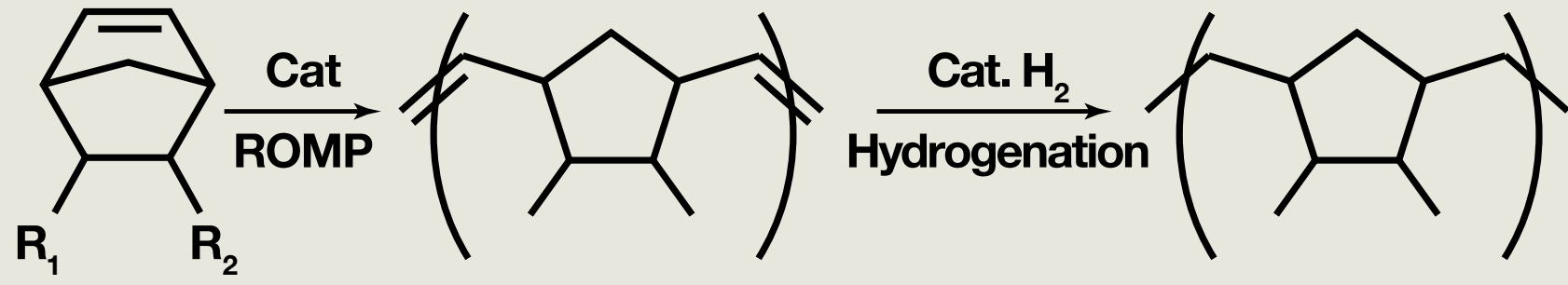


1. What is Cyclo Olefin Polymer?

Cyclo Olefin Polymers (ZEONEX[®], ZEONOR[®]) were commercialized in 1990 and have found increasing use in pharmaceutical syringes and vials due to their unique benefits vs. glass and other plastics.



Product Grade	Water Absorption (%)	Light Transmittance (%)	Glass Transition Temp (°C)	Elongation at Break (%)
ZEONOR [®] 1020R	<0.01	92	102	90
ZEONEX [®] 690R	<0.01	92	136	20
ZEONEX [®] 790R	<0.01	92	163	10
NEW GRADE ZEONEX[®] 5000	<0.01	92	69	120

Passes US/EU/Japan Pharmacopoeia, ISO 10993, DMF listed

2. Benefits of ZEONEX[®] for Pre-Filled Syringe

Syringes made of ZEONEX[®] offer:

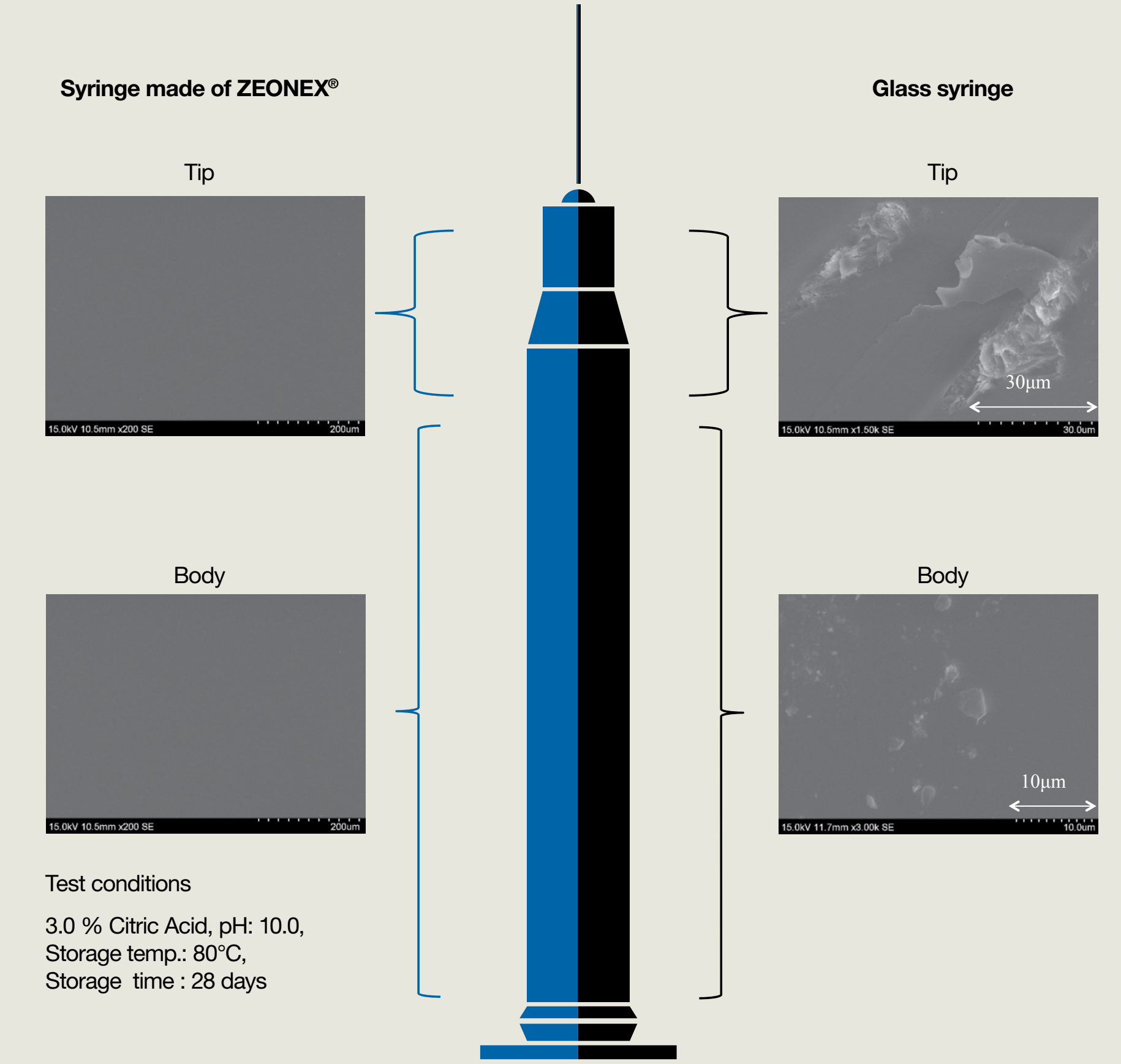
- High transparency
Easy to inspect the drug
- High break resistance
Improved drop tolerance
- Sterilization
Gamma, EB, Steam
- No delamination
No flakes or particles
- Drug compatibility
Acids, alkalis and alcohols
- Low impurities
Very low residual metals
- Low adsorption
Retain drug activity
- High moisture barrier
Long-term drug storage
- Adhesive free
No contamination
- Silicone oil free
No aggregation

Typical devices where ZEONEX[®] is used:

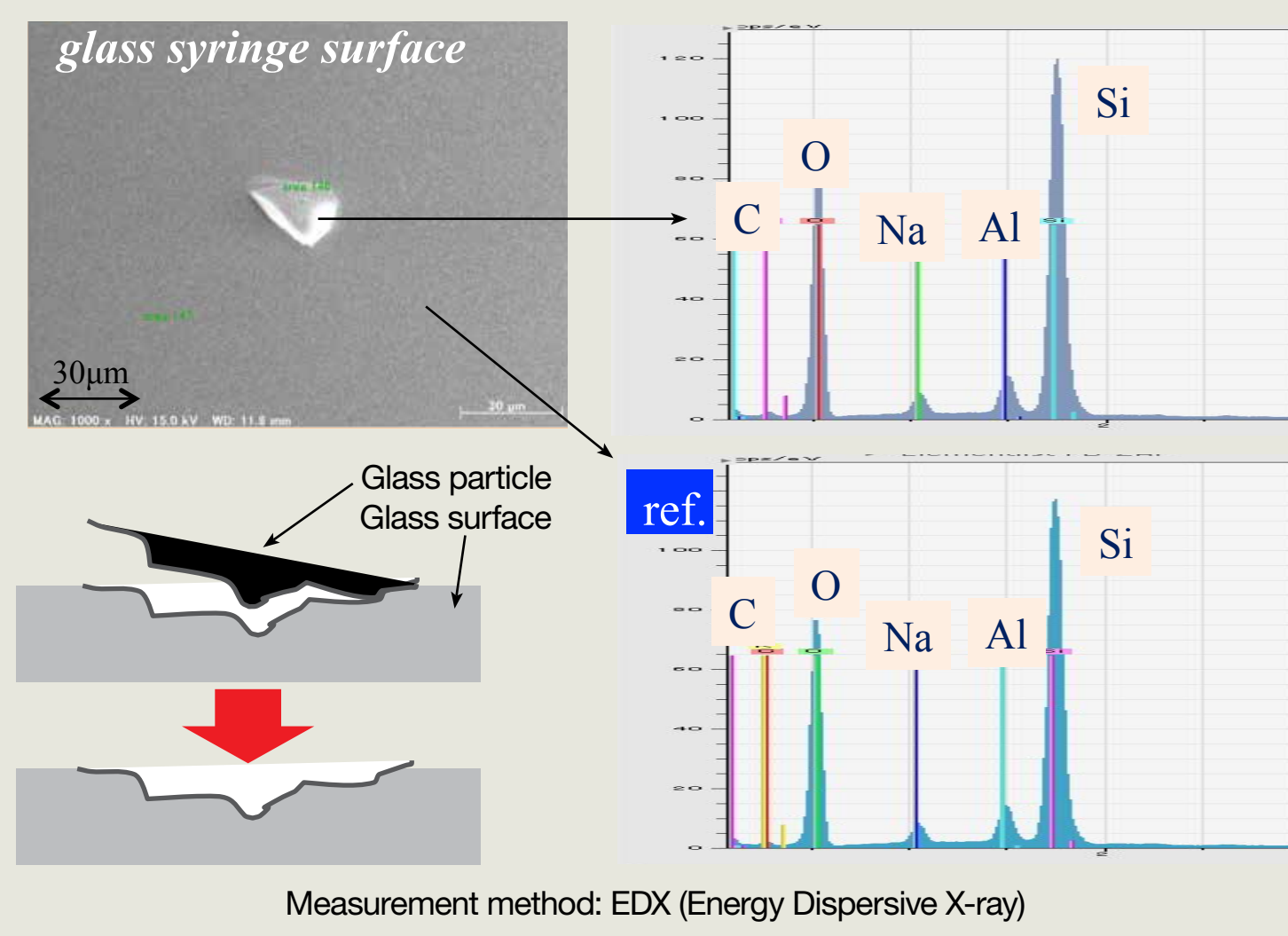
- Pre-filled syringes
- Pre-filled cartridges
- Vials and bottles for long-term storage of biologics
- IV and Total Parenteral Nutrition (TPN) bags
- Bio-reactors
- High-pressure injection syringes (Needle-free, viscous drug, and large dosage injection)

3. No Delamination – No Flakes or Particles

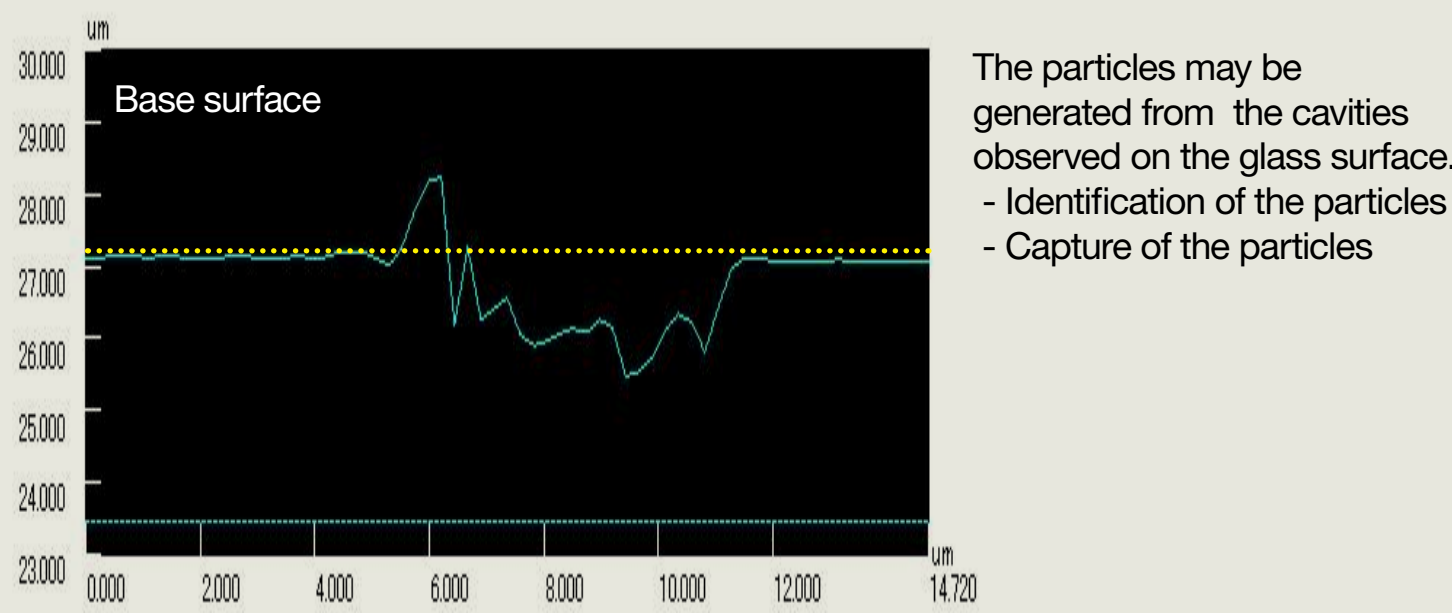
- Delamination most commonly occurs at the tip of glass syringes where process heat history exposure is the highest.
- Particles are observed with glass syringes.
- No particles are observed in ZEONEX[®] syringes.



4. Identification of Particles



Glass surface profile after testing



5. Safe Material

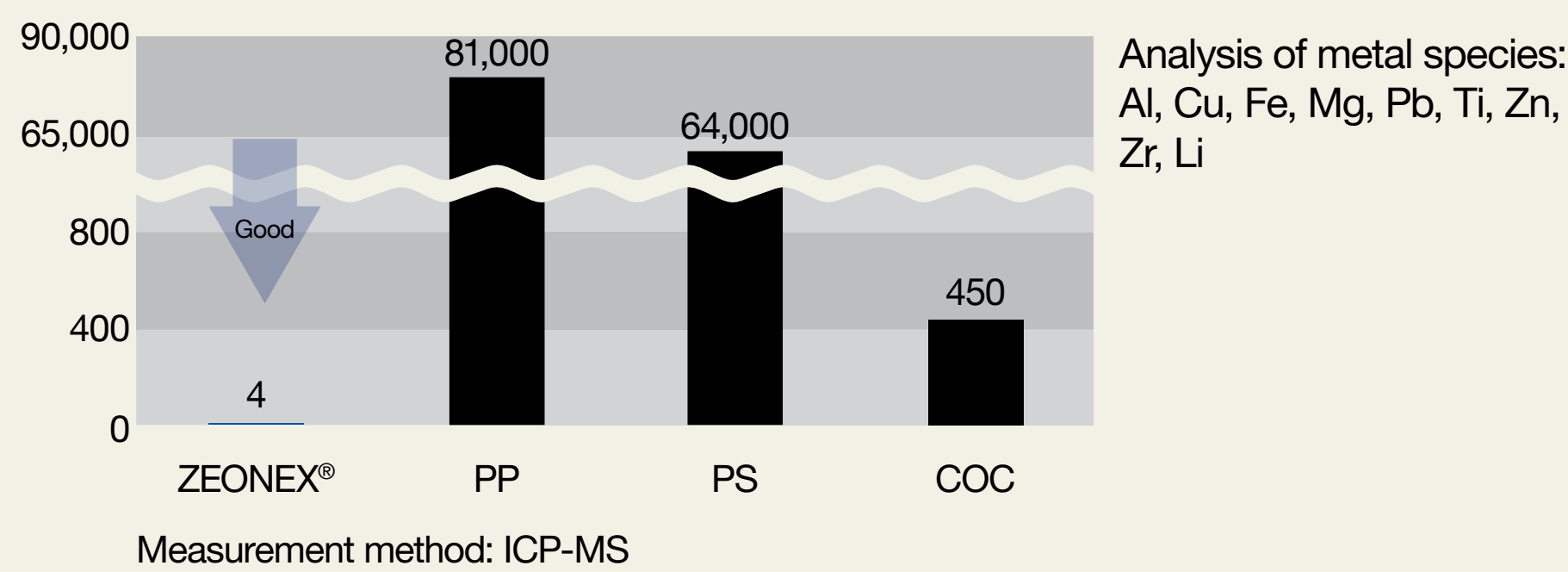
- High purity
- Residual metals less than 0.02 ppm
- Contains no lubricants/process aids
- Low outgas

Residual metals of ZEONEX[®] 690R

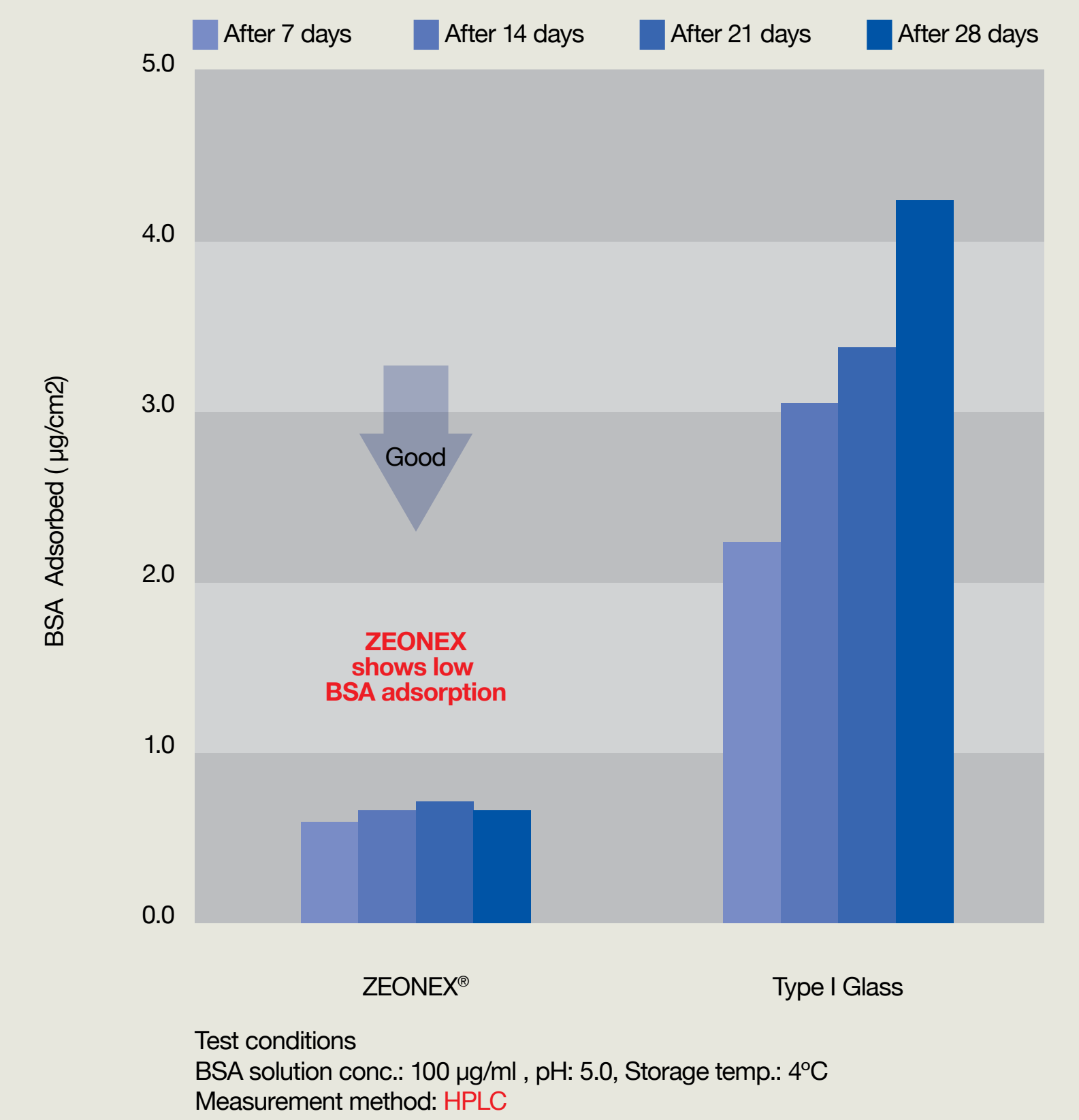
Al	V	Zr	Mg	Ti	Pd
<0.02	<0.02	<0.02	<0.02	<0.02	<0.02
Cr	W	Fe	Ni	Zn	Cd
<0.02	<0.02	<0.02	<0.02	<0.02	<0.02

Unit: PPM Measures by ICP-MS analysis

Very low residual metals (vs. other plastics)

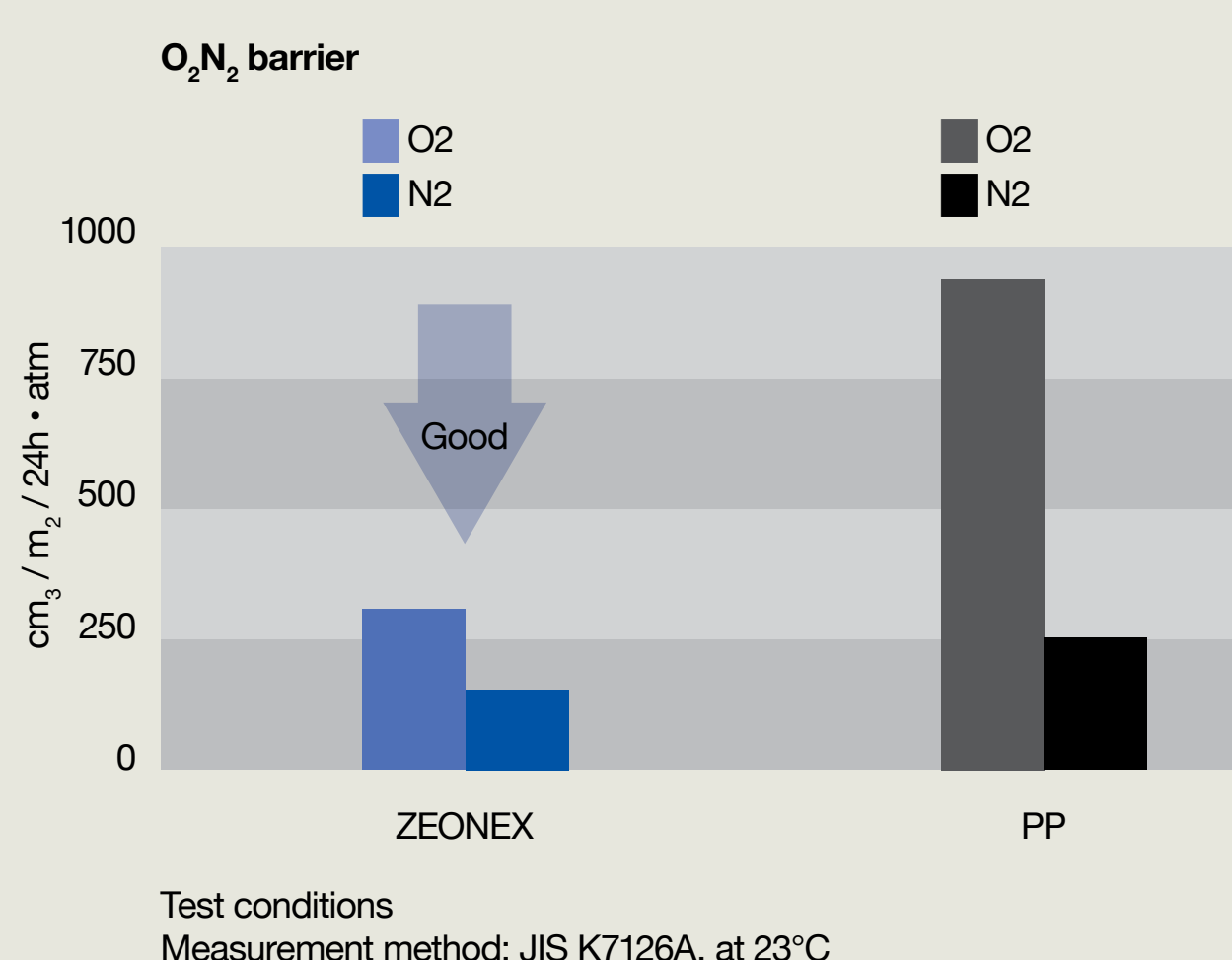
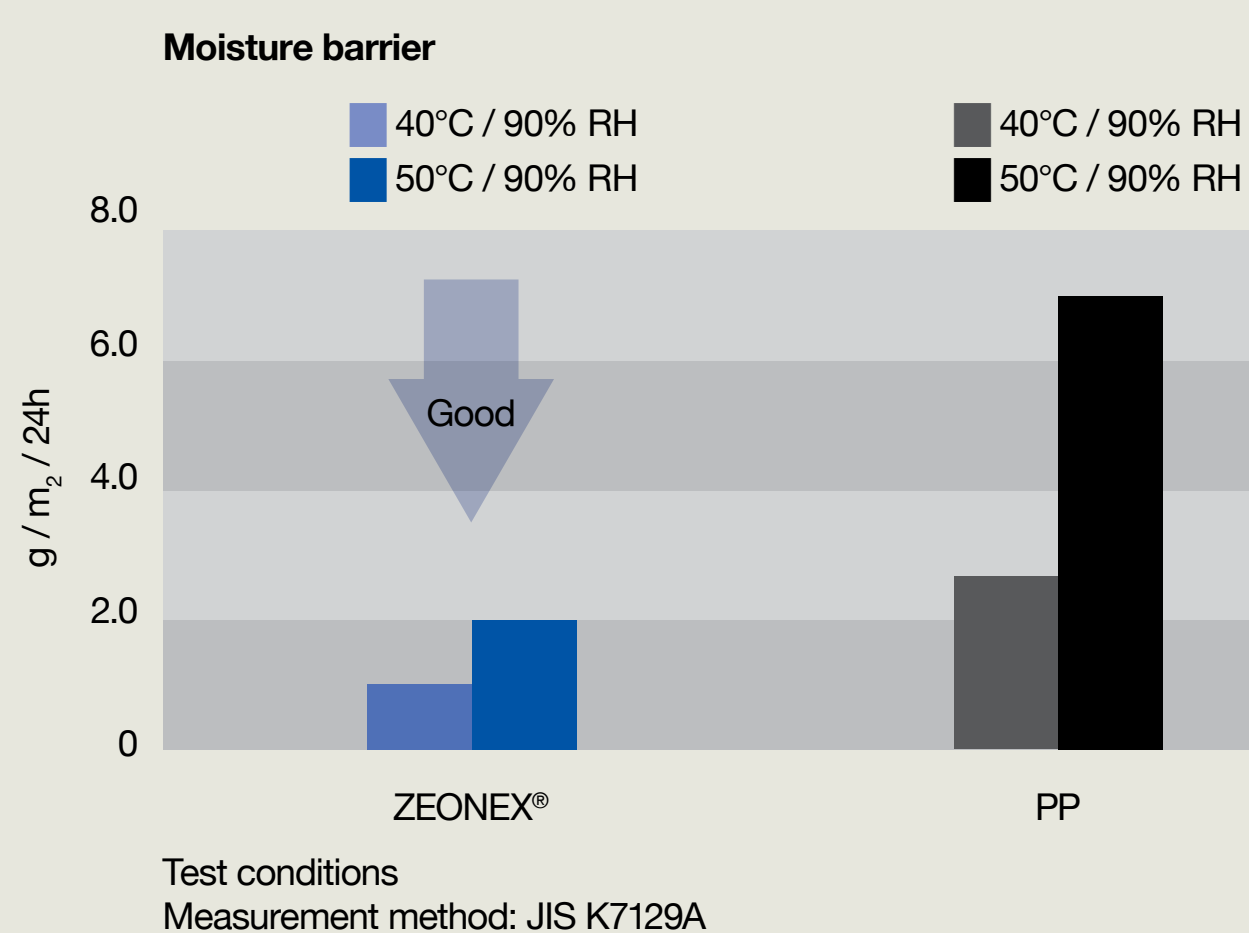


6. Low Adsorption



7. Low Moisture Pass - Thru

- Excellent moisture barrier → prolonged drug shelf life
- 3x better gas barrier vs. polypropylene (PP)



8. Sterilize with Gamma, EB, or Steam

ZEONEX[®] is minimally influenced by exposure to standard sterilization methods.

ZEONEX [®] Properties	Unit	Initial	Sterilization *2			
			Steam	EOG	Gamma	
					25kGy	20kGy
Light Transmittance *1	%	91	91	91	87	88
Yellow Index (ΔYI) *1	-	0.3	0.8	0.3	4.1	5.8
HAZE *1	-	0.1	0.6	0.2	0.1	0.2
Tensile Strength	MPa	68	74	68	67	67

*1 Test piece: injection-molded plate (3 mm in thickness)

*2 Sterilization conditions

Steam: 121°C, 20 min. EOG: 50°C, 6 hours, EOG conc. 600 mg/l

Color shift occurs after irradiation sterilization but quickly recovers

