Handling of TEGO® RC Silicones

Hardi Döhler | Jürgen Pomorin

What are RC Silicones?

- RC = Radiation Curing, i. e. UV light or electron beam
- Solvent-less silicones, 100 % active, liquid, clear/slightly turbid, viscosity from 150 – 2 500 mPas
- Silicone acrylates = free radical curing mechanism
- Epoxy silicones = cationic curing mechanism
- UV curing needs photoinitiator
- Different components for different release properties from premium easy to super tight

Good Workplace Practice

- Most RC's are non-sensitising, however they are eye irritants, safety glasses and goggles recommended
- Avoid contamination of skin, wear rubber gloves
- Avoid inhalation of silicone aerosol
- Flashpoint of Silicones > 100 °C
- Avoid spillage to tools or machinery parts because of slippiness on floor and machinery
- Contamination of printing inks and equipment can cause severe printing problems (wetting, anchorage)
- Try to arrange for a silicone mixing place/area

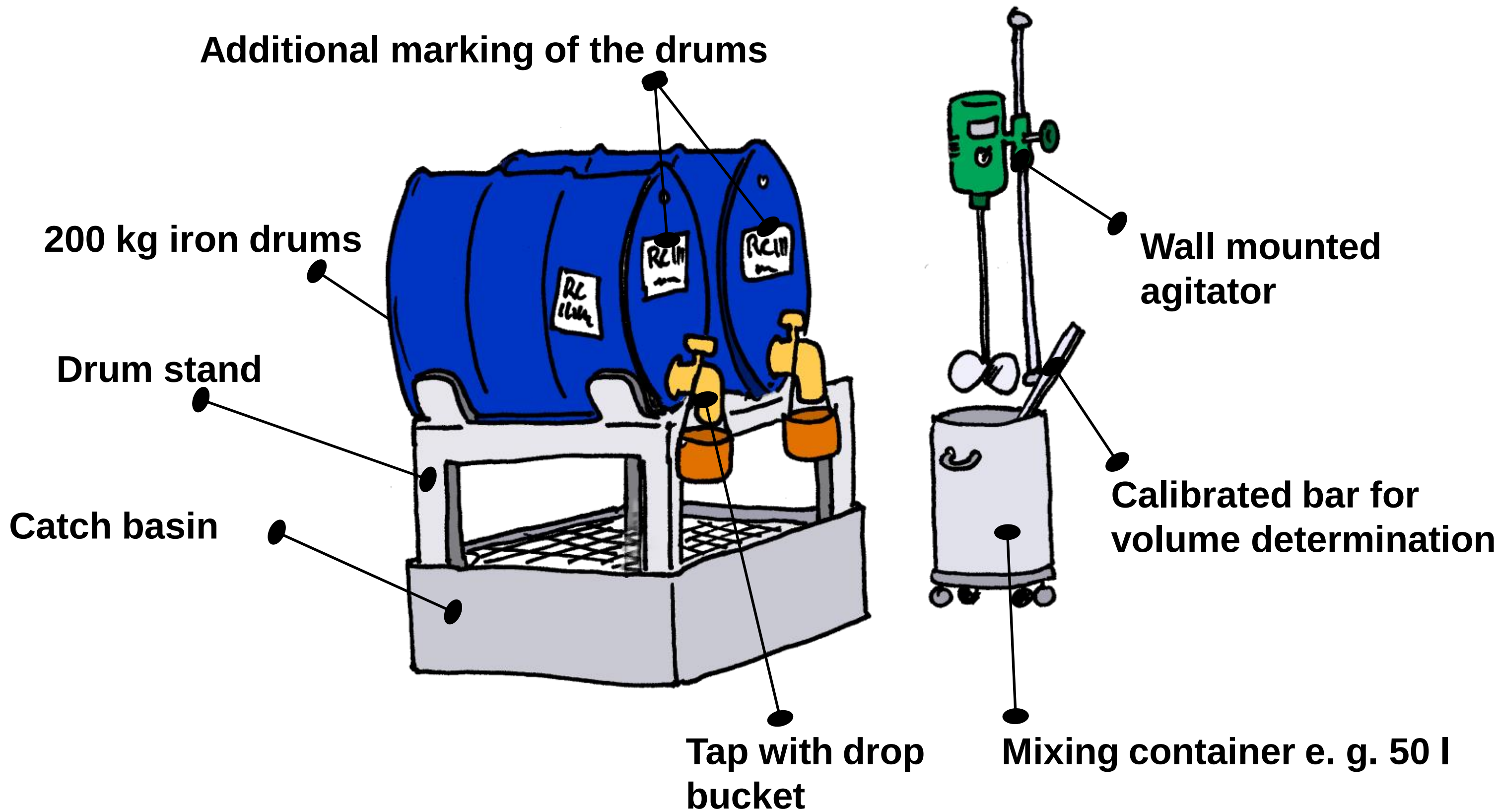
Storage

- Shelf-life up to 24 months
- Silicone acrylates: very long bath life, up to 12 months
- Epoxy silicones: limited bath life, few days or weeks
- Store in closed and dark containers, no direct sunlight
- Recommended to store inside
- Avoid temperatures of > 30 °C for long time (especially with epoxy silicone formulations!)
- Avoid contact with e. g. inks, oil, water, dust …

Mixing of RC Silicones

- No specific order of adding components
- Recommendation:
  - add small volume components at the end
  - add high viscous components at the end
- Stir manually or with motor driven agitator
- Accuracy of ± 1 – 3 % (rel.) sufficient
- Most RC components not homogeneously mixable
  ⇒ turbid mixture, needs re-mix after time

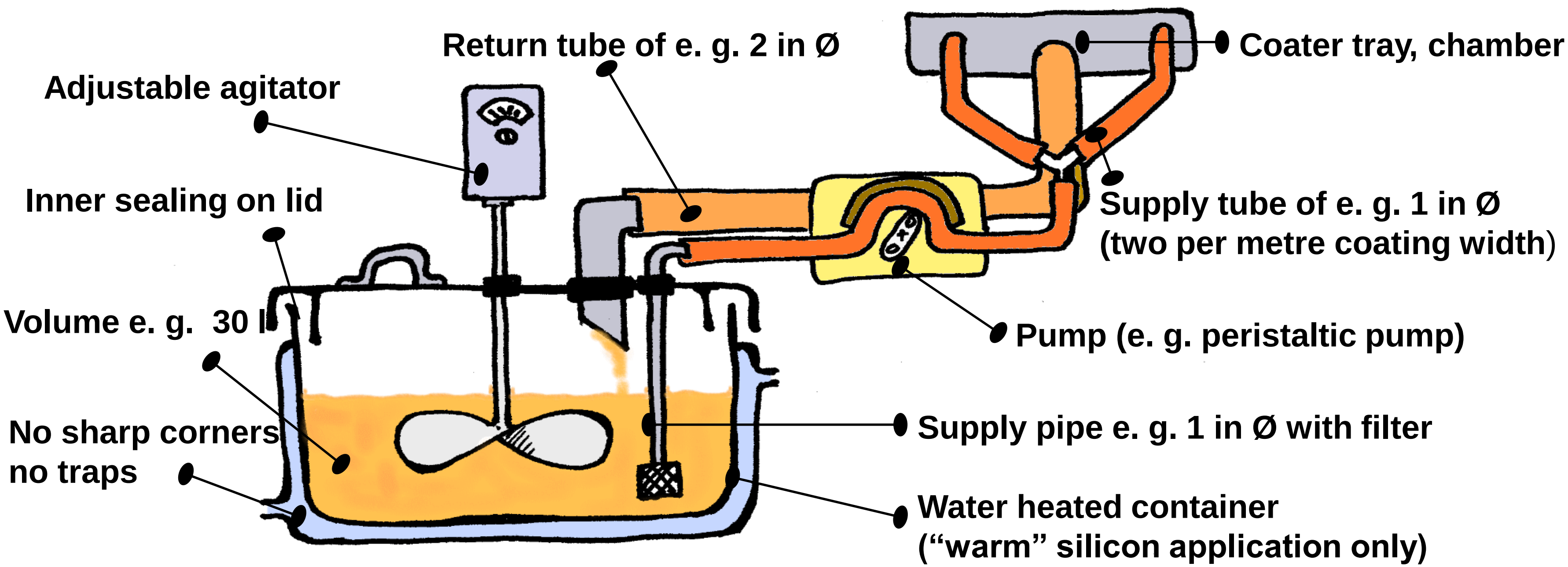
Example of equipment for medium range silicone consumption of 20 to 200 kg/day



RC Silicones on the Coating Line

- Keep the ready-to-use mixture in a closed holding tank
- In case of long down times or storage times install a slowly rotating stirrer on the holding tank
- The silicone blend will stay mixed on the coating equipment by the rotation of the cylinders
- Get air bubbles out by an overflow circulation system
- Silicone acrylates only: lowering of viscosity by heating the coater up to 60 °C possible

Example of a holding tank for medium range silicone consumption of 20 to 200 kg/day



EVONIK
POWER TO CREATE

Cleaning

- Cleaning of the mixing and coating equipment with rags and solvents, e. g. isopropanol
- Silicone acrylate: no gelation over night due to very long pot life, cleaning of piping, vessels and pumps not always necessary
- Epoxy silicones: always clean after production
- Careful cleaning when changing silicone systems e. g. from thermal or cationic to free radical
- No cleaning necessary if next production with similar blend
- Change between different RC formulations possible without thorough cleaning when going tight to easy
- Going from easy to tight release requires good cleaning

Coating

- Complete coverage of the substrate, e. g. no pinholes
- Coat weights similar to solvent less thermal curing silicones
- Good wetting of the substrate, also due to corona
- Silicone acrylates: In-line corona pre-treatment on films and papers to ensure good anchorage of silicones
- Epoxy silicones: corona not always needed

Coating – offset gravure

Roller speeds

R1 = 10 - 100 %

R2 = 95 - 105 %

R3 = web speed

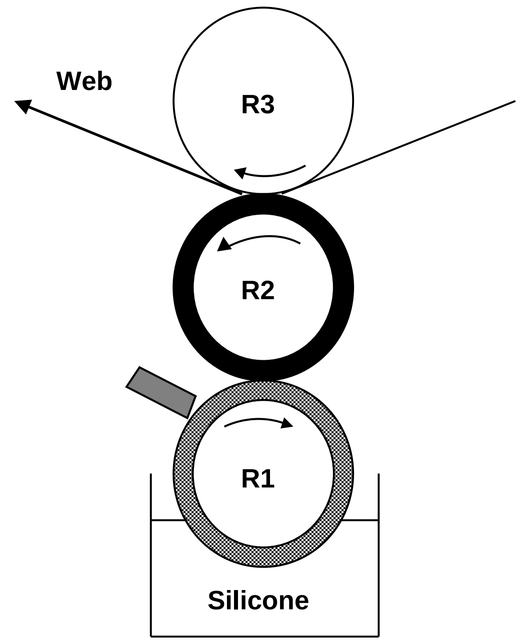
= 100 %

Gravure roller

100 - 200 lpi

max. volume 3.0 – 8.0 g/m²

coat weights 0.2 – 2.0 g/m²



Offset Gravure Coater

Coating – 5-Roll-Coater

Roller speeds

R1 = 1 – 3 m/min. const.

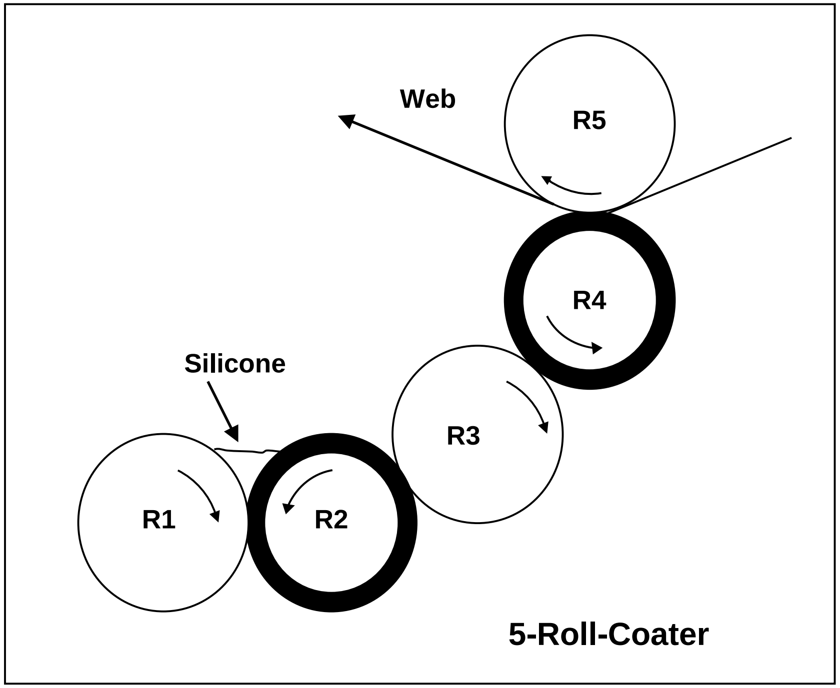
R2 = 10 – 30 %

R3 = 60 – 90 %

R4 = 95 – 105 %

R5 = web speed

= 100 %



EPDM, PU

50 – 70 shore

5 – 15 mm foot print

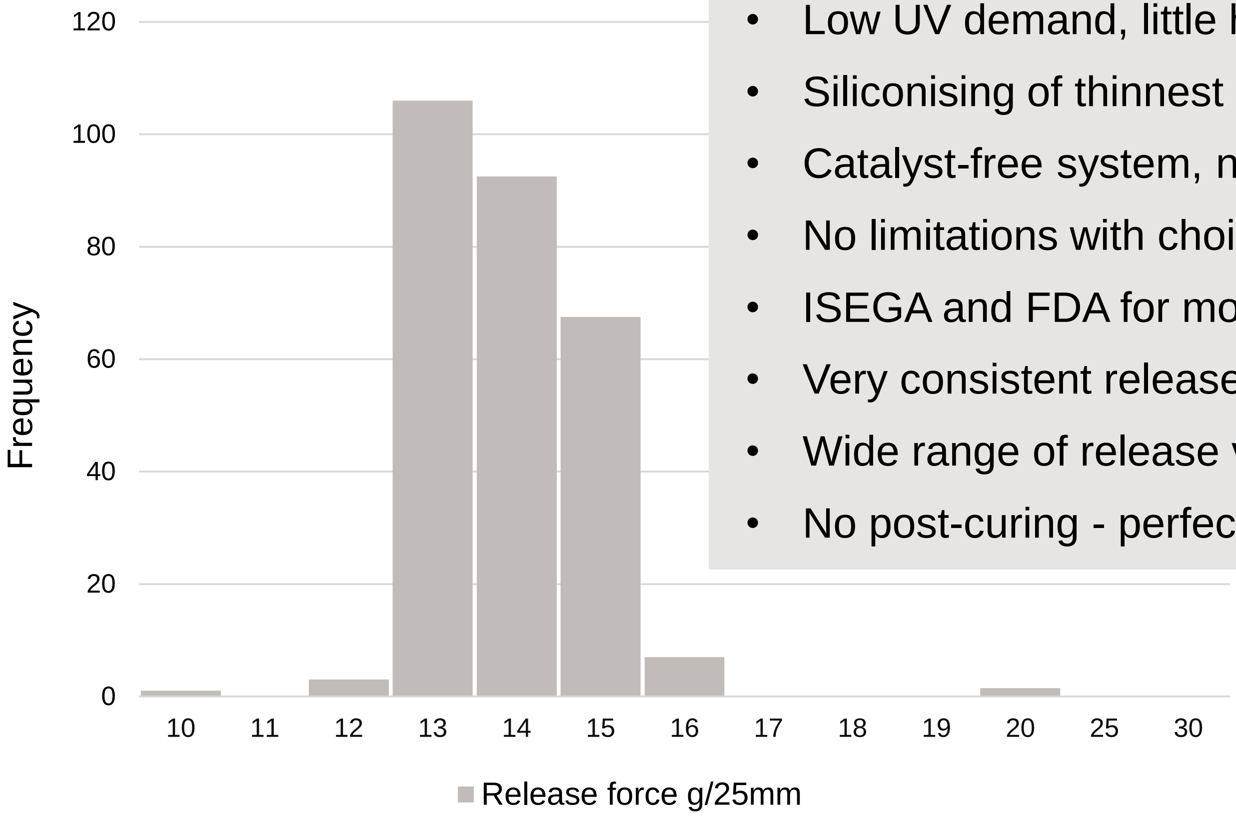
Coating

Typical coat weights for:

• Glassine papers	0.9 – 1.2 g/m^2
• Clay coated papers	1.0 – 1.3 g/m^2
• Alternative papers	1.0 – 2.0 g/m^2
• Smooth films (PET, PP, PE)	0.6 – 1.0 g/m^2
• Embossed films	0.8 – 2.0 g/m^2
• Textiles, non-wovens	1.5 – 8.0 g/m^2

Advantages of free radical UV curing

Start up quality control of RC 902/RC 711/A16 70:30:2



- Low UV demand, little heat from the UV lamp
- Siliconising of thinnest plastic films possible
- Catalyst-free system, no photoinitiator poisoning
- No limitations with choice of substrates
- ISEGA and FDA for most RC Silicones
- Very consistent release values
- Wide range of release values
- No post-curing - perfect for in-line coating

Curing – free radical

- Very fast curing reaction (chemically)
- No post-curing reaction – ideal for inline process
- Good compatibility (curing and anchorage to most substrates)
- Reaction with silicone acrylates is stopped by oxygen

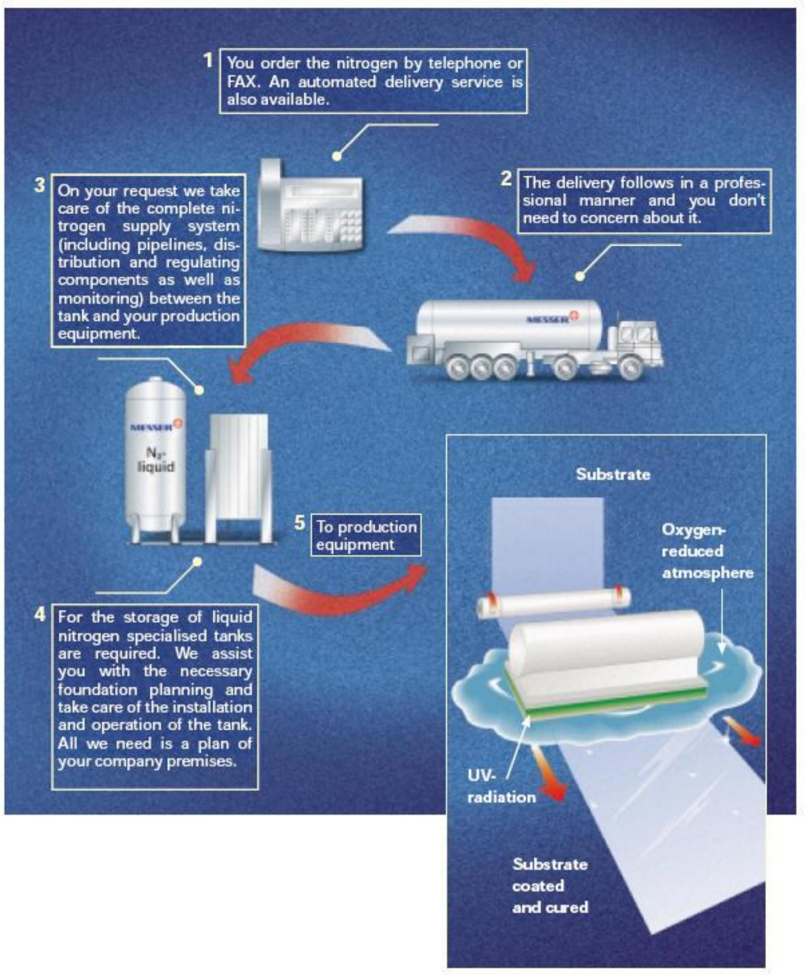
Free radical curing - Inerting

- Silicone acrylates will not cure in air, due to O_2
  - contamination of adhesive
  - loss of adhesion
- Inerting of the curing chamber with N_2
- Residual $[O_2] < 50$ ppm
- Measuring of $[O_2]$ in the chamber with an oxygen analyser
- Nitrogen quality 4.6 or 5.0 (< 10 ppm O_2)

Free radical curing - Inerting

Conversion

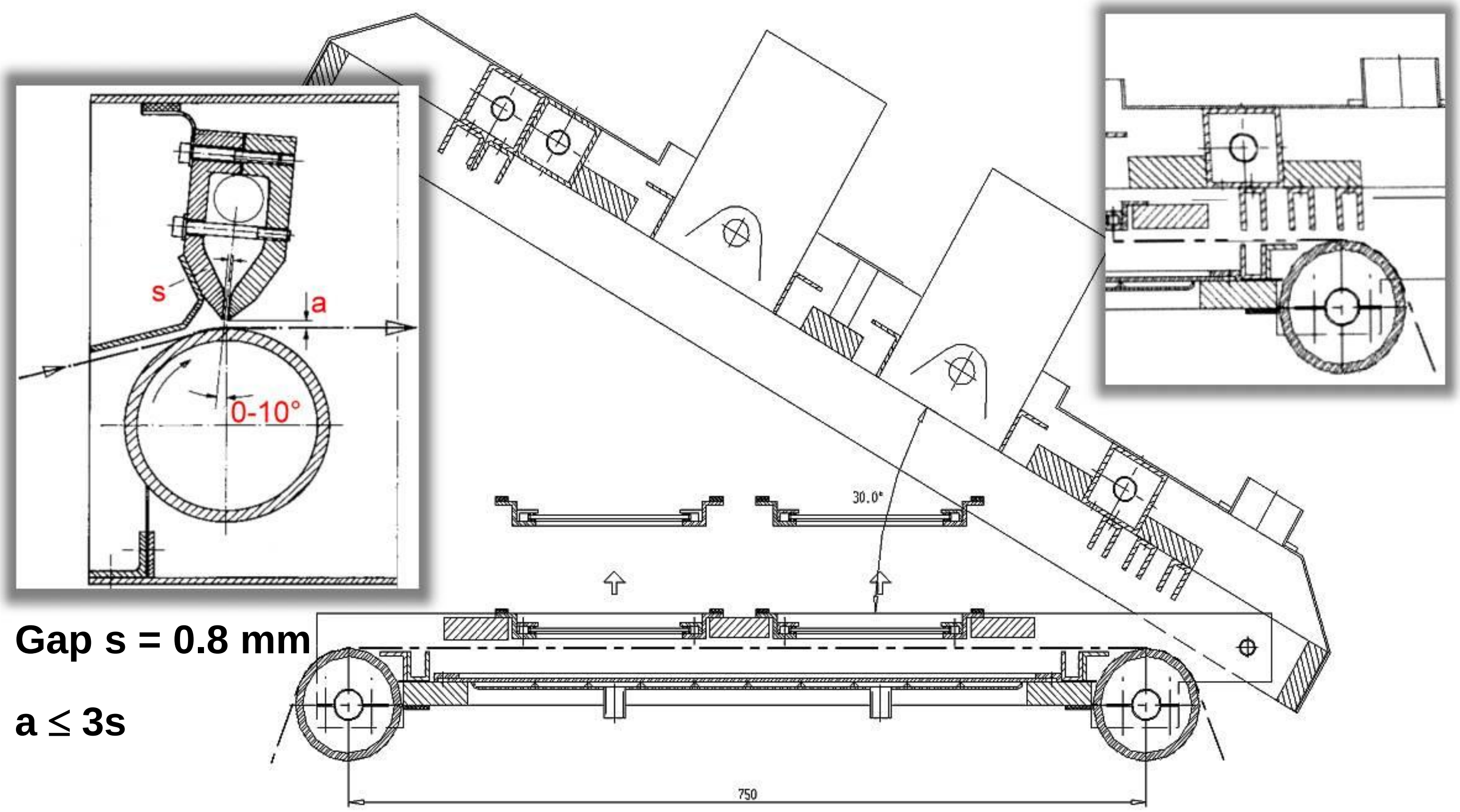
m³ gas @ 15 °C, 1 bar	l (liquid)	kg (liquid)
1	1,447	1.17
0.691	1	0.809
0.855	1.237	1



Free radical curing - Inerting

Laminar flow for the replacement of the boundary layer

Labyrinth



Gap s = 0.8 mm

a ≤ 3s

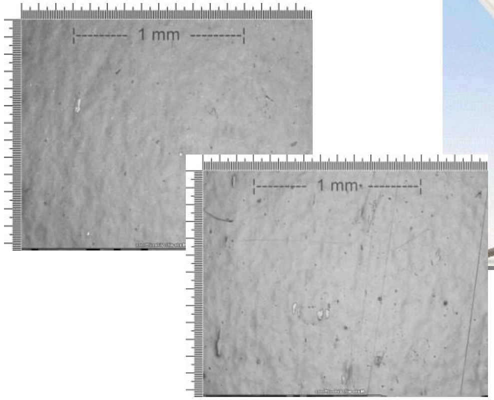
Curing – cationic

- Slower curing reaction (still fast compared to thermal curing silicone
- Reaction does not need nitrogen inerting
- Post-curing reaction for some hours
- Initial cure most important for release properties
- Cure speed depends on poisoning additives in the substrates

Testing

Coating quality

Microscope



Dye stain test

Release testing

Maintenance

Necessary for good curing results

- sufficient UV light (UV bulbs, reflectors, quartz plates)
- good inerting (clean N_2 nozzle, adjustment of nozzle OK, oxygen analyser OK)
- heat management (cooling water, cooling air, air filter)

Maintenance of the UV unit

UV unit check

- Clean quartz plate (from silicone side)
- Check UV dose
- Clean UV bulb and reflectors
- Check air filters
- Ensure proper air and water flow for cooling

Inerting check

- Clean N_2 nozzle
- Check position of N_2 nozzle (if not permanently fixed)
- Calibrate oxygen analyser

Authors

Hardi Döhler

Jürgen Pomorin

Evonik Nutrition & Care GmbH

Goldschmidstraße 100

45147 Essen/Germany

EVONIK

POWER TO CREATE