

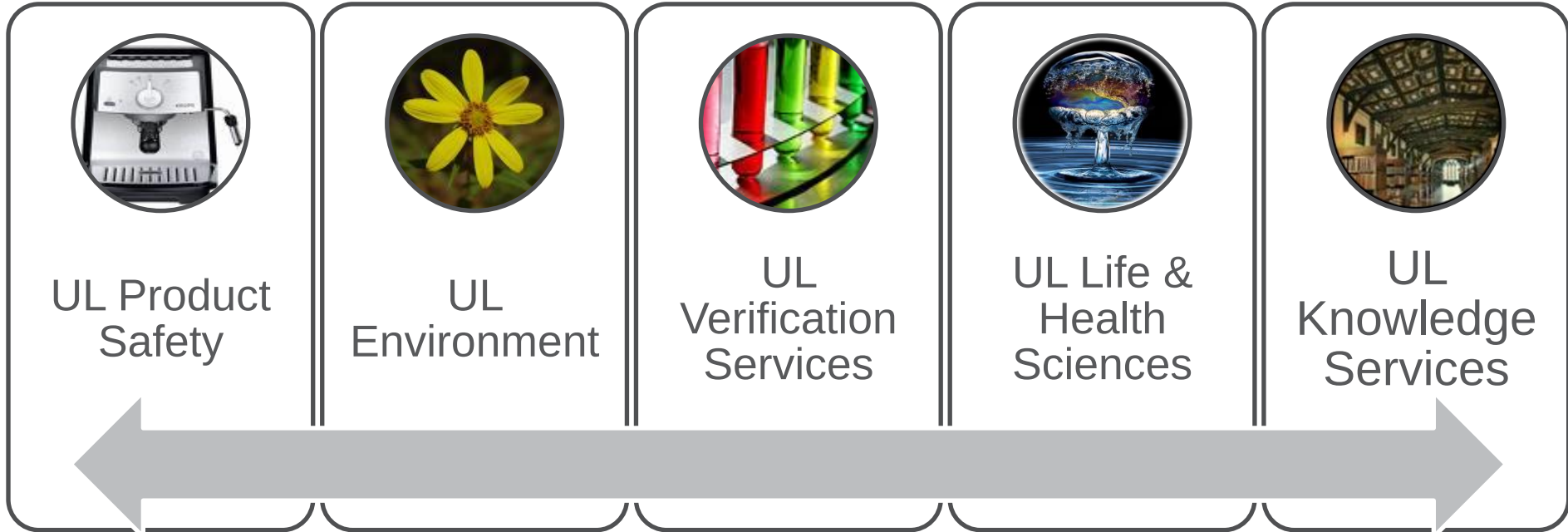
Biopolymere in der Spritzgussverarbeitung

Verarbeitungstechnische Kennwerte für Biokunststoff

Dr. Bahman Sarabi
UL International TTC GmbH



UL family of companies today



Industry Sectors

Appliances	High Tech	Lighting	Energy & Industrial Systems	Chemicals
Wire & Cable	Medical	Building Materials	Life Safety & Security	Food & Water



UL – a Global Company

Key Data	Leading safety brand	Worldwide presence
~ 10,000 employees	23 billion UL Marks on products	67,000 customers in 103 countries
\$1.4 Billion USD	88,000 products tested annually	73 labs and certification facilities across the world

North America

- **United States**
 - Northbrook
 - Camas
 - Melville
 - Research TP
 - Santa Clara
- **Canada**

Latin America

- Argentina
- Brazil
- Mexico

Europe

- Germany
- France
- Denmark
- Italy
- Netherlands
- Poland
- Spain
- Sweden
- Switzerland
- United Kingdom

Asia

- Hong Kong
- China
- India
- Japan
- Malaysia
- New Zealand
- Singapore
- South Korea
- Taiwan
- UAE
- Vietnam



Recent Global Acquisitions & Investments

2012: Wiklund Research & Design, USA

2012: IDES, USA

2012: Witham Labs, Australia

2012: Collis, Netherlands

2012: DEWI, Germany

2012: EduNeering, USA

2012: LED Performance Testing, Italy

2012: eco-INSTITUT, Germany

2012: Magnus Textiles Services, Bangladesh

2011: Softlines Testing - STR

2011: New Lab and Office, Denmark

2011: New Lab and Office, Germany

2011: Medical Device Testing, Germany

2010: Wireless – RFI, UK

2010: Europe's largest PV lab, Germany

2009: Materials Testing – TTC, Germany

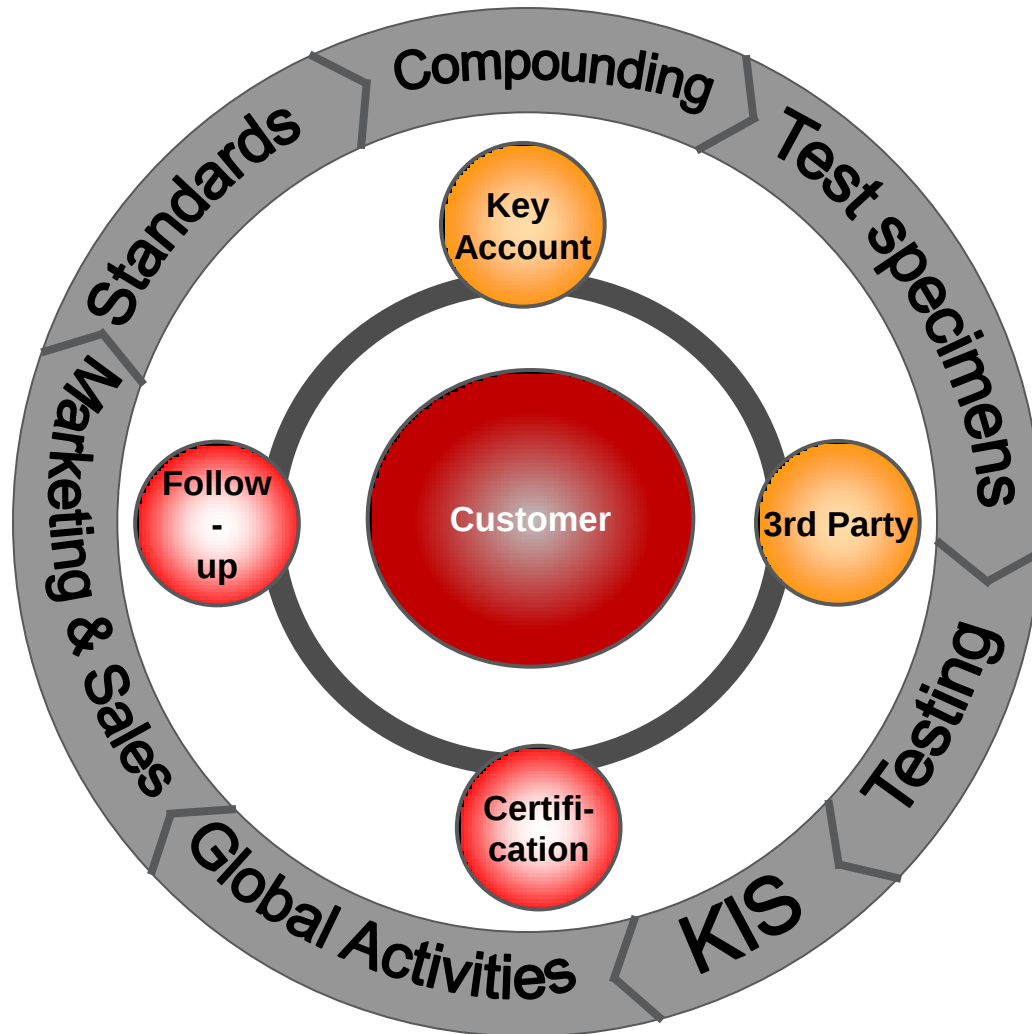


Global expansion

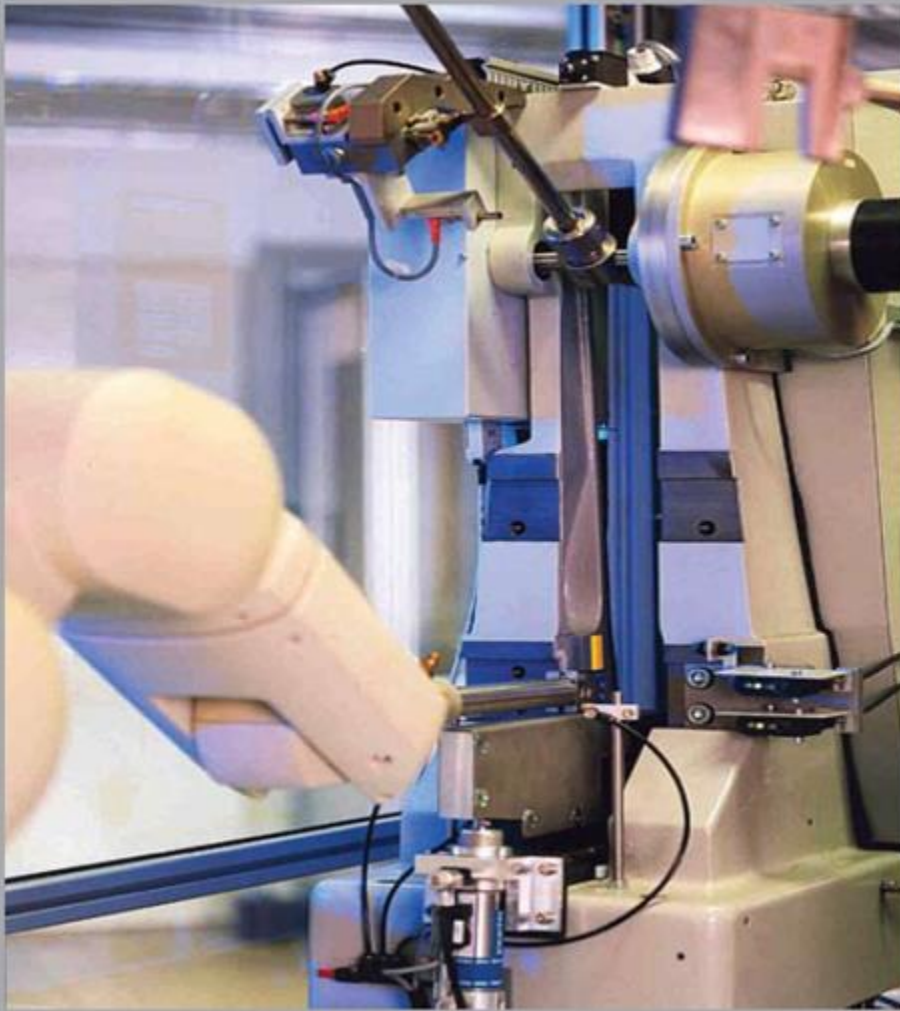


CHEMPARK 
Europas Chemiepark
Krefeld-Uerdingen

ULTTC One Stop Service for Operation and Commercial



UL TTC in Figures



- 40 automated systems to raise capacity
- 60 years of testing experience
- 100 different test specimen molds
- 180% productivity increase in 6 years
- 200 different plastics tests
- 24/7 non-stop testing and results access
- 5000 square meter facility
- 17025 accreditation (DIN EN ISO IEC 17025)



CORE-Technologies of ULTTC for Bioplastics

Processing Properties

- Plastification
- Cycle Time
- Demolding
- Size Stability
- Processing Window

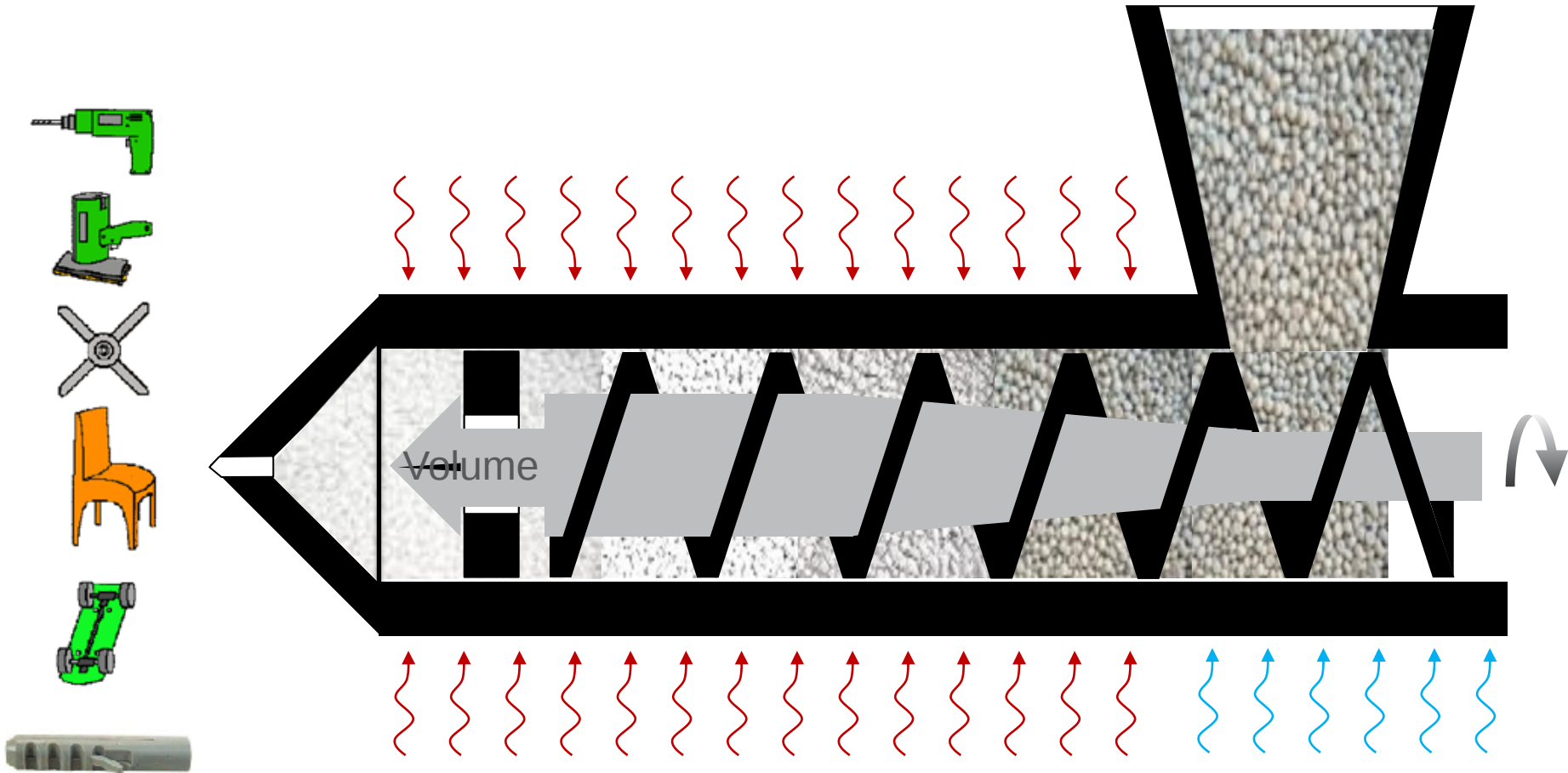
Design Properties

- Crash Properties
- Influence of Temperature
- Long Term Loading
- Weathering

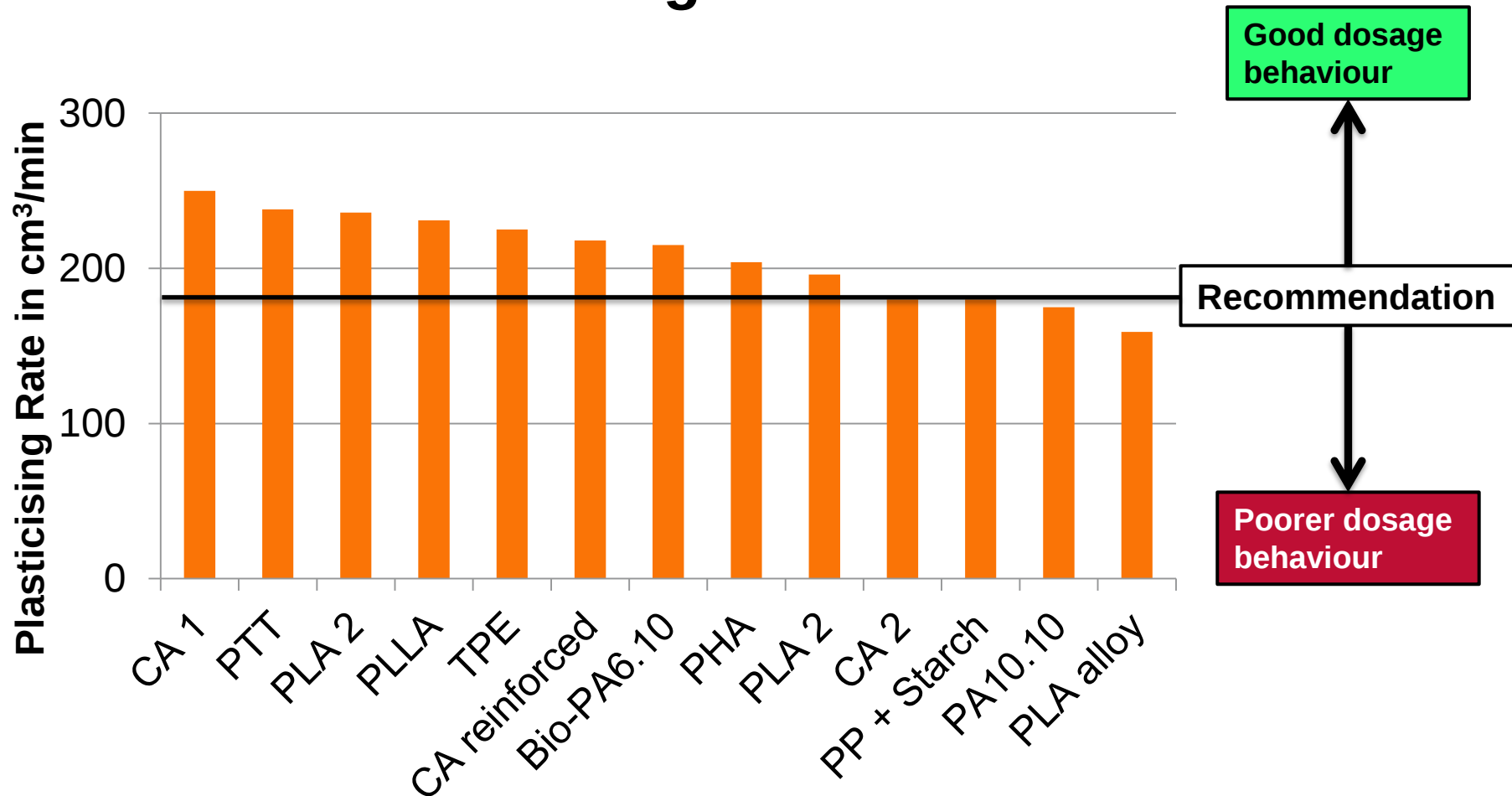
Materials

Chemical Names	
PLA (1)	Poly lactide (injection molding grade)
PLA (2)	Poly lactide (extrusion grade)
PLA/PHB	Poly lactide / Polyhydroxyalcanoate
(PLA+PHB)-M	Poly lactide/Polyhydroxyalcanoate+Mineral
PA6.10	Polyamide 6.10
PA10.10	Polyamide 10.10
CA-blend (1)	Blend of Cellulose Acetate
CA-blend (2)	
CA	Cellulose Acetate
PP+Starch	Polypropylene + Starch
TPE	Thermoplastic Elastomers
PTT	Polytrimethylenterephthalate

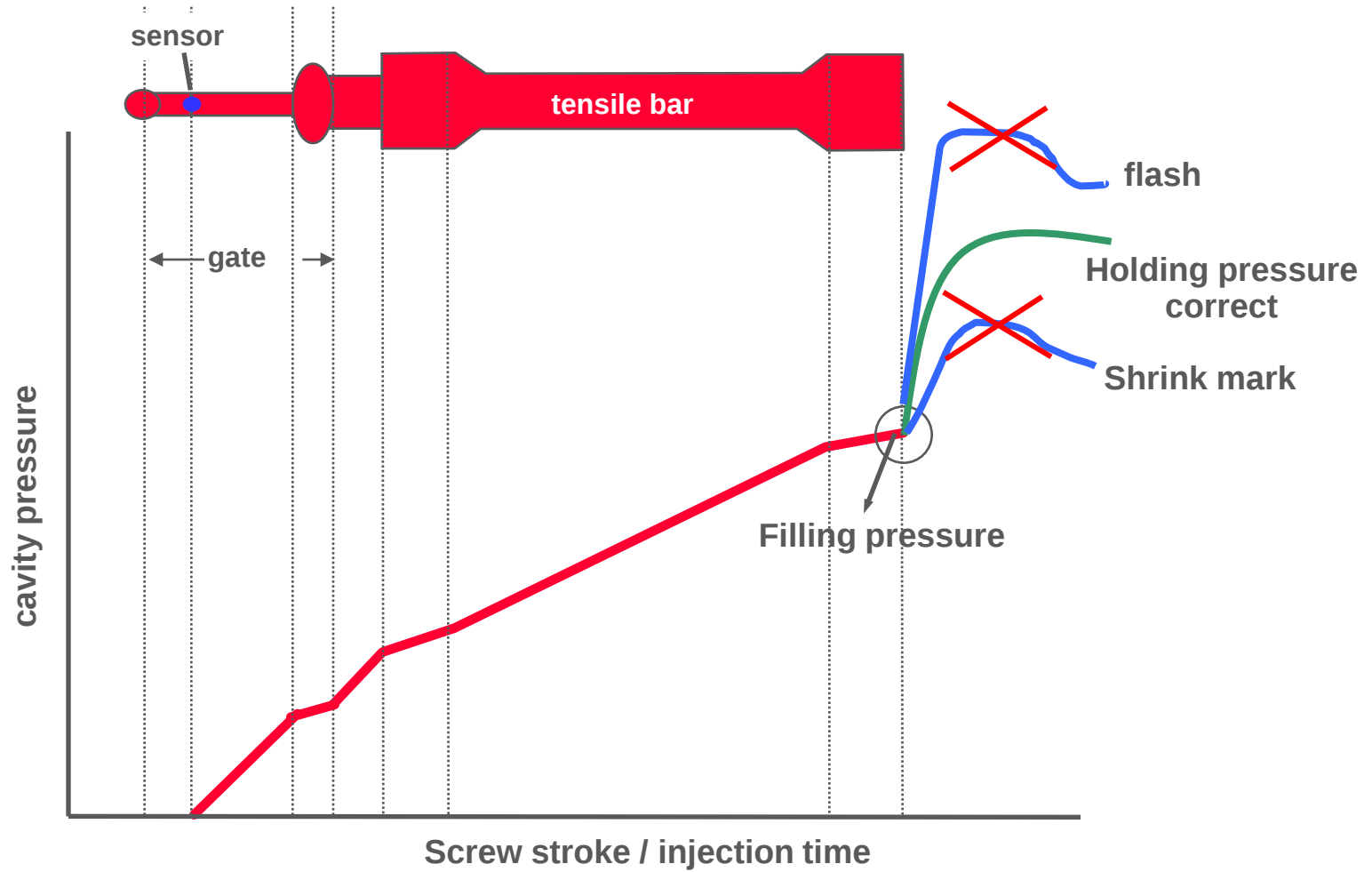
Indicator for Plasticizing



Dosage behaviour at Standard Injection Molding Machines



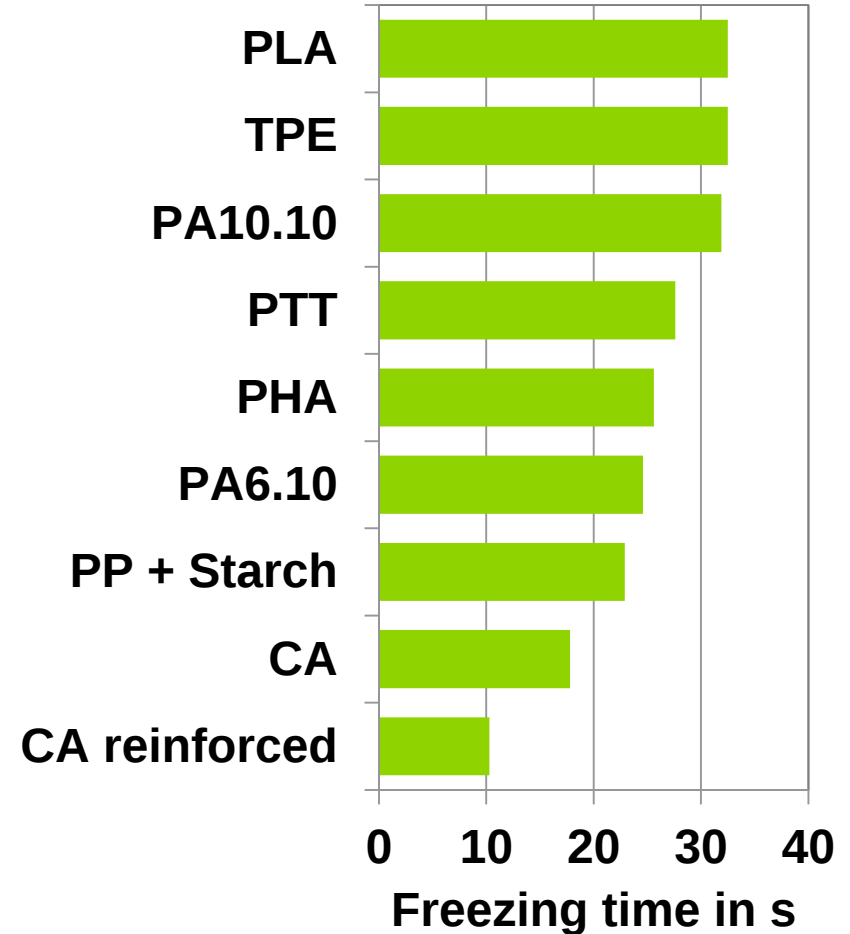
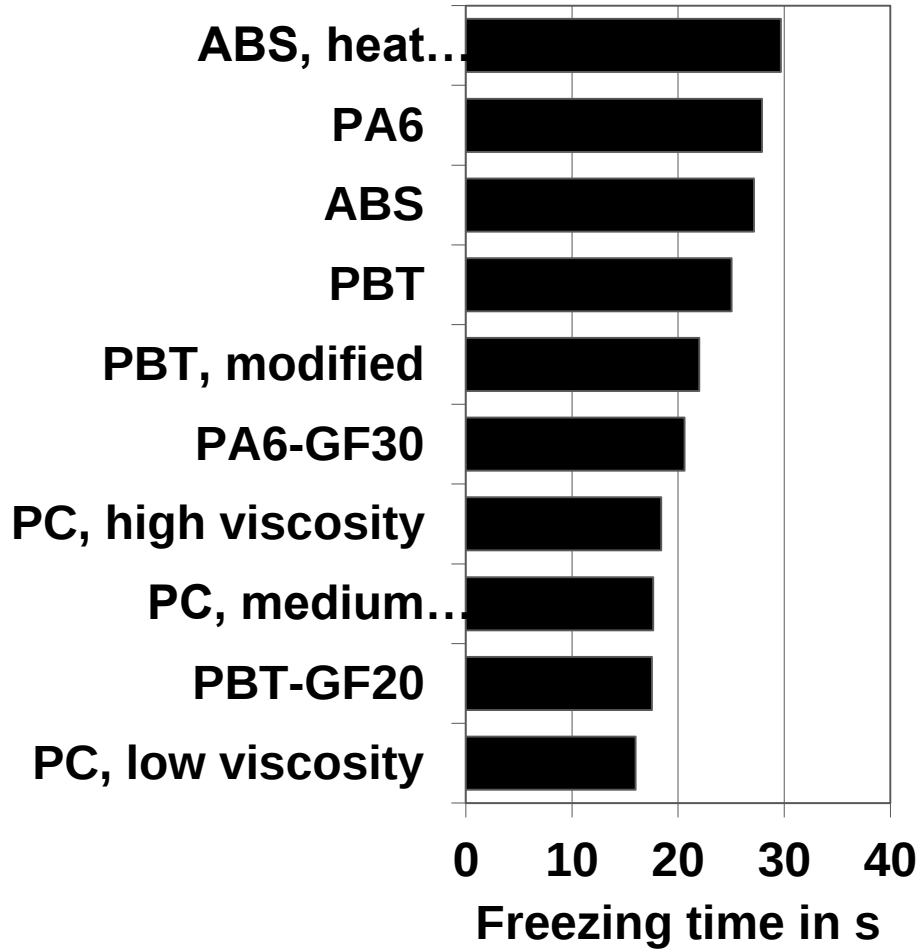
Mold control system for measurement of freezing time



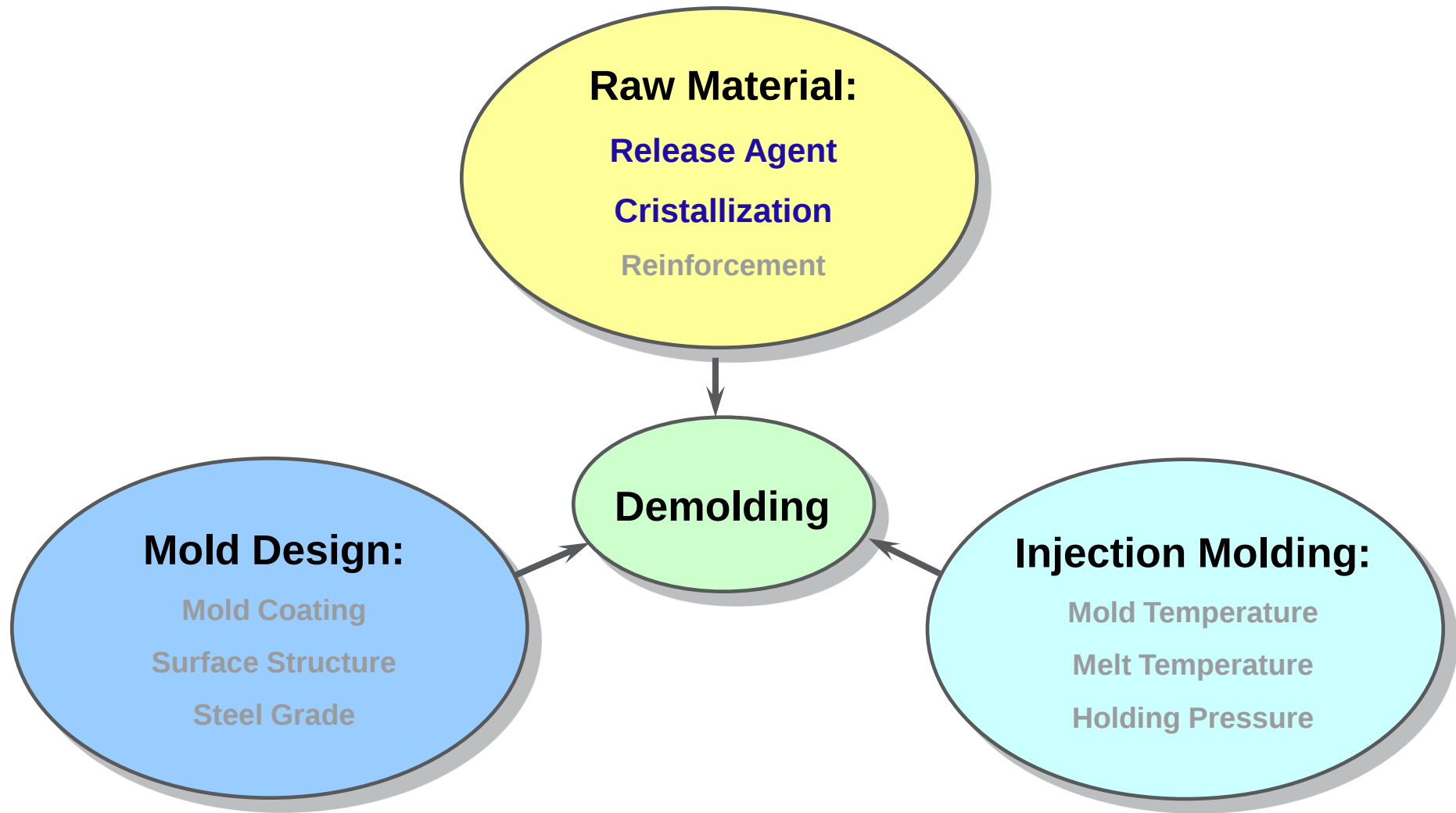
Freezing Time

fossil

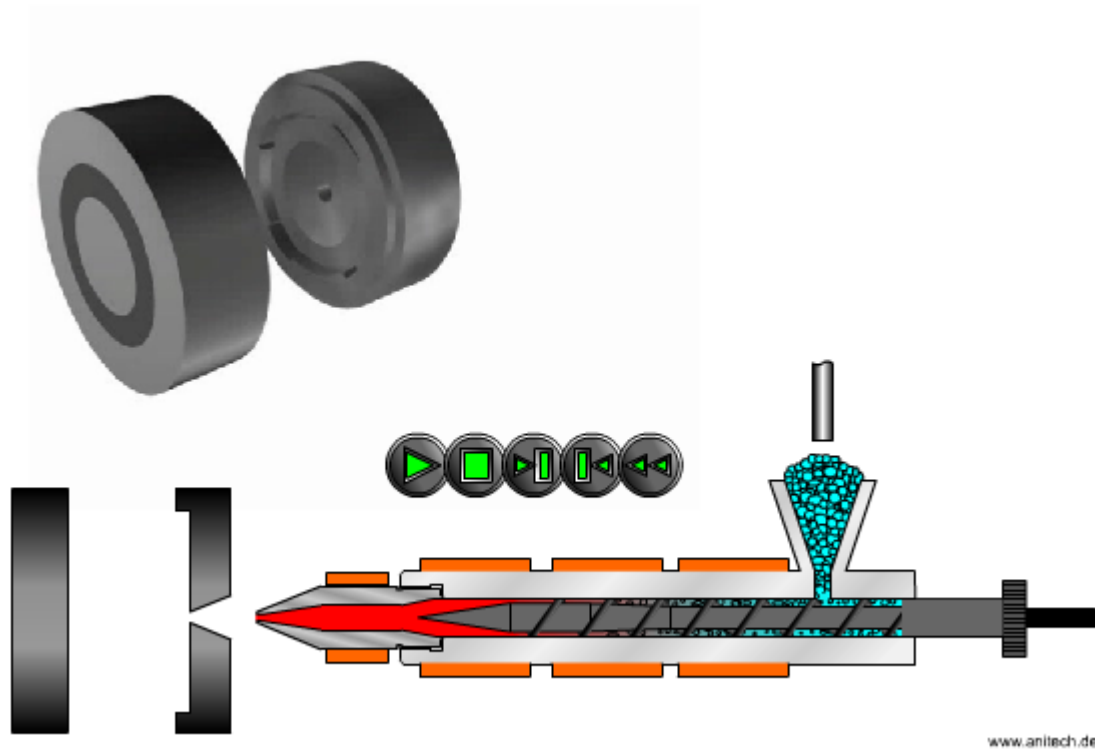
biobased



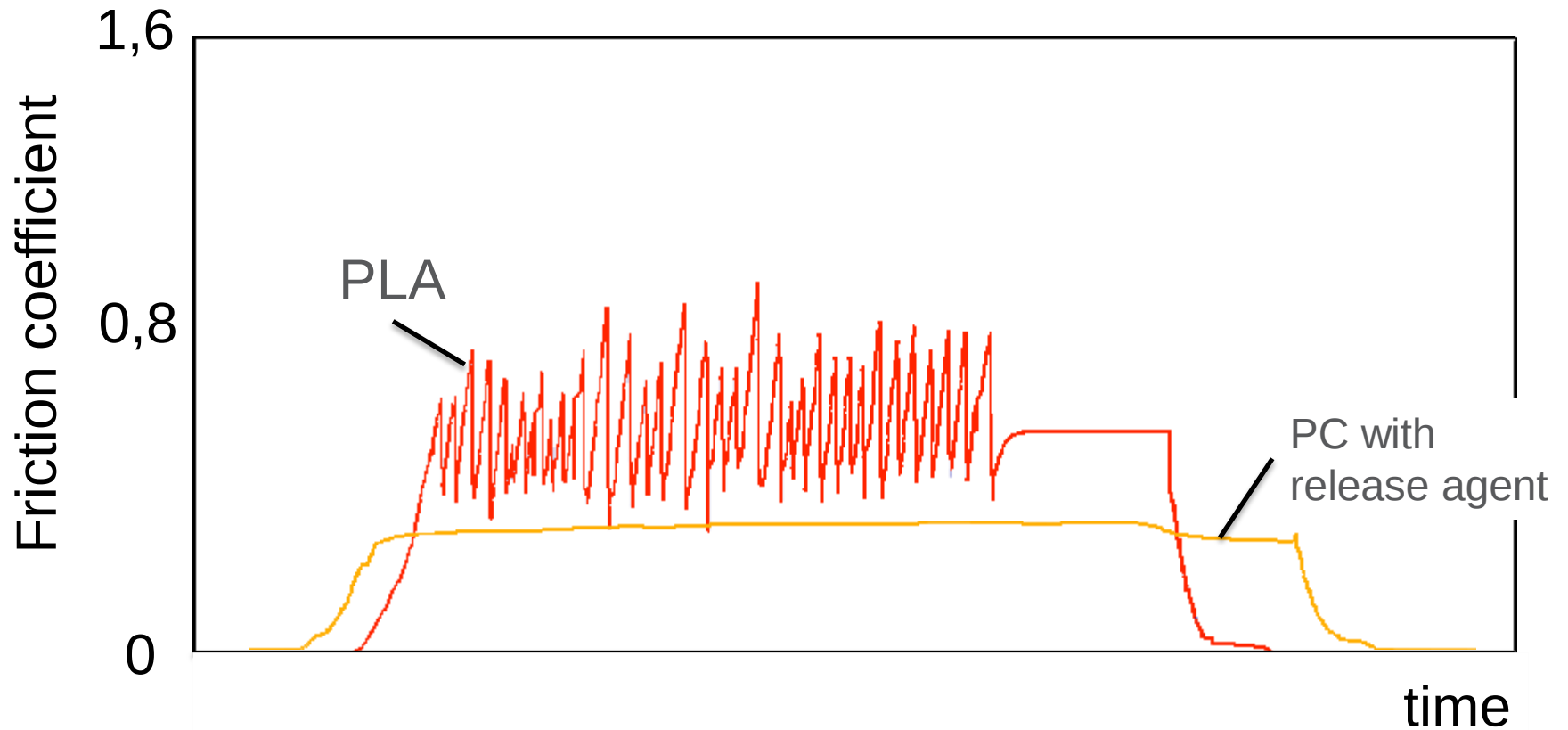
Impact on Demolding



Determination of Demolding Properties



Demolding Properties: PLA Injection Molding Grade



Shrinkage Measurement

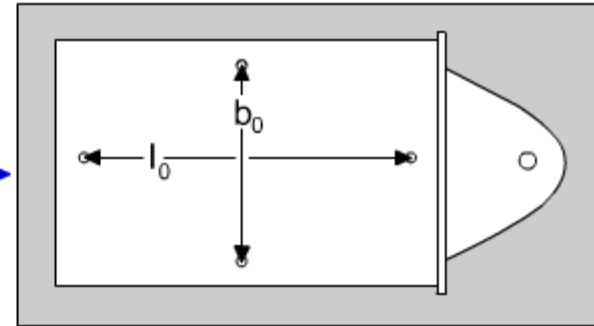
Molding shrinkage
at room
temperature
16-24h



Post-shrinkage
at elevated
temperature



Injection molding tool
(plan view)



Injection molding tool
(side view)

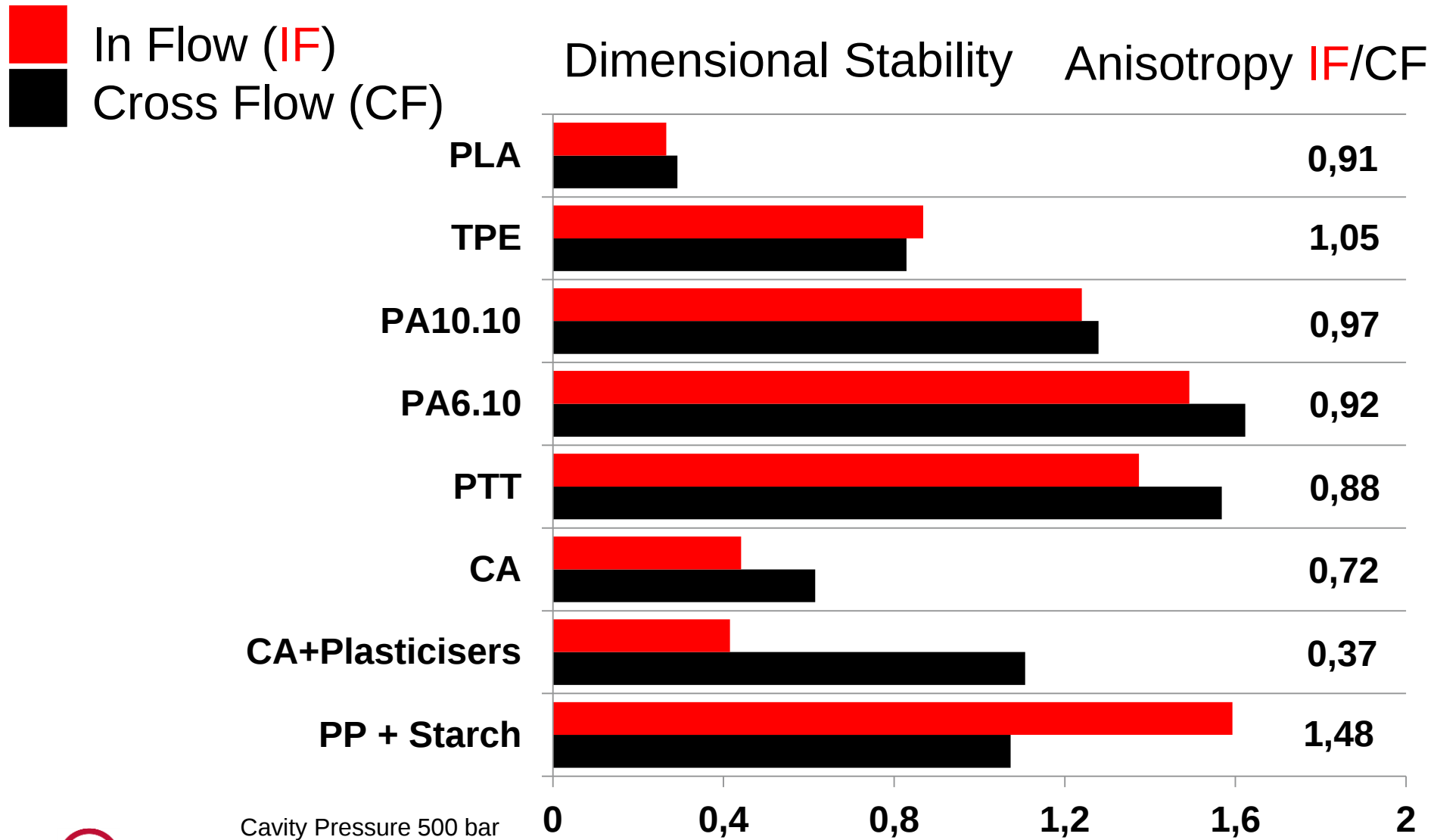


Mold markings	
l_0 [mm]	b_0 [mm]
130,00	80,00

	Molding shrinkage		Post - shrinkage		Overall shrinkage	
	l_1 [mm]	b_1 [mm]	l_2 [mm]	b_2 [mm]	l_{1+2} [mm]	b_{1+2} [mm]
von						
bis						

www.anitech.de

Overview: Mold Shrinkage in %



Summary

- **UL TTC as Competence Center for injection molding, testing, design data and certification of bioplastics**
- **Lack of processing and design data for evaluation of bioplastics applications**
- **Enormous optimization requirements of biopolymer properties for applications and components**

