

Requirements for silicone materials used in household appliances and medical devices

HCR Excellence 2024 – Wacker Burghausen

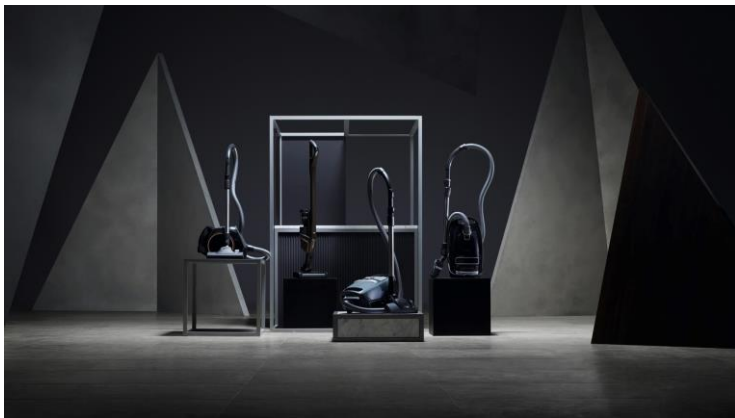
April 2024 – Dr. Viola Buchholz

Tradition & Innovation – for 125 years

- Company founded in 1899 by Carl Miele and Reinhard Zinkann
- Family-owned company with more than 80 family shareholders
- Six Executive Directors, including two founders' great-grandsons
- Consistent positioning in the premium segment
- Considered as the quality and innovation leader in its branch of industry



Focus on innovative solutions for household, commercial and medical technology



Strong base: 8 out of 15 production plants in Germany



Where and why does Miele use silicone?

Applications for liquid silicone rubber

Cup rack of dishwasher

- chemical resistant
- hygienic
- colour resistant



Sealing of cooking chamber of steam oven

- resistant against high temperature and steam
- chemical resistant
- food contact material



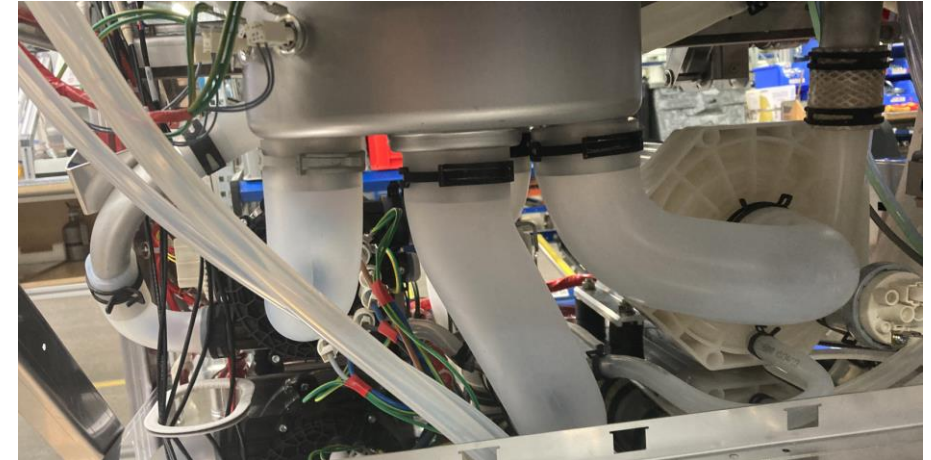
Where and why does Miele use silicone?

Applications for solid silicone rubber



Door gasket (wash dryer)

- chemical resistant
- temperature resistant
- highly flexible



Hoses for medical technology (e.g. disinfectors)

- highly chemical resistant
- mechanical stable
- extruded and moulded parts
- partially fabric-reinforced

Miele Laboratory Rubber & Plastics

Shared Service for all Business Units



Longtime chemical resistance test – automated media storage

manual setup



automated setup

Resistance against media

- large diversity of detergents, pH values from 1 to 14
 - cleaning agents
 - rinse aids (dishwashing)
 - fabric softener (laundry)
 - disinfectants (medical)
- Testing in dilute concentration for application and in concentrates for dosing equipment
- hot air up to 280°C (e.g. ovens)

Test duration: minimum 3000h up to 8000h

Elastomeric materials in medical applications

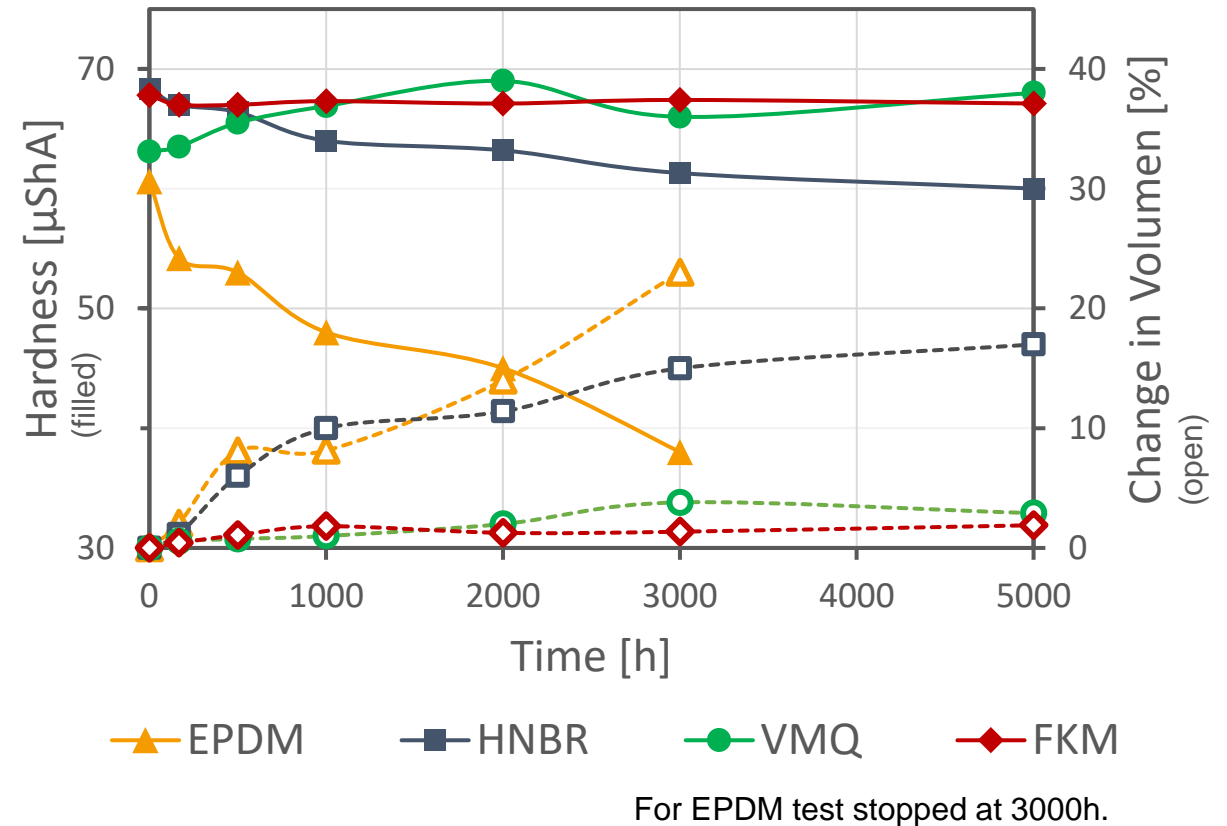
OLYMPUS

- Cooperation between Olympus and Miele since 1988
- fully automatic washer-disinfector for flexible medical endoscopes
- Standard-compliant cleaning to meet the stringent regulatory requirements of the medical device industry
- reprocessing chemicals for cleaning and disinfecting
- peracetic acid chemistry and enzyme-based cleaner
- low temperature process

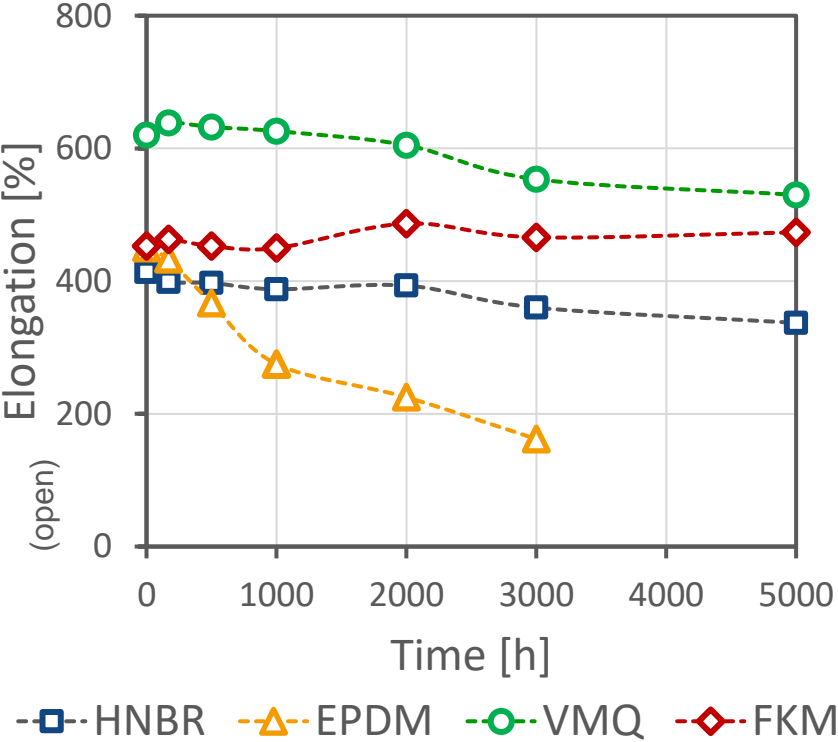
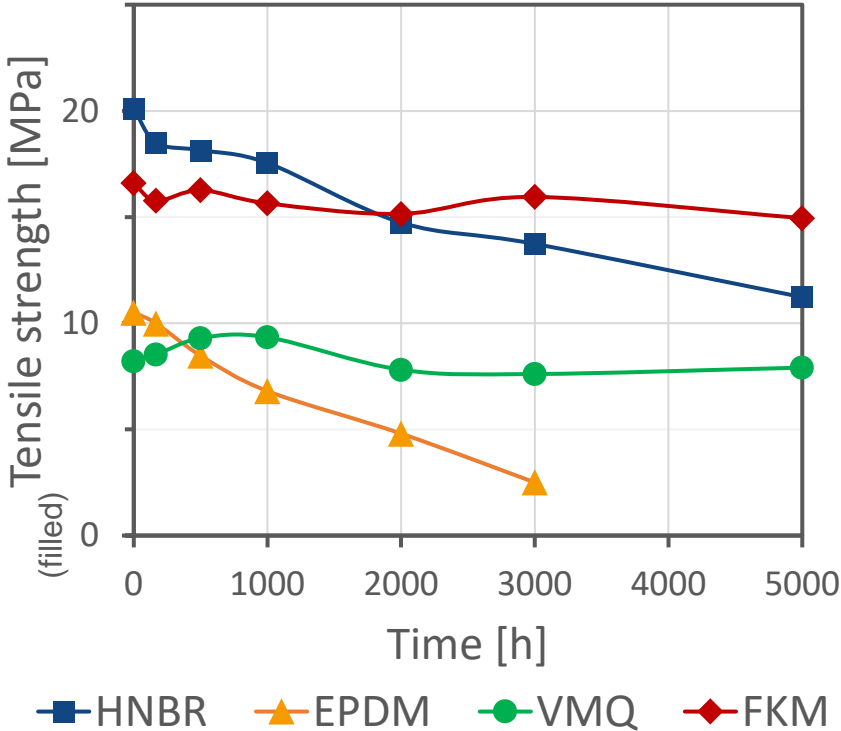


Chemical resistance test for medical application

- Disinfectant based on peracetic acid
- Mixture of hydrogen peroxide, acetic acid and sodium hydroxide
- Temperature 40°C
- Automated resistance test with continuous media change: complete exchange every 4 hours
- Analyzed ageing time: 5000h



Chemical resistance test for medical application



Evaluation criteria:
Changes in properties,
also absolute values

- EPDM is not suitable
- FKM shows very good resistance
- VMQ and HNBR acceptable changes

Special test with component-related specifications

Combination of long-time chemical aging and mechanical stress

Application example

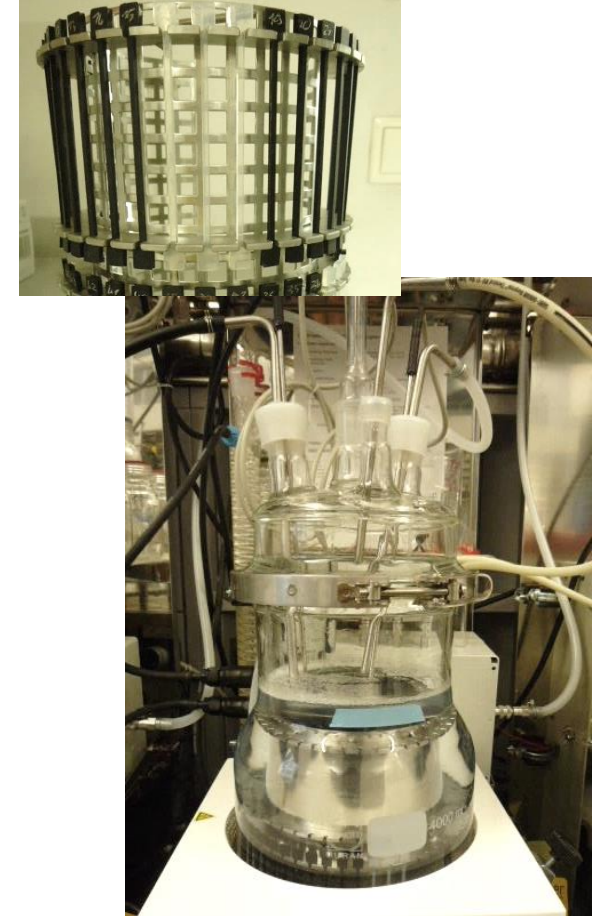
- Connecting tube for the upper basket in the dishwasher
- Highly flexibel, chemical resistant

Resistance against dishwashing agents

Tensile load for connecting tube: 30% (calculated by simulation)

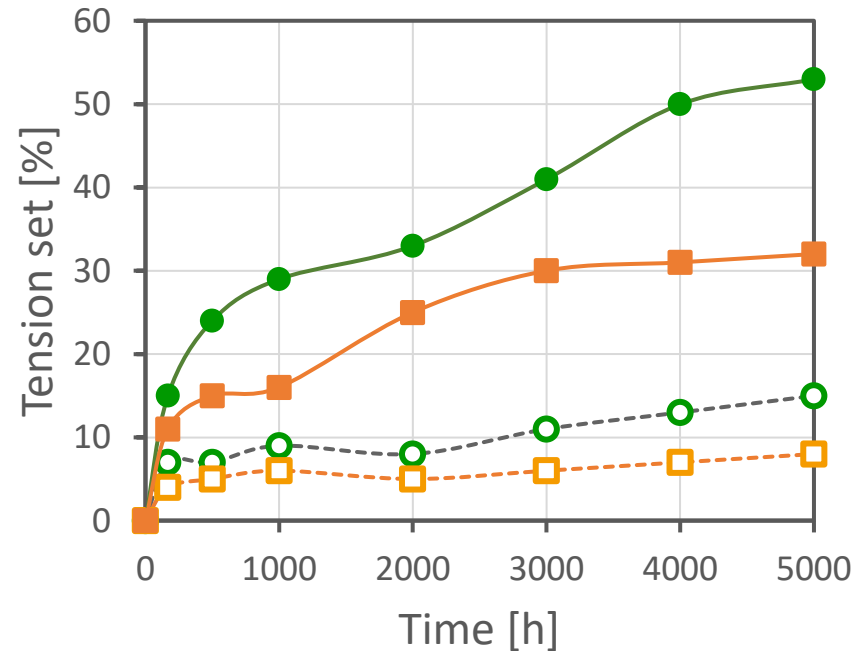
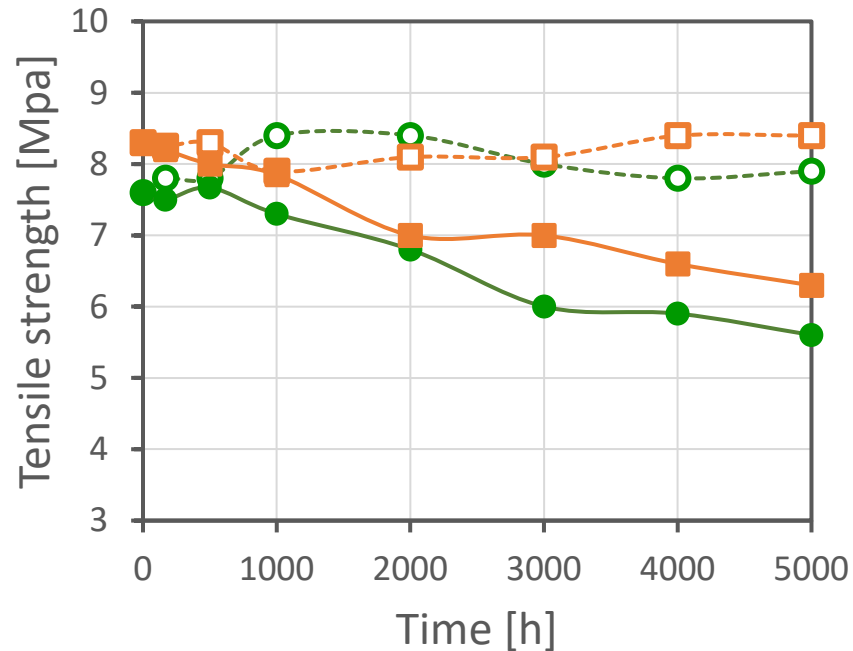
Tension set:

permanent elongation in relation to the absolute elongation



Special test with component-related specifications

Direct comparison of two silicone types (HCR)



-○- VMQ_1 in hot air -□- VMQ_2 in hot air
 -●- VMQ_1 in media -■- VMQ_2 in media

Conditions:

Media: 4 days at 80°C, Somat powder 5g/L; 3 days at 60°C, Somat rinse aid 1ml/L

Hot air: constant at 80°C

Tensile strength measured on tension set samples

Tension set (procedure A): samples relaxed immediately after removal from oven, 30 min relaxation

- No relevant differences in tensile strength
- Smaller differences in tension set in hot air
- Significant differences in media

Outlook on actual topics and projects



Qualification process for defining standard materials

Long list of requirements, intensive test scenario, especially in media

Hardly feasible externally

Cost and time-intensive

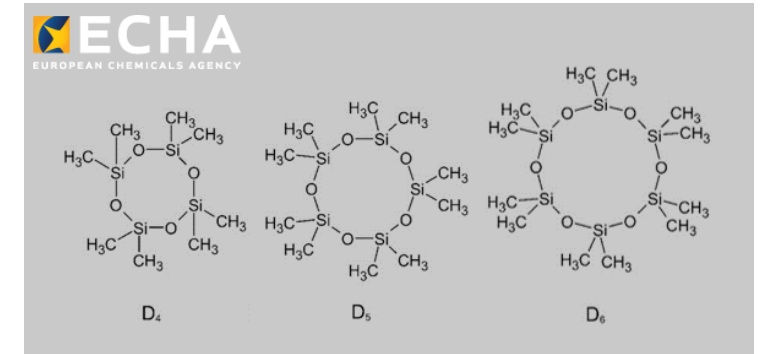


Cooking appliances: oven and steam cooker

Suitable stabilizers for high temperature

Food contact material

Stable against steam



ECHA: REACH classification of siloxanes

Analysis and identification of affected materials

Waiting on the legal requirements

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