

SUSTAINABLE CARBON BLACKS FOR RUBBER APPLICATIONS

General Brochure GB R154-GL

INTRODUCTION



“We are committed to finding solutions to make renewable carbon black a vibrant part of our offerings.”

Investing in sustainability is core to Orion’s growth strategy and key to our success as a business. We’re facing huge demand from our customers for sustainable products.

To further demonstrate our commitment to sustainability, we recently formally announced our aspirations to achieve net-zero emissions of greenhouse gases by 2050 in line with the Paris Climate Agreement.

Like most companies that have expressed similar ambitions, we can’t say we have all the answers now. But we’re determined to work hard to find sustainable solutions with collaboration, innovation and the right regulatory environment. We’ve been exploring multiple pathways to make sustainable materials. To be clear, we’ve hit some dead ends and speed bumps. But we see a pathway is emerging, and we’re going to get there. Frankly, there’s no other choice. Ignoring sustainability creates an existential threat to us and the whole chemical industry. When we announced our net-zero aspiration, we wanted to make sure it’s meaningful and realistic. To show how committed we are, Orion developed a roadmap with near- and long-term targets.

We aspire to:

- Launch a broad range of products using recycled materials by 2025, and during the same period, position the company to enlarge its footprint in the conductive additives space. For example, we will be providing materials for lithium-ion batteries used in electric vehicles, high-voltage cables for wind farms and other applications critical for the transition toward electric power.
- Generate 30% of its adjusted EBITDA through sustainable solutions by 2030.
- Grow the sustainable solutions’ share of adjusted EBITDA to 50% by 2035.
- Set new aspirational, mid-term goals for greenhouse-gas emissions reduction that are aligned with science-based methodologies.

We’re proud that this year Orion earned a Gold Medal rating by EcoVadis, an independent organization that assesses companies’ sustainability performance in the areas of environment, labor & human rights, ethics, sustainable procurement, and overall sustainability governance. The rating places us in the top 3% of companies assessed by the organization. I have also signed the U.N. Global Compact, the world’s largest corporate sustainability initiative. The compact calls on companies to align strategies and operations with universal principles on human rights, labor, anti-corruption and the environment. We have long supported the compact’s principles, and they have been part of our strategy, culture and daily operations.

We’re confident that by being innovative and understanding our customers’ needs, we will continue to deliver solutions for a more sustainable future.

Corning F. Painter,
Chief Executive Officer

OUR SUSTAINABILITY STRATEGY



We believe that climate change is real and that decisive actions are needed to transition toward a low carbon future. We believe that the two key trends most relevant to our industry and required for this transition are decarbonization and the establishment of circular economy for tires.

Decarbonization is largely about reducing, if not eliminating, CO₂ emissions arising from the use of fossil fuel. In the mobility sector, electrification coupled with renewable power are seen as providing an effective alternative to fossil fuel-based internal combustion engine systems. In the petrochemical sector, including the carbon black industry, the challenge is to reduce and eventually eliminate CO₂ emissions from the production process.

We are the premium supplier of carbon black. We generate long-term value for stakeholders while remaining committed to responsible business practices with a focus on team culture, reliability, innovation and sustainability.

Our sustainability strategy is to accelerate Orion on its path toward a low-carbon future.



We are committed to growing our business profitably with a minimal environmental footprint to ensure sustainable returns to our stakeholders on an ongoing basis. Related material topics include:

- Emissions and energy
- Water consumption
- Waste and spills
- Product stewardship

SUSTAINABLE GROWTH



Compliance is about being responsible and adhering to the operating standards set out in the applicable laws, regulations and our policies, including:

- Operational compliance
- Business compliance and code of conduct
- Operational safety

COMPLIANCE



We are committed to a diverse, fair and inclusive culture with equal opportunity for all and being a contributing member to our host communities.

- Diversity and inclusion
- Talent management and development
- Employee representation
- Local community engagement

LIVING OUR VALUES



We believe that our sustainability performance is only as good as the standards set by the weakest link in our value chain. We are committed to working with our suppliers to enhance their ESG performance.

- Sustainable procurement

VALUE CHAIN ENGAGEMENT

3 MEGA TRENDS:

Decarbonization

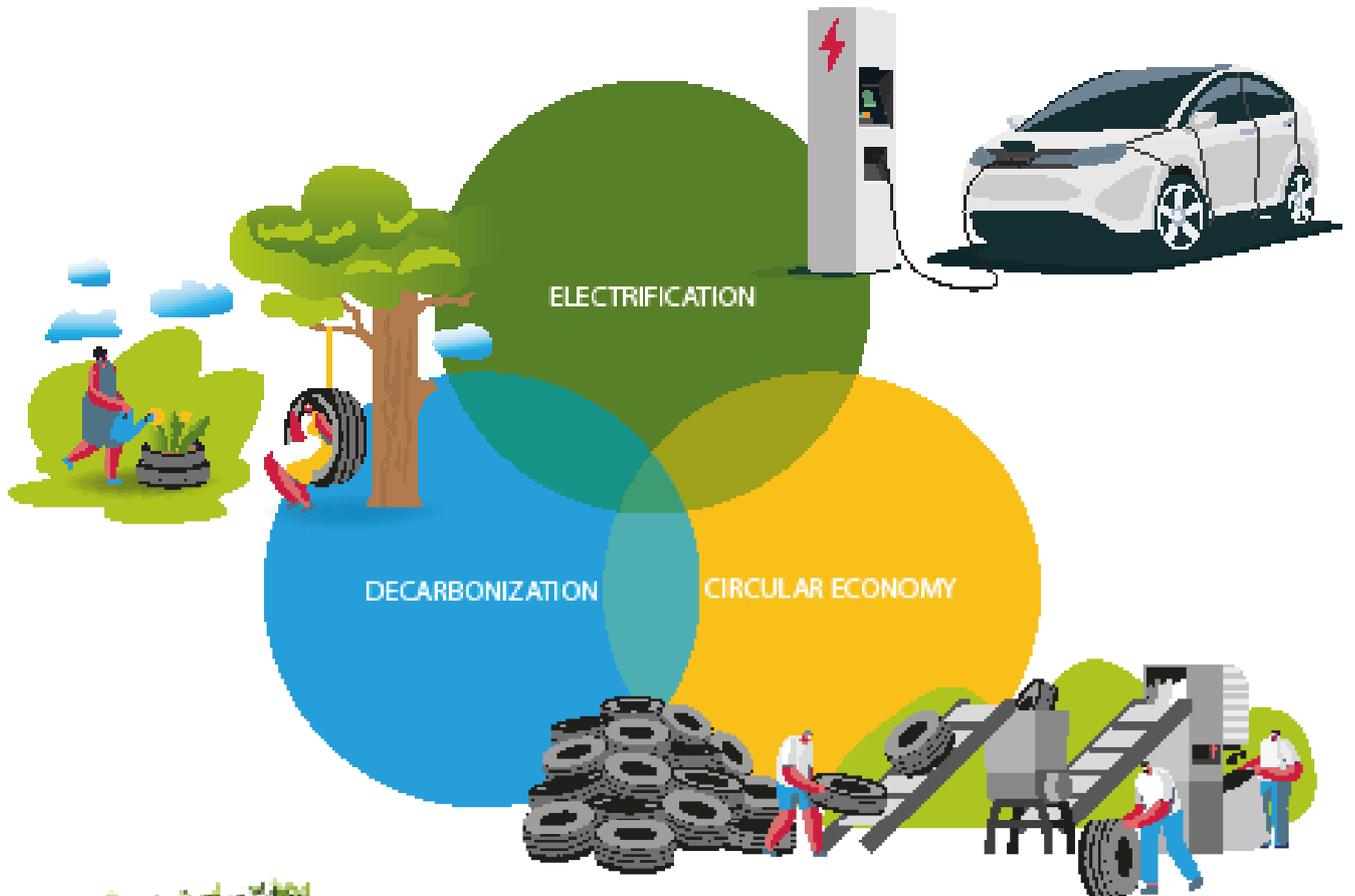
Decarbonization of our carbon black production process: replacing fossil-based oils by renewable oils, reducing emissions

Circularity

Contributing towards ELT circularity: making carbon blacks from old tires, reducing dependence on fossil fuels and eliminating waste

Electrification

Supporting electrification in the mobility and other sectors: conductive carbons such as our acetylene black (PRINTEX® kappa 100 and 400) – is expected to grow to support the demand for lithium-ion batteries



CORPORATE SUSTAINABILITY – OUR TARGETS

Our environmental impact is measured by emission levels of greenhouse gases (GHG), sulfur dioxide (SO₂), nitrogen oxide (NO_x) and particulate matters (PM).

- Renewable feedstocks
- Enhancements in operational efficiency
- Application of air pollution systems

| | NORMALIZED SCOPE 1 GHG INTENSITY | SO ₂ INTENSITY | NO _x INTENSITY | PM INTENSITY |
|---------------------|-------------------------------------|---------------------------|---------------------------|----------------|
| Emission targets | 8 % Reduction | 50 % Reduction | 25 % Reduction | 15 % Reduction |
| 2020 Status vs 2014 | - 5 % | - 17 % | - 5 % | + 1 % |

Energy is not only a critical input in the carbon black production process but is also an output

- The energy we consume is in the form of feedstock, natural gas, electric power, heat, and steam. In turn, the carbon black production process generates not only carbon black but also heat and tail gas, which has residual energy content that can be used as fuel.
- We have a two-pronged approach to energy management. One is to minimize the input energy and the other is to maximize the use of waste energy generated from the carbon black production process.
- We are also committed to recirculating waste heat back into the production process and utilizing the byproduct tail gas to produce energy for internal consumption and third-party sales. At the group level, our overall tail gas utilization rate¹⁵ is estimated to be 76%. Our new energy target is to increase our tail gas utilization rate by 4% to 79% by 2029.

| ENERGY | 2020 | 2019 | 2018 |
|--------------------------|------|------|------|
| Energy consumption (TWH) | 18.1 | 21.3 | 22.8 |
| Intensity | 2.05 | 2.05 | 2.06 |

| ENERGY TARGET | TARGET | 2020 |
|---------------------------|--------|------|
| Tail gas utilization rate | 79 % | 76 % |



RUBBER BLACK AND SUSTAINABILITY



“We’re aggressively leveraging our innovation capabilities and our deep understanding of our customers’ needs to seek ways to deliver sustainable solutions.”

The tire industry is the largest consumer of carbon black with tire producers estimated to account for more than 70% of global demand. Therefore, a key component to achieving a low carbon future in this sector is to establish an effective process to recycle end-of-life tires (ELTs) in a technically, environmentally and economically viable manner.

This presents us with the following challenges and opportunities:

- Decarbonization of our carbon black production process
- Contributing towards ELT circularity
- Supporting electrification in the mobility and other sectors

As we tackle and find solutions to these challenges, we expect our product portfolio to shift toward:

- Enabling carbon blacks
- Renewable carbon blacks
- Recycled carbon blacks



OVERVIEW SUSTAINABLE RUBBER BLACKS

“We understand that charting a path to a more sustainable world will require multiple solutions and collaboration across the industry and the scientific community.”



Enabling carbon blacks are specially designed to help our customers develop more sustainable products that in turn reduce emissions and save resources. We currently offer a range of enabling carbons. In addition, we are developing next-generation carbon blacks to address the special needs of electric vehicles and other sustainable trends.

Renewable carbon blacks are made from industrial-grade vegetable oils or other feedstocks derived from waste and residues of biological origin from agriculture or forestry. These feedstocks are currently mostly used as biodiesel.

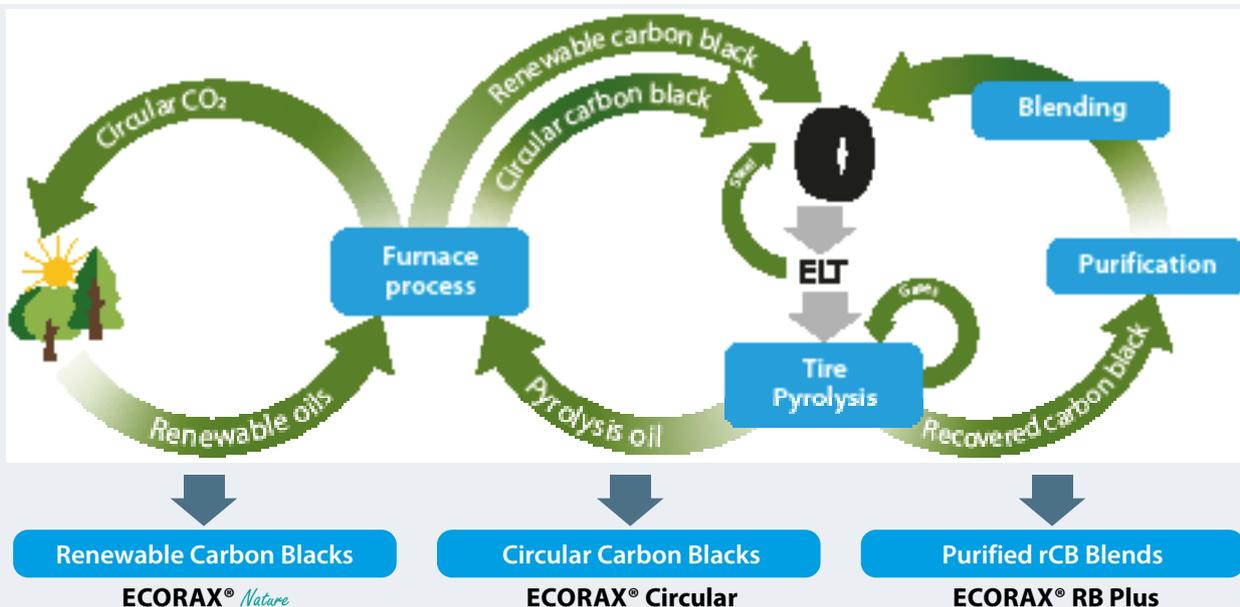
Orion was the first major carbon black producer to develop and commercialize a renewable carbon black a decade ago. In 2021 we launched the first product made from 100% renewable feedstock and designed for rubber applications: ECORAX® Nature 105. In early 2022 we launched ECORAX® Nature 200, which is based on a second-generation, animal-free, bio-based

feedstock. We will develop new grades and extend production to other sites to support our customers' requirements.

Recycled carbon blacks are made from post-consumer recycled products. The major focus of the rubber carbon black business is on the tire circular economy. Our primary raw material is end-of-life tires (ELT). Under this pillar, we have developed two distinct product lines:

ECORAX® Circular products are made from tire pyrolysis oils (TPO) derived from ELT. In 2021 we developed soft and hard blacks, made from 100% TPO, that match the in-rubber performance of virgin carbon blacks. In 2022 we are launching the first commercial grades based on TPO.

ECORAX® RB Plus products are based on carbon blacks recovered from ELT (rCB), which are purified and blended to match customer requirements in rubber applications.



ENABLING CARBON BLACKS

Below a non-exhaustive list of our Enabling Carbons. The OEC Technical Marketing Manager in your region will be happy to assist you with the right choice for your application.



| PRODUCT | IODINE mg/g | STSA m ² /g | OAN ml/100g | COAN ml/100g | APPLICATION |
|----------------------|----------------|---------------------------|----------------|-----------------|---|
| ECORAX® S 204 | 19 | 19 | 138 | 76 | Premium carbon blacks for the tire body, designed to reduce tire rolling resistance resulting in fuel savings and lower emissions |
| ECORAX® S 470 | 54 | 47 | 133 | 86 | Premium carbon blacks for the tire body, designed to reduce tire rolling resistance resulting in fuel savings and lower emissions |
| ECORAX® S 600 | 60 | 60 | 144 | - | Premium carbon blacks for the tire sub-tread, designed to reduce rolling resistance while keeping high compound stiffness resulting in fuel savings and lower emissions |
| ECORAX® S 206 | 19 | 19 | 75 | 60 | Premium carbon blacks for inner liners, designed to reduce air permeability resulting in fuel savings and lower emissions |
| CORAX® HP 130 | 115 | 118 | 135 | 107 | Premium carbon blacks for the tire tread, designed to reduce rolling resistance while keeping high wear resistance resulting in fuel savings, lower emissions and conservation of resources |
| PUREX® family | - | - | - | - | Premium carbon blacks for mechanical rubber goods enabling reduced scrap rates resulting in conservation of resources and elimination of waste |
| PUREX® LS 18 | 19 | 19 | 73 | 60 | Low conductivity carbon blacks for rubber parts, enabling the usage of aluminium to make cars lighter resulting in fuel savings and lower emissions |



RENEWABLE CARBON BLACKS



Below you can find the first commercially available product for rubber applications.

ECORAX® Nature 200 was developed as a drop-in solution for sensitive applications using the ASTM grade N326.

It is based on a second-generation bio-circular feedstock and produced from an oil blend, enabling a gradual transition from fossil to renewable feedstocks on a large industrial scale. We can track the bio-based content using the mass-balance principle, which can be certified by an accredited auditor.

| PRODUCT | STSA m ² /g | OAN ml/100g | COAN ml/100g | APPLICATION |
|---------------------------|---------------------------|----------------|-----------------|--|
| ECORAX® <i>Nature</i> 200 | 77 | 72 | 69 | Usage of bio-based feedstock and drop-in solution to CORAX® N326; application fields are steel cord adhesion compounds and special compounds for mechanical rubber goods |

The new product has been extensively tested at our advanced application laboratories in Kalscheuren, Germany. The graph below shows that it can replace the ASTM grade N326 in rubber applications.

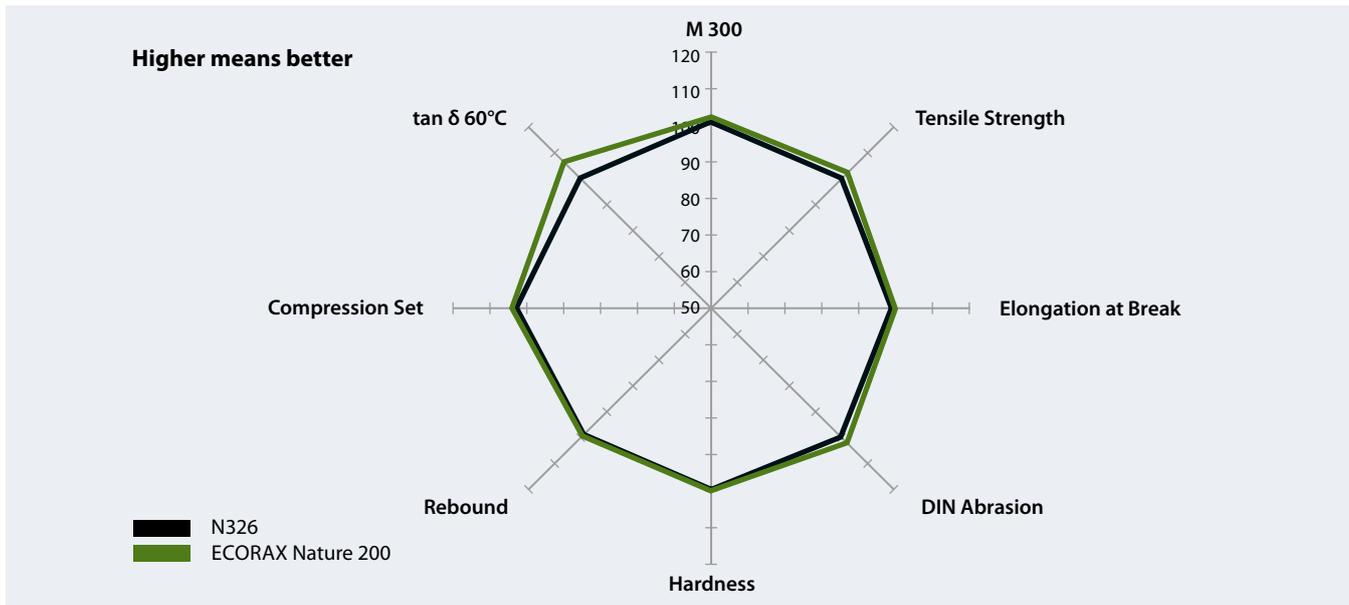
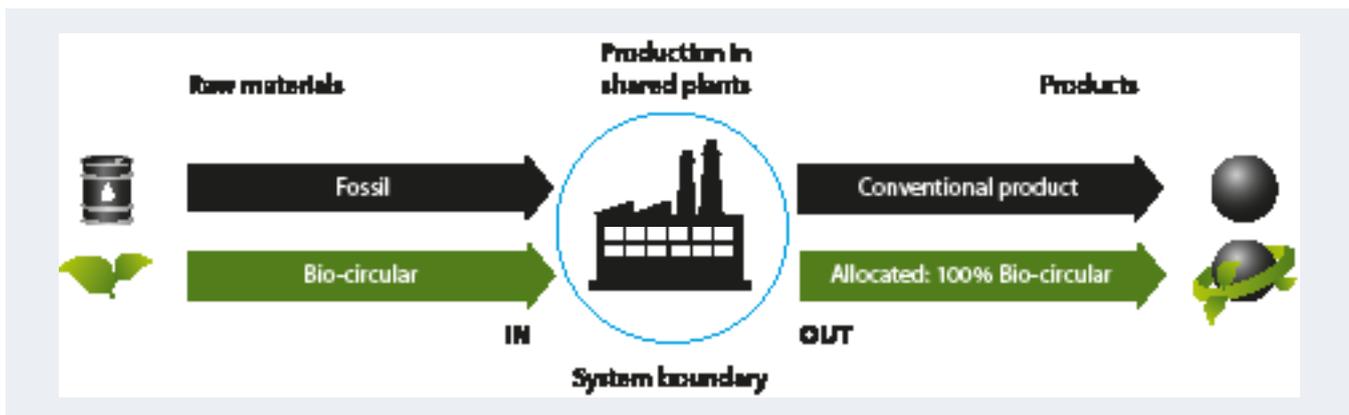


Illustration of the mass-balance principle applied in our plants

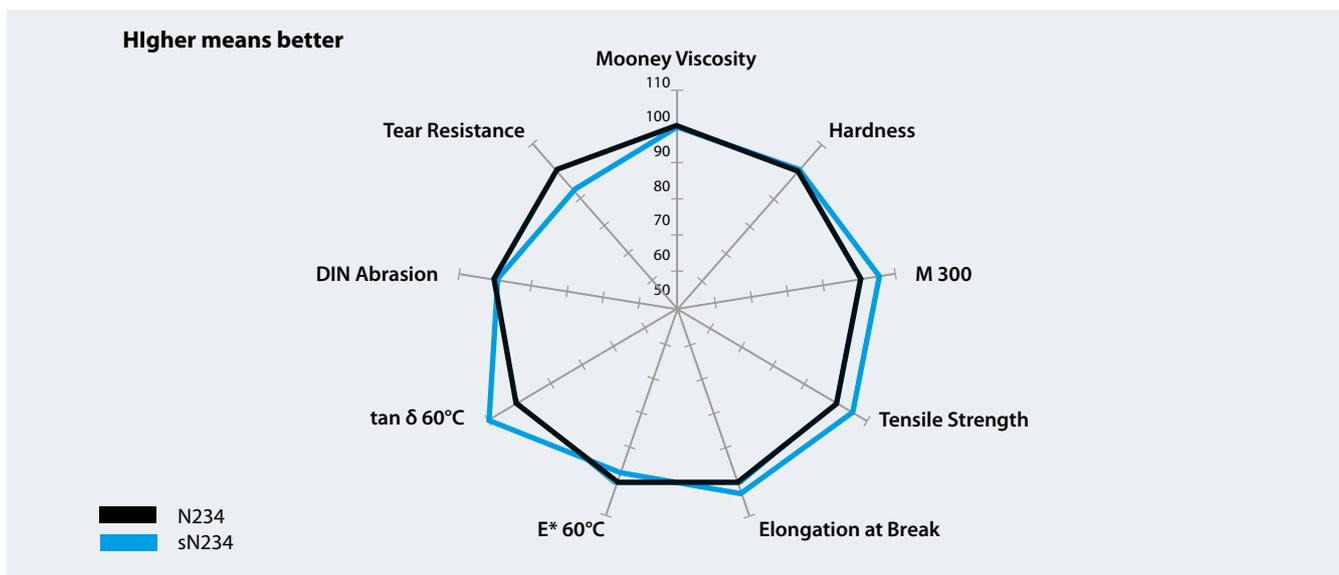


CIRCULAR CARBON BLACKS



Circular carbon blacks are made from oils stemming from a pyrolysis of rubber products, particularly end-of-life tires (ELT). These recovered oils are used in our production to produce carbon blacks which represent drop-in solutions for regular carbon blacks.

As aforementioned, we have produced soft and hard blacks from 100% TPO that perfectly match performance of ASTM-grades. Please find below the in-rubber testing results of one of those grades vs. N234.



Following our experience with mass-balance on ECORAX® Nature 200, we are commercializing 3 circular carbon blacks based on TPO. These products have been designed to match in-rubber performance of ASTM grades.

| PRODUCT | IODINE mg/g | STSA m ² /g | OAN ml/100g | COAN ml/100g | APPLICATION |
|-----------------------------|-------------|------------------------|-------------|--------------|---|
| ECORAX® Circular 210 | 82 | 76 | 102 | 88 | Is a drop-in for N330 which offers well balanced properties of green compounds and vulcanizates and a good compromise between rubber reinforcement and hysteresis |
| ECORAX® Circular 215 | 43 | 39 | 121 | 85 | Is a drop-in for N550 and provides a relatively low specific surface area and a high structure. It imparts excellent extrudability to rubber compounds |
| ECORAX® Circular 220 | 36 | 34 | 90 | 74 | Is drop-in for N660 and thus has good processing characteristics. Reinforcing potential is moderate and vulcanizates exhibit good dynamic properties |

PURIFIED RCB BLENDS

We are currently working to enable the usage of recycled carbon blacks from the pyrolysis of rubber products, particularly end-of-life tires (ELT). As these so called rCBs are mixtures of different CBs used in the rubber products and contain impurities we are working both in purification and in blending processes to offer our customers solutions to use recycled CBs in their high quality products.



Orion is your go-to partner for sustainable innovation



The first major carbon black producer to commercialise a carbon black made from renewable sources: ECORAX® Nature



The first major carbon black producer to develop and manufacture carbon blacks from ELT pyrolysis oils to enable the tire circular economy: ECORAX® Circular



We fully understand the needs of tire and MRG customers - application technology, quality consistency, and scale - and are equipped to deliver



Investing in innovation and partnerships along the value chain to ensure that sustainable innovation can be commercially implemented



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