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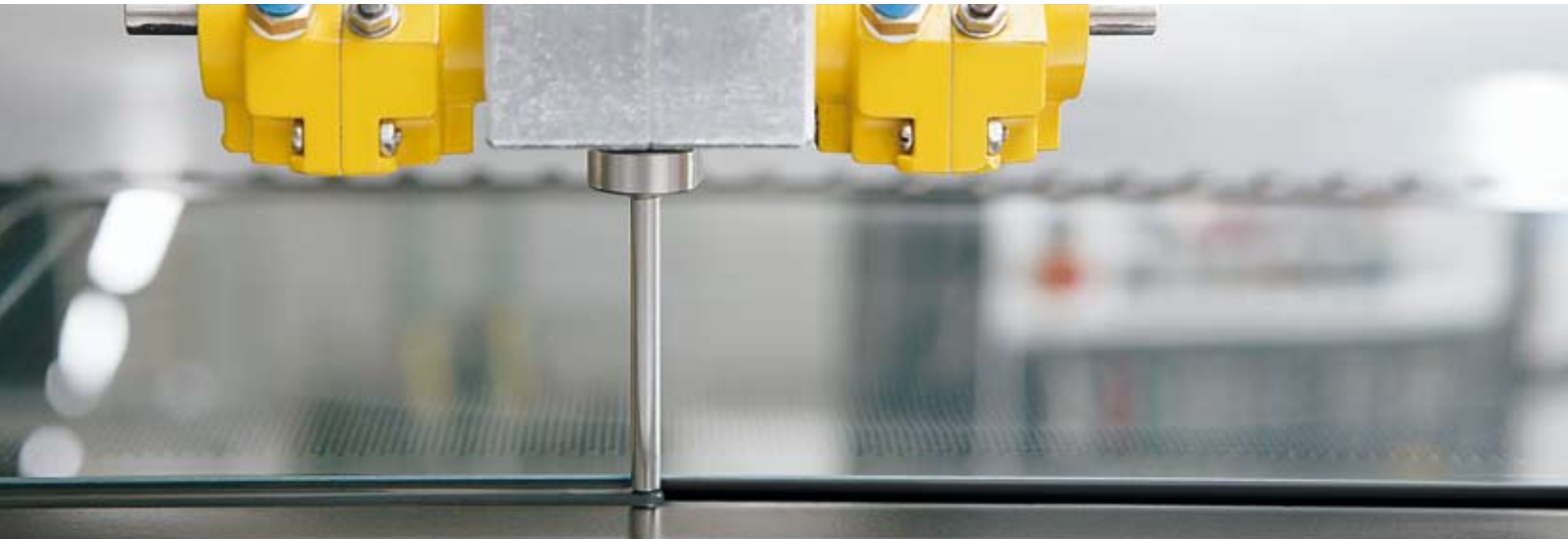
SILICONES

ELASTOSIL®

PROCESSING RTV-2 SILICONE RUBBERS

CREATING TOMORROW'S SOLUTIONS

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OPTIMAL PROCESSING RESULTS
ARE OBTAINED BY KNOWING HOW
RTV-2 WORKS

KNOWING HOW

Room-temperature-curing 2-component silicone rubbers (RTV-2) are ready-to-use products that owe their popularity to their ease of processing. They find application both in the do-it-yourselfer's workshop and industrial-scale production lines.

Even though, or precisely because, RTV-2 silicone rubber is so easy to use, better knowledge of individual grades will help you get optimal results while avoiding some common errors. What's important when metering? How does curing take place? How do I remove uncured rubber from tools? What should I do with the cured rubber?

This brochure summarizes the key chemical processes and provides practical tips on usage. Before processing, make sure you have all necessary product information (available in the product leaflet and safety data sheets). To acquire product documentation, contact your WACKER distributor, who will gladly answer all questions regarding usage in your specific application.

UNDERSTANDING THE PRODUCT

The essential features of room-temperature curing RTV-2 silicone rubber are its:

- Consistency
- Reactivity
- Curing properties
- Condensation and addition curing properties

Consistency

In terms of consistency, it may be pourable, spreadable, nonsag-spreadable or kneadable. The viscosity of the material approximately describes its flow characteristics. The higher the viscosity number, the more viscous the pourable compound or the stiffer the spreadable paste.

Non-sag spreadable grades differ from spreadable grades in their reduced flowability: up to a specific maximum coating thickness (usually 10 mm), they neither run off under gravity from a vertical or inclined surface nor sag. Their consistency, like that of kneadable compounds, is usually characterized by quoting the penetration (penetration depth, in mm/10, of a standard cone under a specific load). The higher the penetration value, the softer the rubber compound.

In non-Newtonian or thixotropic systems, the consistency is described by quoting the viscosity at various shear rates. The viscosity in the high shear-rate range characterizes the flow properties of the compound under intense shear, for example during metering, extrusion, stirring, doctoring, etc.

The viscosity numbers in the low shear-rate range describe the performance at low or zero shear rates, for example the flow of the compound after application.

Reactivity

The reactivity is described by the pot life and vulcanizing time. The pot life usually indicates the maximum period of time after which the catalyzed mix is still pourable, spreadable or kneadable. In applications in which good flowability is an important requirement (for example the encapsulating of electrical or electronic components with very small gaps), the time required for the initial viscosity to double in value is usually quoted as the pot life.

The figures quoted for the vulcanizing times usually only specify the time for the rubber to cure tack-free, i.e. when it can be handled. The ultimate properties of room-temperature-cured rubber, however, are usually only reached after some days. Even vulcanizates produced at relatively high temperatures usually continue to crosslink to a greater or lesser extent during the subsequent room-temperature ageing. The ultimate properties of the vulcanizate are reached fastest by ageing for several hours at relatively moderate temperatures (100–120 °C), otherwise known as post-curing.

Properties of the Vulcanizate

Among the most important properties of the vulcanizate are its mechanical and electrical values.

Apart from the indentation hardness, usually quoted on the Shore A scale (the higher the Shore A value, the harder the vulcanizate), one of the most important mechanical properties is tear strength. If the material has values above approximately 10 N/mm, then it is a so-called high-strength grade, i.e. it has a significantly higher tear strength than grades having “standard” mechanical properties.

The hardness of cured printing pads or silicone gels is too low to allow measurement of the Shore A hardness. For printing pads, the Shore 00 indentation scale is used; for the even softer gels, however, the penetration (the penetration depth in mm/10 of a standard cone under a specified load) is quoted. Whereas for both Shore 00 and Shore A hardness, higher values mean greater hardness, for penetration the reverse is true: the higher the value, the softer the vulcanizate.

The electrical properties of the vulcanizate are largely independent of its consistency, reactivity, mechanical properties and the curing system.

Most of the properties of the mix and vulcanizate, however, are additionally determined by the type of curing system.

SELECTIVE CURING

Condensation Curing

Condensation-curing RTV-2 silicone rubbers are cured by adding a liquid or pasty T-series catalyst to the rubber base.

The rubber base and catalyst always have different lot numbers.

The pot life and curing time can be lengthened and shortened by selecting the type of catalyst or varying the amount added, particular catalyst types and concentration ranges being specified for each grade of rubber.

If the amount added falls below the prescribed proportion range, incomplete curing will result. The rubber remains soft or even tacky and its mechanical strength is much lower. Its resistance to swelling by solvents and casting resin components is also significantly reduced.

If the prescribed proportion range of the catalyst is exceeded, the vulcanizate contains an excess amount of cross-linking agent: the release property of the rubber decreases. Air humidity also causes post-curing of the vulcanizate, leading to a substantial decrease in its mechanical strength.

Condensation-curing RTV-2 silicone rubbers may be cured at temperatures between 0 °C and, at most 80 °C (at temperatures above 80 °C the crosslinking reaction is reversed, a phenomenon known as reversion: the system remains in, or reverts to, a tacky or liquid state).

In addition to the organotin-based catalyst, correct curing requires small concentrations of moisture both in the rubber base and in the ambient air. The crosslinking reaction eliminates a low alcohol, usually ethanol or propanol. The vulcanizate cannot be used until all the alcohol formed has evaporated. Evaporation of the alcohol causes a reduction in the weight and three-dimensional shrinkage of the vulcanizate of the order of < 5 percent by volume.

Addition Curing

Addition-curing RTV-2 silicone rubbers are cured by mixing the two components A and B. The two components must always have the same batch number, as otherwise significant changes to the product properties are to be expected.

With the exception of silicone gels, components A and B must always be mixed in the prescribed ratio by weight. A different ratio of A:B generally leads to incomplete curing with similar consequences to those described above for condensation-curing grades.

Addition-curing RTV-2 silicone rubbers may be crosslinked at temperatures between 10 °C and 200 °C. Since no volatile reaction products are produced during crosslinking, there is neither reversion of the crosslinking reaction at elevated temperatures nor chemical shrinkage of the vulcanizate due to weight loss. Vulcanizates of addition-curing RTV-2 silicone rubbers can therefore be used immediately after demolding.

If inhibitors, i.e. substances that impair the crosslinking reaction by inhibiting the reactivity of the platinum-complex catalyst, come into contact with the uncured rubber, they can make it difficult or even impossible to use addition-curing RTV-2 silicone rubbers.

CORRECT STORAGE

Condensation-Curing Grades

As mentioned above, condensation-curing RTV-2 silicone rubbers, particularly when thickly applied, only cure properly if small amounts of water vapor are present in the rubber base. To prevent the moisture added during production from escaping from the uncured rubber, store the material at temperatures of between 5 °C and 30 °C in tightly sealed drums. After removing small amounts of compound, always seal the drum again immediately. It must never be stored for a long time open or with a loose lid. The result of this may be that it takes significantly longer until the material can be demolded or is no longer tacky, or else that thick layers may be slower to cure and show a strong tendency to adhere to the mold. If such problems in curing occur as a result of lack of moisture, correct curing properties can be easily restored: Stir 1-2 grams of water per kilogram of rubber into the uncured rubber compound not yet containing the catalyst, and then store the compound in a tightly closed drum for at least 24 hours at room temperature. During this time, the water evaporates and the rubber becomes permeated with the moisture required for curing.

T-series catalysts, on the other hand, react with moisture to form a flocculent precipitate. Therefore, always tightly seal the bottles again after you have removed some of the catalyst. Store them in as cool a place as possible, preferably between 5 °C and 24 °C. Small amounts of precipitate do not affect the mixing or curing characteristics.

Addition-Curing Grades

You should store the components of the addition-curing RTV-2 silicone rubbers at temperatures between 5 °C and 30 °C in tightly sealed containers.

Important

Even tiny amounts of the platinum catalyst are enough to start a reaction if they come into contact with components containing the crosslinking agent. The uncured material will then contain cured particles up to several centimeters in diameter, or hydrogen may be liberated. This type of contamination with platinum catalyst may be caused just by the drums of components A and B standing open next to one another. You should therefore always seal the drums tightly after removing some of the contents.

Once equipment has come into contact with the catalyst-containing component or a mixture of the two components, it must never come into contact with the component containing the crosslinking agent. So as to avoid confusion, we strongly advise you to clearly mark equipment that has to be used separately. The respective product leaflet indicates which of the two components contains the catalyst and which the crosslinking agent.

MODIFYING SILICONE RUBBER

Modification of the Consistency and Curing Properties

The viscosity of pourable and spreadable compounds and the penetration of kneadable and non-sag spreadable compounds can be varied within a wide range through various additives.

For example, viscosity or penetration can be varied by adding an AK-series silicone fluid. If the fluid is less viscous than the rubber compound, the system viscosity decreases in proportion to the amount added; if a higher-viscosity fluid is added it increases commensurately, whereas the addition of fluid always increases penetration (the system becomes softer).

Important

Silicone fluid does not take part in the curing, and therefore behaves as a plasticizer towards the vulcanizate, modifying its mechanical properties to a greater or lesser extent. The vulcanizate hardness, tensile strength and tear strength decrease to varying extents, the elongation at break increases. If no more than 5% by weight is added, modification of the vulcanizate properties is generally modest.

According to the viscosity of the silicone fluid added and the composition of the rubber (crosslinking density, filler content), the fluid not crosslinked in the vulcanizate has a greater or lesser tendency to exude, resulting in a fluid film of variable thickness on the surface of the vulcanizate. The higher the fluid viscosity and the vulcanizate hardness, therefore, the more pronounced is this tendency to exude. As a rule of thumb, AK fluids with viscosities below

200 mm²/s have only a slight tendency to exude, but those over 10,000 mm²/s a much greater one.

The flow characteristics of products that are originally pourable may also be varied immediately prior to application by adding certain additives, the extent of the variation ranging from slightly restricted flow to complete sag resistance. Whereas for pourable compositions with "standard" mechanical properties, a few percent by weight of a pyrogenic silica (such as WACKER HDK® N 20) can be added, the "high-strength" condensation-curing grades can be thickened to a non-sagging consistency by adding 1–2% by weight of Thixotropic Additive M and the "high-strength" addition-curing products by adding 0.3–0.5% by weight of Stabilizer 43.

An AK-series silicone fluid is also added if it is necessary to reduce the original hardness of a rubber for a specific purpose, for example to obtain a very soft vulcanizate for printing pads.

If the surface of the vulcanizate is to remain as free as possible of exuding fluid, it is necessary to use an AK fluid with a viscosity below 50 mm²/s.

If an oily surface is desired, a portion (at most 25%) of the amount of low-viscosity fluid necessary for reducing the hardness, e.g. AK 35, should be replaced by an AK fluid with a viscosity above 10 000 mm²/s, for example AK 30 000. Since the addition of silicone fluid reduces the resistance of the vulcanizate to swelling agents such as solvents, or solvent-containing compositions, the softest grade available should be used in cases in

which maximum swelling resistance is required, so that the amount of fluid required for hardness reduction is as low as possible. If a greater quantity of fluid (> 20% by weight) is added, pot life and curing time are increased as a result of the dilution effect. To compensate for this, the catalyst proportion in the condensation-curing grades can be increased by one percentage point or, in the addition-curing grades, the Catalyst OL can be added to the component that contains the platinum catalyst (see product data sheet and leaflet "Catalyst OL / Inhibitor PT 88").

Coloring

RTV-2 silicone rubbers with a suitable base color can be colored by adding up to 4% by weight of an ELASTOSIL® Pigment Paste FL.

ELASTOSIL® Pigment Pastes FL are ready-to-mix preparations of very finely divided inorganic pigments and a silicone polymer that have the consistency of a soft paste and can therefore be readily incorporated. They are available in a total of 12 colors and provide hues that are resistant to light, UV and hot air.

PRELIMINARY PROCESSING STEPS

Recommended Basic Equipment

For smaller quantities, we recommend the following basic equipment:

- Balance (accurate to 0.1 g), measuring vessel, pipette or disposable syringe
- Clean mixing vessels of metal or plastic (preferably polyethylene)
- Metal, wood or plastic spatula
- Stiff short-bristled brush
- Mechanical stirrer (e.g. electric drill with paddle stirrer; roll mill or kneader for kneadable compounds)
- Vacuum pump (oil or water-jet pump) and vacuum vessel (e.g. glass or plastic desiccator)
- Grease-dissolving solvent (e.g. white spirit, acetone MEK)

A number of manufacturers offer automatic mixing and metering equipment for relatively large quantities of RTV-2 silicone rubber (list available on request).

Preparing the Components

To ensure uniform distribution of the fillers, which may have settled out during storage, the pourable compounds or components (with the exception of the crystal-clear grades) have to be thoroughly stirred, preferably using a mechanical stirrer, each time before a quantity is removed from the drum or before mixing in the drum.

The grades with high tear strength, which may thicken somewhat on relatively long storage, can have their optimum flow properties restored by stirring.

ACCURATE METERING

Metering the Components

It is absolutely essential to meter the components accurately, since only by precisely following the mixing ratio is it possible to obtain reproducible pot lives and curing times and, even more important, vulcanizates whose properties come up to specification.

You can meter either by weight (using a balance) or by volume (measuring vessel, pipette or disposable syringe). The information sheets usually give the mixing ratio only in parts by weight. For mixing by volume, you will first have to calculate the volume ratio using the densities listed in the product leaflets and safety data sheets. This also applies to the use of an automatic mixing and metering system.

Important

If the catalyzed mix is deaerated in the vessel used for weighing, the latter has to have a capacity of at least four times the volume of the catalyzed mix (see under "Removal of Dissolved Air").

Condensation-Curing Systems

In the case of the condensation-curing RTV-2 silicone rubbers, an incorrect amount of catalyst causes the following problems:

Excess amount:

- Reduced pot lives (no curing when the amounts added are highly excessive)
- Tendency to adhere to contact materials (primer effect)
- Significantly increased chemical shrinkage
- Post-curing of the vulcanizates under the effect of air humidity (embrittlement)
- In the case of highly tear-resistant grades, a significant drop in tear strength after a short time

Insufficient amount:

- Delayed crosslinking (in extreme cases, only incomplete curing, if any)
- Tendency to adhere to contact materials (adhesion effect)
- Soft, limp vulcanizates with low mechanical strength and greatly increased susceptibility to swelling

Addition-Curing Systems

With addition-curing RTV-2 silicone rubbers, the actual effects of incorrect metering of component B may vary, the extent depending on the mixing ratio A:B and on which component contains the crosslinking agent and which the platinum catalyst.

However, a change in the optimum polymer/crosslinking agent ratio and the catalyst concentration always results. The consequences are:

- Longer or shorter pot lives (if the mixing ratio departs greatly from that specified, incomplete curing, if any)
- Soft, limp vulcanizates with low mechanical strength and greatly increased susceptibility to swelling
- Post-curing of the vulcanizates (with excess crosslinking agent)
- Increased susceptibility to inhibition (with catalyst deficiency)

UNIFORM MIXING

Mixing the Components (Catalyzing)

Make sure that the two components, rubber and catalyst in the case of condition-curing grades and A and B in the case of addition-curing grades, are thoroughly (homogeneously) mixed.

In the case of pourable and spreadable products use a spatula or, if the amounts are relatively large, use a mechanical stirrer or an automatic mixing and metering system. Suitable stirring tools for the mechanical stirrers are paddle stirrers that have a number of perforations and are inclined slightly out of the plane of the axis, or else, for high-speed stirrers (dissolvers), toothed discs.

The kneadable compounds are mixed on a roll mill or in a kneader, according to the amount involved.

Important

The viscosities of the two components to be mixed may differ greatly, for example, when a T-series liquid catalyst is mixed into a rubber base. In this case the less viscous component tends to accumulate at the wall of the mixing vessel. To avoid a local excess concentration, with the disadvantages of uneven curing and an inhomogeneous mixture, it is necessary to scrape the vessel wall with a spatula at short intervals, even when a mechanical stirrer is used for mixing.

If the two components are differently colored and form a distinctive color on mixing, you will know that the catalyzed mix is homogeneously mixed when it assumes a uniform color. When an automatic mixing and metering system is used, this is especially important for immediately recognizing problems with the feeding of one of the two components or with the mixing element. Even when one of the components is colorless or the two components do not form a distinctive color on mixing, the original components can still in many cases be colored retrospectively. You do this by admixing 0.5–1 % by weight of a WACKER ELASTOSIL® Pigment Paste FL (see the appropriate leaflet).

If the component is a T-series liquid catalyst, shake the bottle well to distribute the insoluble pigment contained in the pigment paste uniformly in the liquid.

Since, because of its high density and the low viscosity of the liquid, the pigment settles out on the bottom after the catalyst has been left to stand for just a short time, you have to distribute it uniformly in the liquid again by shaking the bottle before removing some of the catalyst.

Alternatively, you can color the catalyst an intensive red by adding 1 % by weight of "Red Color Concentrate." Since this colorant is soluble in the catalyst, it cannot settle out. However, the colorant can be dissolved out of the vulcanizate by certain solvents or components of the casting resin. You should avoid using "Red Color Concentrate" whenever the rubber is intended for making molds for casting resins and where any red coloration of the molding would be unacceptable.

REMOVING AIR

Removal of Dissolved Air

Because the rubber base and catalyst, or the two components A and B, are mixed in air, a certain amount of air is unavoidably introduced into the rubber mix. It is only occasionally, however, that the viscosity of the catalyzed mix is low enough for the rubber mix to deaerate itself to a sufficient extent within the respective pot life.

To obtain vulcanizates without any air bubbles, therefore, pourable – i.e. free-flowing – mixtures (with viscosities up to 200,000 mPa s) have to be deaerated (evacuated) in a desiccator or vacuum cabinet at reduced pressure (10–20 mbar). An oil pump is usually used to obtain such low pressures; if tap water of a very low temperature (less than 10 °C) is available, a water-jet pump may be sufficient.

Deaeration causes the catalyzed mix to expand extensively at first, and so the holding vessel may only be filled initially to a quarter of its total volume. This will permit maximum expansion of the rubber compound, and thus ensure the shortest possible deaeration time.

Usually the rising mix collapses before it reaches the rim providing the vessel has sufficient volume. However, if it looks likely to overflow, a small amount of air should be admitted to the vessel. This step should be repeated until the mix collapses completely under full vacuum. Immediately after this condition has been satisfied, deaeration is discontinued.

The deaeration process should not take more than 5 minutes. If the mix has not collapsed completely by then, either the mixing vessel was too small or the vacuum was not strong enough to remove all the air trapped in the rubber. Under no circumstances should it last until no more bubbles are formed. Otherwise, certain compounds essential for curing might escape. In addition, prolonged deaeration wastes pot life.

If, on the other hand, an automatic mixing and metering system is used for processing, this should have an evacuable supply vessel with stirrer, so that when the components reach the mixing head (static or dynamic mixing head), they are already free of air bubbles and can then be mixed without air being entrained.

In contrast to pourable compounds, more highly viscous or non-sag spreadable and kneadable compounds cannot be deaerated by evacuation. In this case you should either attempt to keep the air bubbles as small as possible so that they are less troublesome (by intensive mixing), or else first apply a thin, bubble-free layer of a pourable compound onto the contact surfaces, allow this layer to cure slightly (but it must still be tacky), and only then apply the air-bubble-containing spreadable or kneadable compound.

Application

Pourable RTV-2 silicone rubbers are – after deaeration by means of vacuum – poured in a thin stream from the least possible height.

If no vacuum facilities are available, you can achieve a certain degree of deaeration by pouring the material from a greater height in as thin a stream as possible.

If, however, completely bubble-free contact surfaces are to be obtained or the material is a spreadable grade, first apply a thin, bubble-free layer of catalyzed mix using a stiff, short-bristled brush. After this layer has started to cure but is still tacky, pour on the pourable grade or spread the spreadable grade with a spatula, as appropriate.

Apply kneadable compounds manually or using a roller.

CONSIDERING POT LIFE AND CURING TIME

Pot Life and Curing Time

The pot life, e.g. the period of time over which the catalyzed mix can still be worked, depends greatly on the temperature. This applies to both the condensation-curing and addition-curing grades.

The pot life is reduced by heating the compound and extended by cooling it. A rule of thumb is that a temperature change of approx. 7 °C halves or doubles the pot life, as the case may be.

Incipient curing is marked by an increase in viscosity (thickening, poorer flow or plasticity). Therefore use the material well before the pot life has elapsed, i.e. while it is still as fluid or soft as possible.

The curing time of addition-curing grades is also very heavily temperature dependent, but that of condensation-curing grades less so.

Other criteria used are the tack-free time of the vulcanizate, after which, for example, the part can be demolded or the cast or coated part can be manipulated without damage, and the time for complete curing. The latter may extend from a few minutes for addition-curing products to several months for condensation-curing products. Unless the curing is complete, deformations of relatively long duration can cause permanent distortion of the vulcanizate as a result of post-curing.

If curing is accelerated by application of elevated temperatures (**Note:** with condensation-curing grades, the temperature must not exceed 80 °C because of the risk of reversion of the crosslinking process!), the vulcanizate will shrink in volume on cooling to an extent depending on the rubber's coefficient of thermal expansion. Depending on its pot life, among other factors, the rubber may be uncrosslinked or crosslinked when thermal expansion takes place. Cooling to room temperature can therefore cause distortion of the vulcanizate geometry in some cases. This applies both to condensation-curing products (which are also subject to chemical shrinkage) and to addition-curing products. If high dimensional accuracy is required, either curing has to be carried out at the temperature at which the rubber will subsequently be employed or else the dimensional change has to be calculated or determined experimentally and taken into account accordingly.

It is vital to allow for the thermal expansion of the system on heating, even when vulcanizing in a closed system, for example in a housing. Since silicone elastomers can only be compressed by applying extremely high pressures, thermal expansion of the rubber without the possibility of "escape" can also cause the build-up of very high pressure with a highly destructive effect.

As an alternative to varying the mixing and curing temperature, the pot life and curing time can be varied within wide limits by adding Inhibitor PT 88, or additional Catalyst OL. The appropriate product leaflets give detailed information and graphs.

AVOIDING CURING PROBLEMS

Problems with Curing

Condensation-curing RTV-2 silicone rubbers require small amounts of moisture for rapid and complete curing.

You can find information about how to proceed in the event of a moisture deficiency under "Storage."

If the ambient air has a relative humidity of less than 40%, the vulcanizate surface exposed to the air remains tacky to fluid in consistency. In this case, raise the humidity of the air in the room by means of evaporators, atomizers or wet cloths. Humidity can be easily monitored by means of a hygrometer. Adding water to the mix is not an effective remedy!

A number of substances or materials, which impair the action of the platinum-complex catalyst, can inhibit vulcanization of addition-curing RTV-2 silicone rubbers if they come into contact with the uncured rubber. These may be present either on the surface of a substrate (model, mixing equipment, etc.) that will come into contact with the rubber base, or in the ambient air, such as in post-curing ovens and drying cabinets used for curing casting resins that may release inhibiting compounds.

The most important inhibitors are:

- Sulfur, specific sulfur compounds such as polysulfides and polysulfones and other sulfur-containing substances, such as natural and certain synthetic rubbers (e.g. EPDM)
- Amines, urethanes and amine-containing substances such as certain polyurethanes, amine-cured epoxy resins, etc.
- Organometallic compounds (especially if the metal is thin) and substances that contain them, e.g. vulcanizates and catalysts of condensation-curing RTV-2 silicone rubbers
- Various natural and synthetic oils, greases, waxes and resins, as well as substances containing such materials, for example many release agents and almost all types of plasticine

We therefore strongly recommend carrying out preliminary trials to identify those materials that inhibit curing by direct contact with the rubber. Inhibition manifests itself in the form of liquid phases, tacky vulcanization surfaces and markedly delayed curing.

POST-TREATING VULCANIZATES

Preparing the Vulcanizate

Before a cured RTV-2 silicone rubber is used for the first time, certain prerequisites have to be met and certain specific measures taken that vary according to the particular crosslinking system, the curing conditions and conditions of use.

Vulcanizates of condensation-curing rubbers have to be completely free of volatile alcohol formed during the curing reaction before they are:

- permanently deformed, for example as a seal – otherwise there is a compression set of up to 100%, i.e. no resilience remains
- heated to temperatures above 90 °C, since otherwise reversion occurs – which leads to softening or even liquefaction of the rubber in relatively thick layers or in closed systems
- sealed, e.g. in encapsulated electrical components, so that the alcohol vapor cannot escape – otherwise there is severe metal and plastics corrosion in the long term, even at room temperature
- brought into contact with chemically corrosive or physically swelling agents, for example as molds for casting resins – since otherwise there is a drastic reduction in the number of castings that can be achieved

The alcohol can be completely removed from fresh, condensation-cured vulcanizates by ageing them for several days at ambient temperature (rule of thumb: approx. 24 hours per cm thickness to the nearest exposed surface) or for several hours at a maximum of 70 °C (rule of thumb: approx. 6 hours per cm thickness to the nearest exposed surface). The vulcanizate should be stored open with as large an exposed surface area as possible.

Vulcanizates of addition-curing rubbers contain no reaction product and therefore, in principle, can be used immediately after complete curing. Since, however, this process can also take some days at room temperature, it is advisable to carry out subsequent heat treatment at 100 °C for several hours, especially if minimal compression set is required. To obtain full performance from alcohol-free condensation-cured and addition-cured vulcanizates, it has generally proved advantageous to heat them for several hours, at a temperature not less than their future temperature of use but not above 180 °C.

BONDING MATERIALS

Obtaining Adhesion to Various Materials

With the exception of certain special self-adhesive grades, RTV-2 silicone rubbers adhere only poorly, if at all, to other materials as a result of their pronounced release effect. If, nevertheless, a durable, firm bond is desired, it is necessary to pre-coat the surface of the material with a special adhesion promoter known as a primer. Primers are low viscosity solutions of reactive silicone products. After the solvent has evaporated, a silicone resin film forms under the effect of air humidity, to which the rubber then bonds during curing.

The question of which primer is best for the application at hand depends on the type of material, the composition of its surface (absorbent, non-absorbent) and the rubber grade used.

To increase adhesion, roughen the surface in question of the material as far as possible by, for example, sanding or, in the case of metal, sandblasting. After removing the dust, degrease the surface carefully using acetone or white spirit.

The primer may be applied by brushing, spraying or dipping. Several coats may be necessary if the substrates are highly absorbent. However care must be taken that the resin film is not too thick, since this would reduce adhesion.

The drying time at room temperature is at least half an hour, but more likely one hour, at a relative humidity of at least 40%. The best adhesion results are obtained if the rubber is allowed to cure as slowly as possible, the maximum adhesion strength not being achieved until after 48 hours.

Adhesion to other silicone rubber vulcanizates represents a special case. Conventional primers are not suitable for this.

Condensation-curing RTV-2 silicone rubbers, however, generally bond with sufficient adhesion to relatively freshly produced vulcanizates if they are also of the condensation-curing type and have been cleaned using acetone or white spirit (layer bonding).

Bonding of addition-curing RTV-2 silicone rubbers to addition-cured vulcanizates requires special measures. We will be glad to advise you about your particular case.

Bonding to Various Materials

Cured RTV-2 silicone rubbers can be bonded to other materials using RTV-1 silicone rubber adhesives that cure under the effect of air humidity. The products ELASTOSIL® E 4 (solvent-free, non-sag), E 41 (solvent-containing, low viscosity) and E 43 (solvent-free, soft), all translucent, have proven especially useful for this.

Apply the single-component rubber adhesive thinly onto the pretreated and properly primed surface of the material and onto the cleaned (acetone or white spirit) surface of the RTV-2 silicone rubber vulcanizate. Then, without delay, fit the two parts together, sliding the parts over each other if adjustment is necessary. Wipe off any excess adhesive oozing from the sides. A strong bond is usually obtained within only 1–2 hours. However, this is only a guide value since layer thickness, relative air humidity and temperature play an important role. The odor of acetic acid emitted when ELASTOSIL® E grades cure disappears once curing is complete.

If silicone rubber vulcanizates are to be bonded together, brush each of the surfaces, which have been cleaned using acetone or white spirit, with one of the aforementioned ELASTOSIL® E grades and join them together without delay. Otherwise proceed as described above for bonding RTV-2 silicone rubber vulcanizates to non-silicone materials.

SAFETY FIRST

Safety Precautions

Several decades of experience have shown that neither condensation-curing RTV-2 silicone rubbers nor their addition-curing counterparts are toxic or irritating as delivered. It is therefore unnecessary to take any special safety measures apart from the normal industrial hygiene precautions.

The catalysts used for condensation-curing grades, on the other hand, which have names starting with a "T," can cause irritation if they come into contact with the skin or eyes in undiluted form. Some people may even react allergically to them. Therefore take appropriate protective measures.

If, despite these measures, undiluted catalyst still comes into contact with the skin, clean the affected area immediately with soap and water. If catalyst enters the eyes, irrigate them immediately with copious amounts of water for several minutes. If irritation still occurs, seek medical advice at once.

You will find detailed information about all safety matters in the respective safety data sheets, which can be obtained from your local WACKER subsidiary, if not included with the consignment.

Removal of Rubber Residues

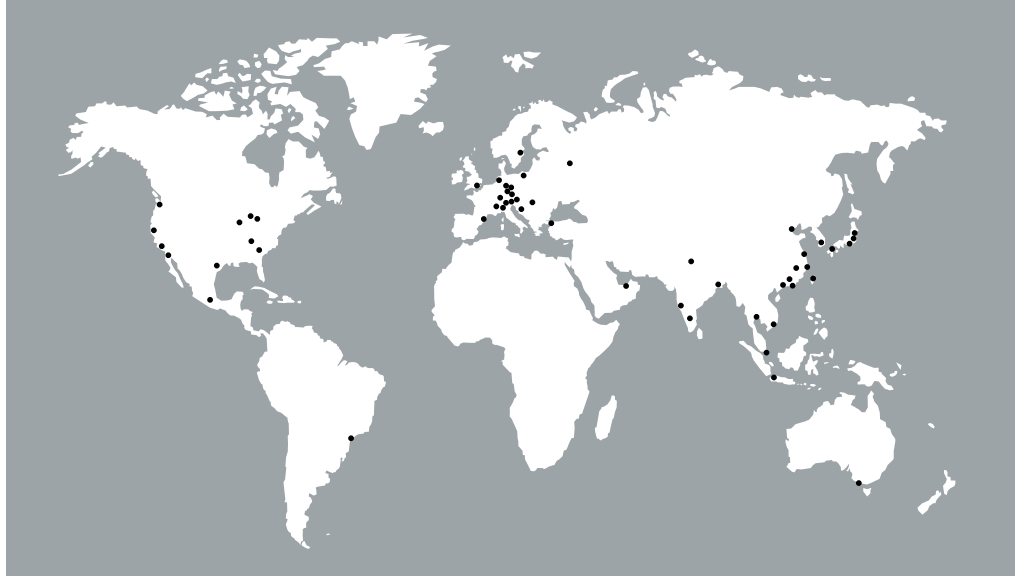
A grease-dissolving solvent, such as white spirit or acetone, will remove uncured rubber from containers and clothing. It is best to allow surplus catalyzed mix to cure in the containers, after which it can be readily removed.

Cured material can only be removed mechanically, i.e. it cannot be redissolved. Swell it first in a solvent and then scrape it off. Bear these points in mind when deciding on working clothes.

Take care that the workplace is well ventilated when you handle solvents, and also follow the appropriate safety instructions.

The instructions for proper disposal of the uncured components and vulcanizates are also given in the respective safety data sheet.

WACKER AT A GLANCE



WACKER is a technological leader in the chemical and electrochemical industries and a worldwide innovation partner to customers in many key global sectors. With around 14,400 employees, WACKER generated sales of EUR 2.76 billion in 2005. Germany accounted for 21% of sales, Europe (excluding Germany) for 31%, the Americas for 22% and Asia-Pacific, including the rest of the world, for 26%. Headquartered in Munich, Germany, WACKER has some 20 production sites worldwide and a global network of over 100 sales offices. With R&D spending at 5.3% of sales in 2005, WACKER is among the world's most research-intensive chemical companies.

WACKER SILICONES

is a leading supplier of complete silicone-based solutions that comprise products, services and conceptual approaches. As a provider of solutions, the business division helps customers press ahead with innovations, exploit global markets fully, and optimize business processes to reduce overall costs and boost productivity. Silicones are the basis for products offering highly diverse properties for virtually unlimited fields of application, ranging from the automotive, construction, chemical, electrical engineering and electronics industries, through pulp and paper, cosmetics, consumer care and textiles, to mechanical engineering and metal processing.

WACKER POLYMERS

is the global leader for high-quality binders and polymer additives. This business division's activities encompass construction chemicals and functional polymers for lacquers, surface coatings and other industrial applications, as well as basic chemicals, i.e. acetyls. Products such as dispersible polymer powders, dispersions, solid resins, powder binders and surface coating resins from WACKER POLYMERS are used in the construction, automotive, paper and adhesives industries, as well as by manufacturers of printing inks and industrial coatings.

WACKER FINE CHEMICALS

is an expert in organic synthesis, silane chemistry and biotechnology, providing tailored solutions for its customers in the life sciences and consumer care industries. The range of innovative products includes complex organic intermediates, organosilanes, chiral products, cyclodextrins and amino acids.

With its comprehensive expertise, WACKER FINE CHEMICALS is a preferred partner for highly challenging custom-manufacturing projects in the fields of chemistry and biotechnology.

WACKER POLYSILICON

has been producing hyperpure silicon for the semiconductor and photovoltaics industries for over 50 years. As one of the largest global manufacturers of polycrystalline silicon, WACKER POLYSILICON supplies leading wafer and solar-cell manufacturers.

Siltronic

is one of the world's leading producers of hyperpure silicon wafers, supplying many major chip manufacturers. Siltronic develops and produces wafers up to 300 mm in diameter at facilities in Europe, the USA, Asia and Japan. Silicon wafers form the basis of state-of-the-art micro and nanoelectronics used, for example, in computers, telecommunications, motor vehicles, medical technology, consumer electronics and control systems.

WACKER

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