UL-WEBINAR:

CUSTOMISED SILICONE SOLUTIONS FOR THE ELECTRICAL AND ELECTRONICS INDUSTRY

AGENDA

1. About WEVO-CHEMIE
2. Choosing the right base chemistry
3. Silicones: Definition, production, properties
4. WEVOSIL product groups
5. Defining your own optimal WEVOSIL solution
6. Summary/takeaways

01

ABOUT WEVO-CHEMIE

WEVO-CHEMIE GMBH

AN INDEPENDENT FAMILY-OWNED COMPANY WITH AN INTERNATIONAL PRESENCE

We are the experts for all encapsulation applications and for special-purpose bonding and sealing applications.

Our resin systems are mainly used in electrical and electronic components – especially in automotive electronics.

OUR INDUSTRIES

CUSTOMISED RESIN SYSTEMS FOR ELECTRICAL AND ELECTRONIC COMPONENTS

Automotive

Home

Engineering

Energy

CUSTOMISED PRODUCTS AND SERVICES

Product tailoring

Testing and application support

Aftersales service

Flexible logistics

CERTIFICATIONS AND PRODUCT APROVALS

Wevo-Chemie is committed to supplying innovative products and services that comply with regulations and standards on chemicals and their safe use.

COMPREHENSIVE PROTECTION

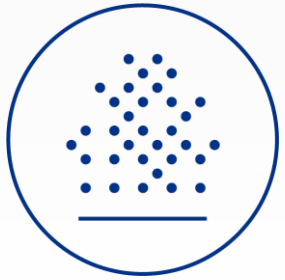
SILICONE SOLUTIONS FROM WEVO PROTECT SENSITIVE COMPONENTS AGAINST:

Chemicals

Vibrations

Particles

Temperature



Dust

Humidity

KNOWLEDGE TRANSFER

At Wevo, technical and chemical experience is complemented by the knowledge gained from numerous practical applications.

100 test days yearly in our technical center

Technical advice

1500 industry experts trained by Wevo

Education/ seminars

wevo

02

CHOOSING THE RIGHT BASE CHEMISTRY

PRODUCT PORTFOLIO

THREE PRODUCT CHEMISTRIES FOR CUSTOMISED SOLUTIONS – FOR EVERY REQUIREMENT

WEVOPUR

Balanced systems with highly configurable profile

WEVOPOX

High-strength systems with high thermal stability

WEVOSIL

High-elasticity systems with high thermal stability

COMPARISON OF PU, EP AND SIL

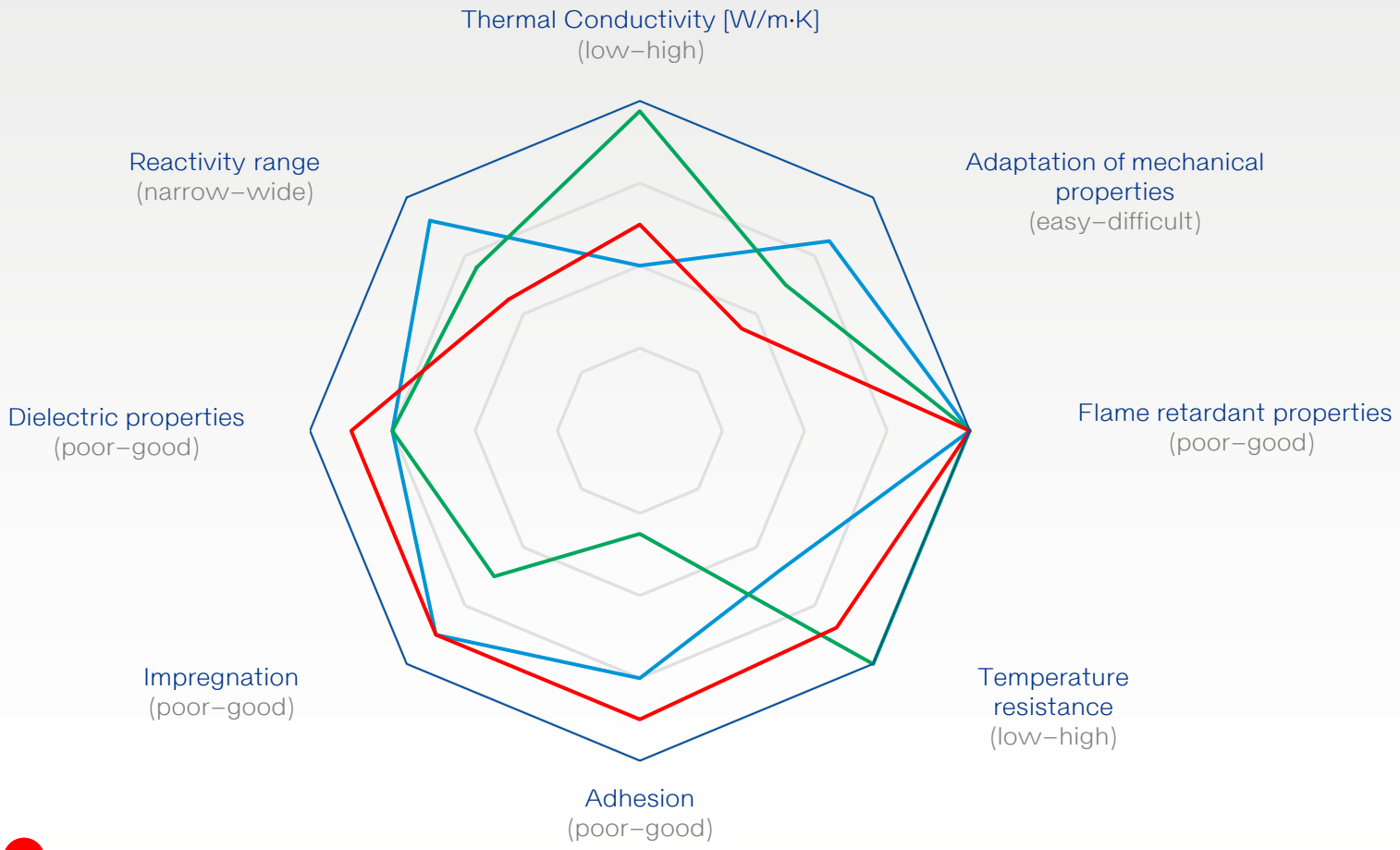
To help our customers select the right materials, we considered the generics of each chemistry.

PARAMETER	POLYURETHANE	EPOXY	SILICONE
Room temp. cure	Yes	Yes	Yes
Heat temp. cure	Yes	Yes	Yes
Rigid (D90+)	No	Yes	No
Semi-rigid (D60–85)	Yes	Yes	No
Elastomeric (A60–80)	Yes	No	Yes
Gel (<A40)	Moderate	No	Yes
Thermal conductivity	Yes	Yes	Yes
Flame retardant	Yes	Yes	Yes
Electrical properties	Excellent	Excellent	Excellent
Repairability	Possible	Difficult/Impossible	Possible

The table shows that today's advancement in material design has created a degree of parity across the three main base chemistries.

These base chemistries fulfil similar requirements, e. g. curing profiles, flame retardancy and electrical properties. However, each chemistry typically incurs a technical trade-off to achieve certain specifications.

PUR, POX AND SIL: THE COMPARISON AT A GLANCE



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03

SILICONES: DEFINITION, PRODUCTION, PROPERTIES

WHAT ARE SILICONES?/1

Terminology:

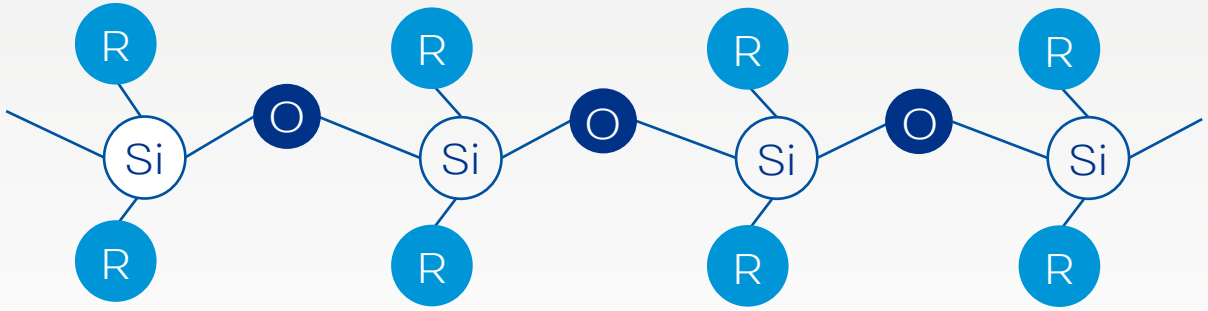
- Silicon: the metalloid chemical element with the symbol Si and atomic number 14 (“Silicium”)
- Silicone: a synthetic inorganic polymer made up of siloxane ($R_3Si–[O–SiR_2]_n–O–SiR_3$, where R = organic group)
- (Poly)Siloxanes with $R=CH_3$ are called polydimethylsiloxanes (PDMS)

Image source: Silicon metal, Wevo

WHAT ARE SILICONES?/2

The high bond energy between the silicon and oxygen atoms of siloxanes compared with an organic polymer backbone is responsible for the high temperature and UV resistance of silicone materials:

- Si–O bond: 451 kJ/mol
- C–C bond: 352 kJ/mol
- UV energy (sunlight): 315–400 kJ/mol



→ Message: Silicone = Polyorganosiloxane

KEY GENERAL PROPERTIES OF SILICONES (CURED)/1

- High temperature resistance (all silicones up to 180 °C; with additives, special formulations up to 250–300 °C)
- High radiation resistance (incl. microwaves & UV); transparent or translucent if unfilled and uncoloured
- Constant electrical (insulating) properties across the very wide temperature range from –45 °C to +180 °C
- Nearly constant mechanical (elastomeric) properties across the very wide temperature range from –55 °C to +180 °C
- Adjustable adhesive or release properties (by means of the formulation)
- Thermal conductivity adjustable over a very broad range
- Low T_g: ~ –55 °C

KEY GENERAL PROPERTIES OF SILICONES (CURED)/2

- Biocompatible, non-toxic, non-hazardous
- Hydrophobic; low moisture absorption
- High gas permeability
- Excellent fire/burning behaviour: low toxicity of smoke and fumes; flame-retardant grades are possible
- Very good resistance to weathering (outdoor applications), corona discharge and ozone

APPEARANCE OF SILICONES WHEN CURED

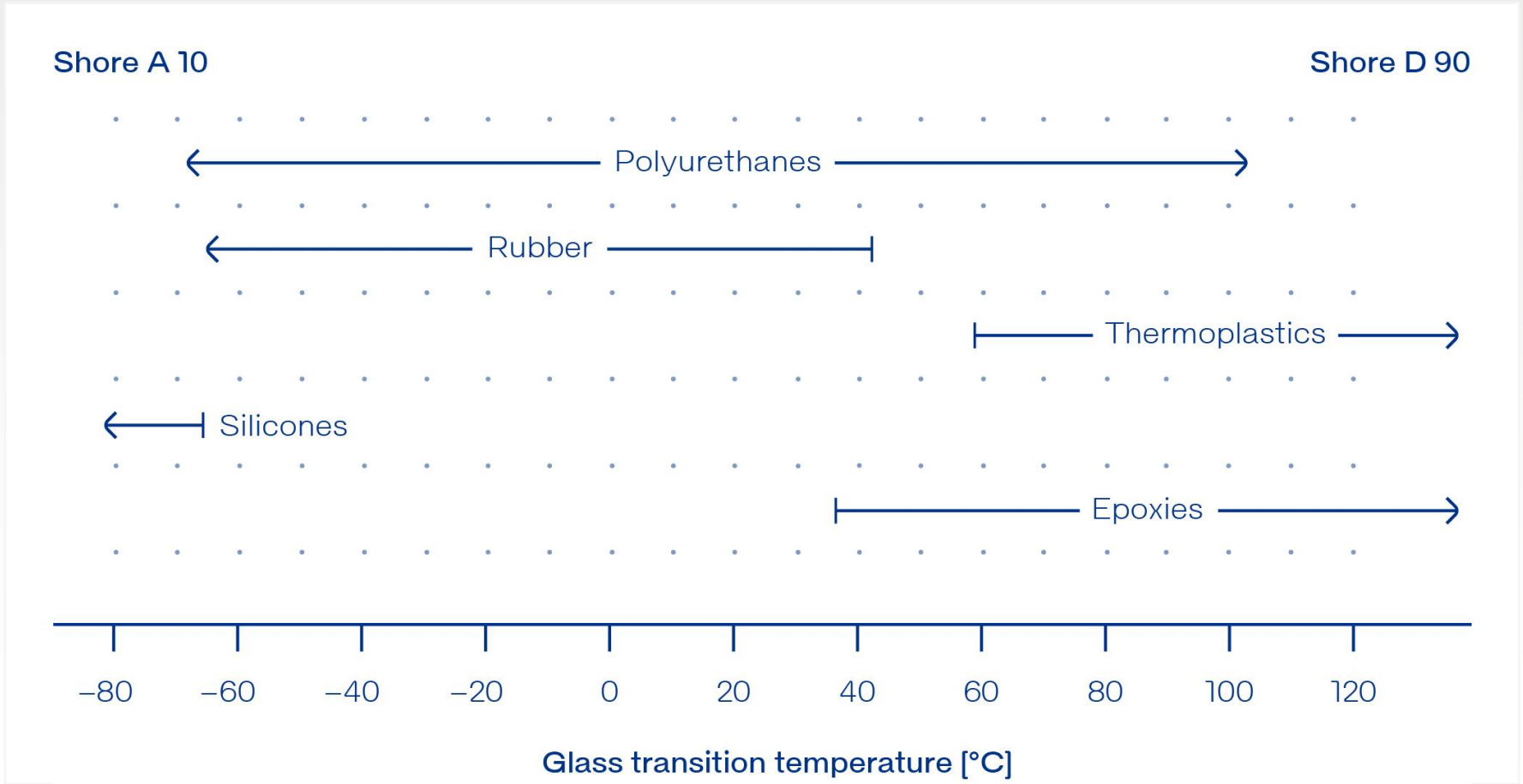
- Hardness
  - Extra soft: gels → penetration
  - Typical: Shore A range
- Not even experts are always able to say precisely which uncured system has been used to produce a certain vulcanisate with a typical Shore A hardness
- The lighter test to prove whether something that appears to be a silicone, is indeed a real one – or it's e.g. a TPE:
  - Silicone will form a white ash and will self-extinguish shortly if it catches fire at all
  - Thermoplastic materials will actually burn, stay on fire, melt and leave dark, foul-smelling ash

Image source: Adobe Stock

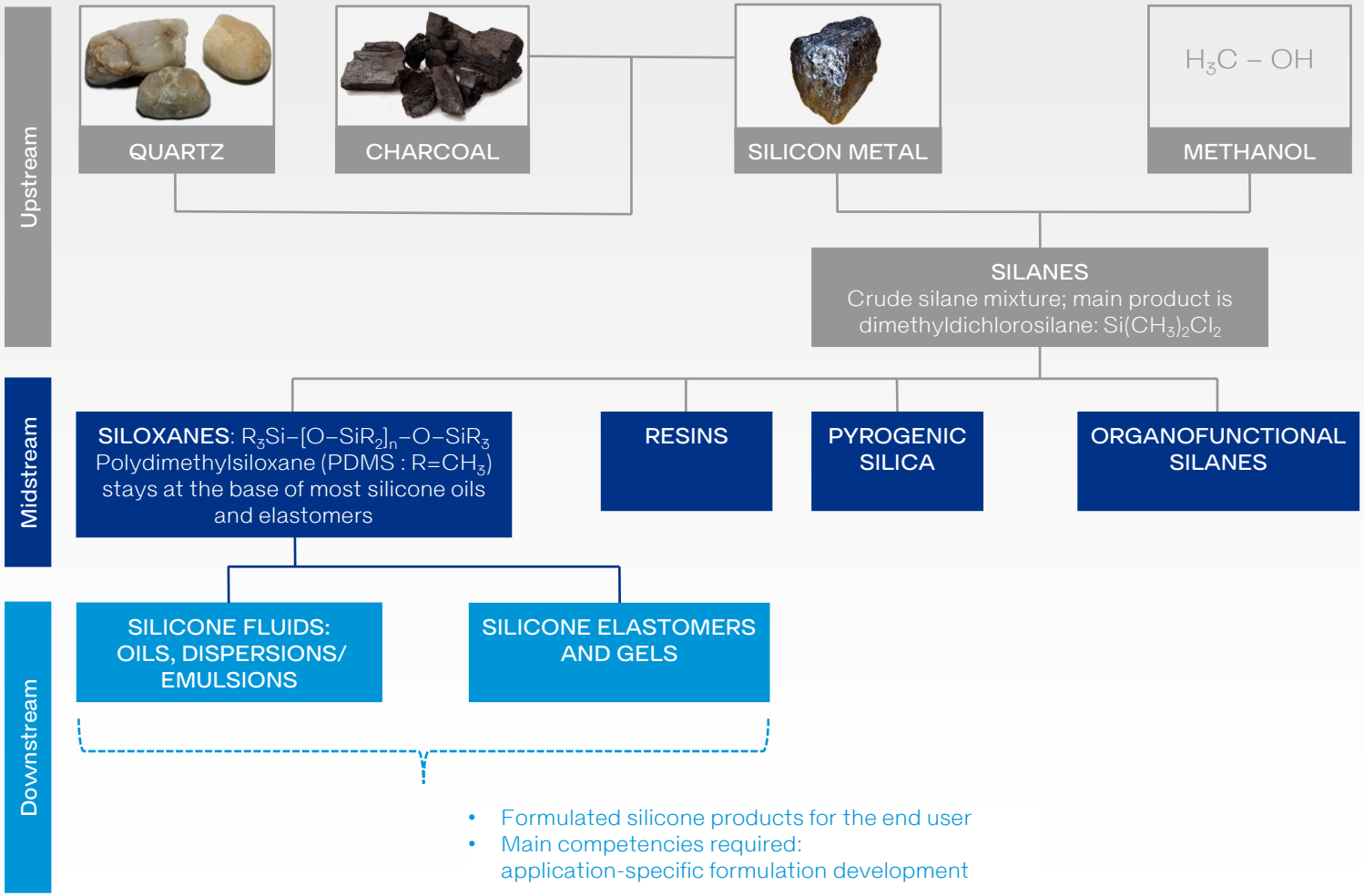
SHORE A HARDNESS SCALE

	Extra soft									Soft							Medium				Hard		
Shore A	0	5	10	15	20	25	30	35	40	45	50	55	60	65	70	75	80	85	90	95			
Shore D							6	7	8	10	12	14	16	19	22	25	29	33	39	46	60	75	90
Shore 00		45	55	62	70	76	80	83	86	88	90	91	93	94	95	97	98						

GLASS TRANSITION TEMPERATURE



PRODUCTION OF SILICONES



- Such backwards-integrated silicone production requires very high capital investment
- Chloromethane synthesis – with HCl fully recirculated – and finely crushed silicon undergo in a fluidized bed the Müller-Rochow process reactor for chlorosilane synthesis
- Hydrolysis then Polycondensation of the silanes result in siloxanes
- The upstream intermediate dimethylcyclosiloxane (DMC) is also marketed
- As a formulator, Wevo uses the following intermediates as raw materials for WEVOSIL: PDMS polymers (vinyl terminated) as bases, some resins as modifiers, silica as a reinforcing filler and some silanes as e.g. adhesion promoters
- All current WEVOSIL products are speciality silicone elastomers and gels

Image sources: Wikipedia, Wevo; Kies: Von Der Messer

PRODUCTION OF SILICONES

Upstream

QUARTZ

CHARCOAL

SILICON METAL

$H_3C - OH$

METHANOL

SILANES
Crude silane mixture; main product is dimethyldichlorosilane: $Si(CH_3)_2Cl_2$

Midstream

SILOXANES: $R_3Si-[O-SiR_2]_n-O-SiR_3$
Polydimethylsiloxane (PDMS : R=CH_3) stays at the base of most silicone oils and elastomers

RESINS

PYROGENIC SILICA

ORGANOFUNCTIONAL SILANES

Downstream

SILICONE FLUIDS: OILS, DISPERSIONS/ EMULSIONS

SILICONE ELASTOMERS AND GELS

- Formulated silicone products for the end user
- Main competencies required: application-specific formulation development

WEVOSIL

For a WEVOSIL grade, the final downstream production step – customising – is carried out in Ostfildern near Stuttgart

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POSSIBILITIES TO CLASSIFY THE SILICONE ELASTOMERS

By mixing ratio:	• 1K (HCR, RTV-1) • 2K (HCR, LSR, RTV-2): 1 : 1, 9 : 1, 10 : 1, 100 : 1, 100 : 1.5, etc.
By appearance/viscosity when uncured:	• Solid (HCR = HTV) • Liquid (LSR, RTV-1, RTV-2)
By curing system:	• Peroxide curing (HCR) • Condensation curing (RTV-1, RTV-2) • Addition-(platinum) curing (HCR, LSR, RTV-2)
By curing temperature:	• Room-temperature vulcanising (RTV-1, RTV-2) • High-temperature vulcanising (HCR, LSR)
By application area:	• Rubber parts with silicone as their raw material • Auxiliary material to obtain a specific effect (protection, adhesion, gap filling, insulation)

→ It will never be possible to reach a 100 % clear distinction, there will always be crossovers and exceptions found

MECHANICAL PROPERTIES OF SILICONES BY PRODUCT CLASSES

		RTV-2	LSR	HCR
Hardness	Shore A	Gel–50	5–85	10–90
Elongation at break	%	100–1000	300–900	300–1200
Tear resistance	N/mm	8–25	15–45	20–55
Tensile strength	N/mm^2	2–6	5–10	6–12
Compression set	%	30–70	8–25	10–40
Rebound resilience	%	20–50	40–60	35–65
Density	g/cm^3	0.7–3: function of filler type & amounts (typically 1–1.6)		
Viscosity	mPa·s			

APPLICATION FIELDS OF HCR & LSR SILICONES

Automotive

- Spark plug boots
- Pencil coils
- Vibration dampers
- Connector seals
- Exhaust pipe hangers
- Turbocharger hoses
- Gaskets
- Cables

Technical textiles

- Airbags
- Conveyor belts
- Architectural membranes
- Antislip: gloves, carpets
- Tents
- Paragliders
- Safety clothing

Lighting

- Moulded lens
- Light guides
- Gaskets

Lifestyle

- Diving masks
- Sport & fashion articles

Medical

- Catheters
- Tubing
- Seals, valves, membranes
- Respiratory care

Industrial

- Window profiles
- Keypads
- Moulded & extruded articles

Food & household

- Bakeware
- Oven door gaskets
- Coffee machine tubing
- Washing machine bull's eye gaskets
- Dishwasher gaskets
- Tubing

Cables

- Fire safety cables
- Battery cables
- Ignition cables
- EV/HEV cables
- General purpose cabels

Transportation

- Profiles
- Bellows (railway & buses)

Baby care

- Pacifiers
- Baby-bottle teats
- Breastfeeding articles

Electrical energy

- Insulators
- Cable accessoires
- Insulator coatings

Water management

- Irrigation
- Sanitary

APPLICATION FIELDS OF RTV SILICONES

Automotive
- Power train
- Seals & gaskets
- Dampers
- Head- and taillights
- Control units
- Sensors
- Actuators

Electronics
- Automotive electronics
- Consumer electronics
- Power modules
- Chargers

E-mobility
- Battery management
- Fuel cells
- Electric motors
- Cables & connectors
- On-board chargers

Textile industry
- Antislip coatings
- Technical textiles
- Wearables

Energy & Electrical
- Solar applications
- Wind power
- Hydro power
- Subsea oil & gas
- Metering

Fire safety
- Cable & pipe duct seals
- Seat cushions

Appliances
- Steam irons
- Dishwashers
- Ovens
- Kitchen hoods
- Hobs
- Filters

Lighting
- LED primary optics
- LED secondary optics
- Optical bonding
- Controllers

Health care
- Prosthesis
- Wound care
- Drug delivery
- Implants
- Medical electronics

Moulding & mould making
- Prototyping
- Reproductions
- Tampon (pad) printing
- Composites
- Construction moulding

Transportation
- Heavy duty vehicles
- Railway
- Marine
- Aerospace

Food industry
- Heat resistant coatings
- Antislip coatings

→ WEVOSIL grades were primarily introduced for casting, bonding and sealing applications

→ Other uses are also possible (e.g. moulded parts or coatings)

RTV-2: ADDITION OR CONDENSATION-CURING?

1. Addition-(Pt) curing	
Advantages	**Disadvantages**
No by-products → No smell, no corrosion	Less robust regarding adhesion and inhibition
No shrinkage (< 0.1 %) → Dimensional stability	Surface treatment very often necessary for good adhesion
Curing is possible in closed systems Does not require atmospheric moisture Uniform curing in volume/mass	
Curing speed can be adjusted over a wide range through the proper use of catalyst and inhibitor	
Curing can be greatly accelerated by heat	
Rheology, hardness and reactivity can be adjusted over a wide range	
Both components “fillable” → Mixing ratio of 1 : 1 is possible	

2. Condensation-(moisture) curing	
Advantages	**Disadvantages**
Excellent adhesion on nearly all substrates	Shrinkage due to the formation of decomposition by-products (~ 3 %)
Not sensitive to inhibition (much less than addition curing in comparison)	Decomposition by-products are formed (alcohol/oxime/amine/ acetic acid)
Curing speed can be adjusted over a wide range by means of the mixing ratio and the use of different catalysts	No significant acceleration by heat is possible
Fast curing is possible to achieve (also in thicker layers)	Corrosion risk with certain by-products
Both components “fillable”	Unpleasant smell of by-products

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→ **Conclusion: Addition curing for WEVOSIL**

APPLICATIONS/1 – POTTING: PROTECTION FOR ELECTRONICS

Protection	Appearance (can be partial)	Sil. class	Mechanical protection (impact, vibrations)	Corro-sion and particles	Water, humidity, chemicals	Electrical arcs	Design / IP security	Durability and resilience	Heat dissipation
Potting / Encap-sulation		RTV-2	+++	+++	+++	+++	+++	+++	+++

→ We focus on grades that are designed to provide total protection by potting/encapsulation

APPLICATIONS/2 – BONDING: DISPENSING SILICONE GASKETS

Gasket type	Appearance	Sil. class	Applied by	Curing	Adhesion	Assembly	Repair	Sealing method
Preformed gasket		HCR, LSR	Inserting	Before assembly	None	Dry	Possible	Compression
CIPG (cured in place gasket)		RTV-1, RTV-2	Dispensing	Before assembly	One side	Dry	Possible	Compression
FIPG (formed in place gasket)		RTV-1, RTV-2	Dispensing	After assembly	Both sides	Wet	Impossible	Adhesive bond

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FIPG (formed in place gasket)		RTV-1, RTV-2	Dispensing	After assembly	Both sides	Wet	Impossible	Adhesive bond

→ WEVOSIL 28001 and WEVOSIL 28002 – as well as further self-adhesive WEVOSIL grades under development – are suitable for CIPG and FIPG applications

WHERE IS THE LINE?

- There is no completely clear-cut line between the materials used for producing moulded articles and those used to obtain a certain effect by dispensing:
  - Protection, sealing, adhesion
- Therefore, basically it is also possible to produce moulded articles from a WEVOSIL potting compound
- So although quite similar in terms of their basic structure, WEVOSIL formulations are optimised for the specific requirements of our customers by their:
  - Rheology
  - Processing window
  - Electrical, thermal and mechanical properties

Image source: Adobe Stock

WORKING WITH WEVOSIL

Mixing ratio	Filler sedimentation	Exothermy
1 : 1 parts by weight	Filled systems are prone to sedimentation of the filler over a longer period of time, in both components	Unlike with PU and epoxy systems, very little heat develops as silicones cure
This is always roughly the same for volume parts, too, but weight parts are to be used		
This ratio must be adhered to in order to achieve the specified product performance	In order to avoid an excess or a lack of reactive components and achieve a proper curing, both components need to be homogenised before use	Therefore, all energy required must be transferred to the system from outside
Tolerance is +/– 2 %		
Developing a different mixing ratio (e.g. 9 : 1 or 10 : 1) is possible within the framework of a project in justified cases	All WEVOSIL grades are free of silicone oils → all of the polymeric material that might float to the top of the container is reactive material!	The curing speed is the same for a droplet or for a kg of the material

04

WEVOSIL PRODUCT GROUPS

PRODUCT OVERVIEW SILICONE CASTING RESINS

(as of Nov 2021)

WEVOSIL COMPONENT A/B		20201	20001	20002	27001 FL	28001	22006 FL	22002 FL	22005 FL	22007 FL	22008 FL	26001 FL	26011 FL	26008 FL	26010 FL	26009 FL	26007 FL	26020 FL
Mixing ratio (parts by weight)		1 : 1	1 : 1	1 : 1	1 : 1	1 : 1	1 : 1	1 : 1	1 : 1	1 : 1	1 : 1	1 : 1	1 : 1	1 : 1	1 : 1	1 : 1	1 : 1	1 : 1
Mixed viscosity at 22 °C [mPa·s]	Rotational viscometer/rheometer	300–700	1,000–1,500	15,000–35,000	4,000–8,000	30,000–60,000	2,000–2,800	2,500–4,000	4,000–8,000	10,000–20,000	4,000–8,000	paste-like	paste-like	paste-like	paste-like	paste-like	paste-like	paste-like
Reactivity at 22 °C [min]*	Rotational viscometer/rheometer	50–70	50–70	120–150	50–60	60–90	90–120	50–70	50–70	50–70	50–70	50–70	50–70	50–70	50–70	50–70	50–70	50–70
Density of component A/B at 22 °C [g/cm³]	DIN EN ISO 2811-1:2016-08	0.96–1.00	0.96–1.00	0.99–1.04	1.10–1.14	1.28–1.32	1.36–1.40	1.65–1.70	2.28–2.32	2.29–2.33	2.79–2.83	2.28–2.32	2.02–2.06	2.84–2.88	2.18–2.22	2.89–2.93	3.02–3.06	3.10–3.12
Shore hardness 00/A/D	DIN ISO 7619-1:2012-02	gel	-- / 35–45 / --	-- / 25–35 / --	-- / 25–35 / --	-- / 70–80 / --	-- / 47–55 / --	-- / 35–45 / --	-- / 55–65 / --	60–80 / -- / --	50–70 / -- / --	50–70 / -- / --	60–80 / -- / --	50–70 / -- / --	60–80 / -- / --	60–80 / -- / --	60–80 / -- / --	60–80 / -- / --
Operating temperature [°C]		-60 up to +200	-60 up to +180	-60 up to +180	-60 up to +250	-60 up to +200	-60 up to +180	-60 up to +180	-60 up to +180	-60 up to +165	-60 up to +200	-60 up to +180	-60 up to +165	-60 up to +200	-60 up to +165	-60 up to +200	-60 up to +200	-60 up to +200
E modulus [N/mm²]	DIN EN ISO 527-2:2012-06	–	1.7	1.0	1.5	4.5	4	2	6.4	1	0.25	0.7	0.6	0.6	1.2	1	0.8	0.6
Thermal conductivity [W/m·K] (pressureless)	DIN EN ISO 22007-2:2015-12	0.2	0.2	0.2	0.2	0.3	0.6	1.0	1.5	2.0	2.2	1.5	2.2	2.0	2.5	2.5	3.0	3.5
Thermal conductivity [W/m·K] (0.55 Mpa = 80 PSI = 5.5 bar)	ASTM D 5470-12	–	–	–	–	0.70	1.00	1.60	2.00	2.30	2.80	1.90	2.20	2.50	3.00	3.00	3.50	4.00
Melting point [°C]***	TMA ISO 11359-2:1999-10	< -50	< -40	< -50	< -50	< -55	-50	-45	-45	-50	-55	-45	-50	-45	-55	-50	-55	-50
Coefficient of expansion [ppm/K] > melting point***	TMA ISO 11359-2:1999-10	400	330	300	400	210	240	200	160	120	135	180	115	135	110	125	55	120
Water absorption [%]	30 days, 22 °C	–	< 0.2	< 0.3	< 0.3	< 0.2	< 0.2	< 0.1	< 0.2	3.64	< 0.3	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	0.1
Flammability	UL 94	HB	HB	HB	V-0	V-1	V-0 4 mm**	V-0 2 mm**	V-0	V-0	V-0	V-0	V-0	V-0	V-0	V-0	V-0	V-0
Dielectric strength [kV/mm]	DIN EN 60243-1:2014-01	23	> 25	> 25	> 25	> 30	33	24	30	> 16	> 19	> 19	> 20	> 20	> 15	> 19	> 15	> 20
Volume resistivity [Ω·cm]	DIN EN 62631-3-1:2017-01	> 10^{14}	> 10^{14}	> 10^{15}	> 10^{14}	> 10^{14}	> 10^{14}	> 10^{14}	> 10^{10}	> 10^{11}	> 10^{15}	10^{10}	> 10^{13}	> 10^{13}	> 10^{13}	> 10^{14}	10^{14}	> 10^{13}
Dielectric constant ε (at 50 Hz, 23 °C)	DIN EN IEC 62631-2-1:2018-12	–	2.7	2.7	2.7	3.1	3.8	4.5	5.2	6.7	5.8	5.3	5.4	7.4	6.1	7.7	7.5	7.0
Loss factor tan δ (at 50 Hz, 23 °C)	DIN EN IEC 62631-2-1:2018-12	–	0.004	0.008	0.009	0.013	0.065	0.060	0.048	0.112	0.010	0.020	0.070	0.140	0.044	0.150	0.057	0.019

All application parameters refer to processing at room temperature. All mechanical, thermal and electrical properties are based on complete curing.
* The indicated range of pot life corresponds with current standard versions. Adjustment of pot life is possible.
** UL listing under file No. E108835 *** Melting point spring into action, if cold-crystallization occurred at temperatures lower -60 °C.

For a more detailed technical description of our systems please refer to the corresponding data sheets which are available for all products.
Please see our special notes on the back of this leaflet.

PRODUCT GROUPS

The overview shows an excerpt of our different silicone product groups:

• Gels	(WEVOSIL 202XX)
• Optically clear	(WEVOSIL 200XX)
• High temperature resistance	(WEVOSIL 27XXX)
• Adhesives (2-component addition)	(WEVOSIL 28XXX)
• General-purpose encapsulation/potting	(WEVOSIL 22XXX)
• Thermally conductive encapsulation/potting	(WEVOSIL 22XXX)
• Thermally conductive gap fillers (pasty)	(WEVOSIL 26XXX)
• Flame retardancy	(WEVOSIL XXXXX FL)
• Chemical resistance	(no own nomenclature)

GELS

WEVOSIL 20200 Series

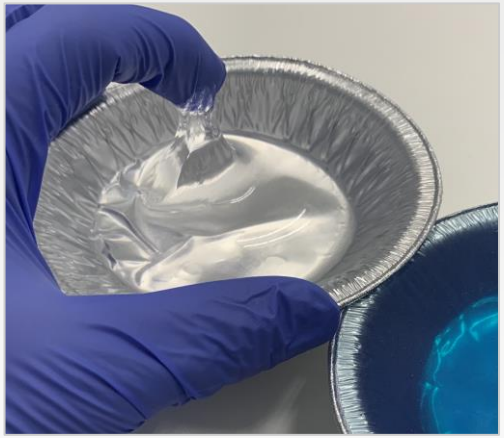
- Viscosities of all gel systems below 500 mPa·s
- Penetration hardness is adjustable at customer's request
- Slight colouring possible at customer's request
- Gel with higher adhesion to nearly all substrates than inner strength
- All gel systems fulfil SVHC declaration (SVHC < 0.1 % cyclic siloxanes D4–D6)
- All gel systems have an operating range from –60 °C up to +180 °C

In development

- Low-temperature silicone gel down to –80 °C without cold-crystallisation, but not based on phenyl methyl polymers (price range similar to standard gels)
- Silicone gel with 1.0–1.5 W/m·K thermal conductivity

Application

- Coating/encapsulation/potting of sensitive electronics



PRODUCT MOTIVATION

- Lower viscosities than the standards in the market
- Slight colouring also possible
- Penetration hardness adjustable
- Gel with higher adhesion than the inner strength and natural "tackiness"

OPTICALLY CLEAR

WEVOSIL 20200 Series

- All clear systems have an operating range from –60 °C up to +180 °C
- High stability to yellowing
- High UV resistance

WEVOSIL 20001

- Low viscous system for potting or for molded parts
- Yellowing stable up to +180 °C

WEVOSIL 20002

- For applications with high mechanical demand
- Good basic adhesion without need for primer for nearly all substrates
- Highly viscous, but still self-levelling properties
- Yellowing stable up to +140 °C

Application

- Potting of LED stripes/optical lenses

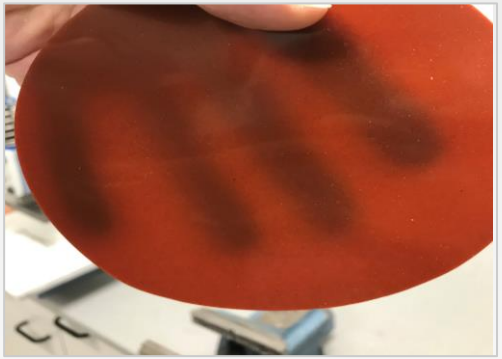
HIGH TEMPERATURE RESISTANCE

WEVOSIL 27001 FL

- Operating range from –60 °C up to +250 °C
- Mechanical performance after > 2,000 hours 250 °C > 50 %
  (e.g.: elongation at break)
- Thermal conductivity < 0.25 W/m·K suppression of heat spreading,
  suppression of “thermal runaway” of e.g. battery cells
- No toxic burning products

Application

- Safety coating/potting of battery cells or parts nearby
- Potting of electronics with need for high long-term temperature stability



PRODUCT MOTIVATION

- Thermal mitigation/
  suppression of “thermal
  runaway”

ADHESIVES (2K ADDITION)

WEVOSIL 28000 Series

- Operating range from –60 °C up to +200 °C
- No shrinkage
- No cure byproducts
- No pretreatment or primer necessary

WEVOSIL 28001

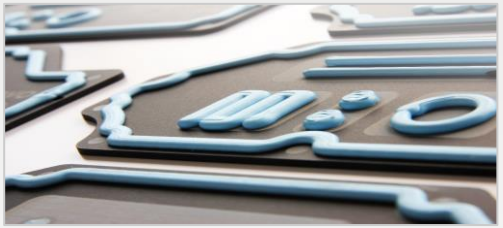
- Adhesion > 6 MPa on nearly all substrates
- Potting adhesive with self-levelling properties

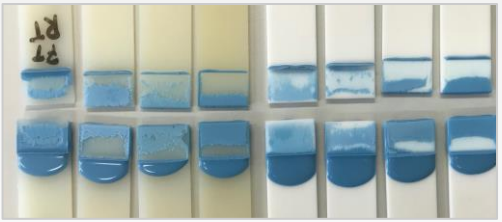
WEVOSIL 28002

- Adhesion > 1 MPa on nearly all substrates
- Sealing material

Application

- Adhesive for potting or sealing, with high temperature requirements





PRODUCT MOTIVATION

- Adhesive without cure byproducts
- No shrinkage
- Low-danger labelling
- No pretreatment or primer necessary

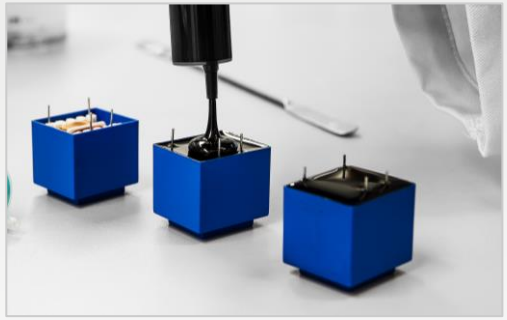
GENERAL-PURPOSE ENCAPSULATION/POTTING

WEVOSIL 22006 FL

- Operating range from –60 °C up to +180 °C
- Low viscosity for good flow behaviour
- Good mechanical and electrical properties
- UL certification (all colour registration)
- Suitable for ATEX applications

Application

- Encapsulation of all kind of electronics
- Potting of transformers
- Encapsulation of battery packs



PRODUCT MOTIVATION

- General purpose
- UL certified
- ATEX compliant

THERMALLY CONDUCTIVE POTTING UP TO 1.5 W/M·K

WEVOSIL 22002 FL / 22004 / 22005 FL

- Flowable potting resins (all viscosities < 8,000 mPa·s)
- Increased thermal conductivity up to 1.5 W/m·K (Hot-disk measurement pressureless and also ASTM D5490 measurement 0.069 MPa)
- All Shore hardnesses approx. A: 30–60

WEVOSIL 22004

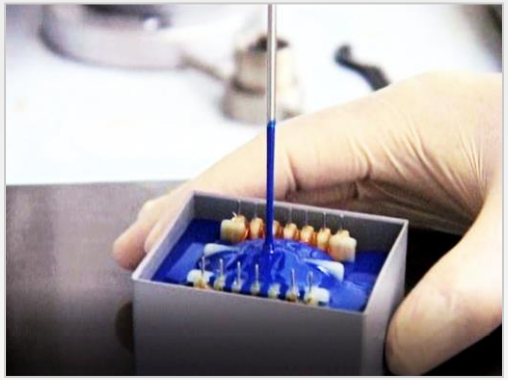
- Adhesion > 1 MPa on nearly all substrates without hot-curing

WEVOSIL 22005 FL

- Elevated basic adhesion > 1 MPa after 1 hour at 100 °C

Application

- Encapsulation of all kinds of electronics where higher thermal conductivity is needed



PRODUCT MOTIVATION

- Increasing thermal conductivity of standard encapsulation materials

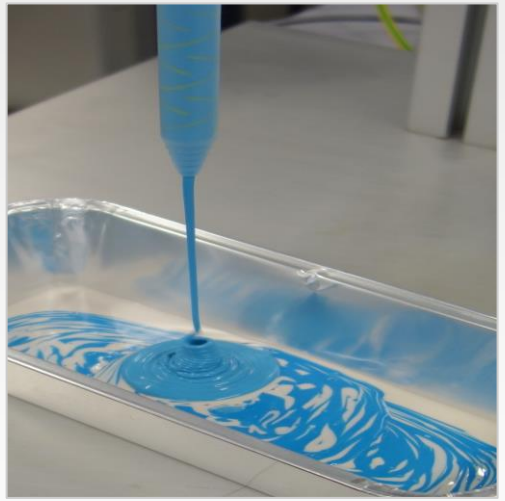
THERMALLY CONDUCTIVE POTTING UP TO 2.8 W/M·K

WEVOSIL 22007 FL

- Flowable under pressure (viscosity < 20,000 mPa·s)
- Low density
- Temperature stable up to +165 °C
- Thermal conductivity up to 2.0 W/m·K (Hot-disk measurement pressureless)
- Thermal conductivity up to 2.2 W/m·K (ASTM D5490 Measurement 0.069 MPa)
- Soft (Shore 00: 50–80) → harder version possible

WEVOSIL 22008 FL

- Flowable under pressure (viscosity < 8,000 mPa·s)
- Temperature stable up to +200 °C
- Thermal conductivity up to 2.2 W/m·K (Hot-disk measurement pressureless)
- Thermal conductivity up to 2.8 W/m·K (ASTM D5490 measurement 0.069 MPa)
- Soft (Shore 00: 50–80) → harder version possible



PRODUCT MOTIVATION

- Increasing thermal conductivity to a maximum, where flowability is still needed
- Soft for sensitive applications

Application

- Thermal management where a soft yet low-viscous material is required, power electronics

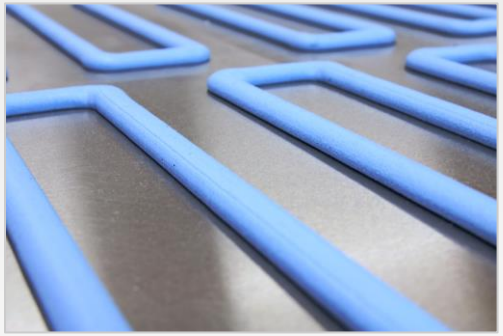
THERMALLY CONDUCTIVE GAP FILLER HIGH TEMPERATURE

WEVOSIL 26007 FL / 26008 FL / 26009 FL / 26020 FL

- Temperature stable up to +200 °C
- Thermal conductivity up to 3.5 W/m·K (Hot-disk measurement pressureless)
- Thermal conductivity up to 4.0 W/m·K (ASTM D5490 measurement 0.069 MPa)
- Reduced abrasiveness/dosing rates higher than 5 mL/second possible
- Good mechanical properties (e.g. elongation at break)
- Bond line thickness < 100 µm

Application

- Thermal management for battery applications
- Power electronics



PRODUCT MOTIVATION

- Standard gap fillers with different thermal conductivities
- All systems available in cartridges
- No stir up necessary for minimum 3 months
- Reduced abrasiveness

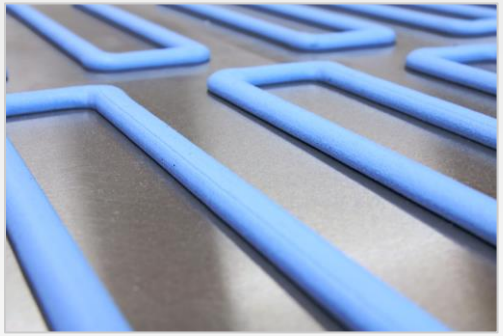
THERMALLY CONDUCTIVE GAP FILLER LOW DENSITY

WEVOSIL 26001 FL / 26010 FL / 26011 FL

- Temperature stable up to +165 °C
- Low density
- Thermal conductivity up to 2.5 W/m·K (Hot-disk measurement pressureless)
- Thermal conductivity up to 3.0 W/m·K (ASTM D5490 measurement 0.069 MPa)
- Reduced abrasiveness /dosing rates higher than 5 mL/second possible
- Good mechanical properties (e.g. elongation at break)
- Bond line thickness < 150 µm

Application

- Thermal management for battery applications



PRODUCT MOTIVATION

- Low density
- Standard gap fillers with different thermal conductivities
- All systems available in cartridges
- No stir up necessary for minimum 3 months
- Reduced abrasiveness

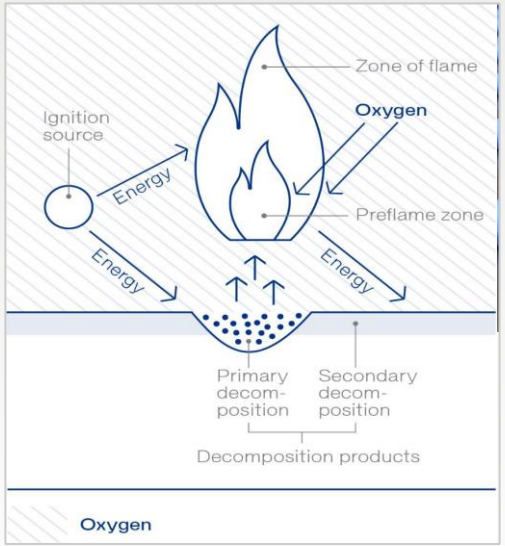
FLAME RESISTANCE

WEVOSIL products with “FL” at the end of the name

- Different kinds of flame retardancy
  - Active, by adding fillers/additives with flame retardant properties
  - Passive, by adding fillers in high concentrations
- With regard to passive flame retardancy we are in discussion with UL to test the properties on coated alumina sheets, and also with regard to customer applications and mechanical properties where it is a challenge to produce shoulder bars for tests when super soft mechanical properties are required
- It is also possible to test UL 94 H class and H5A burning test, which are not standard in the silicone market with regard to gap filler applications

Application

- Any application where flame retardancy is necessary



PRODUCT MOTIVATION

- Burning behaviour or flame retardancy after UL 94 V class
- As thin as possible, especially with regard to gap fillers where small gaps will be standard for thermal management

CHEMICAL RESISTANCE

WEVOSIL 28001

- Due to high crosslinking density and the use of special fillers, this product exhibits very high chemical resistance properties
- The benefits of 2K addition-curing silicone are still given:
  - No shrinkage
  - No cure byproducts
  - Optimised for high adhesion
- High temperature stability
- In use as adhesive in vanadium redox flow batteries
- Further information on examples and research projects: wevo_pi_redox_flow_battery_210120, wevo_ifbf_a4_word_201111, wevo_ifbf_poster_a3_201111

Application

- Adhesive with high thermal and chemical resistance (self-levelling)

PRODUCT MOTIVATION

- High chemical resistance to concentrated acids and bases
- High chemical resistance to fuel cell electrolytes
- High chemical resistance to standard automotive liquids

INNOVATION WITH WEVOSIL

IN OUR R&D THERE IS ALWAYS WORK ONGOING TO DEVELOP UP-TO-DATE SOLUTIONS FOR CHALLENGES ENCOUNTERED BY OUR PARTNERS

Silicone gels with enhanced thermal conductivity
- Keep the outstanding mechanical damping properties of the silicone gels
- Combine these with thermal conductivity for better thermal management

Thermally conductive silicone adhesives
- Offer a stable mechanical bond while supporting heat dissipation
- Still easy to dispense

EMC/EMI shielding directly with silicones
- Develop electrically conductive or antistatic silicone grades with superior properties
- Combine adhesion with electrical conductivity
- Adjustable permittivity (dielectric constant) ε from 7 to > 20 for perfect shielding properties

Continuous screening of various fillers
- Further counteract the sedimentation tendencies of highly filled materials
- Control the rheology to achieve a desired flow behaviour at different viscosity values

05

DEFINING YOUR OWN OPTIMAL WEVOSIL SOLUTION

MODIFICATIONS OF STANDARD WEVOSIL PRODUCTS

Is pot life/reactivity adjustable?
- Yes, by adding more catalyst: from 1–2 minutes up to several hours
- Yes, by adding more retarder: from several hours up to 1–2 days (heat curing may be necessary)

Can mix viscosity be adjusted?
- Increasing the mix viscosity is easily possible (thixotropic effect)
- Limited means of decreasing the mix viscosity: choose another product

Can hardness be adjusted?
- Yes, most of the products can be adjusted harder up to Shore A: 40–50 (new product)

Can temperature class be adjusted?
- No, choose another product

Can mechanical properties be adjusted?
- Yes, but limited (correlate with the hardness of the product); (new product)

CUSTOMER REQUESTS

In order to find the WEVOSIL product that best fits your needs, the following information is required:

- Ideally: a specification/requirement catalogue (necessary for automotive projects)

For new developments and where specifications are missing, we need five basic items of information before starting:

- Operating temperature range xxx °C (long-term)
- Flowable or thixotropic (range of viscosity) → type of application
- Hardness
- Thermal conductivity
- UL classification necessary

For optically clear products, three further items of information are required:

- Colour stability; non-yellowing up to xxx °C
- UV resistance
- Transmission rate at wavelength of xxx nm

06

SUMMARY/ TAKEAWAYS

KEY TAKEAWAYS

- Wevo-Chemie is your reliable partner for electronic and electrical protective solutions based on silicones, polyurethane and epoxy
- Each chemistry is characterised by its individual advantages and limits
- We offer a great variety of tailor-made solutions for the safe operation of your E & E components
- Adapted properties – such as increased temperature resistance and thermal conductivity – of our high-performance materials can cope with the increasing technical demands of emerging technologies like e-mobility, energy storage and smart grid applications
- Ask our global experts to discuss your individual projects and needs

THANK YOU VERY MUCH FOR YOUR ATTENTION!

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