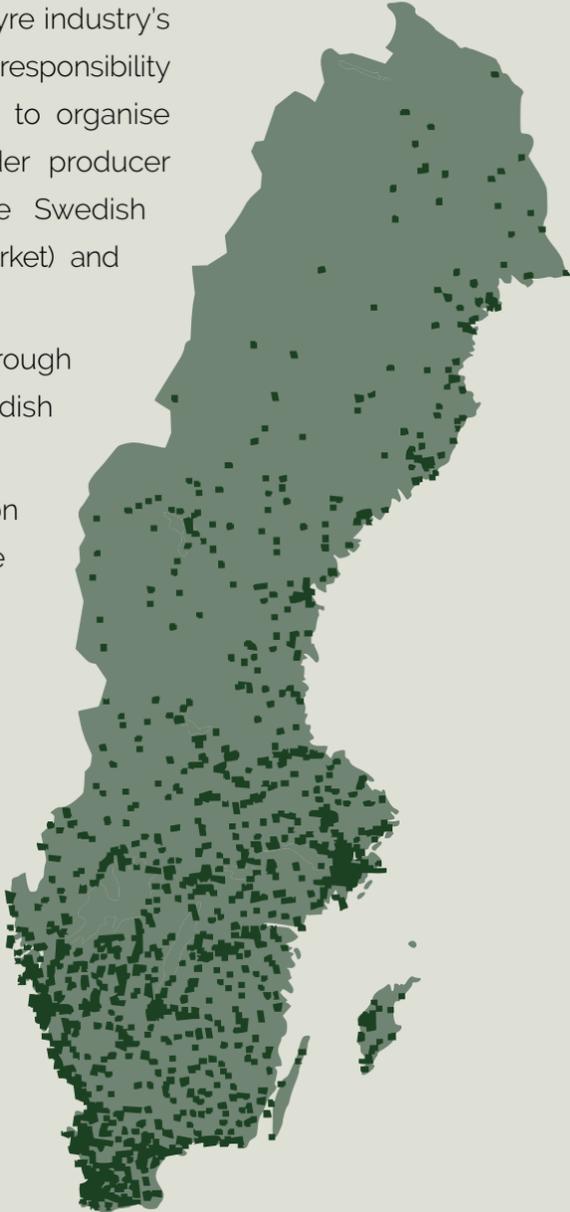
The Swedish Tyre Recycling Association has a broad network within all industries working with tyres and tyre recycling, as well as various applications.

Recycling facts

The Swedish Tyre Recycling Association is the tyre industry's response to the Swedish regulation on producer responsibility for tyres (Regulation 1994:1236) and its task is to organise the collection and recycling of all tyres under producer responsibility. Its supervisory authority is the Swedish Environmental Protection Agency (Naturvårdsverket) and the municipality's environmental department.

The producer responsibility system is financed through recycling fees paid by the importer to the Swedish Tyre Recycling Association.

In turn, the Swedish Tyre Recycling Association uses the recycling fees to finance a nationwide collection and recycling system. After the importer has paid the recycling fees to the Swedish Tyre Recycling Association, they are usually passed on by the distributor to the consumer. This means that the consumer fulfils their environmental responsibility by paying a recycling fee when purchasing new tyres.



100,761 tonnes of tyres recycled in 2022

The amount of used tyres that the company's main contractor, Ragn-Sells Däckåtervinning AB (RSDAB), recycled on behalf of the Swedish Tyre Recycling Association was 100,761 tonnes in 2022, which is a significant increase compared to the 80,348 tonnes recycled in 2021. The main reason for this is that the inventory of collected but unrecycled tyres was unusually large at the beginning of 2022, and this has been normalised during 2022. The collection of used tyres has been relatively stable in comparison, amounting to 91,986 tonnes in 2022 compared to 91,079 tonnes in 2021.

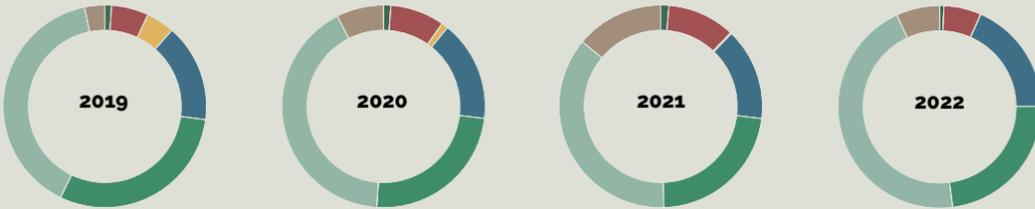
At the beginning of 2023 the Swedish Tyre Recycling Association took over the coordination of collection and recycling in-house. For the used tyres that had been collected until then, RSDAB is continuing to recycle and allocate these on behalf of the Swedish Tyre Recycling Association for a transition period.

Recycling categories in 2022

Since RSDAB ceased granulate production in 2019, only a small amount of granulate was allocated and in 2022 the total was just 27 tonnes. RSDAB has reduced its allocation to materials recycling through the production of blast mats to 5,978 tonnes compared to 8,639 tonnes in 2021, and for use as substitute materials in areas such as construction

projects to 6,967 tonnes compared to 11,233 tonnes in 2021. The proportion of material allocated for energy recovery in the cement industry has increased from 29,344 tonnes in 2021 to 45,473 tonnes in 2022. The Swedish Tyre Recycling Association does not deal with tyres for retreading. These flows are managed by commercial operators, before the tyres and carcasses are worn out and submitted for recycling.

Allocations to alternative recycling options are detailed in the table below (thousands of tonnes):



Recycling category	2019	2020	2021	2022
Exports of whole tyres	1,002	982	1,040	689
Materials recycling – blast mats	5,495	7,290	8,639	5,978
Materials recycling – granulate	4,174	883	161	27
Other materials recycling	14,552	13,608	11,800	18,418
Energy recovery	27,952	20,427	18,135	23,210
Energy recovery – cement industry	36,870	35,053	29,344	45,473
Materials substitution	2,964	6,331	11,233	6,967
Total recycled	93,010	84,574	80,348	100,761

Key events in 2022

Q 1

Preparations are in full swing for the Swedish Tyre Recycling Association (SDAB) to take over operational responsibility for Sweden's tyre recycling in-house starting on 1 January 2023. Project "SDAB 2.0" became an increasingly popular term within the industry, both in Sweden and internationally. The office in Vaxholm started designing a showroom for tyre recycling, to include finished products and raw materials. The Swedish Tyre Recycling Association's CEO, Fredrik Ardefors, participated in the "Däckpodden" podcast, run by industry magazine Däcksnack. The conversation focused on the opportunities that recycled tyre material offers in a circular economy. This audio introduction to tyre recycling turned out to be very popular.

Q 2

The image and inspiration platform Rubber Hall goes live (www.rubberhall.com / Instagram: rubberhall). The annual industry event Däckbranschdagen (Tyre Industry Day) was held after a long break. It was a long-awaited and much appreciated day, with many inspiring and educational presentations by representatives from different parts of the industry. The Swedish Tyre Recycling Association finalises its annual report, which this year discusses tyre recycling and carbon impact on the planet. At the end of June the Swedish Tyre Recycling Association participates in RAR2022, a conference exclusively focusing on the latest developments in rubber asphalt applications. The conference was held in Malaga, Spain.

Q 3

In its business intelligence role, the Swedish Tyre Recycling Association attends Almedalen Week – a meetingplace for politicians, business people and others – in Visby, Gotland. The Swedish Tyre Recycling Association participates in Tyre & Rubber Recycling magazine's international podcast to share information about the transition project "SDAB 2.0". The magazine also publishes a feature on the same topic. The collaboration between the Swedish Tyre Recycling Association and its Norwegian counterpart Norsk Dekkretur expands, with the CEO of each company being appointed as a board member in the other country's respective organisation. During this period the Swedish Tyre Recycling Association's customer service department also grows from one to three employees.

Q 4

The Swedish Tyre Recycling Association provides more information about its new operations and what this means in practice for both existing and new customers. A "Tyre Collection App" is launched, and both new and existing customers registered for the app, which was activated for orders of worn-out tyres on 1 January 2023. As the Swedish Tyre Recycling Association establishes its new tyre recycling organisation, parts of the organisation's visual identity are updated and modernised. Towards the end of the year customer service moves to new offices in Ekeby in southern Sweden, the showroom in Vaxholm is completed and the development phase of the End-of-Life Tyre Research Portal (ELTRP) nears its end.



Contact details

Would you like to work on innovation within tyre recycling or do you have any other questions for us?

Contact our customer service department on +46 (0)8 50 23 90 20.

PUBLISHED BY

Swedish Tyre Recycling Association
(Svensk Däckåtervinning AB - SDAB)

PO Box 124, SE-185 22 Vaxholm

Visiting address, Strandgatan 3

+46 8-50 60 10 55

info@sdab.se

sdab.se



**Svensk
Däckåtervinning**

ABOUT THE SWEDISH TYRE RECYCLING ASSOCIATION

Established in 1994, the Swedish Tyre Recycling Association (in Swedish, Svensk Däckåtervinning AB - SDAB) is a not-for-profit recycling company. Based on the producer responsibility for tyres laid down in law, it is tasked with organising collection and recycling of the approximately 90,000 tonnes of tyres that reach end of life in Sweden each year. Working with dynamic partners we have established a unique and world-leading recycling organisation starting in 2023 to ensure that tyres are disposed of in a sustainable way, with the aim of increasing materials recycling, paving the way for new applications and enhancing the value of recycled tyres as a raw material. In its work the Swedish Tyre Recycling Association aims to contribute knowledge and curiosity about recycled tyre rubber and to develop a recycling organisation that inspires innovation and creativity. Learn more about the changes that are happening at sdab.se.