siloxene

Enabling disruptive interface chemistry

Short technical overview “coatings technology”

Who are we ?

Siloxene AG is a spinoff company from the Swiss Federal Laboratories for Materials Science and Technology (Empa) in Switzerland

spin-off | Empa

siloxene improves product performance and profitability through its unique and proprietary platform of environmentally friendly, performance-boosting specialty chemicals

Si
siloxene

Si

Molecular architecture drives properties

Tailored performance

Stronger bonding

Circular economy enabler

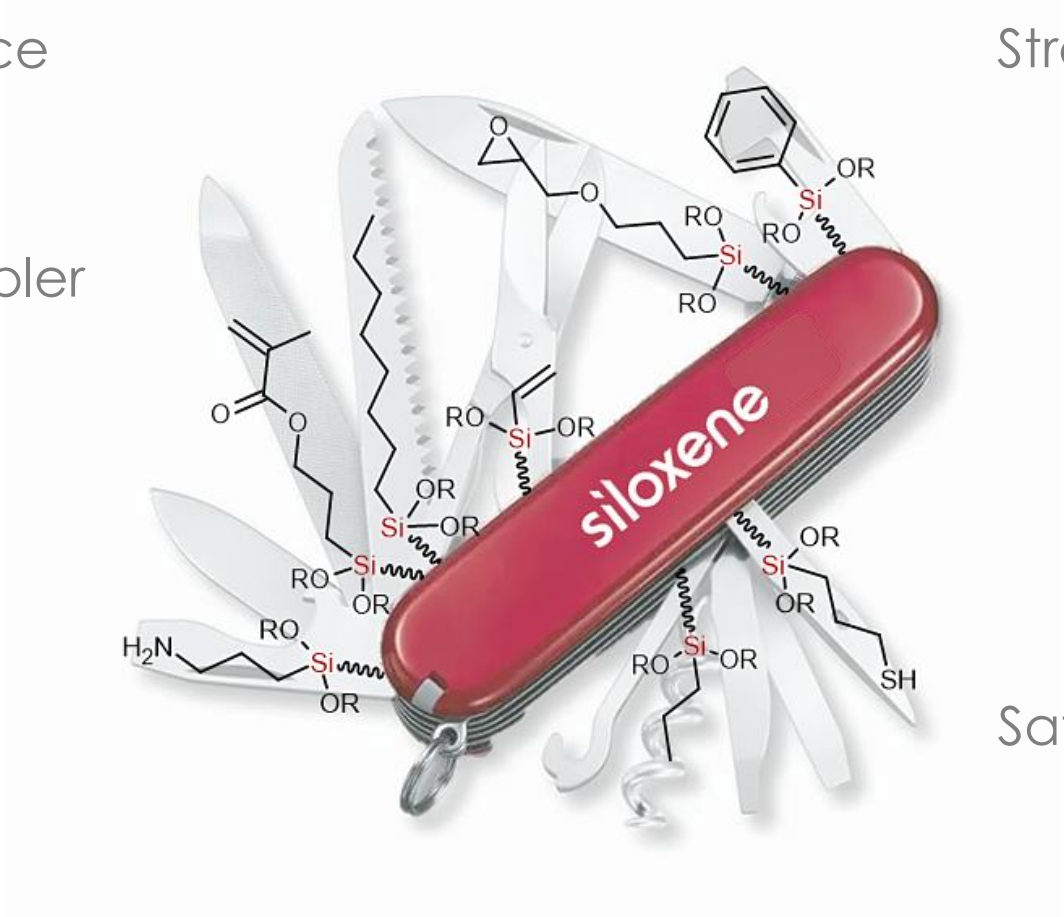
Faster

Non-hazardous

Energy saving

Tougher

Safe & efficient



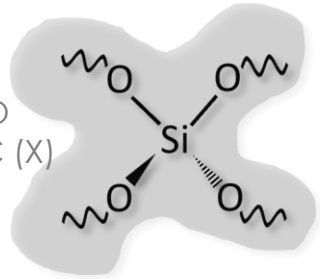
siloxene enables next generation materials chemistry & solutions

Q-T-D-M nomenclature and materials

Q, T, D, M parameters are used to designate organosilicon compound in terms of its oxygen (siloxane) and organic (functional substituent) molecular connectivity

◊ Q-type

4 Si-O
0 Si-C (X)

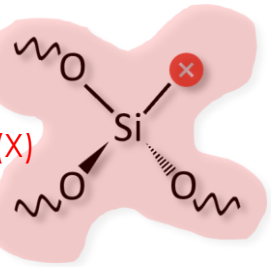


No X functionality

- ◊ Q from "quadri"
- ◊ Organosilicates
- ◊ Main use:
  - ◊ Coating systems
  - ◊ Sol-gel precursor
  - ◊ Nanosilica

◊ T-type

3 Si-O
1 Si-C (X)

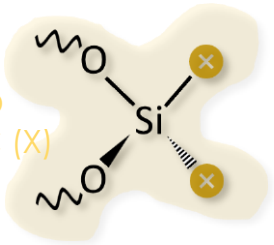


Wide range of functional X

- ◊ T from "tri"
- ◊ Functional silanes
- ◊ Main use:
  - ◊ Coupling agent
  - ◊ Adhesion promoter

◊ D-type

2 Si-O
2 Si-C (X)

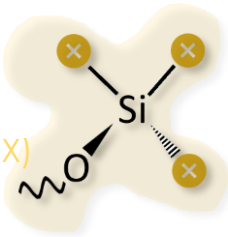


X groups selected from methyl, vinyl, phenyl

- ◊ D from "di"
- ◊ Organosilicates
- ◊ Main use:
  - ◊ Silicone oils
  - ◊ Silicone elastomers

◊ M-type

1 Si-O
3 Si-C (X)



X groups selected from methyl, (vinyl, phenyl)

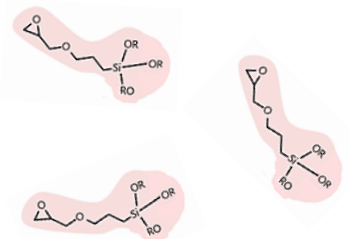
- ◊ M from "mono"
- ◊ Organosilicates
- ◊ Main use:
  - ◊ Hydrophobisation
  - ◊ End-capping of siloxanes
  - ◊ CVD for semi-conductor industry

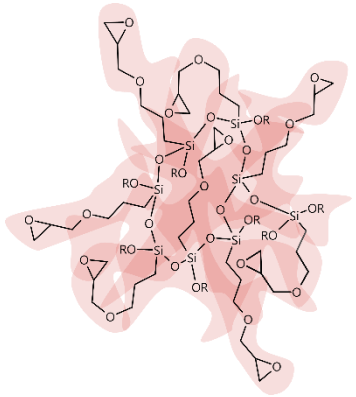
Si

QT-resins are silane chemistry 3.0

- Monomer
- Oligomer

T-type functional silanes

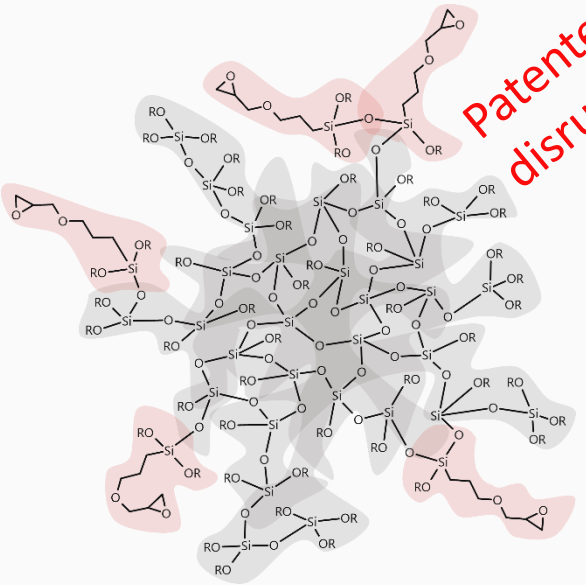




- MW 180 - 350
- Flammable
- Single functionality

- MW 1000 -1500
- Low alkoxy group accessibility
- Single functionality

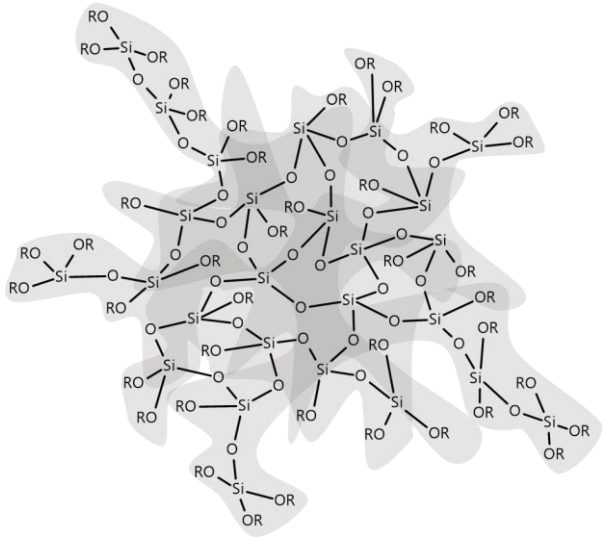
- QT-resins



- MW 2500 - 5000
- High alkoxy group accessibility
- Tailored multi- functionality

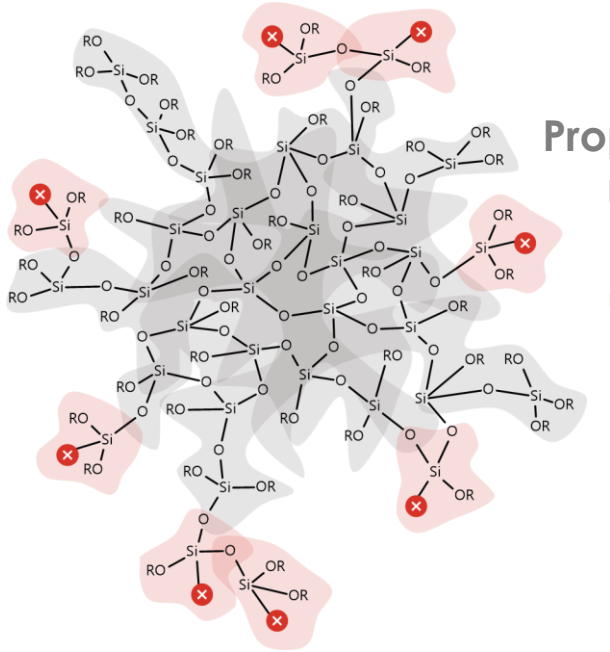
Siloxene QT-resins (silicate-silane polymers) control surface bonding, adhesion and wetting at the molecular level, creating smart functional interfaces

Siloxene technology tree



Dendritic ethylsilicate polymer

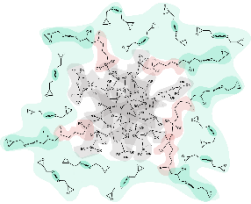
Proprietary grafting of T-silanes



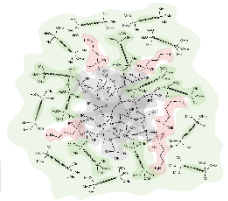
XenSlick
XenCure

OFS

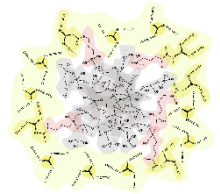
Proprietary chemical modification of X-functionality



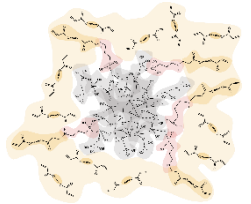
XenRes E
(epoxy)



XenRes H
(STP / SPUR)



XenRes I
(isocyanate)



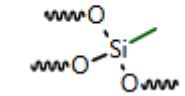
XenRes U
(UV curable)

XenCure C
XenRes

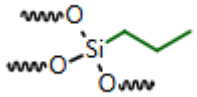
SPA

XenSlick™ and XenCure™ options

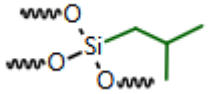
XenSlick™



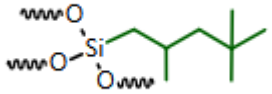
XenSlick™ M



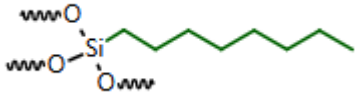
XenSlick™ P



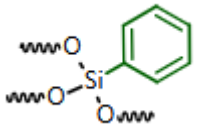
XenSlick™ iB



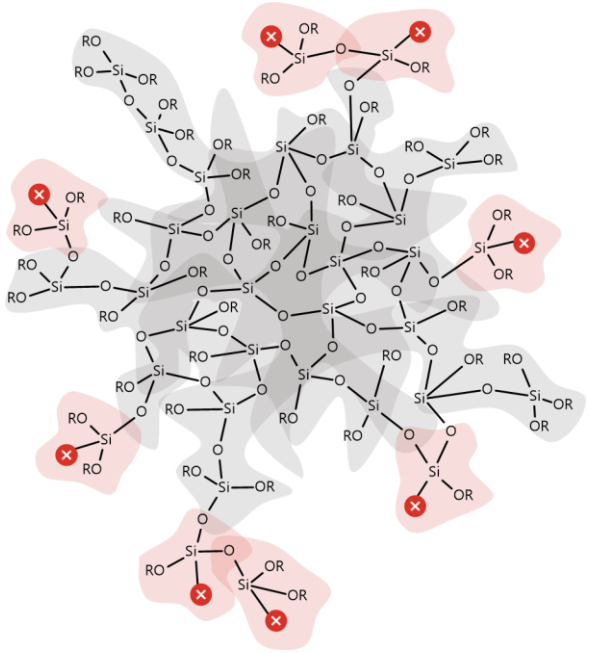
XenSlick™ iO



XenSlick™ O



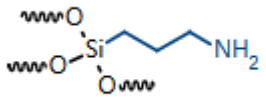
XenSlick™ R



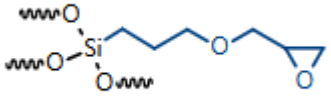
OFS

(QT-resin)

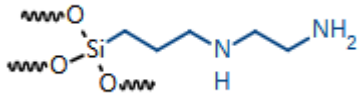
XenCure™



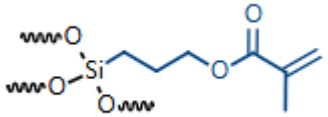
XenCure™ A



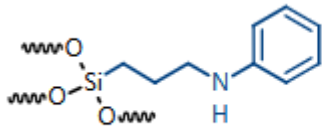
XenCure™ G



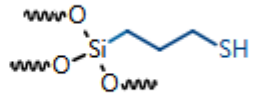
XenCure™ 2A



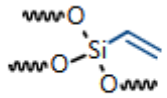
XenCure™ U



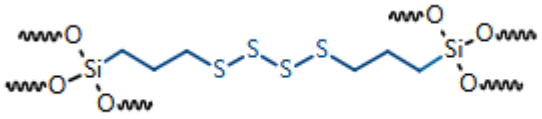
XenCure™ A1



XenCure™ S



XenCure™ V



XenCure™ 4S

Nomenclature of product codes

- For XenCure™, XenSlick™ and XenLink™

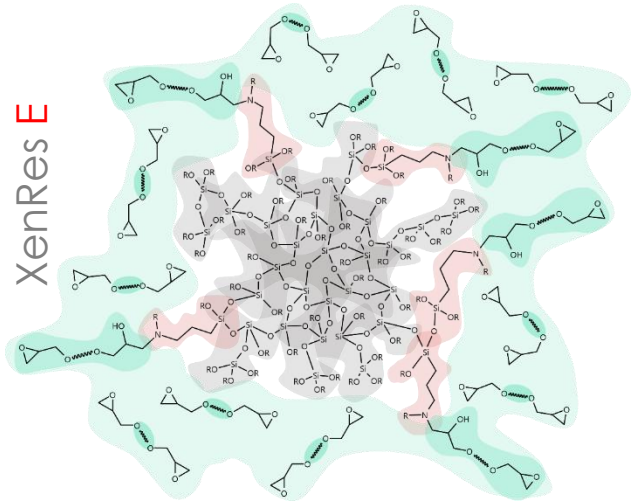
Siloxene product families: XenRes

- XenRes SPAs are

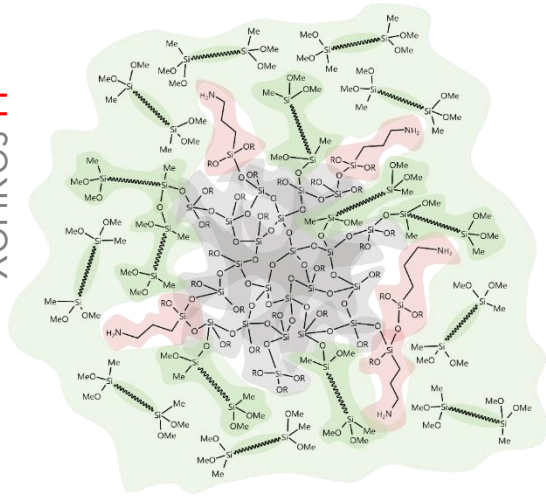
x-group reaction products with commodity resins

- XenRes E – hybrid epoxy resins
- XenRes H – hybrid STP (silane terminated polymer) resins
- XenRes I – hybrid isocyanate resins
- XenRes U – hybrid (meth)acrylate resins

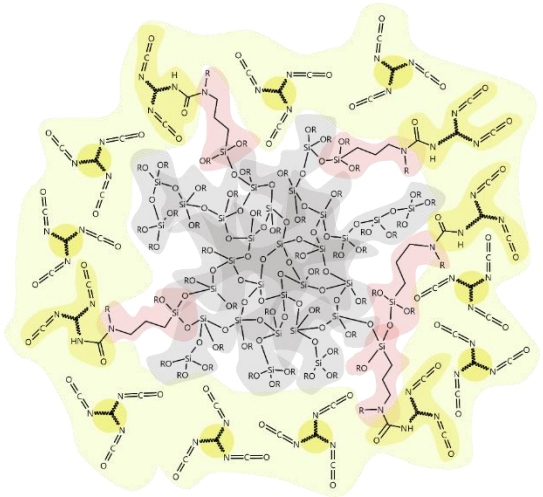
XenRes E



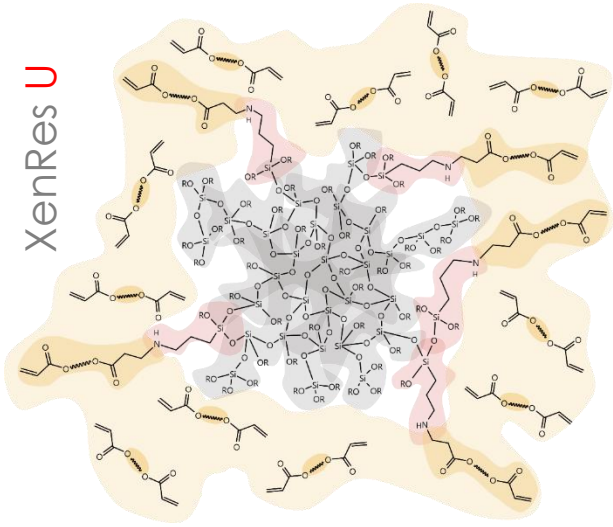
XenRes H



XenRes I



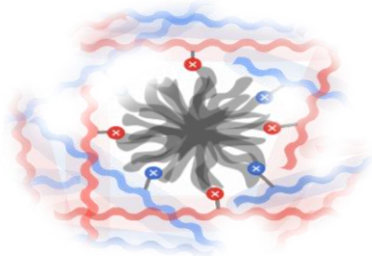
XenRes U



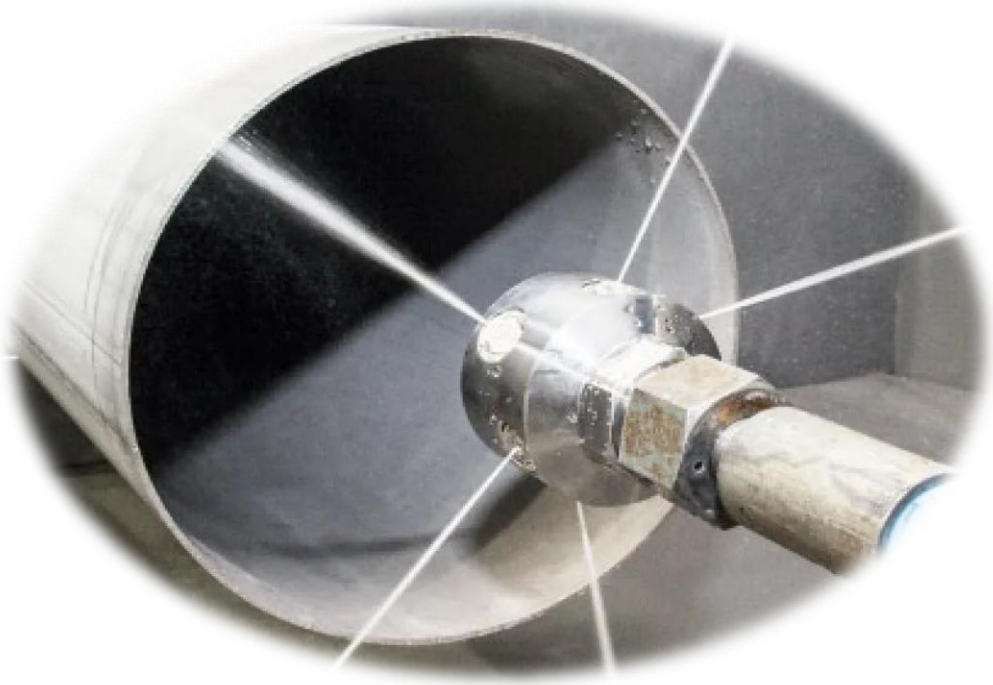
XenRes products are commodity polymer precursor derivatized QT-resins

siloxene technology USPs

- Improved wetting
  - Maximizes adhesion and multi-material compatibility
  - Processing and performance benefits
- Curing by design
  - Time / energy savings
  - Cost effective, isocyanate-free multi-cure resins
- Eco-benefits
  - Label-free, high solids content, solvent-free, non-flammable
  - Free of HAZMAT, organotin, PFAS etc.
- Durability
  - Extreme UV, weathering & chemical resistance
  - Solutions tailorable to the specific formulation



1st application topic “coatings”



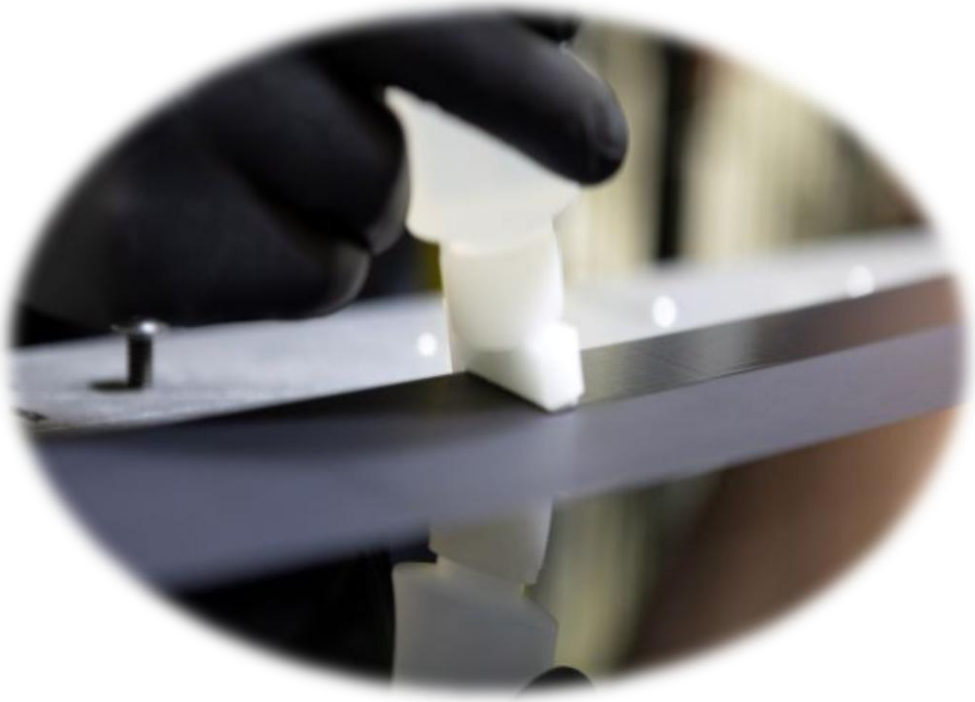
siloxene XenBlu™ CD120 for metal pretreatment

“XenBlu™ CD120 is a **Cr, Ti and F-free** non-toxic water-based pretreatment solution & conversion coating applied directly as part of the precleaning, creating excellent adhesion to metal”

Application examples

- Steel production
- Al activation
- Coil / Can coating
- MRO coatings
- PCB industry (Cu-adhesion)

2nd application topic “coatings”



siloxene XenRes™ H286 as a primer

“XenRes™ H286 is a label-free 1K **ultrafast moisture curing primer** system. It is solvent-free and can be sprayed or painted and provides excellent adhesion to many different metals and plastics.”

Application examples

- Rubber-to-metal bonding
- Primer for paints
- Polymer foil roll-to-roll processing
- Cement and building materials

3rd application topic “coatings”

siloxene XenRes™ E675 next-gen hybrid resins

“XenRes™ E600 is a highly durable, **fluorochemistry free,** non-toxic 2K next-gen silicate/epoxy hybrid resin with excellent durability, antifouling, anti-icing and anti-graffiti properties. It is low viscosity and can be formulated completely without solvent. ”

Application examples

- Low friction, anti-icing coatings
- MRO coatings
- Exterior cladding
- Surface protection

4th application topic “coatings”

siloxene XenCure™ A35 isocyanate-free crosslinker

“XenCure™ A35 is an **isocyanate free** crosslinker for polyol based coatings, providing a non-toxic alternative to PU chemistry. It allows for rapid curing coating compositions with high durability, scratch-, chemical and UV / weathering resistance ”

Application examples

- Clearcoat
- MRO coatings
- Outdoor coatings
- Coil/can coatings

5th application topic “coatings”

siloxene XenSlick™ MR344 surface modifier additive

“XenSlick™ MR344 is a **PFAS & PDMS free**, hydrophobic surface modifier additive for coatings, improving durability & scratch resistance whilst lowering friction. It is readily compatible with standard epoxy, PU, STP and UV-cure chemistries ”

Application examples

- PU clearcoat
- MRO coatings
- UV-cure wood protection
- Water-based paints

Take home

- New and unique chemistry
  - QT-resins are a unique and proprietary technology of siloxene
  - Tailored solutions for targeted solutions & formulations
- Potential for industry partners
  - Next generation innovative resins & curing chemistries
  - Non-toxic activator / primers & adhesion promoters
  - PFAS-free surface-property enhancing additives
- Collaboration framework
  - First technical exchange
  - Decision on way forward under NDA
  - Technical solution meeting and sampling
  - Follow-up, technical proof of concept, definition of milestones