A Subsidiary of PETRONAS Chemicals Group

Guideline Formulation

BRB Polyaddition RTV-2 Formulation

Elastomers

BRB International BV
PO Box 3552 NL-6017 ZH Thorn. Office: Europastraat 5 NL-6014 CD Ittervoort The Netherlands.
T: +(31) 475 560 300
www.brb-international.com

Background information

This product group comprises various liquid vinyl-functional silicone polymers (vinyl-fluid), SiH-functional silicone crosslinkers, catalysts and additives for the formulation of addition-cured silicone elastomers. These products vulcanize at ambient or elevated temperatures via a platinum catalyzed reaction. As a result, they can be used for a wide variety of applications, such as tooling (mold-making rubbers), encapsulation or sealing in electrical and electronic devices. Due to the low volatile content of the products and the nature of the addition-reaction, the shrinkage of the polymer is almost nil and no significant amount of volatiles or corrosive compounds is formed while curing.

Calculation Formulations

Vulcanization of the silicone RTV-2 proceeds when combining:

- **Vinyl fluid** – our range consists of fluids of different viscosity with the according vinyl content
- **Hydride(SiH)-functional crosslinkers** – we offer a wide range of crosslinkers with varying SiH-contents and viscosities
- **Platinum catalyst** – Pt 10000 (1 wt% Pt) and Pt 20000 (2 wt% Pt) are available
- Optionally: curing inhibitor – Inhibitor Vinyl D4 and Vinyl M2 can be used to delay the vulcanization

Silicone polymers

The curing characteristics and properties of the cured material are influenced by the vinyl fluid/crosslinker ratio and the concentration of platinum. To determine the formulation of the addition-cured RTV-2, the following equation should be used:

$$m_{Crosslinker} = F * \frac{m_{Vinylfluid} * [Vi]}{[SiH]}$$

$m_{Crosslinker}$ = Quantity of selected crosslinker which is needed in g
$m_{Vinylfluid}$ = Quantity of selected vinyl fluid to be vulcanized in g
[Vi] = Vinyl content of the selected vinyl fluid in mmol/g
[SiH] = SiH-content of the selected crosslinker in mmol/g
F = Factor to adjust the molar ratio of SiH- and vinyl-groups: 1,3 < F < 3,0

Catalyst

The total platinum content in the formulation should be selected between 15 ppm and 20 ppm:

Pt 10000: 0.150 - 0.200 wt% of the total formulation
Pt 20000: 0.075 - 0.100 wt% of the total formulation

Curing Inhibitor

The vulcanization typically proceeds in a matter of minutes at room temperature. In most cases, it is therefore necessary to slow down the curing reaction to enable processing and application of the RTV-2. This can be done be adding a curing inhibitor, such as BRB Inhibitor Vinyl D4 or Vinyl M2. The concentration of the curing inhibitor has to be determined by experiment, because its effect is dependent on the specific formulation that is used. The mechanical properties of the final formulation should always be checked after the curing time has been set, because overdosing the inhibitor may alter these. The overdose-concentration of the inhibitor is also dependent on the specific formulation.

Ratio of the RTV-2 System

Addition-cured RTV-2 vulcanize when the A-component is mixed with the B-component. The vulcanization is chemically initiated when the platinum catalyst and the crosslinker come into contact with each other. Therefore, it is common practice that the A-component contains the Pt catalyst, whereas the B-component contains the SiH-functional compounds.

When the A- and B-component ratio is chosen, the different compounds in the formulation have to be distributed. The following equations can be used:

$$A = T * \frac{R}{R+1} \qquad B = T * \frac{1}{R+1}$$

T = total quantity of RTV-2 in g
A = quantity of A-component in g
B = quantity of B-component in g
R = ratio of A vs B ➔ R = 100 if A:B = 100:1
➔ R = 10 if A:B = 10:1
➔ R = 1 if A:B = 1:1

Additional information

Heat increases the curing rate for addition-cured RTV-2. Once an RTV-2 has been processed and applied, the curing can be accelerated if the application allows temperatures of 60-120°C (140-250°F). Production processes involving addition-cured RTV-2 can thus be made more efficient.

Modifier 1439 and Modifier 1449 are SiH-terminated polydimethylsiloxanes. These polymers can be used in combination with crosslinkers to adjust various properties of addition-cured RTV-2. Please consult your BRB representative to learn more about formulating with chain extenders.

As with most room temperature cured silicone elastomers, the mechanical properties of the unfilled materials are rather poor. This can be improved considerably by addition of appropriate fillers such as carbon black, silica and/or other fillers that are used in compounding silicones.

It is highly important to note that the precious metal catalyst is sensitive to agents that may poison it. This can result in discolorations, changes in the mechanical properties of the cured material, incomplete curing or failure to cure. Organic sulphur compounds, amines, amides and inorganic heavy metal compounds of lead, tin, cadmium and mercury are known to poison the platinum catalyst. Extreme care should be taken to avoid contamination of RTV-2 equipment with these substances.

Formulation Calculation Example

Polymers

Selected vinyl fluid: BRB Vinyl fluid 1000
Vinyl-content: 0.13 mmol/g

Selected crosslinker: BRB Crosslinker 434H4
SiH-content: 4.0 mmol/g

The amount of crosslinker needs to be calculated to vulcanize 200 g of Vinyl fluid 1000. F is chosen to be 2.

$m_{Vinylfluid}$ = 200 g
[Vi] = 0.13 mmol/g
[SiH] = 4.0 mmol/g
F = 2

$m_{Crosslinker}$ = 2 * 200 * 0.13 / 4.0 = 13 g Crosslinker 434H4

Catalyst

The selected catalyst is Pt 10000 and is chosen to be dosed at 20 ppm.

20 ppm Pt in the formulation requires 0.20 wt% of Pt 10000
$m_{Vinylfluid} + m_{Crosslinker}$ = 213 g
$m_{Catalyst}$ = 0.20 / 100 * 213 = 0.43 g Pt 10000

Curing Inhibitor

Vinyl D4 was found to get the desired pot life and curing time when dosed at 0.15 wt%.

$m_{Vinylfluid} + m_{Crosslinker} + m_{Catalyst}$ = 213.43 g
0.15 / 100 * 213.43 = 0.32 g Inhibitor Vinyl D4

Ratio of the RTV-2 System

Formulation: 200.00 g Vinyl fluid 1000
13.00 g Crosslinker 434H4
0.43 g Pt 10000
0.32 g Inhibitor Vinyl D4

A addition RTV-2 system is desired with A:B = 10:1

T = 213.75 g of RTV-2
R = 10

A = 194.32 g
B = 19.43 g

A contains: 0.43 g catalyst
Remainder: 194.32 – 0.43 = 193.89 g Vinyl fluid 1000

B contains: 13.00 g Crosslinker 434H4
0.32 g Inhibitor Vinyl D4
Remainder: 19.43 – 13.00 – 0.32 = 6.11 g Vinyl fluid 1000

Final formulation of example RTV-2:

	A		B	
	(g)	(wt%)	(g)	(wt%)
Vinyl fluid 1000	193.89	99.78	6.11	31.45
Crosslinker 434H4			13.00	66.91
Pt 10000	0.43	0.22		
Inhibitor Vinyl D4			0.32	1.64

A Subsidiary of PETRONAS Chemicals Group

www.brb-international.com