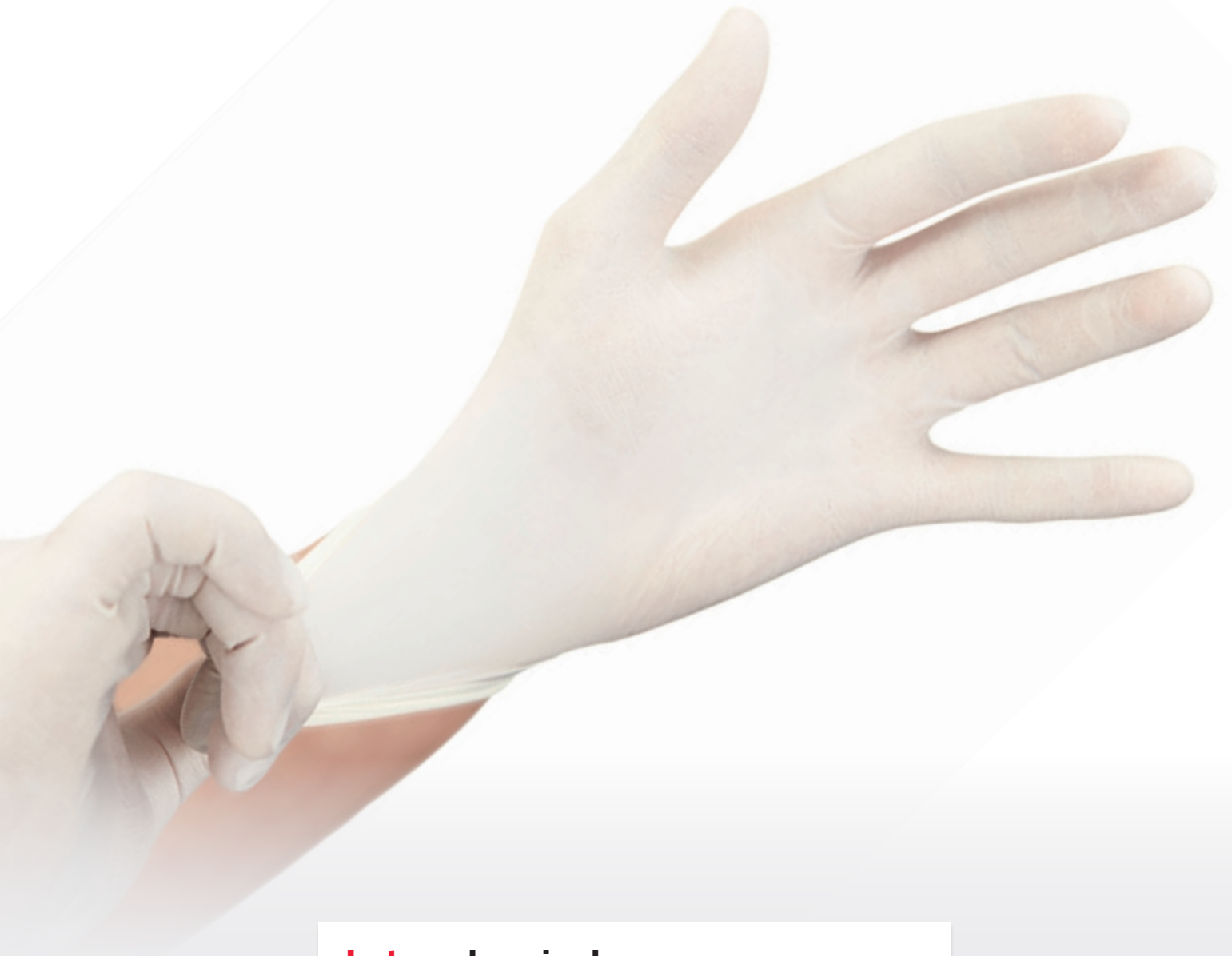


# QUALITY PERFORMS.



## **Latex** chemicals

Product range and applications



**QUALITY WORKS.**

**LANXESS**  
Energizing Chemistry



## LATEX APPLICATIONS

LANXESS is a globally operating supplier of latex chemicals for the latex processing industry with a broad product range, tailored to meet the requirements of a wide variety of applications.

### Several generations of latex specialists

In latex processing LANXESS can look back on a long history of achievement. Important milestones include the first patent for synthetic latex in 1912 and the development of thiazoles and dithiocarbamates as accelerators, which are particularly suitable for the manufacture of dipped and molded articles. Further landmarks were innovations in an important class of zinc oxides, and in colloidal sulfur, antioxidants and special-purpose latex chemicals.

### Expertise at every level

This considerable experience is one of the reasons why LANXESS has become one of the most important partners of the latex processing industry. Others include the high quality of the products, which is assured through internal and external quality management systems, the high reliability of delivery ensured through in-house production and a world-wide service network, enabling LANXESS to provide individual on-site support for specific issues concerning latex.

Please find below information on our portfolio of latex chemicals. For further or more detailed information e.g. on food contact applications please do not hesitate to contact our local experts. You will find their addresses at the end of this brochure.

### Know-how for your products

Whatever your application is, chemicals experts at LANXESS will provide individual technical advice tailored to your needs. We are aiming to optimize applications for individual customers by modifying products or formulations.

### Examples of solutions

For producers of rubber threads, for example, a special formulation of the accelerator ZMBT containing only a small amount of free MBT has been developed.

Due to its structure, MBT can cause breakage in fine rubber threads. By reducing the free MBT content we have managed to improve the quality and reduce the number of rejects. The following pages illustrate further examples.

# LATEX APPLICATIONS

Latex chemicals	International abbreviation	Coagulated goods						Foams		Shoes					Automotive			
		Examination gloves	Surgical gloves	Household gloves	Industrial gloves	Balloons	Condoms	Latex threads	Foam mattresses	Carpet foams	Artificial leather	Shoe inner soles	Adhesives	Leather crumbs	Gaskets	Tire cords	Rubberized hairs	Wiping cloths
<b>Accelerators</b>																		
Vulkacit® LDA	ZDEC	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■
Vulkacit® LDB	ZDBC	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■
Vulkacit® P extra N	ZEP	■	■	■	■			■		■				■		■	■	
Vulkacit® ZBEC/C	ZBEC	■	■	■	■	■		■	■	■	■	■	■	■	■	■	■	■
Vulkacit® Thiuram/C	TMTD	■	■	■	■													
Vulkacit® ZM/ZM-2*	ZMBT	■	■	■	■			■	■	■	■	■	■	■	■	■	■	■
Vulkacit® Merkaptol*	MBT							■	■	■	■	■	■	■	■	■	■	■
NaMBT Solution*	NaMBT							■	■		■					■		
Vulkacit® 576					■													
<b>Antioxidants</b>																		
Vulkanox® SP*/**	SPH	■	■	■	■			■	■	■	■	■	■	■	■	■	■	■
Vulkanox® SKF*		■	■	■	■	■	■	■				■						■
Vulkanox® MB2/MG*	MMB	■	■	■	■			■					■	■		■	■	■
Vulkanox® ZMB2*/C-5*	ZMMBI	■	■	■	■								■	■		■	■	■
Vulkanox® HS*	TMQ								■					■		■		
<b>Specialties</b>																		
Zinc Oxide Transparent							■											
Zinkoxyd aktiv®		■	■	■	■	■	■			■	■	■	■	■	■	■	■	■
Colloidal Sulfur 50		■	■	■	■			■	■	■	■	■	■	■	■	■	■	■
Coagulant WS		■	■	■	■					■								■
Emulvin® WA		■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■
Emulvin® AS		■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■

\* Marketed by LANXESS business unit Advanced Industrial Intermediates

\*\* Marketed only outside the EU

# LATEX FORMULATION GUIDELINE

Property required	Latex types	End product	Crosslinking vulcanization	Chemicals
High elasticity	Natural latex (NR)	Examination gloves Surgical gloves Balloons, Condoms	Vulcanization paste	Colloidal Sulfur 50, Zinkoxyd aktiv®, Zinc Oxide Transparent, Vulkacit® LDA, Vulkacit® ZBEC/C, Vulkacit® ZM-2, Vulkanox® SKF, Vulkanox® MB2/MG
High elasticity	Natural latex (NR)	Rubber threads	Vulcanization paste	Colloidal Sulfur 50, Zinkoxyd aktiv®, Vulkacit® LDA, Vulkacit® ZM-2, Vulkacit® 576, Vulkanox® SKF
Low permeability	Nitrile latex (NBR)	Surgical gloves Industrial gloves	Vulcanization paste	Colloidal Sulfur 50, Zinkoxyd aktiv®, Vulkacit® LDA, Vulkacit® P extra N, Vulkacit® ZBEC/C, Vulkacit® ZM-2, Vulkacit® 576, Vulkanox® SKF
Low swelling	Nitrile latex (NBR)	Gaskets	Vulcanization paste	Colloidal Sulfur 50, Zinkoxyd aktiv®, Vulkacit® LDA, Vulkacit® P extra N, Vulkacit® ZBEC/C, Vulkacit® ZM, Vulkanox® SKF
Chemical resistance High elasticity	Chloroprene latex (CR) Natural latex (NR)	Industrial gloves Mattresses	Vulcanization paste	Zinkoxyd aktiv®, Vulkacit® 576 Colloidal Sulfur 50, Zinkoxyd aktiv®, Vulkacit® LDA, Vulkacit® ZM, Vulkanox® BKF, Vulkanox® SKF
Foamability, mechanical stability	Styrene-butadiene latex (SBR)	Carpet backing	Vulcanization paste	Colloidal Sulfur 50, Zinkoxyd aktiv®, Vulkacit® LDA, Vulkacit® ZM, Vulkanox® HS
Abrasion resistance	Nitrile latex (NBR)	Artificial leather Industrial gloves	Vulcanization paste	Colloidal Sulfur 50, Zinkoxyd aktiv®, Vulkacit® LDA, Vulkacit® ZM, Vulkacit® 576, Vulkacit® P extra N, Vulkanox® SKF
Washability	Nitrile latex (NBR)	Wiping cloth	Vulcanization paste	Colloidal Sulfur 50, Zinkoxyd aktiv®, Vulkacit® LDA, Vulkacit® ZM, Vulkacit® P extra N
Stiffness	Styrene-butadiene latex (SBR)	Toe caps	No paste	–
Good bonding	Chloroprene latex (CR)	Inner soles	Vulcanization paste	Zinkoxyd aktiv®, Vulkanox® BKF
Heat sensitivity	Nitrile latex (NBR)	Wiping cloth Artificial leather	Vulcanization paste	Emulvin® WA, Coagulant WS
Flexibility	Natural latex (NR)	Leatherboard	Vulcanization paste	Colloidal Sulfur 50, Zinkoxyd aktiv®, Vulkacit® LDA, Vulkacit® ZM, Vulkanox® SKF
Oil resistance	Nitrile latex (NBR)	Industrial gloves	Vulcanization paste	Colloidal Sulfur 50, Zinkoxyd aktiv®, Vulkacit® LDA, Vulkacit® ZBEC/C, Vulkacit® ZM, Vulkacit® P extra N, Vulkanox® SKF
Zinc oxide crosslinking	Nitrile latex (XNBR); Styrene-butadiene latex (SBR)	Various applications	Zinc oxide dispersion	Zinkoxyd aktiv®, Zinc Oxide Transparent
Moisture barrier	Nitrile latex (NBR)	Paper, tapes	No paste	–
Ozone resistance	Chloroprene latex (CR)	Weather balloons	Vulcanization paste	Zinkoxyd aktiv®, Vulkanox® BKF, Vulkanox® MB2/MG
Permeability	Chloroprene latex (CR)	Gloves	Vulcanization paste	Zinkoxyd aktiv®, Vulkanox® BKF
Water permeability	Chloroprene latex (CR)	Bitumen modification	Vulcanization paste	Emulvin® WA
	Chloroprene latex (CR)	Inner soles	Vulcanization paste	Zinkoxyd aktiv®, Vulkanox® BKF

## Vulcanization with Vulkacit® ZBEC

The use of vulcanization accelerators such as dithiocarbamates (ZDEC, ZDBC, ZDMC and ZEPC) and thiurams (TMTD), just to mention the most important types of latex accelerators, can cause the formation of carcinogenic nitrosamines during vulcanization and subsequent storage. LANXESS offers the product **Vulkacit® ZBEC** which, according to current knowledge, does not form any dangerous nitrosamines (please see for example German Technical Regulations on Hazardous Substances, TRGS 552). It is in chemical compliance with 21 CFR FDA §§ 175.105 (Adhesives) and 177.2600 (Rubber articles intended for repeated use), subject to the limitations of these regulations and any other applicable regulations. It also is in chemical compliance within certain limits with the German BfR\* Recommendation XXI (Commodities based on Natural and Synthetic Rubber).

### Safer production

The use of **Vulkacit® ZBEC** reduces the formation of nitrosamines to such an extent that they become negligible in the manufacture of products such as foam coatings for carpet coverings (GuT carpet regulations for Europe), car seats made of rubberized hair and all kinds of gloves. This is particularly important when exporting these articles to Europe and the USA where legal specifications demand the use of "safe amines".

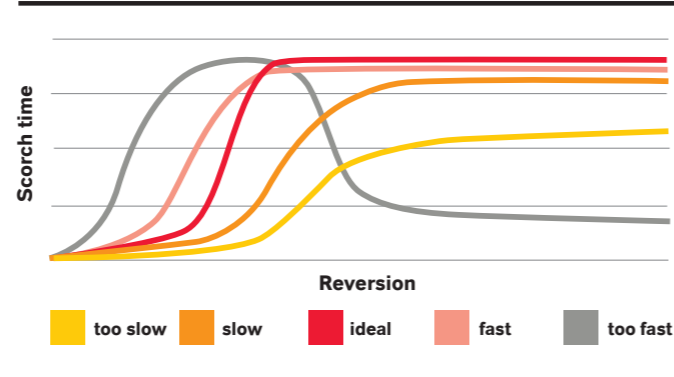
### Technical information

**Vulkacit® ZBEC** is mainly used as an ultra-accelerator for latex articles such as dipped goods, impregnated nonwoven fabrics, and foam. It does not cause discoloration, has a neutral

\* BfR = Federal Institute for Risk Assessment.

odor but has low resistance to aging which means that anti-oxidants must also be used. Vulcanization is slower than with the nitrosamine-forming dithiocarbamates. The graphs below show different vulcanization curves that can be controlled using **Vulkacit® ZBEC**.

### Theoretical vulcanization curves



## Vulcanization of highly sensitive articles – Colloidal Sulphur 50

### Fine-particle Colloidal Sulfur 50 for highly sensitive articles

In the traditional vulcanization technology of latex, sulfur is required as crosslinker. **Colloidal Sulfur 50** is a special product from LANXESS which, due to its high transparency and outstanding dispersibility, is predominantly suitable for the production of highly sensitive articles, such as the production of condoms.

### Higher product quality

The use of milled and predispersed colloidal sulfur leads to very high transparency in latex films. Due to its special production process the particle size of **Colloidal Sulfur 50** is much smaller compared to standard sulfur grades. This allows for better distribution in latex compounds, reducing sedimentation and the risk of overcuring due to poor distribution which is possible with regular sulfur.

## Improving aging resistance by combining Vulkanox® SKF and Vulkanox® MB2

One of the main objectives of manufacturers is to increase the aging resistance of polymers. Everyone involved in manufacturing latex products, whether from latex alone or in combination with other materials, is striving to prolong the life of these products. The fundamental requirements can be satisfied by using suitable antioxidants. Such products can be classified as follows:

- Monofunctional or oligofunctional amines  
Example: **Vulkanox® 4020**
- Monofunctional or oligofunctional phenols  
Example: **Vulkanox® SKF**
- Heterocyclic merkapto (-SH) compounds  
Example: **Vulkanox® MB2**

### Some basic information on oxidation and antioxidants

The oxidation tendency of a polymer depends essentially not only on its content of double bonds, but also on the atoms near the double bonds. The vulcanization system, as well as the antioxidant, plays a part in the oxidation process. As a general rule, in the linking of the rubber molecule chains through sulfur (Sx) bridges, the aging resistance is always better with lower values of x.

The antioxidant effect is based on the existence of active H atoms in the molecule. Essentially this involves:

- -SH
- -OH
- -NH groups

These hydrogen atoms work as chain breakers for the radical chain reactions that transfer oxygen to the polymer substrate. Any remaining antioxidant not involved in this process is stabilized mesomerically.

### Oxygen aging reactions

Oxygen can trigger the following reactions within the product:

1. Scission of the molecular chain – network loosened (degradation/softening)
2. Crosslinking – network closed (cyclization, hardening)
3. Bonding in polymer – chain cleaved or recrosslinked

The changes in the mechanical properties of a vulcanizate caused by the aging process depend on the result of the three competing reactions. Generally only reactions 1 and 2 are effective, with the third playing merely a minor role.

In the case of natural rubber, reaction 1 initially dominates, so that after a maximum has been reached (in the case of thiazole-based accelerators), it is mainly a softening of the polymerizate that is observed. As the aging continues, reaction 2 wins the upper hand and the hardness begins to increase again. Fully oxidized natural rubber vulcanizates are normally hard, stiff and thermoplastic. The increase in hardness is always combined with an increase in modulus and a loss in elongation.

A combination of **Vulkanox® SKF** and **Vulkanox® MB2** has a synergistic effect on the protection of latex articles. The protection effect is significantly larger compared to the effect of one of the single components. Furthermore, the combination is effective against rubber poisons in general.



**Reduction of zinc content using Zinkoxyd aktiv® and Zinc Oxide Transparent**

**Reduction of the zinc content in latex compounds with Zinkoxyd aktiv®**

Organic vulcanization accelerators nearly always require the addition of inorganic and/or organic activators. The most important inorganic activator is zinc oxide. For economic and especially environmental reasons, however, it is desirable to keep the zinc oxide content in latex compounds as low as possible. LANXESS offers two special Zinc Oxide grades for this application to meet this requirement.

Zinkoxyd aktiv® has particularly fine particles and contains a very high surface area as indicator for its activity. For this reason, an addition of 0.5 phr to natural latex, for example, is enough to help ensure that for many purposes vulcanization proceeds at an acceptable rate to give a sufficient degree of cure. With standard grade or coarser particle size products, higher additions or longer vulcanization times are required. Further more the articles obtained by curing with Zinkoxyd aktiv® are more transparent compared to those produced using other grades.

**Zinc Oxide Transparent**

Zinc Oxide Transparent is chemically a caustic zinc carbonate. It can be used as alternative to zinc oxide if its higher solubility in rubber and a high transparency of light colored rubber article are desired. Due to its higher molecular weight and to achieve the same degree of vulcanization, however, it is necessary for stoichiometric reasons to use higher amounts of zinc carbonate than of standard zinc oxide. Zinc carbonate also has a greater stiffening effect than zinc oxide.

**Making environmental and economic sense**

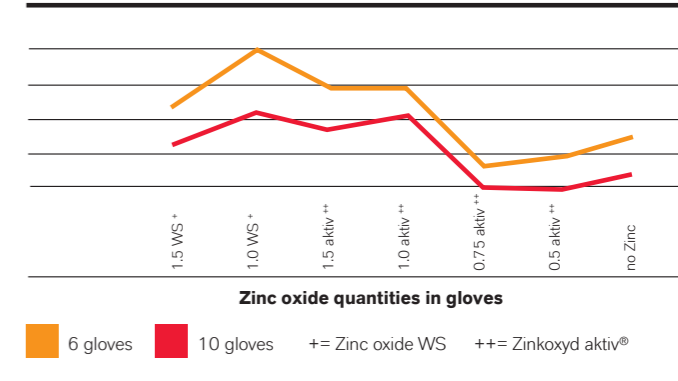
Both products, Zinkoxyd aktiv® and Zinc Oxide Transparent, can be easily incorporated into latex. During preparation of the vulcanization paste the amount of dispersing agent has to be increased to compensate for the larger surface area of these highly active products. Zinkoxyd aktiv® in particular has important benefits in the production of latex articles. Owing to its very fine particles, Zinkoxyd aktiv® can considerably lower the zinc content of a latex compound. At the same time, the large surface area of the zinc oxide particles prevents an increase in the number of zinc ions in the waste water. This considerably reduces environmental impact and helps to save costs.

The concentration of zinc ions in waste water is regulated for example in the United States by the Clean Water Act. Even in countries where there are no such regulations, there is a need for a reduction of zinc ions in waste water streams in accordance with the Responsible Care initiative. Since the manufacture of gloves necessitates several washing routines owing to the proteins, stabilizers and chemicals contained in natural latex, large amounts of waste water are generated. The use of finely divided, surface-active zinc oxide will reduce the likelihood of separate treatment measures being necessary in order to meet wastewater standards.

**Advantages in production and disposal**

Zinkoxyd aktiv® is also a suitable alternative for European carpet manufacturers. First of all, efforts to reduce the amount of zinc in these formulations will lower the concentration of zinc ions in wastewater. Secondly, the incineration of scrap carpet is subject to limits which can be exceeded by the use of larger amounts of zinc oxides with a low surface area. For this reason, it is recommended that in the foam coating of tufted carpets by the gel process, normal zinc oxide seal grades (RS, GS and WS) should be replaced by grades with a higher surface area such as Zinkoxyd aktiv®.

**Zinc<sup>++</sup> in wastewater**



■ **For economic and especially environmental reasons:** keeping the zinc content in latex compounds as low as possible



## Coagulant WS: A product with a variety of effects

**Coagulant WS** was originally developed as a heat sensitizer. In practice it turned out that this product could do a lot more. Today it is used as a release agent, a film former, a film thickness equalizer, a defoaming agent and as a viscosity regulator in carpet manufacture.

### Heat sensitization with Coagulant WS

Since the initial phase of Coagulant WS the product is used as a coagulator for heat sensitive latex compounds. Together with the emulsifier **Emulvin® WA**, this polysiloxane specifically adjusts the coagulation point of latex compounds. In this way, migration of the latex particles to the surface can be avoided, for example, when thick textile structures such as nonwovens are impregnated with heat-sensitive latex compounds. This property is also used with cleaning cloths: in this case after a specific penetration time the foam can be spontaneously coagulated into the nonwoven or fabric by infrared treatment.

### Coagulant WS for an even film thickness and more homogeneous film formation

The addition of Coagulant WS leads to a more even film formation, especially in the case of gloves made of NBR. Incorporating only a small amount into the latex compound improves the rate of coagulation and thus prevents visible flaws on the latex film. Gloves that are produced this way show significantly improved appearance and also production is more reliable.

### Coagulant WS as a release agent

In glove manufacturing, Coagulant WS improves the release properties of the vulcanized latex when added to the pre-dip solution before applying it to the former. This helps to avoid overstretching of the latex film while it is not yet completely vulcanized and reduces the number of flaws. The adhesive effect of natural latex is also slightly reduced.

### Coagulant WS as a defoaming agent

With its silicone-containing structure Coagulant WS has a slight defoaming effect. In contrast to other silicone defoaming agents, however, it has no tendency to “fish eye” formation since it was specially designed for aqueous applications.

### Coagulant WS in the carpet industry

In the case of carpet backings, e.g. for drainage knob applications Coagulant WS can be used as a viscosity regulator in certain latices. Knobs are mainly applied to textile floor coverings used outdoors. Only the high viscosity of the compound prevents the knobs from collapsing during drying, thereby ensuring that the desired drainage effect takes place. These needlefelts or tufted carpets are then used as “artificial lawns” for the surrounds of swimming pools or on patios and balconies.

■ **Coagulant WS** in the backing material of carpets gives the product a drainage effect

## Emulvin® AS as a dispersing agent for latex compounding

### Dispersing agents are important chemicals in the production of latex articles.

With **Emulvin® AS**, LANXESS offers a dispersing agent that has additional benefits for the quality of latex goods through dispersions of rubber chemicals. It wets the powder materials used in latex compounding, which are insoluble in water to bring them into dispersion. Once materials are dispersed, **Emulvin® AS** prevents re-aggregation in the latex dispersion. **Emulvin® AS** is a light yellow to brown colour powder which is soluble in water and also free flowing for excellent dosage. Replacing an existing dispersing agent in a formulation with **Emulvin® AS** is possible, usually in the ratio 1:1.

Compared to casein, dispersions based on **Emulvin® AS** do not show the tendency of petrification.



■ Simplified dispersion of latex chemicals with Emulvin® AS

## Emulvin® WA as a stabilizer for heat-sensitized compounds

Emulsifiers are important chemicals in the production of latex articles. With **Emulvin® WA**, LANXESS offers an emulsifier that has additional benefits for the quality of latex goods.

### Adjusting the coagulation point

**Emulvin® WA** is an excellent stabilizer for heat-sensitized mixtures of different latices. In combination with **Coagulant WS** it enables the coagulation point to be adjusted between 35 °C (95 °F) and 70 °C (158 °F).

### Protection of Latices

**Emulvin® WA** can also be used to protect natural and synthetic latices against mechanical and chemical influences, especially against the sensi-tizing effects of fillers and electrolytes. In both applications it is important to note that in its supply form **Emulvin® WA** has a high viscosity. Hence for use in latex, **Emulvin® WA** should be diluted with water and stirred to a concentration of 20 to 25 % before being added to the compound. In its diluted form, distribution is quicker and more effective.

■ **Emulvin® WA** – increasing the quality of latex products

### Use as a nonionic emulsifier

Another advantage is its use as a nonionic emulsifier for oils, plasticizers and waxes etc. that normally cannot be used for latex applications. Emulsification is then carried out in a 2–10 % solution of **Emulvin® WA**, the ratio between oil etc. and emulsifier solution being between 40:60 and 50:50 pbw. A high-speed stirrer or jet dispersion unit must be used to produce a stable emulsion. The aqueous phase should be stirred vigorously while the oily substance is added very slowly. The rate of addition can be increased as the emulsion forms. Warming both components can aid the formation of the emulsion. By using a jet disperser the pressure of both liquids can be increased to create finer particles. In order to obtain a very stable emulsion, it is necessary to adjust the dispersion unit to achieve a particle size of around 0.5 µ.



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