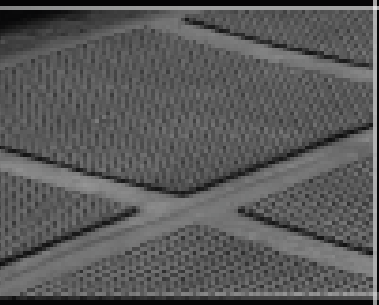
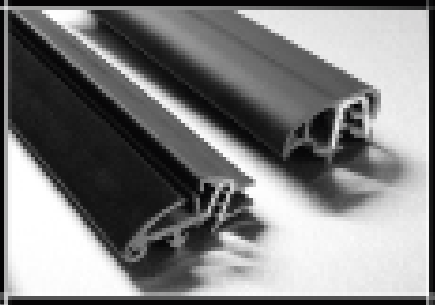


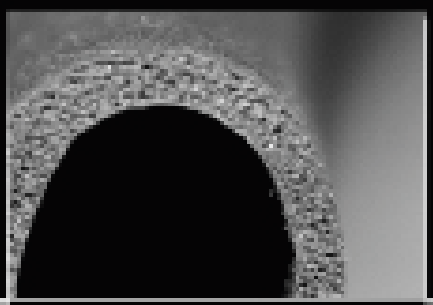
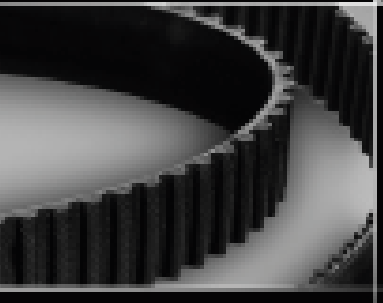



orion

Delivering sustainable solutions

PREMIUM CARBON BLACKS FOR MECHANICAL RUBBER GOODS

General Brochure R153-EA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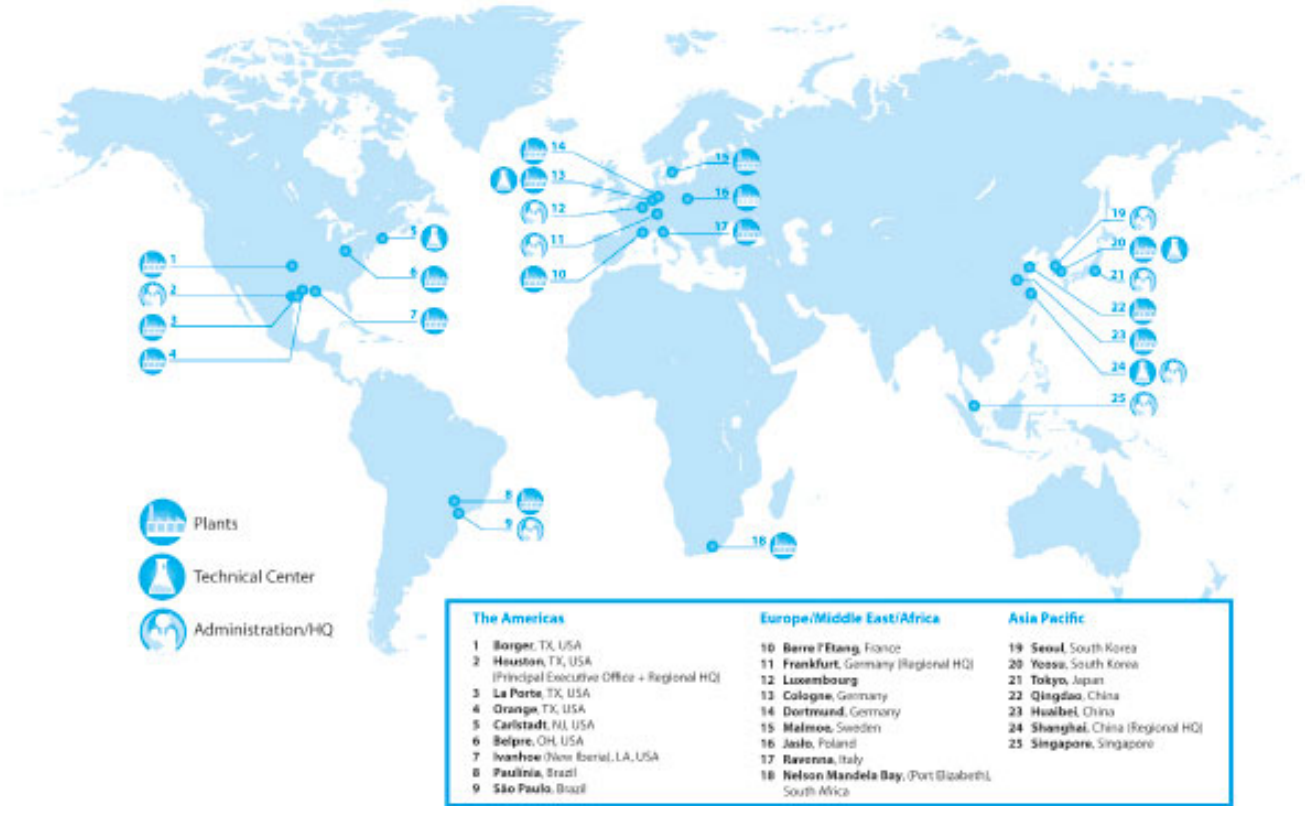
1. ABOUT ORION

Orion is one of the world's leading suppliers of carbon black. We offer standard and high-performance products for coatings, printing inks, polymers, rubber and other applications. Our high-quality gas blacks, furnace blacks and specialty carbon blacks tint, colorize and enhance the performance of plastics, paints and coatings, inks and toners, adhesives and sealants, tires, and mechanical rubber goods such as automotive belts and hoses. With 1,600 employees worlwide, Orion runs 15 global production sites and 4 applied technology centers, focusing on quality supply and collaborative partnerships with customers. Common shares of Orion are traded on the New York Stock Exchange under the symbol OEC.

Figure 1

Orion sites globally



Worldwide countless products made from rubber are manufactured and in every-day use. Probably the prominent are tires, but there is a whole so called mechanical rubber goods ("MRG") or technical rubber goods industry producing a huge variety of different rubber products. This MRG industry traditionally operates with a vast number of different compound formulations to fulfill all the requirements for the numerous specific applications.

In most of these formulations carbon black play important roles such as

- A filler with excellent reinforcing properties,
- An effective processing aid,
- A low cost diluent for expensive polymers.

Standard ASTM grades do a good job with regard to reinforcement properties. However, for the increasingly demanding MRG industry, carbon blacks have to fulfill more specific requirements.

Orion is offering carbon blacks for rubber applications under many trademarks and registered trademarks such as CORAX, ECORAX, PUREX, PRINTEX, SABLE, AROSPERSE and DUREX1 that can assist in meeting the demanding requirements of the MRG industry. Please contact your Technical Market Manager for options available in your specific region.

With this brochure we intend to give a brief overview of the MRG industry and a guideline for using specialized carbon blacks from Orion to meet the specific requirements of this industry. For further support Orion has technical market managers and innovation for rubber technology in all regions. The main technical center is located in Kalscheuren (Germany)

[1] Note: The above mentioned trade names are trademarks or registered trademarks of ORION Engineered Carbons GmbH

where physicists, chemists and engineers investigate the mechanism of rubber reinforcement and develop new products to meet today's and future requirements of the rubber industry. A modern and well-equipped laboratory is available for research work, for application studies and for centralized test programs to monitor the in-rubber performance of our products. Multi-scale pilot plants allow fast new product development and scale-up.

Orion continuously works on improvements of test methods and is actively involved in standard organizations. Technical market managers offer technical support in all questions related to our product range, quality features and to the most beneficial application of our products. Additional service units are at our customers' disposal when it comes to specific questions regarding product safety, product handling, logistics or packaging. Beyond this, the central laboratories of Orion may be consulted for sophisticated analytical tests.

2. APPLICATIONS

This chapter describes briefly some of the numerous MRG applications.

2.1. Profiles

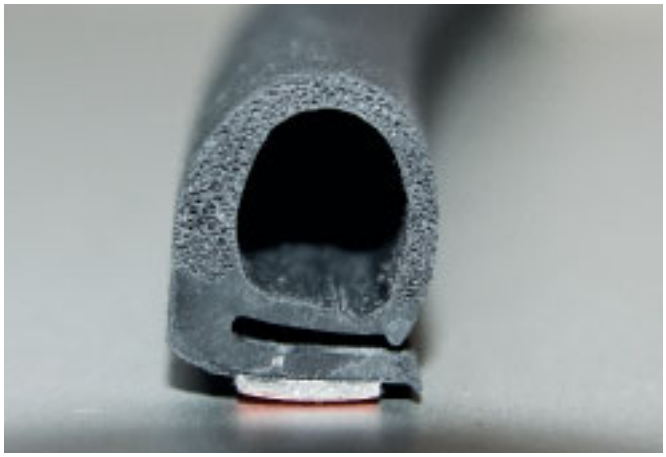
EPDM is the dominant polymer in this segment.
The main requirements of the automotive industry are:

- High level of smoothness of the profile surface
- Low conductivity; the development of the high class automotive segment, using light metals like magnesium or aluminium, requires low conductivity compounds to avoid electrochemical corrosion
- Gloss of the surface
- Recyclable components
- Light weight components and noise reduction (i.e. by sponge rubber)

To be more efficient the MRG industry moved away from using ASTM grades. Pure carbon blacks like the PUREX® or the SABLE family as well as DUREX® 0 allow lower production costs by reducing scrap rate, increasing strainer lifetime or even avoiding any straining. To achieve such a reduction, the prerequisite is a well dispersed clean carbon black in the rubber matrix. Consequently, the use of low specific surface area and high structure carbon blacks such as PUREX® HS 45, PUREX® HS 40, SABLE 6500, PUREX® HS 22, PUREX® HS 25 or DUREX 0 is recommended.

Figure 2
Automotive profiles

Figure 3
Door sealing with sponge rubber



Further properties which are enhanced by the use of PUREX® and SABLE grades include:

- Prevention of electrochemical corrosion with very low specific surface area carbon blacks such as PUREX® HS 22, PUREX® HS 20 or PUREX® LS 18
- Switching from 2-stage to 1-stage mixing to reduce mixing costs
- Coloristic properties
- Improved matting/low gloss of components by use of a low specific surface area carbon black like PUREX HS 20
- Highly glossy surface e.g. with PUREX® HS 40 or PUREX® HS 45
- Fast response to UHF curing systems e.g. PUREX® HS 40, PUREX® HS 45 or PUREX® HS 55
- Today, for some automotive profiles TPE is used instead of rubber. As this application also requires characteristics like smoothness of the surface PUREX® and SABLE grades would be the right choice.

2.2. Anti-vibration systems (AVS)

Anti-vibration systems are used in a multitude of applications: automotive and transport, construction and industry. Examples are engine mounts, bushings, air springs and bridge bearings.

The goal is to reduce vibrations and noise by engineered products which often consist of metal supports and rubber elements. Natural rubber is the main polymer used in this segment due to its unique mechanical properties; some components are made of EPDM or silicone rubber or styrene butadiene rubber. Anti-vibration systems must provide the necessary mechanical strength and they have to exhibit the required damping characteristics at certain frequencies and strains. The selection of the appropriate carbon black and the right filler loading help to achieve these goals.

For low heat build-up and tan delta PUREX® HS 20, PUREX® LS 30 RP or SABLE 7700 are recommended. As impurities are often the starting point of failures, the use of PUREX®/SABLE grades provides a solution to extend the service lifetime of AVS parts. These product families stand for high purity and they contain extremely low amounts of foreign particles (sieve residue).

Figure 4

Selection of different anti-vibration systems

2.3. Precision sealings

Precision sealings must safely and reliably seal two mechanical pieces. Defects due to impurities or improper raw material choices can lead to failures. Simple seals are usually manufactured by extruding a tube and slicing it in thin rings. The smoothness of the surface of the component plays an important role since a poor smoothness caused by carbon black residue or non-dispersible matter can be the origin of defects in the compounds. Due to the high cost of some polymers, the carbon black content may be increased to achieve a lower price of the compound. In this case, the best choice might be PUREX® HS 22, SABLE 7700 or PUREX® LS 18.

The molding process is less sensitive to non-dispersible matter, however, due to the process of injecting the compound in the press, it is necessary to use a high flowability compound mixed with a very low specific surface area and low structure grade such as PUREX® LS 18.

For specific food-contact applications, mainly for seals in contact with liquids like oil, water or milk, Orion has developed by the "PUREX® RP" product family (cp. chapter 2.8).

Figure 5

Consumer product containing rubber parts (sealings, hoses)

2.4. Hoses

Hoses play an important role in industry and automotive applications: they convey fluids like fuel, oil, concrete, air, etc. in different temperature and pressure ranges (examples: air conditioning, hydraulic hoses, turbo charger hoses). The requirements of the automotive industry depend on the specific application of the hose, such as

- Durability, mechanical properties, media & heat resistance
- Prevention of electrochemical degradation (ECD) of the hoses used for the cooling systems
- Decrease of the cost of the components
- Improvement of the air impermeability
- Light components/weight reduction

These components may be produced by extrusion, calendering or molding. The low specific surface area and relatively low structure imparted by the PUREX®

and SABLE grades offer the ability to improve the processability of the compounds during the molding step, allowing better flowability and less mold fouling. Mechanical properties are also improved due to the tensile strength developed by the component.

These improvements can be achieved by the use of PUREX® LS 18 and PUREX® HS 22.

In order to impede the electrochemical degradation of radiator hoses used in cooling systems it is necessary to increase the resistivity of the compounds. The use of low specific surface area grades with low structure leads to lower electrical conductivity of the compound and thus to better results with respect to the electrochemical degradation.

The best grades to use for these applications are PUREX® HS 22 and PUREX® LS 18, which may contribute to a cost saving due to the higher content of the carbon black.

To decrease air permeability, the objective is to create a barrier in the rubber compound. The air permeability coefficient is improved when a low specific surface area carbon black such as PUREX® LS 18 is used. This large particle CB helps to:

- Reduce of the air permeability at the same thickness level of the component
- Decrease the thickness of the compound at equal level of permeability and therefore a reduction in weight and cost of the components
- Enable cost savings by using cheaper polymers like NR in comparison to the expensive butyl rubber

Figure 6

Hydraulic hose

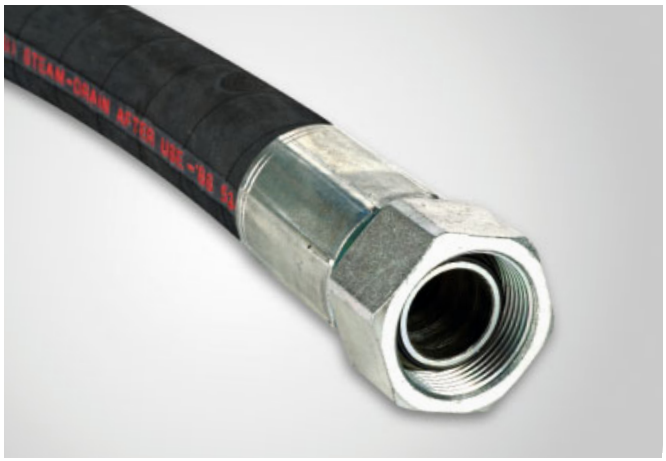


Figure 7

Turbo hose

2.5. Transmission belts

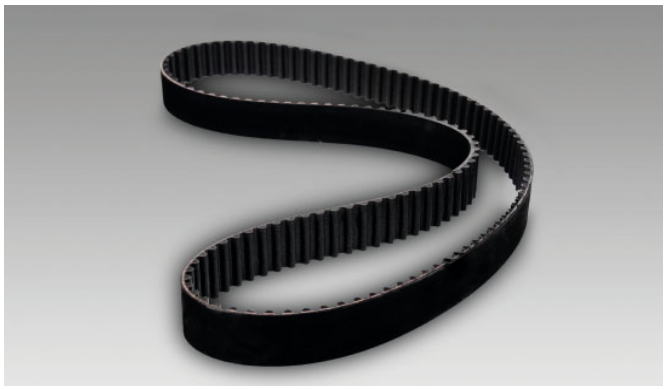
The transmission belt consists of several layers with different functions. The layer in contact with the pulleys must match the following requirements in its rubber composition:

- Excellent initial and aged electrical conductivity
- Excellent flex fatigue and tear resistance
- Excellent abrasion resistance
- Low heat build-up.

Many belt constructions use both hard and soft blacks. For hard black requirements Orion ECORAX® or HP grades are recommended and for soft black requirements PUREX® and SABLE grades are best suited.

Figure 8

Transmission belt



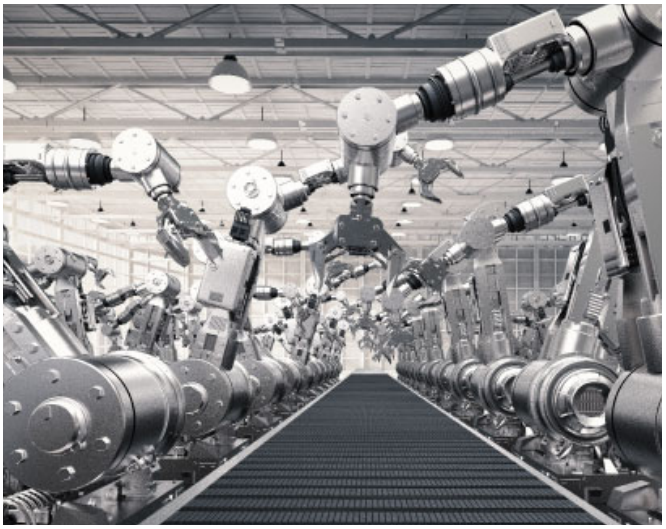
2.6. Conveyor belts

Belt conveyors consist of at least two pulleys which drive an endless loop of rubber made up of multiple layers of material. In general, there are two distinct applications for conveyor belts:
Transport of packaged goods within a factory and handling of large volume bulk materials such as ore, coal, grain and more. These belts can be very long to transport e.g. ore from a mine to a refinery and require material properties similar to those of a tire. Abrasion resistance, chip and chunk resistance, low heat build-up and low energy loss are all aspects which must be considered.

Almost all of these belts consist of several layers. The upper layers may be composed of different materials: the surface of the cover which is in direct contact with the material and the sub-cover which provides stability and protects the carcass from mechanical damage. The compound in direct contact with the material has to be resistant to abrasion and cut and chip:
The recommended grade is CORAX® HP 1125. The sub-cover needs to provide strength at low energy loss of the belt and CORAX® HP 130, CORAX® HP 1107 or ECORAX® soft blacks fit this requirement.

Figure 9

Conveyor belt



2.7. Roofing

EPDM roofing is in competition with bituminous waterproofing for buildings as weather protection for roofs. It has to be in compliance with several building standards and has to be weather resistant for a long period of time (30 years or longer).

The carbon black used in roofing must allow good calendering properties with very low number and size of defects at the surface. Soft carbon blacks fulfill the requirements of the calendering process; the recommended grades for these applications are PUREX® HS 40 and HS 45.

Figure 10

Roofing with rubber sheets

2.8. Food contact/low Polycyclic Aromatic Hydocarbons (PAH)

In recent years numerous regulations have been put in place globally concerning rubber applications with food or skin contact. Some regulations place direct restrictions on the type and weight percent of carbon blacks, others focus on the final rubber product. Generally, health concerns arise from the very low amount of Polycyclic Aromatic Hydrocarbons (PAHs) accompanying carbon blacks. Although studies show that the PAHs are tightly bound to the carbon black particle surface and that no migration through the rubber matrix can be detected, precautionary limits have been defined. To meet the resulting demand for compliant carbon blacks, Orion has developed a family of clean MRG grades with reduced PAH content: the so called "PUREX® RP family". Please refer for details to the below table and our separate technical brochures.

Figure11

Rubber seals with food contact

Table 1

ORION's low PAH product portfolio

PRODUCT	ASTM EQUIVALENT	DESCRIPTION	BAP [PPM]	8 EU [ppm]	15 AfPS [ppm]
DUREX® 0	-	LAMP BLACK	<0.03	<1	<10
PUREX® LS 30 RP	N772 (clean)	Furnace Black	<2.5	<2.5	<100
PUREX® HS 45 RP	N550 (clean)	Furnace Black	<0.25	<1	<10
PUREX® HS 75 RP	N330 type	Furnace Black	<0.03	<2.5	<100
PUREX® HS 95 RP	N220 type	Furnace Black	<0.03	<2.5	<50

3. PROCESSING

3.1. Mixing and dispersion

The reinforcing potential of a carbon black is mainly defined by structure and specific surface area. This reinforcing potential can only be achieved when the maximum contact surface is created. The maximum contact surface can only be reached when the carbon black is optimally incorporated, distributed and dispersed. Incorporation, dispersion and distribution are strongly influenced by the design and control of the mixing process. The mixing process and the reinforcing properties are linked.

The dispersion is the fragmentation of large carbon black agglomerates into smaller agglomerates and aggregates during mixing. The maximum performance of filler in rubber is strongly dependent on its dispersion in order to reach the optimum filler-polymer interaction. The optimum dispersion consists in the breakdown of carbon black pellets to the smallest dispersible unit (aggregate).

The ultimate objects, called „aggregates", have a typical size of 100 -1000 nm.

Figure 12

Carbon black aggregates

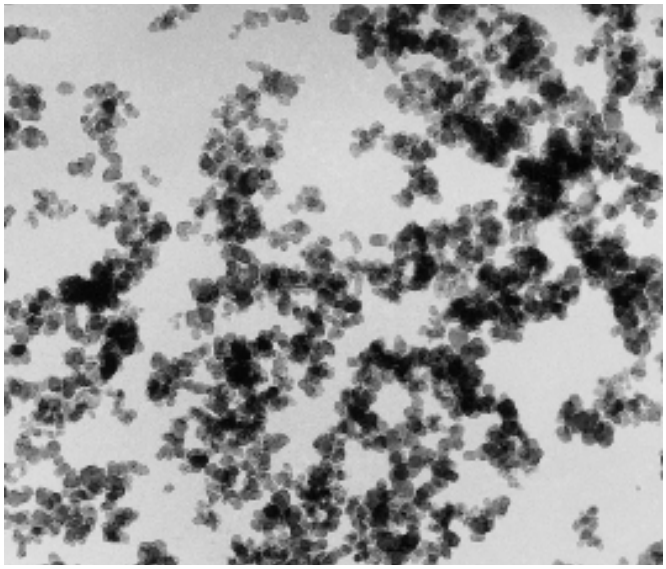
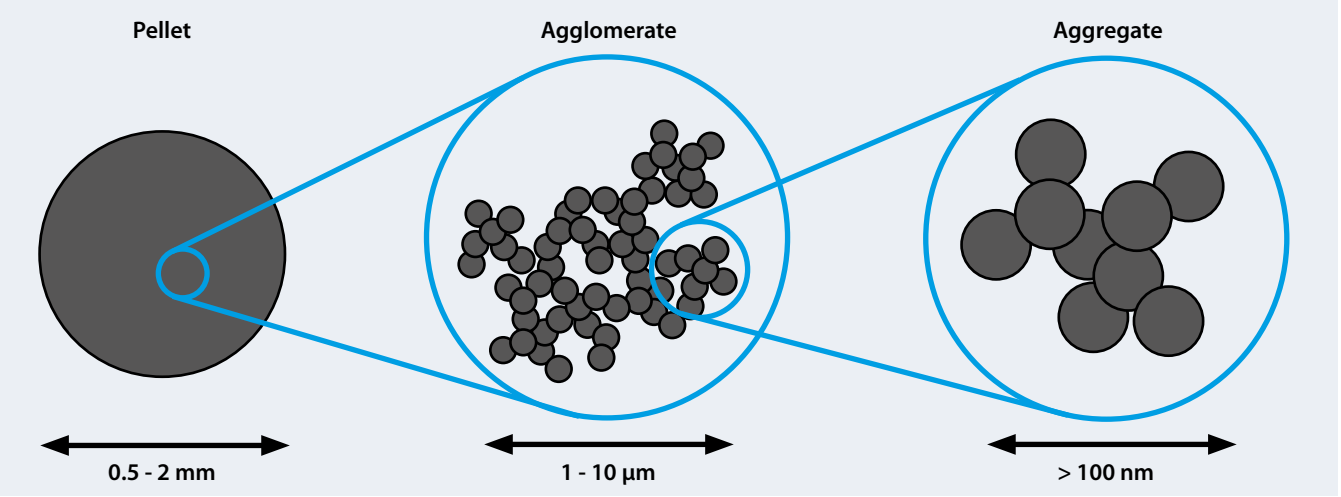


Figure 13

Carbon blacks' aggregates



3.2. Extrusion

During extrusion of rubber, the raw compound is fed from a hopper through a screw and a barrel. At the front of the barrel, the viscous rubber compound leaves the screw and sometimes also travels through a screen pack (so called "strainer") to remove any contaminants.

The compound enters the die which is the tool that gives the final product its shape. It must be designed so that the rubber compound flows evenly from a cylindrical profile to the product's profile shape. Uneven flow at this stage can produce a product with unwanted residual stresses at certain points in the profile which can cause warping upon cross-linking. Due to the flow, small impurities will move towards the profile surface and cause spots, particularly if there is no screen-pack installed in the extrusion line. This is the reason why clean blacks are needed in profile compounds.

After the die, the product enters the cross-linking zone, a zone in which the compound is vulcanized either by hot media (air, salt bath, etc.) or UHF radiation. In this vulcanization area the green strength of a compound is very important as it keeps the dimensions stable.

Figure 14

Extrusion

3.3. Molding

The molding process is applied to produce components such as seals, AVS components or hoses starting from the uncured compound which is placed in a mold having the shape of the final components.

Several processes of molding are used in the MRG industry depending on the type of components: injection molding, compression molding and transfer molding.

3.3.1. Injection molding

During injection molding, green compound is injected into a heated mold to form the desired shape of the finished article. Prior to injection, the compound is fed to a holding tank using a relatively small extruder until the mold is available. During injection, the temperature of the compound increases dramatically due to high shear occurring at the walls of the mold allowing complete filling of the mold. The part is then held at a constant temperature within the mold for a specified period until dimensional stability is achieved.

3.3.2. Compression molding

The mold consists of two plates whose inner cavities define the shape of the final rubber article. A pre-weighed quantity of green
compound is put on the lower plate, and then the upper plate closes the mold forcing the compound to flow through the shape of the lower and upper inserts. This operation is performed under specified temperature and pressure during a determined time.

3.3.3. Transfer molding

The mold consists of a pot in which a pre-weighed quantity of compound is placed, the mold (a multi-cavities mold) into which the compound will be transferred by a plunger which forces the compound to feed the cavities under a high pressure through small holes corresponding to the feeding entries of the cavities. The mold is held closed till the end of the curing cycle. At the end of the cure cycle the plunger is moved up, the mold is opened and the components can be removed.

The most demanding process is injection molding with the main requirements:

- Pure compound in order to avoid the plugging of the compound injector; the use of Purex grades such as Purex HS 45, Purex HS 25 and Purex HS 22 is recommended.
- Consistent scorch properties in order to avoid pre-curing of the compound in the injection chamber, leading to a change in viscosity or blocking of the injector by scorched compound.

Figure 15

Example: compression molding

3.4. Microwave curing

The vulcanization of various rubber articles like extruded profiles and hoses is often achieved by exposure to ultra-high frequency (UHF) radiation, i.e. microwaves. The carbon black plays an important role in the rate of temperature increase: By rule of thumb, UHF absorption mainly depends on the specific surface area of the carbon black (-> the higher, the faster) and on the carbon black quantity in the rubber compound (-> the more, the faster). Structure (oil absorption number) also contributes, especially for carbon blacks with low specific surface area (-> the higher, the faster).

4. TESTING

Standard ASTM test methods are not sufficient to predict performance of carbon blacks in demanding applications such as extrusion of profiles for automotive body seals. As a result Orion is constantly searching for test methods which correlate better with in-rubber performance as experienced by end users. The goal is developing test methods which allow rapid determination of whether a specific production run of a carbon black is suitable for the most demanding applications. Such tests should be quick, repeatable, not labor intensive and transferable to customers.

Figure 16

NDM device

4.1. Non-dispersible matter (NDM)

The amount of foreign insoluble matter in carbon black is usually tested by a wet sieving method as described in ASTM D1514:
100 g of carbon black are washed with water through a wire-mesh screen with an opening of typically 45 µm until all that remains is a non-carbon black residue. This residue is dried, weighed, and the amount of residue is expressed as mg/kg (ppm) of the original sample. The drawback of this test procedure is the relatively small amount of carbon black used and the operator-dependent "rub-out steps" both on the wet sieve and after drying the residue. The dried residue is transferred to a piece of paper and then gently rubbed to remove any carbon black remaining on the residue. This is made until the white paper no longer shows any smears.

Experience has shown that this method is suitable for non-critical applications. However, when it comes to extruded products with high demands for surface smoothness (e.g. extruded automotive profiles), this test turned out to be insufficient. Despite a low figure for sieve residue according to ASTM D1514, users of standard carbon black may encounter surface imperfections which can be traced back to non-dispersed matter originating from the carbon black. This matter may include hard carbon black pellets, coke residue, inorganic matter, metals or metal oxides and other contaminants.

To address this, Orion developed a more sensitive test method which has been published as ASTM D7724 non-dispersible matter (NDM). The goal was to be able to sieve a larger amount of carbon black (500 g) in a short period of time (less than 20 min) and to obtain a test result which is operator-independent. This means, the remainders on the sieve are not manually treated, but only dried and weighed. The test result is expressed in mg/kg (ppm). Studies have shown a good correlation between the level of non-dispersed matter (NDM) and the number of surface defects on extruded tapes, measured by an optical system. ORION has implemented this analytical test method as a production control for premium rubber blacks, in particular for the PUREX® family.

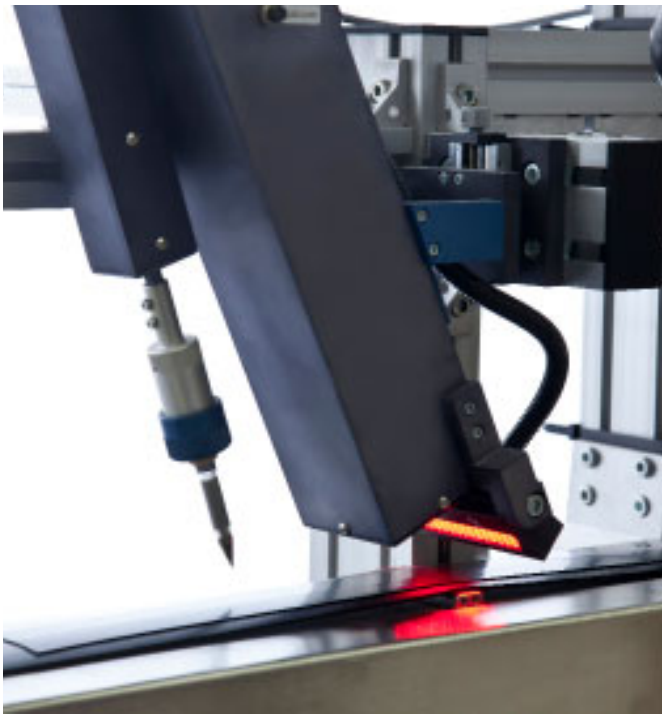
4.2. Surface defect inspection

This test method has been implemented in Orion's innovation & application centers in order to measure surface defects of extruded tapes. Such tapes can be evaluated visually and then assessed with a rating, e.g. from 1 (very poor) to 10 (no visible defects). However, this evaluation is strongly operator-dependent and it provides no information on the size (-distribution) of such defects. The profile control system offered by the company Pixargus is an optical device which detects surface defects ("hills" or "valleys") by the deflection of a light beam, and the results can be reported in a table listing the number of defects of a certain size range or by expressing the relative defect area (area of all defects divided by the total scanned area). Finally the software can also generate a picture of the scanned surface.

The advantage of this method is that carbon black performance can be tested under conditions similar to the ones at the users of the carbon black. This means, the test includes mixing of a rubber compound and processing by extrusion.

Figure 17

Surface defect detector device



4.3. Carbon black dispersion in rubber

The physical and mechanical properties of carbon black filled rubber compounds are strongly influenced by the degree of filler dispersion. In general, better filler dispersion leads to better rubber compound performance, e.g. reinforcement and abrasion resistance. The dispersion process takes place during mixing and corresponds to the filler size reduction from millimeters down to a few hundred nanometers. Carbon black pellets are incorporated into the polymer, broken up under shear forces into individual agglomerates & aggregates and distributed throughout the rubber matrix. Depending on the extent to which carbon black is dispersed, three different regimes are distinguished: visible, macro and micro dispersion.

4.3.1. Topography

Whereas the surface defect inspection test is used to measure visible surface defects of extrudates, the so-called topography test measures the macro-dispersion of carbon black in a cured rubber compound. The size of the specimens is in the millimeter range and the principle of the test is different in this case. The surface roughness is measured by a stylus in direct contact to the sample. Roughness measurements play an important role in various industries, e.g. to analyze metal surfaces. Orion has adopted this method using a commercial test device, modified to cope with the special behavior of rubber. Today, this test is fully automated and can be operated 24/7. Standard specimens are freshly cut pieces from 3 mm cured sheets and the test results can be reported as the number of peaks of certain size ranges or by the relative peak area (in %).

4.3.2. Confocal light microscopy (CLM)

Confocal light microscopy (CLM) has been developed for various industries and applications as a new standard technique to measure surface roughness. By focusing monochromatic light onto a sample and detecting the intensity of its reflection, surface textures of different sizes can be obtained by high speed in non-contact mode. Based on this technology, Orion invented a new in-house test method to characterize the carbon black dispersion in rubber. Depending on the optical magnification used (10x, 50x, or 100x), wide ranges of surface roughness down to sizes of a few hundred nanometers are accessible. Compared to the well-established topography method, the CLM offers several advantages:

- Quantification of both carbon black macro and micro dispersion
- No scratching, damaging or deformation of rubber compounds
- Analysis of soft and uncured rubber samples
- Shorter measuring times

4.4. Filter pressure test

The filter pressure test represents the pressure in front of the strainer measured at a small lab extruder. The sieves of the strainer separate undispersed particles from the compound. If the number of undispersed particles is too high, the sieve blocks and subsequently the pressure in front of the sieve increases.

5. CARBON BLACKS FOR THE MRG INDUSTRY

5.1. ASTM furnace blacks

ORION offers a wide variety of standard ASTM blacks commonly used in the MRG industry. Most relevant grades comprise (but not limited to) CORAX® N115, N220, N234, N330, N326, N375, N550, N650, N660, N762, N772 and N774. These grades are standardized to a certain extent and thus have a good global availability. Nevertheless most ASTM blacks were created to meet the requirements of the tire industry rather than the MRG industry. Consequently, ORION has developed a specific family of grades for the demanding MRG applications; the PUREX® and SABLE family (see next chapter).

Figure 18

Packaged special carbon black grades

5.2. PUREX® & SABLE grades

5.2.1. Concept

The Purex® and SABLE families of soft grades are produced using the same furnace technology as typical rubber grades but with process enhancements intended to improve performance in the most demanding applications. While purity is the main criterion, colloidal and pellet properties have also been optimized to yield the highest extrusion rates, highest levels of dispersibility and the lowest rates of screen pack pressure increase.

Purity is defined as:

- Low sieve residue content according to ASTM D1514
- Low Non Dispersible Matter according to ASTM D7724 which was developed by Orion and has shown good correlation with surface smoothness of extrudates.

5.2.2. Terminology

The naming of the products of the PUREX® family is based on 4 digits. The first two digits characterize the structure of the carbon black:

- LS for low structure
- HS for high structure.

The last two digits indicate the approximate specific surface area: i.e. PUREX LS 18 is a pure grade with a specific surface area of about 18 m^2/g and a low structure.

Because PUREX® cannot be used globally, the brand may not be mentioned in some regions. PUREX® LS 18 will be modified to LS 18.

For the SABLE family a different terminology system is used, based on the ASTM classification: i.e. SABLE 6500 is a clean N650 type.

5.3. Special grades

DUREX® 0

Pelletized DUREX® 0 Beads is a lamp black which satisfies the highest demands for purity. It is especially suitable for extruded articles where the best extrudability and excellent surface smoothness are required. DUREX® 0 Beads can be used at high loadings and it is very easy to disperse, even with short mixing cycles. Moreover it imparts to compounds excellent processability during extrusion (fast extrusion throughput), injection molding and calendering. DUREX® 0 Beads leads to an exceptional quality of profile surfaces in terms of smoothness, color and (low) gloss. Cured compounds exhibit low compression set, good dynamic properties and high elasticity, even at high filler loadings.

CK 3

CK3 is a carbon black which is produced by the gas black process. Therefore CK3 is characterized by a higher surface oxidation (acidic functionality). It imparts considerable scorch safety to rubber compounds by delaying the onset of cure. Additionally the bas black process avoids the development of almost any sieve residue, making CK3 an outstanding clean carbon black. Thanks to its low structure CK3 contributes to improve resistance to crack propagation under dynamic strain deformation. Application fields are seals, rubber-to-metal bonding compounds and molded goods, particularly heavy seals which require long transfer time and thus high scorch safety

CORAX® HP 130, HP 1107 and HP 1125

These furnace blacks are recommended for use in conveyor or transmission belt cover applications where good abrasion resistance and low energy loss are required. HP1125 is recommended in belting applications where chip and chunk resistance would be a benefit; i.e. where there are raised areas on the belt surface which might be subject to high levels of deformation during the loading or unloading phase of the transport cycle.

ECORAX® S 600

ECORAX S 600 is a high structure carbon black with a specific surface area between standard hard and soft blacks. ECORAX S 600 has been developed for application both in mechanical rubber goods and in tires. It provides an optimized balance of reinforcement and hysteresis of rubber compounds. In tire tread applications, ECORAX S 600 features soft-black-like hysteresis properties while wear resistance is kept on the level of an N300 series grade. Low hysteresis and high rigidity turn out to be beneficial for tire sidewall compounds. In MRG applications, compared to conventional soft blacks, ECORAX S 600 allows outstanding high frequency isolation which is requested for anti-vibration systems e.g. in public transport.

ECORAX® S 470

ECORAX® S 470 is a high-structure carbon black with a specific surface area exceeding that of common semi-reinforcing blacks. ECORAX® S 470 was developed for mechanical rubber goods as well as tire applications. Its use allows an optimized balance of reinforcement and rolling resistance properties in rubber compounds. In anti-vibration systems, ECORAX® S 470 imparts decreasing heat build-up and tan delta when used alone or in blends with conventional ASTM carbon blacks, such as N330. Additionally, in other MRG applications, compared to conventional hard blacks, higher loading levels can be achieved with ECORAX® S 470 leading to lower overall compound costs. One application is the rubber layers of belt conveyors.

PRINTEX® MV

PRINTEX® MV is similar to N550 in terms of structure and specific surface area, however it is characterized by a particularly high purity in combination with lowered pellet hardness for optimized carbon black dispersion. Rubber compounds containing PRINTEX® MV are easy to extrude, show a good dimension stability and are suitable for the production of articles with a very smooth surface. Application fields are mechanical rubber goods, especially extruded articles with high surface requirements.

ECORAX® *Nature* 200

The first commercially available carbon black based on renewable feedstock, specifically designed for rubber applications. This product can completely replace CORAX® N326. ECORAX® Nature 200 is manufactured using the mass-balance principle and based on second generation, animal-free, bio-based feedstock.

Y200 BEADS

Y200 BEADS is a beaded acetylene black with a high cleanliness, an outstanding thermal and a good electrical conductivity. The combination of high specific surface area and very high structure facilitates processing in rubber compounds. Typical application fields are thermally conductive compounds like vulcanization bladders, platinum catalyzed silicone compounds and rubber goods requiring electrically and antistatic conductivity.

ECORAX® Circular 210, 215 and 220

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 applying the mass-balance principle. The 3 circular carbon blacks match the in-rubber performance of the corresponding ASTM grades (cp. Table 3).

PRINTEX® XE2 B

PRINTEX® XE2 B is a carbon black with a specific surface area which is far higher than that of conventional reinforcing carbon blacks. It imparts to rubber compounds excellent electrical conductivity. Therefore it is primarily used in electrically conductive rubber goods. Even at low loadings, it leads to very low surface or volume resistivity. Depending on the desired conductivity it can be blended with other reinforcing carbon blacks.

Figure 19

Different carbon black grades

Table 2

Special carbon blacks for MRG applications

PRODUCT	IODINE mg/g	STSA m^2/g	OAN ml/100g	COAN ml/100g
PUREX® LS 18	19	19	73	60
PUREX® LS 30 RP	30	30	65	59
PUREX® HS 20	19	19	138	76
PUREX® HS 22	21	20	102	75
PUREX® HS 25	28	28	123	83
PUREX® HS 33	36	30	121	-
PUREX® HS 40	43	38	111	82
PUREX® HS 45	43	39	121	85
PUREX® HS 55	54	47	133	86
PUREX® HS 45 RP	43	39	121	85
PUREX® HS 75 RP	90	74	99	-
PUREX® HS 95 RP	127	-	102	-
SABLE 6500	36	35	122	85
SABLE 7700	29	27	72	63
AS 7-256	29	28	65	-
DUREX® 0 BEADS POWDER	30 35	17 18	-	-
CORAX® HP 130	115	117	135	107
CORAX® HP 1107	140	128	130	104
CORAX® HP 1125	142	126	102	-
CK 3	-	80	104	-
ECORAX® Nature 200	-	77	72	69
ECORAX® Circular 210	82	76	102	88
ECORAX® Circular 215	43	39	121	85
ECORAX® Circular 220	36	34	90	74
ECORAX® S 204	19	19	138	76
ECORAX® S 206	19	19	75	60
ECORAX® S 470	54	47	133	86
ECORAXv S 600	60	60	144	-
PRINTEX® MV	43	39	121	-
PRINTEX® kappa 70 BEADS	-	130	165	-
PRINTEX® XE2 B	1125	-	420	-
Y200 BEADS	-	61 (BET)	265	-

Table 3

Special carbon blacks for MRG applications

PRODUCT	CHARACTERISTIC PROPERTIES	TYPICAL APPLICATION
PUREX® LS 18	Particularly low specific surface area and low structure, thus allowing high loadings at good processing (viscosity)	Rubber products requiring a very low conductivity and preventing electrochemical corrosion and degradation
PUREX® LS 30 RP	Identical analytical properties to CORAX® N772 with a very low amount of sieve residue and low PAH content	Molded articles with high elasticity and low compression set
PUREX® HS 20	Particularly low specific surface area and high structure, thus allowing high loadings at good processing	Anti-vibration systems and other rubber articles with high elasticity and low heat build-up
PUREX® HS 22	Particularly low specific surface area and medium structure, thus allowing high loadings at good processing (viscosity)	Suitable for precision sealing systems produced by injection molding (good flow properties)
PUREX® HS 25	Particularly low specific surface area and high structure, thus allowing high loadings at good processing confering well balanced processing and reinforcing properties	Rubber articles which are produced by extrusion requiring a high level of smoothness (profiles)
PUREX® HS 33	Similar to CORAX N650 but with a high level of purity, easier processing, lower hysteresis together with excellent dispersion compared to ASTM N550/N650	Automotive profiles and anti-vibration applications
PUREX® HS 40	Premium N539 with respect to sieve residue and pellet properties	Mechanical rubber goods, especially extruded articles with high surface requirements
PUREX® HS 45	Premium N550 with respect to sieve residue and pellet properties	Mechanical rubber goods, especially extruded articles with high surface requirements
PUREX® HS 55	Medium specific surface area and high structure (ASTM N400), allowing high loadings at good processing	Mechanical rubber goods applications (advantageous UHF curing)
PUREX® HS 45 RP	PUREX HS 45 with low PAH content	Extrudates and molded articles in dynamic applications
PUREX® HS 75 RP	N330 with low PAH content	Highly stressed technical articles with high modulus
PUREX® HS 95 RP	High specific surface area in the range of N200 series with a moderate structure, low sieve residue and low PAH content	Articles with high abrasion resistance and high tear resistance
SABLE 6500	Excellent extrudability, smooth surface, low die swell	Automotive profiles, general molded articles
SABLE 7700	High filler loading, low hysteresis, low compression set	Molded articles with high request on dynamic properties, conveyor belts
AS 7-256	High filler loading, low hysteresis, low compression set	Molded articles, hoses
DUREX® 0 BEADS POWDER	Fulfills highest demands for purity, best extrudability, excellent dispersion, very low gloss	Profiles, hoses and molded articles with very high request on purity (food contact)
CORAX® HP 130	High reinforcement, balanced abrasion resistance and hysteresis	Molded articles with high request on reinforcement and dynamic properties, conveyor belts
CORAX® HP 1107	Very high reinforcement, balanced abrasion resistance and hysteresis	Molded articles with very high request on reinforcement and dynamic properties, conveyor belts

PRODUCT	CHARACTERISTIC PROPERTIES	TYPICAL APPLICATION
CORAX® HP 1125	Very high reinforcement, good tear properties and low fatigue, balanced hysteresis	Molded articles with very high request on dynamic tear resistance
CK 3	Good reinforcement, scorch safety, slow cure and low sieve residue	Big molded articles with request on scorch safety, slow cure and low sieve residue (bridge dampers, fenders, big seals,…)
ECORAX® Nature 200	The first commercially available carbon black based on renewable feedstocks, specifically designed to replace N326 in rubber applications	Rubber products with particular focus on the use of renewable raw materials
ECORAX® Circular 210	The first commercially available carbon black based on oils stemming from a pyrolysis of rubber products, particularly end-of-life tires (ELT), specifically designed to replace N330 in rubber applications	Rubber products with particular focus on the use of recycled raw materials/circularity
ECORAX® Circular 215	The first commercially available carbon black based on oils stemming from a pyrolysis of rubber products, particularly end-of-life tires (ELT), specifically designed to replace N550 in rubber applications	Rubber products with particular focus on the use of recycled raw materials/circularity
ECORAX® Circular 220	The first commercially available carbon black based on oils stemming from a pyrolysis of rubber products, particularly end-of-life tires (ELT), specifically designed to replace N660 in rubber applications	Rubber products with particular focus on the use of recycled raw materials/circularity
ECORAX® S 204	Carbon black with particularly low specific surface area and high structure, thus giving rise to good reinforcing properties and a very low hysteresis	Anti-vibration systems and other rubber articles with high elasticity and low heat build-up
ECORAX® S 206	Carbon black with particularly low specific surface area and low structure, thus allowing high loadings at good processing (viscosity)	Rubber compounds requiring high filler loading and good processing, e.g. in conjunction with expensive polymers
ECORAX® S 470	Carbon black with a specific surface area beyond typical semi-reinforcing blacks and with high structure. It provides high reinforcement at moderate hysteresis	When used as an alternative to reinforcing blacks like N330, higher loadings can be achieved, and the compounds exhibit improved heat build-up and hysteresis
ECORAX® S 600	Carbon black with a specific surface area in between that of semi-reinforcing and reinforcing blacks. Provides compounds with high durability (hardness, wear & tear resistance) and good hysteresis properties	Rubber articles with a balance between durability and hysteresis (heat build-up), e.g. for anti-vibration systems, conveyor belts, etc
PRINTEX® MV	Carbon black of the N550 type, but with very high purity and low pellet hardness. These features lead to excellent dispersibility also in soft rubber compounds	Extruded goods with highest requirements for surface smoothness and dispersion
PRINTEX® kappa 70 BEADS	Carbon black with very high specific surface area and high structure, thus providing good electrical conductivity to rubber compounds	Electrically conductive and antistatic rubber goods
PRINTEX® XE2 B	Carbon black with extremely high specific surface area and structure, thus providing excellent electrical conductivity to rubber compounds	Electrically conductive and antistatic rubber goods
Y200 BEADS	Acetylene black with high specific surface area and very high structure, thus providing good electrical and superior thermal conductivity to rubber compounds	Electrically and thermally conductive rubber goods

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