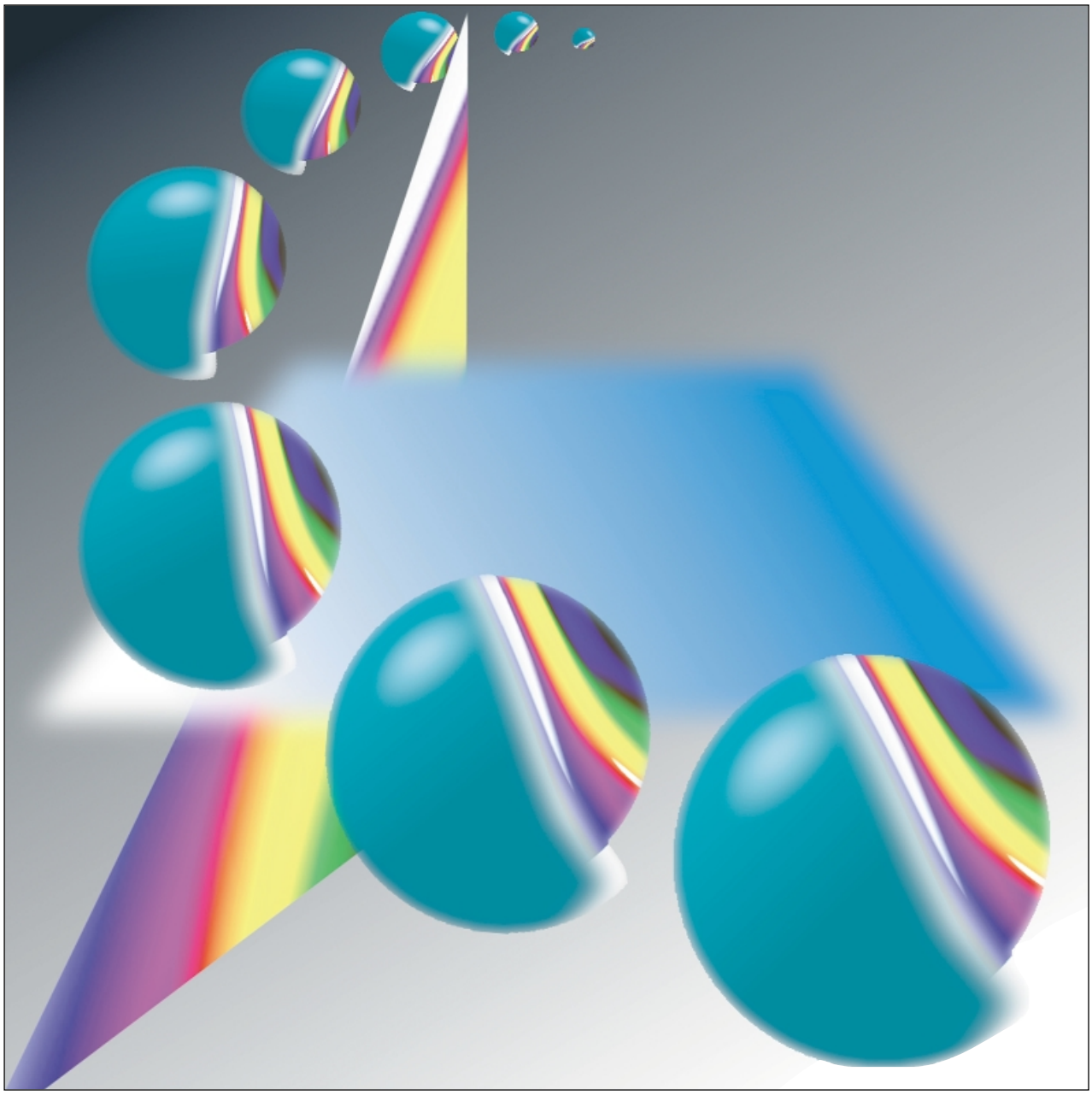
Vulkocell®

Unrivalled quality over a broad spectrum of applications



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Vulkocell®

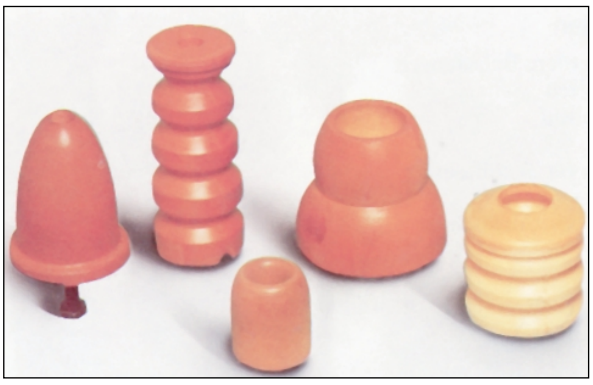
P+S Polyurethan-Elastomere

Polyurethane Elastomers with cell structure

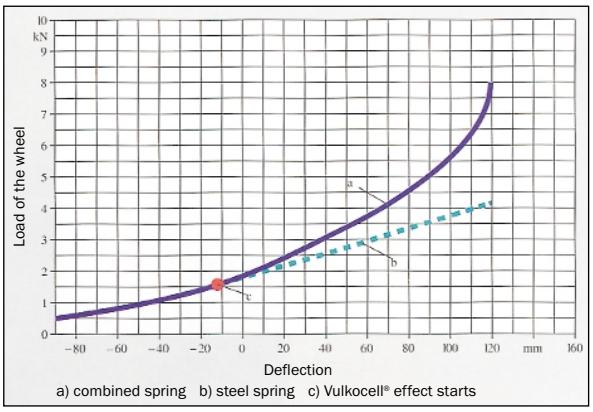
Vulkocell® is one of the group of Polyurethane Elastomers; it is however, the only one with a regular cell structure and excells all other materials such as Rubber and solid Polyurethane Elastomers in one outstanding characteristic:
it is compressible.

Properties of Vulkocell®

Solid Polyurethane Elastomers are well known for their tensile strength and elongation at break, as well as their very good impact strength and high abrasion resistance. Vulkocell® also exhibits all of these properties and in addition it is compressible, it has very good impact resilience and restoring force that does not suffer even under a long-lasting stress.



Vulkocell® springs and buffers for motor vehicles



a) combined spring b) steel spring c) Vulkocell® effect starts

Total hysteresis curve of a car-wheel

Compressive strain behaviour

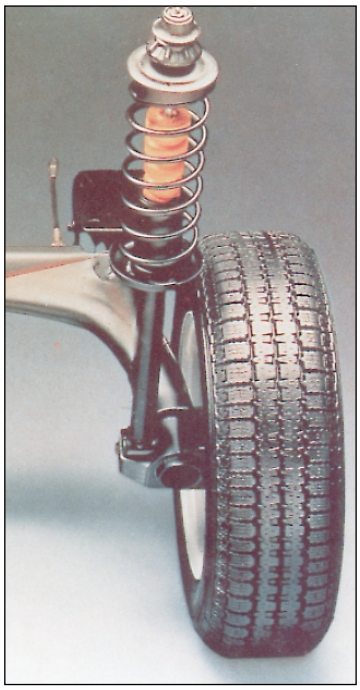
The compressive strain behaviour of cellular Vulkollan® is determined by its chemical structure, its density and the shape of the specimen. From the compression load/deflection diagram illustrated on the next page, a number of points emerge:

- The higher the density, the higher the energy absorption.
- At below approx. 35 % deflection, compressive stress is roughly proportional to deformation – as is the case with frictionless metal springs.
- When the deflection exceeds about 35 %, the force needed to produce further deformation increases progressively.

Another highly significant fact is that the compressive strain behaviour at up to approx. 50 % deflection remains practically constant over temperatures ranging from about +20 °C to +80 °C.

The properties of cellular Vulkollan® change only gradually even under long-term dynamic loading. Whether at room temperature or at +80 °C, the spring characteristic is always found at the same level, and is therefore a calculable factor. Even after 10^6 compressions of 60 % permanent set only amounts to about 3,5 %.

With this exceptional resilience, cellular Vulkollan® can be used to design smaller, lighter springs giving reliable, long-term functional performance.



Wheel assembly on rear

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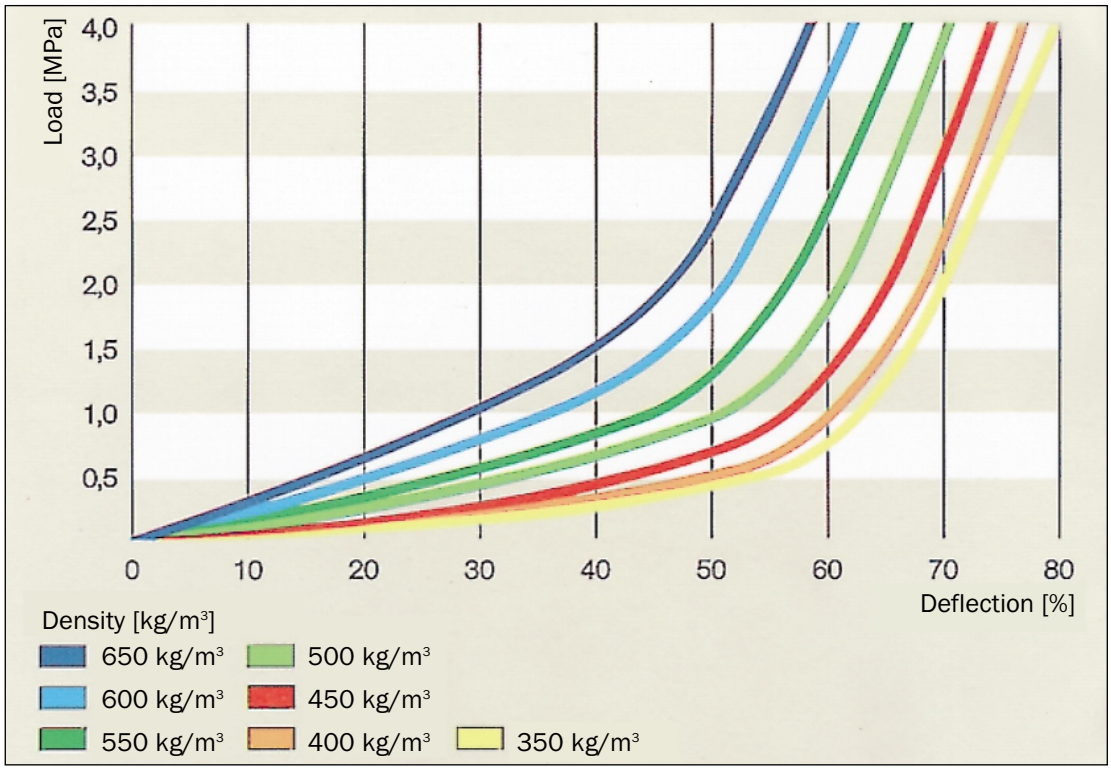
Vulkocell®



Compression load/deflection diagram of cellular Vulcollan® at 23 °C obtained using a cube with 40 mm edges; deflection rate 50 mm/min

Density	Compressive stress (MPa) at a deflection of:				
kg/m³	20%	25%	30%	35%	40%
350	0,13	0,16	0,19	0,23	0,26
400	0,16	0,22	0,26	0,31	0,35
450	0,25	0,31	0,37	0,44	0,50
500	0,34	0,42	0,51	0,60	0,68
550	0,41	0,51	0,61	0,71	0,81
600	0,55	0,68	0,82	0,96	1,10

Compressive stress values obtained using a cube with 40 mm edges; deflection rate 50 mm/min

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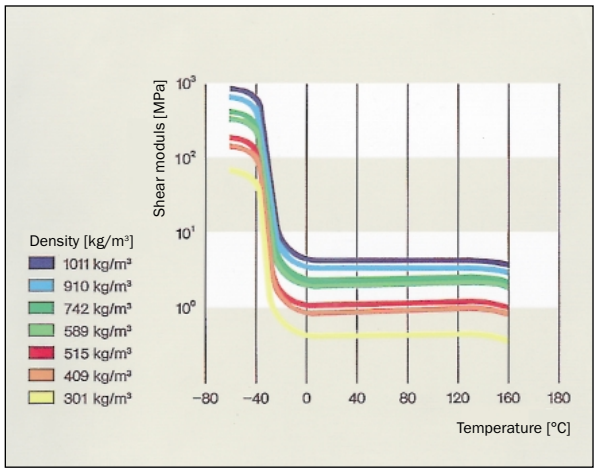
Damping

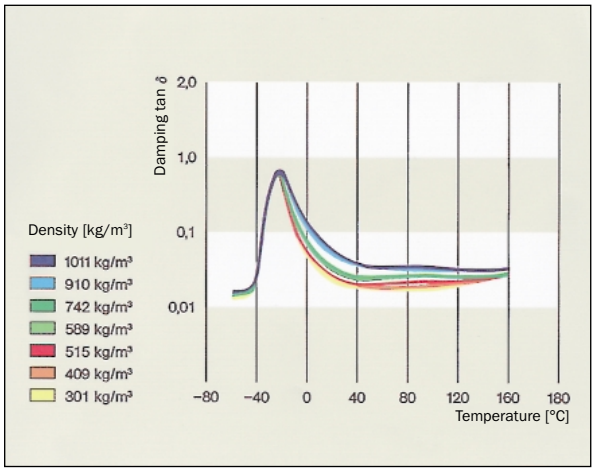
The damping depends on many factors, such as density, temperature, deformation speed, and shape and therefore it is not a constant value. Generally, we may say that the damping descends with elevated temperatures or density. Vulkocell® achieves the maximum damping at about –20 °C; at this temperature it amounts to approx. 40 %. At still lower temperatures Vulkocell® will become hard, however, it does not crystalize or embrittle. In the temperature range of approx. 20 °C to 80 °C the damping effect of even large Vulkocell® parts which are stressed dynamically will not lead to thermal destruction within the core. Due to the fact that the allowable or approachable frequency and amplitude or dynamic stress mainly depends on the volume and shape of the component, the damping effect must be tested individually in each suspension design.

Modules of elasticity

In a temperature range of 0 to 80 °C the elastic modulus of Vulkocell® almost constantly amounts to 1 – 3,5 N/mm² depending on the specific gravity. Due to the hardening of the material at minus temperatures the elastic modules can increase to 60 N/mm² at –40 °C.



Torsion pendulum test to DIN 53 445



Torsion pendulum test to DIN 53 445

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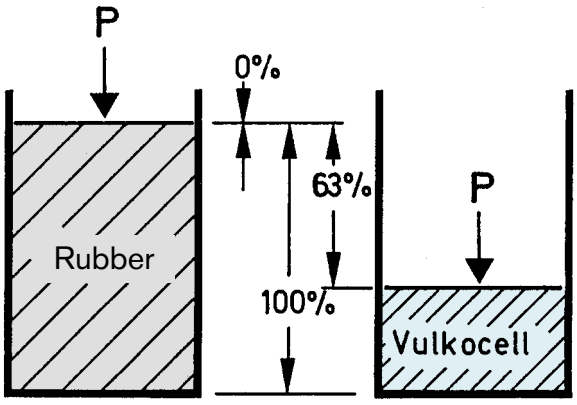
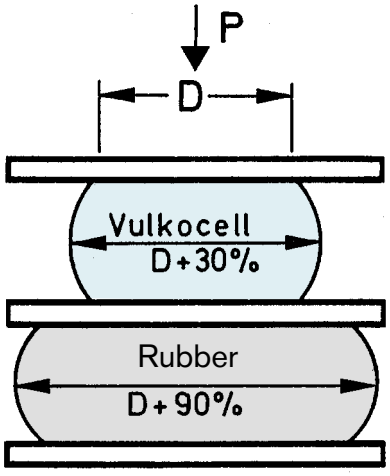
Compressibility of volume and lateral extension

Vulkocell® can be compressed to such a degree that all the cells are pressed together and a homogenous elastic structure is formed. The advantage of this is that at this degree of deformation there is only a slight lateral extension which can often be ignored. It is possible therefore to develop suspension elements with a spring of up to 80 % of its overall height and depending on the specific gravity, the lateral extension will not exceed 45 %.

The advantage of this compressability of volume becomes clear when compared with solid elastomeric materials such as rubber. If both samples are of the same dimensions and rigidity and they are both stressed inside in a standard cylinder, the rubber spring will not compress to any degree while the Vulkocell® can still compressed to 63 % of its original volume.

Furthermore, repeated compression of the Vulkocell® inside this confined space will not cause the material to wear as the abrasion resistance is extremely high.





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Vulkocell®

Chemical properties

Vulkocell® is resistant to aliphatic carbonated hydrogens such as oils and greases as well as to active oxygen and aging. In the technical field therefore it can be said to be generally resistant to lubricants which do not contain certain additives (in which case working tests must be carried out).

Vulkocell® is only conditionally resistant to hydraulic oil and certain types of molykote, it is not resistant to strong acids and alkaline solutions and if used in hot water or water vapor for long periods there will be some degradation despite the hydrolysis protecting agent that is part of the formula.

In combination with chemical reagents the properties of Vulkocell® are affected in different ways; the compression set of Vulkocell® will deteriorate under the influence of supergrade petrol and swelling will occur. On the other hand the same value is slightly increased when under the influence of motor oil 15 W 50 even at temperatures of 80 °C. In this connection it is important to note that in many cases these changes are reversible by removal from the medium.

Influence of temperatures

The influence of elevated or low temperatures on the properties and behaviour of Vulkocell® has already been explained as far as damping, moculs, and chemical resistance are concerned. In general it may be said that Vulkocell® can be used within a temperature range of –20 °C to 80 °C. Short duration temperature peaks of up to 100 °C do not impair the material. The hardening of the material at –20 °C has no effect on its constitution, the material does not embrittle, therefore there is no risk of fracture. In the case of dynamic stress the ambient temperature should not exceed 60 °C.

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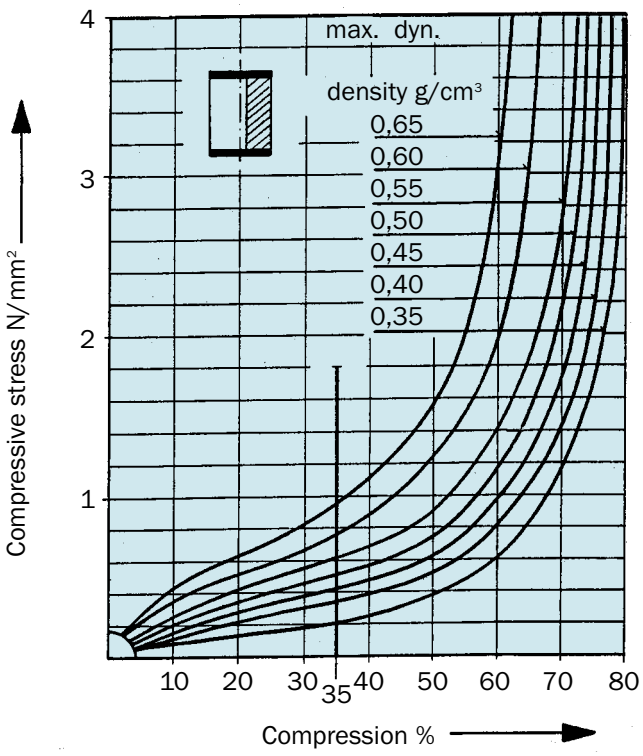
Vulkocell®

Characteristics of the available grades

The various Vulkocell® grades are identified by their density which in general can be adjusted between 350 and 650 kg/m³ (.35 to.65 g/cm³). There are two special grades of 250 and 300 kg/m³ (.25 and .3 g/cm³). The first two letters and the first two figures of the grade number indicate the formulation type, the final two numbers indicate the density.

Compressive stress curves of a cylindrical spring



The table shows a survey on the physical values of Vulkocell® NH 24. The mentioned data are standard alues which have been determined in several single measurements.

Test	Standard	Unit	NH 24/35	NH 24/40	NH 24/45	NH 24/50	NH 24/55	NH 24/60	NH 24/65
Density	DIN 53420	g/cm³	0,35	0,40	0,45	0,50	0,55	0,60	0,65
Tensile strength	DIN 53571	N/mm²	4,0	4,5	5,50	6,5	7,5	8,0	9,0
Breaking elongation	DIN 53571	%	380	410	430	450	460	470	480
Tear strength	DIN 53515	N/mm²	8	10	12	14	18	20	22
Impact resilience	DIN 53512	%	60	60	60	60	60	60	60
Compression set*	DIN 53572	%	2,5	3,0	3,0	3,5	3,5	3,5	3,5
Compression set**	DIN 53572	%	5,0	6,0	7,0	7,5	8,0	8,0	8,5

*= 20° C 70 hours
**= 70° C 22 hours

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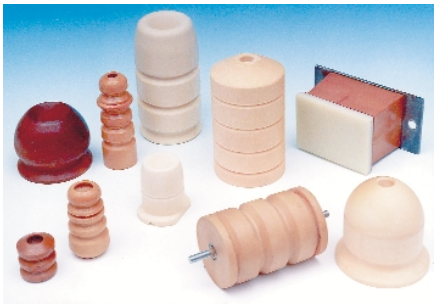
Vulkocell®

Uses and applications of Vulkocell®

In addition to the above mentioned compressibility, Vulkocell® also exhibits the good physical and chemical properties that are the hall-mark of Polyurethane Elastomers and therefore a technical sound barrier has been shattered. The following fields of application are suited to the use of Vulkocell®

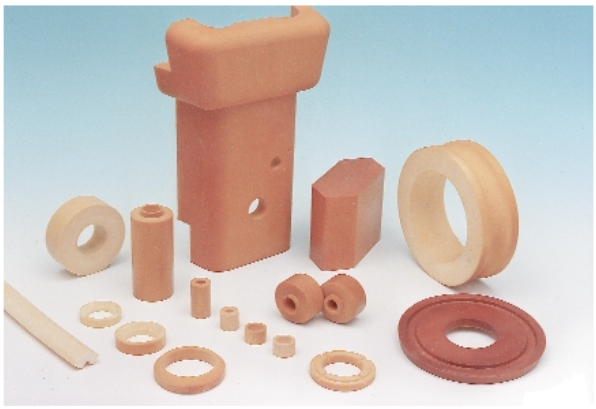


Automobile industry

Vulkocell® is the perfect material for suspension elements and shock absorbers, leaf and coil spring mountings and it can also be used in air suspensions. Due to their progressive spring characteristics, suspension elements made from Vulkocell® are a significant contribution to road performance, and they guarantee an excellent transition from main speing to auxiliary spring under full load conditions. If Vulkocell® auxiliary springs are used, buffers may be omitted as their function will be performed by the progressive compressibility of the Vulkocell® spring.

In the case of trailers and industrial trucks Vulkocell® springs may be the sole suspension element of the vehicle. Here, Vulkocell® elements can be designed as compression/tension springs and metal ties are often not required. The internal damping effect of Vulkocell® (approx. 15 to 20 %) can also make shock absorbers unnecessary.

Rail vehicles can also be equipped with Vulkocell® elements, on the one hand they are used for suspension and shock absorbers, and on the other it is possible to furnish trams with a ram protection made of Vulkocell®. These rams will absorb significant portions of impact force owing to the specific damping effect of Vulkocell®.



General engineering aparatus

As a matter of fact this field is very large and it can best be described by examples: Cyclinders coated with Vulkocell® are installed in paper folding machines and Vulkocell® “Billy-Rollers” or feed rollers are common in the paper processing industry. Owing to their good abrasion resistance and fatigue strength, parts cut from Vulkocell® plates serve as thread pick-ups on Vacuum Cleaners. In the automobile industry Vulkocell® linings are used to seal steering and track-rod joints; due to the ductility and high restoring force of Vulkocell®, these seals can span the wide angles of deflection of these articulations and still maintain an excellent seal.

Tractors, agricultural and construction machinery

In this technical field Vulkocell® linings are often used for the sealing of pivoting bearings and slow speed ball and slide bearings. Here, it is possible to supply oil or grease impregnated Vulkocell® collars as continuous or emergency lubricators. The material has also stood the test of time as oil wipers for piston rods, elastic guiding devices for isolation of vibration, buffers, bushings and differential elements.

Abrasives industrie

In the abrasives industrie Vulkocell® is processed for the manufacture of abrasive and polishing compound backing pads. These are sometimes produced from blocks, plates or cylinders.

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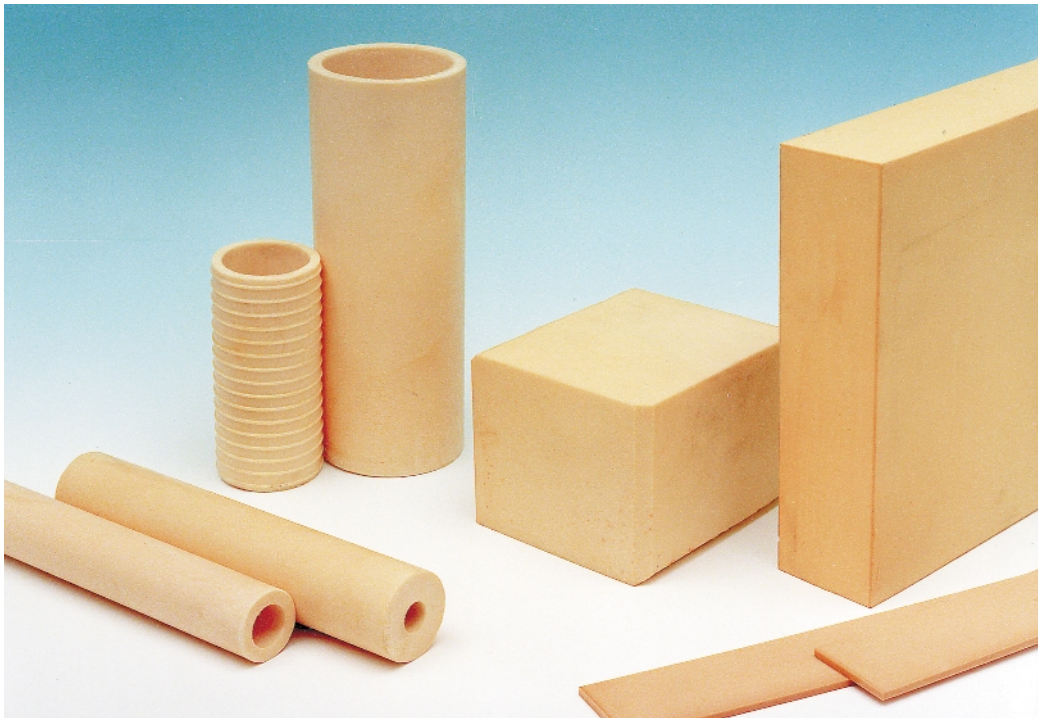
Vulkocell®

Orthopaedic and shoe industry

Owing to its good suspension, and the low compression set properties, Vulkocell® is especially suitable for use as inserts, supports, elastic intermediate layers and non-skid shoe soles etc. In the case of highly stressed shoes e.g. sports shoes and industrial boots Vulkocell® can offer safer and healthier elastic heals.



Semi-finished and ready-made products

While the majority of Vulkocell® products can be moulded and finished in one or two operations, it is not possible to “foam” very small components in a mould due to their size. For this reason, slab stock, blocks, plates, foils, tubes and rods etc. are available in a range of sizes as semi-finished materials from which small components can be cut or machined.

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