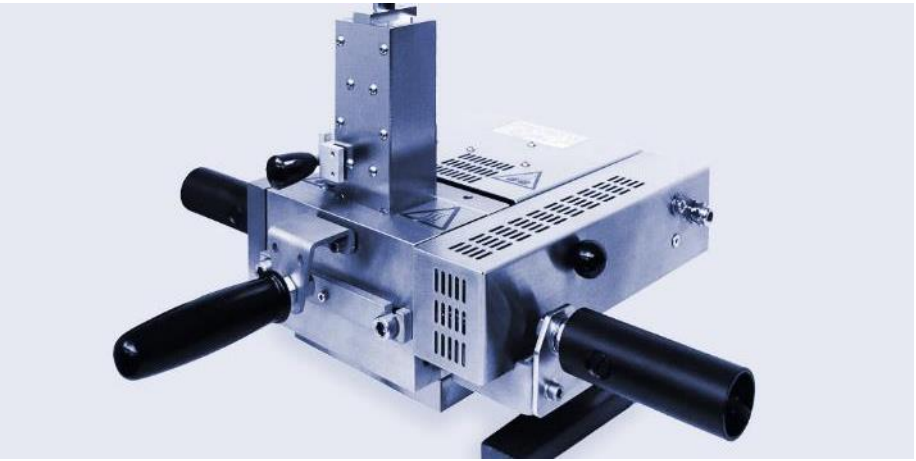
LAB SCALE MIXERS AND EXTRUDERS FOR PVC APPLICATIONS

PVC TRANSFORMATION DRIVING PROCESS IN A CHANGING WORLD

14-08-2025

AGENDA



- Brabender History and News
- Anton Paar Introduction
- Instruments Overview
- Measuring Mixers and Evalutaions
- Measuring Extruders & Applications

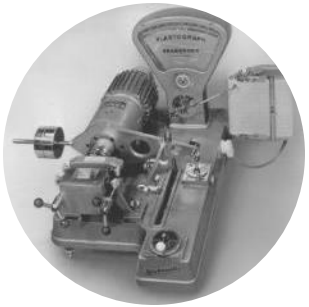
THE HISTORY OF BRABENDER

1923

Foundation of the company by Carl Wilhelm Brabender Purpose: **Major repairs of electric motors and transformers.**

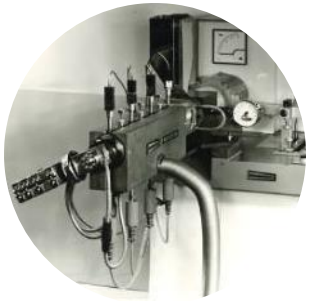
1928

Invention of the **Farinograph** as the world's first torque measuring device for **determining flour quality**



1936

Development of the **Plastograph**, based on the measuring principle of the Farinograph. First measuring mixer on the market for **determining the quality of plastics and rubber**



1965

Brabender enters the extrusion market with **single-screw extruders** for realistic process **simulation on a laboratory scale**

1970

Carl Wilhelm Brabender's wife, **Martha Brabender**, takes over the company after her husband passed away

THE HISTORY OF BRABENDER

2001

Brabender offers its first **twin-screw extruder** with the **clamshell design**, optimized for process monitoring and cleaning.

2012

The **GlutoPeak** is being developed to determine the quality of gluten - Brabender's first **rapid measuring device.**

2015

The first Brabender devices are equipped with the **MetaBridge** software. It enables the customer to retrieve measured values from **any device and location.**

2018

The **ViscoQuick**, the universal viscometer developed by Brabender, **measures** starchy products and liquids of different **viscosities**.

2023

Brabender celebrates its **100th anniversary** and is **integrated** into the Anton Paar Group

Anton Paar develops, produces, and distributes analytical instruments for laboratories as well as process measuring systems, and provides custom-tailored automation and robotic solutions.

Anton Paar GmbH is owned by the charitable Santner Foundation.

FACTS & FIGURES

ESTABLISHED IN
1922

HEADQUARTERS
IN GRAZ / AUSTRIA

4,200+
EMPLOYEES

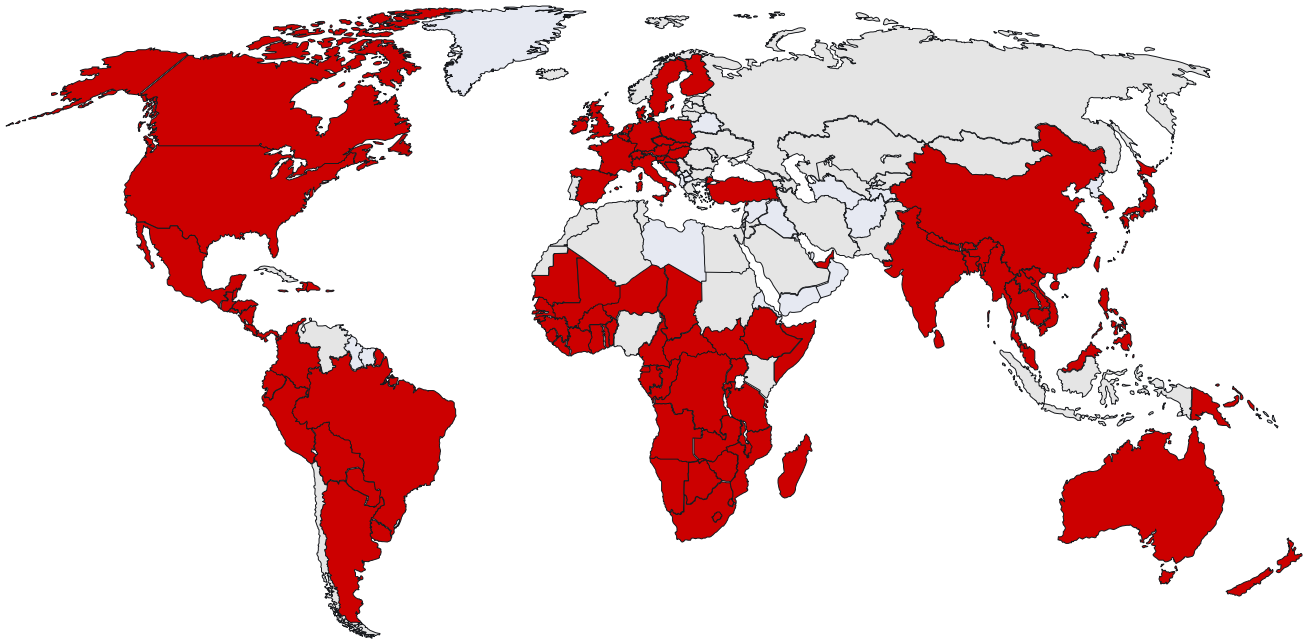
AS PART OF THE
ANTON PAAR GROUP AG
OWNED BY THE CHARITABLE
SANTNER FOUNDATION

14.5 % INVESTMENT
IN RESEARCH AND DEVELOPMENT

FROM ANNUAL TURNOVER
ANTON PAAR GMBH

ALL CRITICAL COMPONENTS
MANUFACTURED IN-HOUSE

OPERATING WORLDWIDE

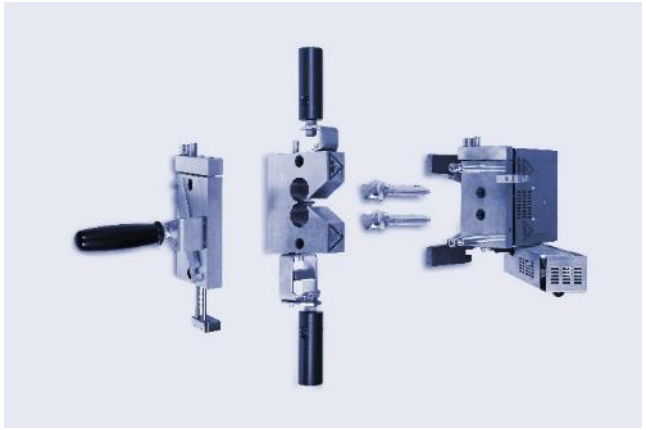


8
PRODUCTION COMPANIES

39
SALES SUBSIDIARIES

32
DISTRIBUTION PARTNERS

SERVICE & SUPPORT



MAXIMUM UPTIME

We help keep the device in good shape and safeguard the investment

THE SHORTEST RESPONSE TIME

A response to inquiries within 24 hours

CERTIFIED SERVICE ENGINEERS

Training and certification of our technical experts at our own facilities

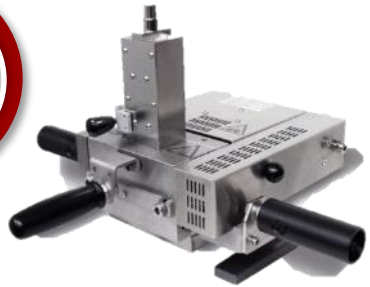
A GLOBAL SERVICE NETWORK

86 locations with a total of 650 certified service engineers

WHERE IS THE BRABENDER MIXER APPLIED

Raw material and recipe development

Laboratory-scale production of samples for further investigation



Material testing

Optimization of the production process

Quality control parallel to production

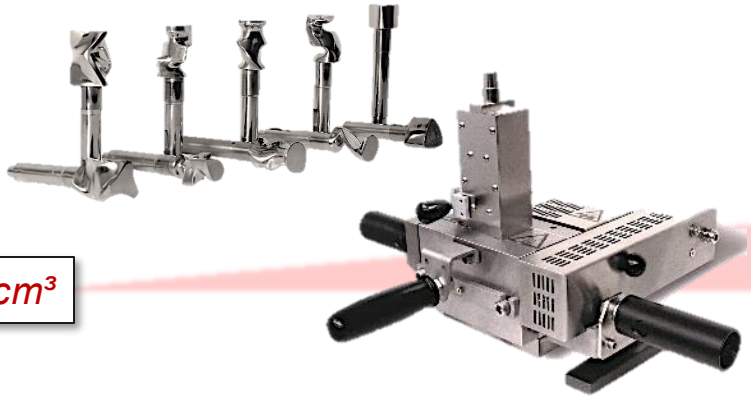
COMPLIANCE WITH NATIONAL AND INTERNATIONAL STANDARDS

(INTER)NATIONAL STANDARDS

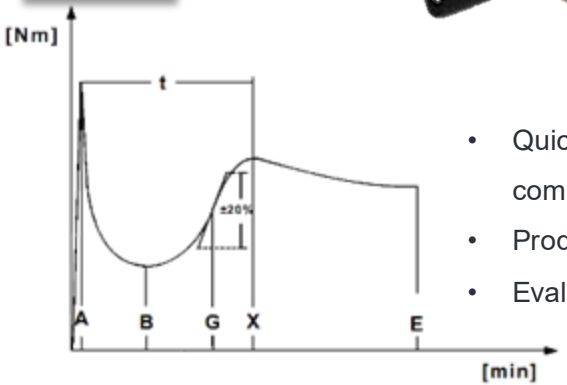
- **ASTM D2538** – Standard Practice for Fusion of Poly(Vinyl Chloride) (PVC) Compounds Using a Torque Rheometer
- **ASTM D3191** – Standard Test Methods for Carbon Black in SBR (Styrene-Butadiene Rubber) – Recipe and Evaluation Procedures
- **ASTM D8471** – Standard Practice for Silica – Reference Compound
- **ASTM D3795** – Standard Test Method for Thermal Flow, Cure, and Behavior Properties of Pourable Thermosetting Materials by Torque Rheometer
- **DIN 53764 (inactive)** – Testing of plastics; pourable thermosets; test method for flow and cure properties

SUITABLE SOLUTIONS IN DIFFERENT EXECUTIONS

Measuring Mixer 30 / 50



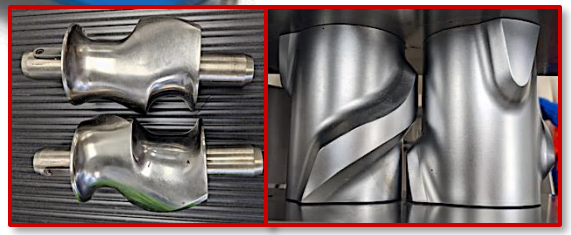
30 cm³



- Quick evaluation of the miscibility of polymer blends and compounds
- Production of small quantities of test material
- Evaluation of process windows using plastograms

Measuring Mixer 350

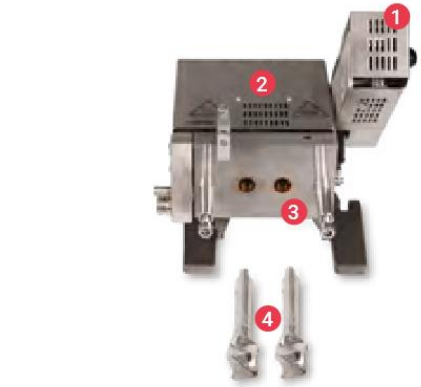
350 cm³



EXEMPLARY SETUP OF A MEASURING MIXER

MetaStation 4E
with measuring mixer
50 EHT

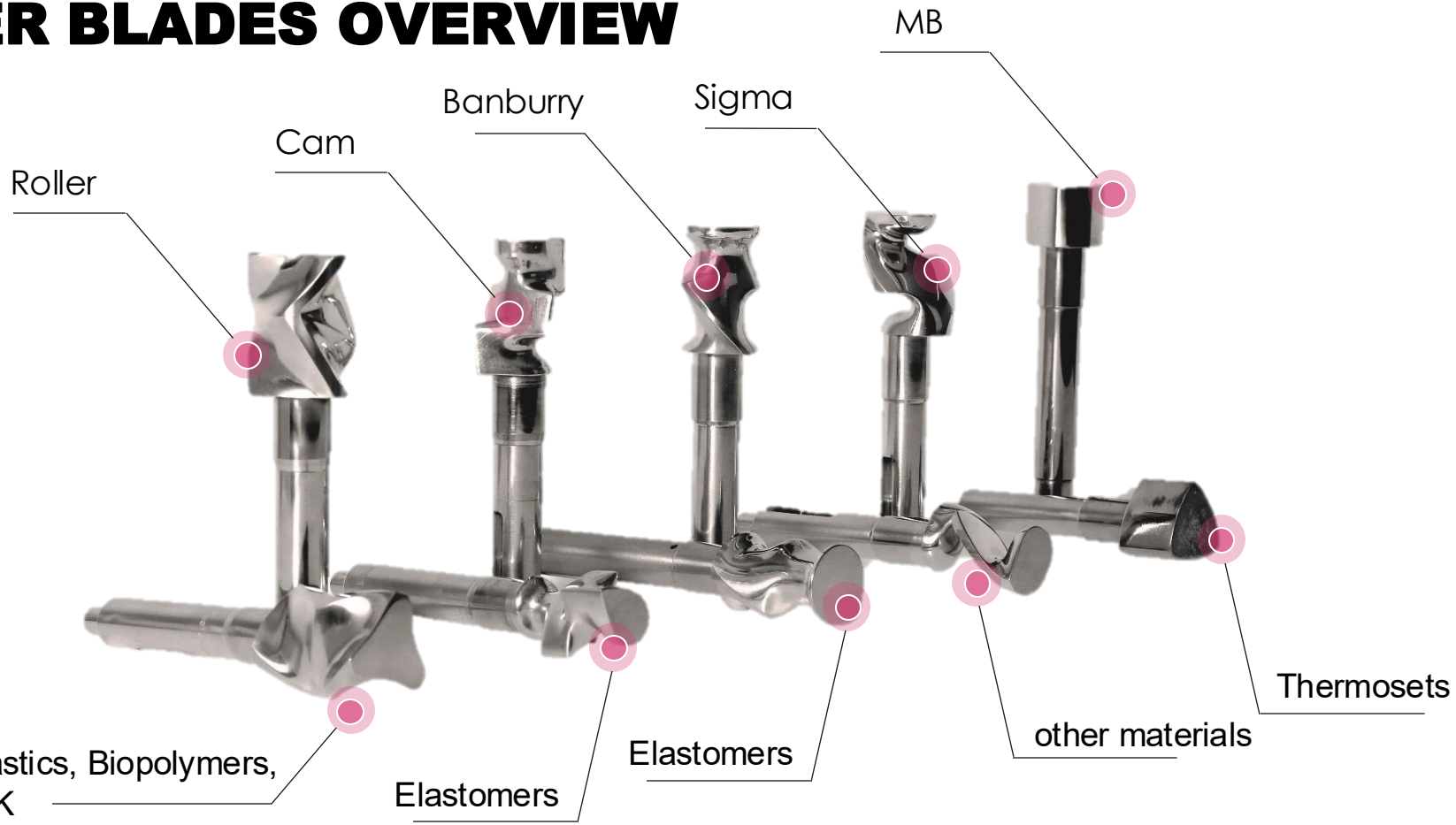
1. MetaStation 4E drive unit
2. Loading chute with weight
3. Mixer
4. Quick opening system
5. Batch collector drawer
6. Control panel



1. Safety shackle
2. Gear box
3. Rear wall
4. Mixer blades
5. Two-hand control device
6. Mixer bowl
7. Front plate

Measuring mixer
50 EHT

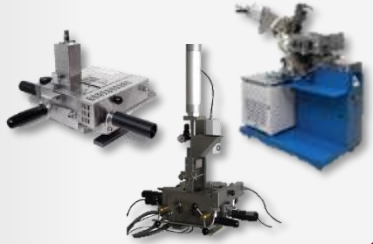
MIXER BLADES OVERVIEW



MEASURING MIXER OVERVIEW

Size

- 30 ccm
- 50 ccm
- 350 ccm



Tempering

- Electrical heated
- Liquid heated

Process

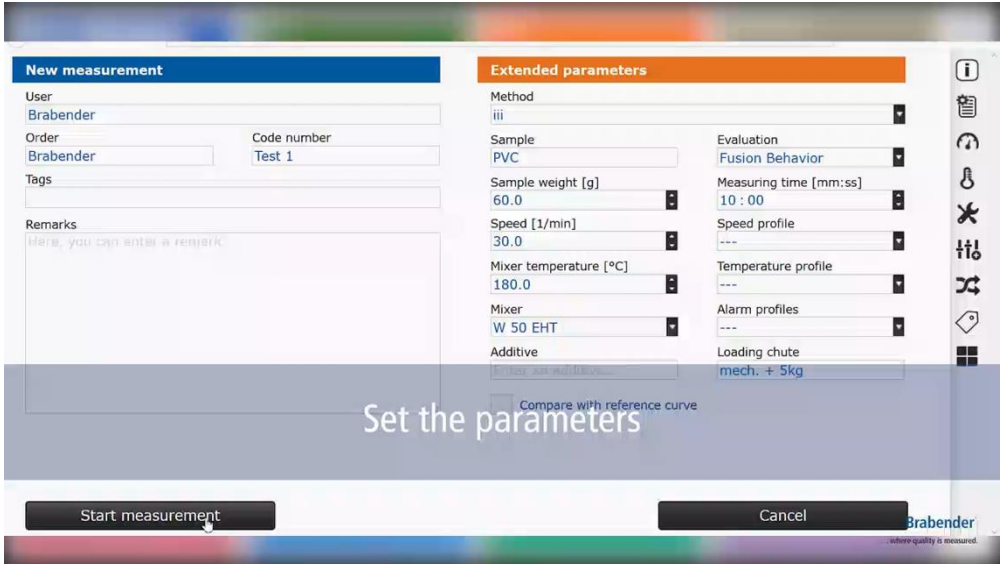
- Blade geometry
- Special resistance necessary?
- Accessories

LOADING CHUTES & PRESSURE RAMS

MANUAL OR AUTOMATIC FILLING AIDS.
EASY HANDLING – OPTIMUM RESULTS.

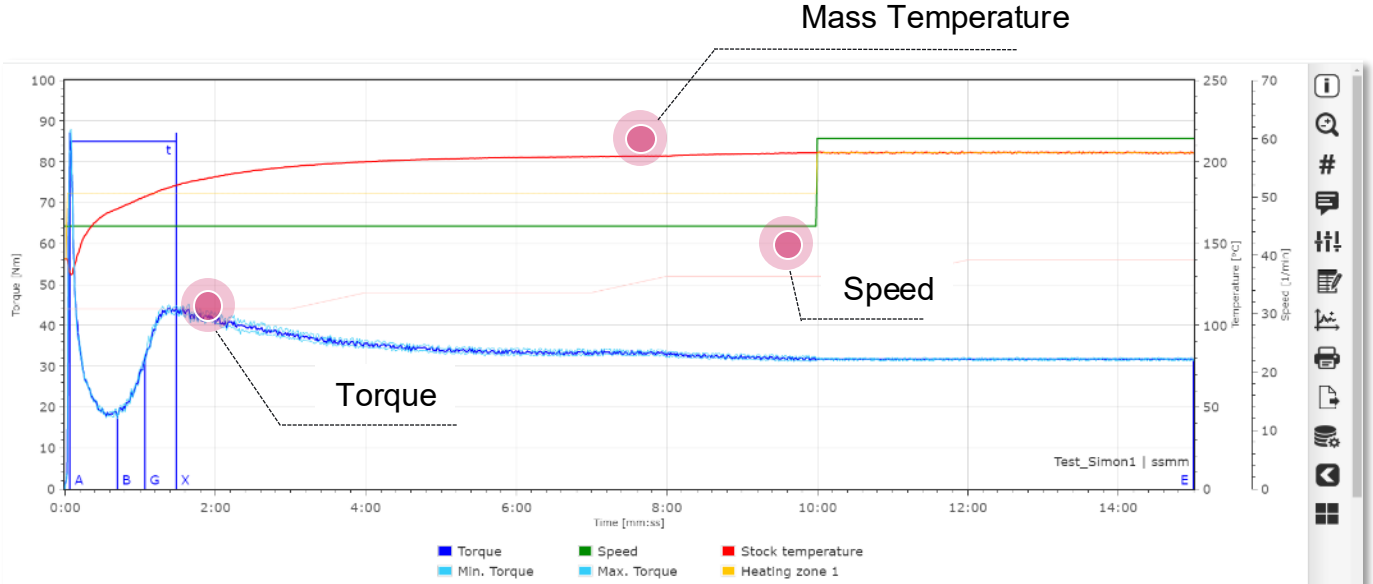
THE WORKING PRINCIPLE OF THE BRABENDER MIXERS

1. discontinuous measuring and production method
2. **Raw material will loaded into pre-heated mixing chamber**
3. Shear and temperature effect cause the material to melt
4. **Determination of torque and mass temperature levels during the trial**
5. depending on the process, different curves with different evaluation points are generated



THE BRABENDER PLASTOGRAM – EVALUATION OF A MIXER TEST

(Live) diagram of the trial



Evaluations in detail

Evaluation points

Point	Time	Torque	Stock temperature	Description
A	00:04 mm:ss	85.03 Nm	132.7 °C	Loading Peak
B	00:42 mm:ss	17.49 Nm	171.2 °C	Minimum
G	01:04 mm:ss	32.16 Nm	178.9 °C	Inflection Point
X	01:29 mm:ss	44.37 Nm	185.8 °C	Maximum

THE BRABENDER PLASTOGRAM – EVALUATION OF A MIXER TEST

Evaluation points can be set by default or manually!

Energy is calculated automatically by the integral between 2 evaulation points!

Evaluation points

Point	Time	Torque	Stock temperature	Description
A	00:00:07 hh:mm:ss	57.52 Nm	132.8 °C	Loading Peak
B	00:00:52 hh:mm:ss	16.42 Nm	168.7 °C	Minimum
G	00:01:37 hh:mm:ss	26.33 Nm	177.3 °C	Inflection Point
X	00:02:31 hh:mm:ss	35.28 Nm	183.6 °C	Maximum
E	00:10:00 hh:mm:ss	29.67 Nm	198.4 °C	End

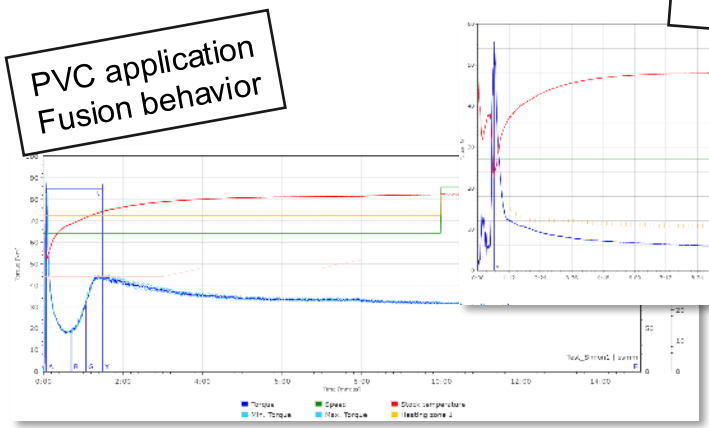
Integration / Energy

Point	Energy	Description
A-B	4.2 kNm	Loading Peak to Minimum
B-X	11.2 kNm	Minimum to Maximum
X-E	59.3 kNm	Maximum to End
A-X	15.4 kNm	Loading Peak to Maximum
A-E	74.7 kNm	Loading Peak to End (W)
	1.2 kNm/g	Specific Energy (W/Sample Mass)
B-X	4.4 kNm	Gelation Area above B

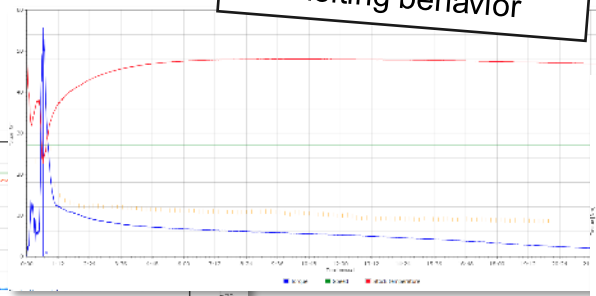
THE BRABENDER PLASTOGRAM – EVALUATION OF A MIXER TEST

Different curves + evaluation points for different materials!

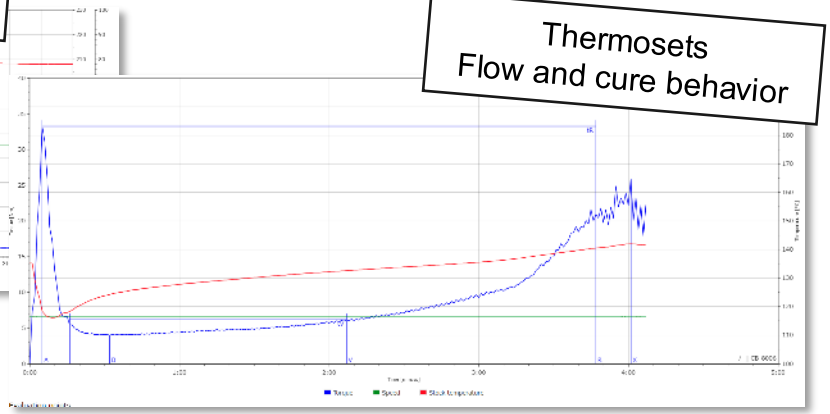
PVC application
Fusion behavior



General thermoplastics
melting behavior



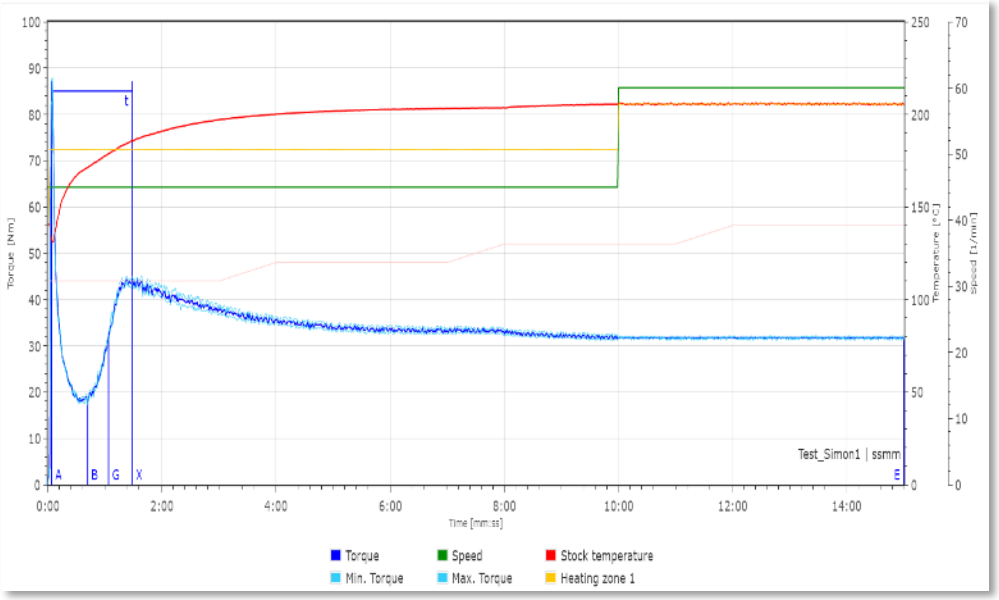
Thermosets
Flow and cure behavior



THE BRABENDER PLASTOGRAM – EVALUATION OF A MIXER TEST

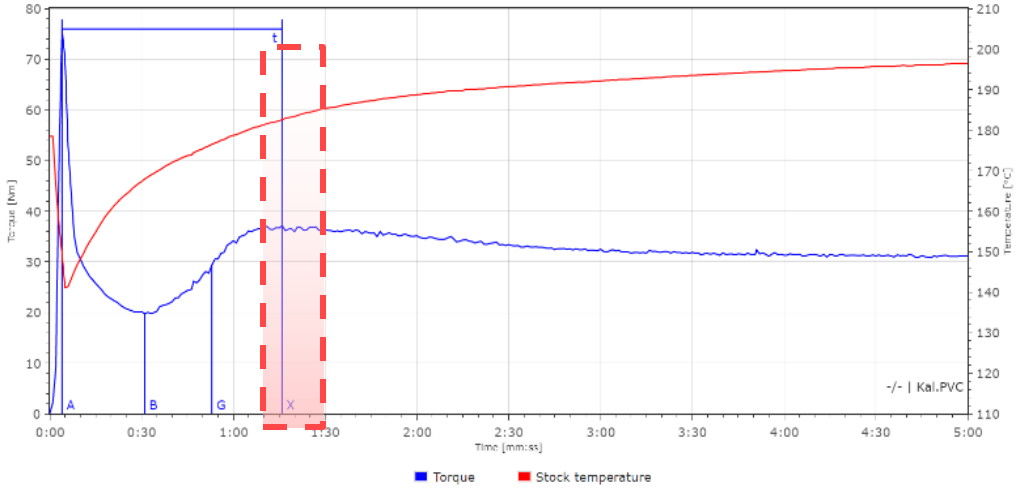
FUSION BEHAVIOUR (PVC)

- Use this evaluation method for testing the fusion behavior of thermoplastic polymers.
- Measure material-specific Plastograms which also permit to draw conclusions as to the history of the material.
- The software analyzes the curve and determines, among others, characteristic values in the torque curve (as a measure for viscosity), fusion time, gelation speed, and the mechanical energy input.
- These material characteristics are valuable data for incoming and final inspection or for the configuration of production processes.



THE BRABENDER PLASTOGRAM – EVALUATION OF A MIXER TEST

FUSION BEHAVIOUR (PVC)



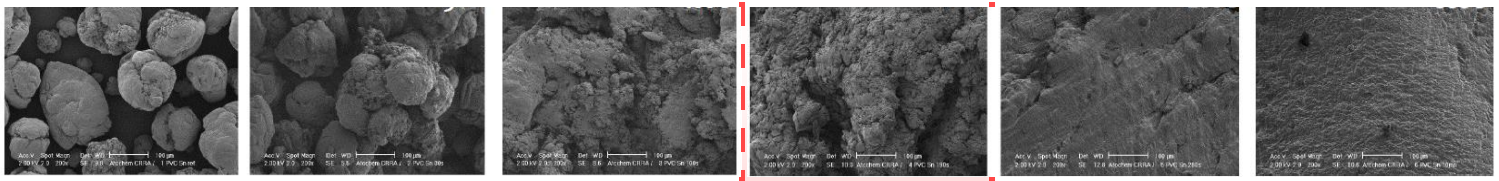
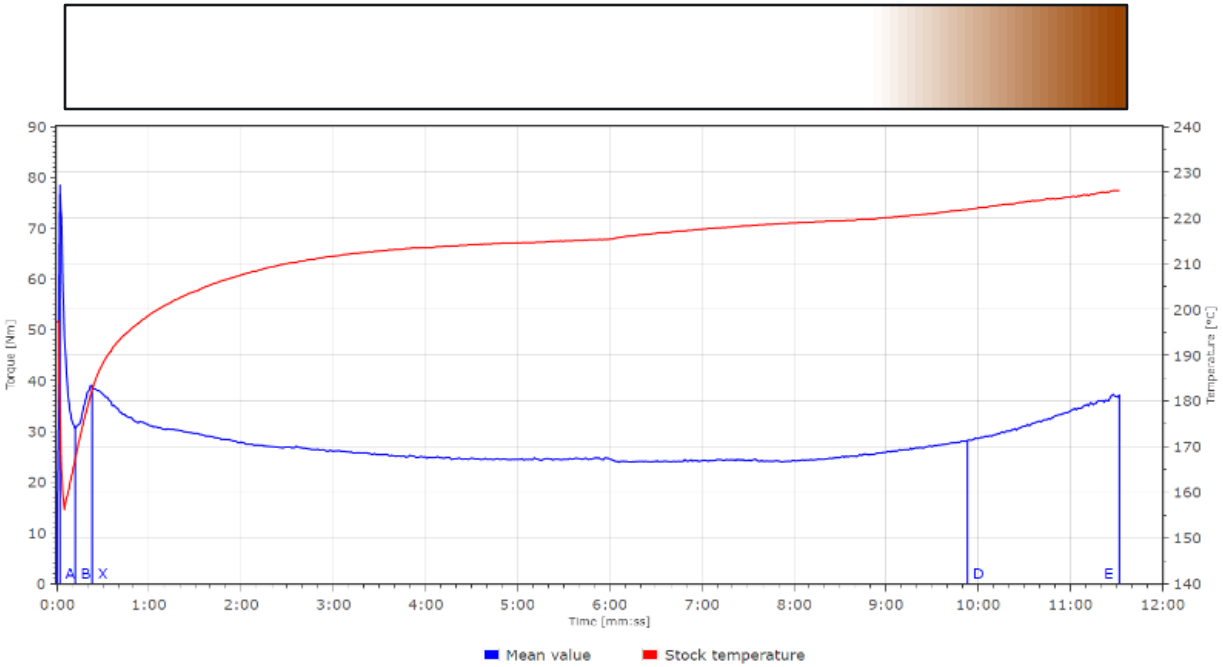


image source: Arkema

THERMAL STABILITY TEST

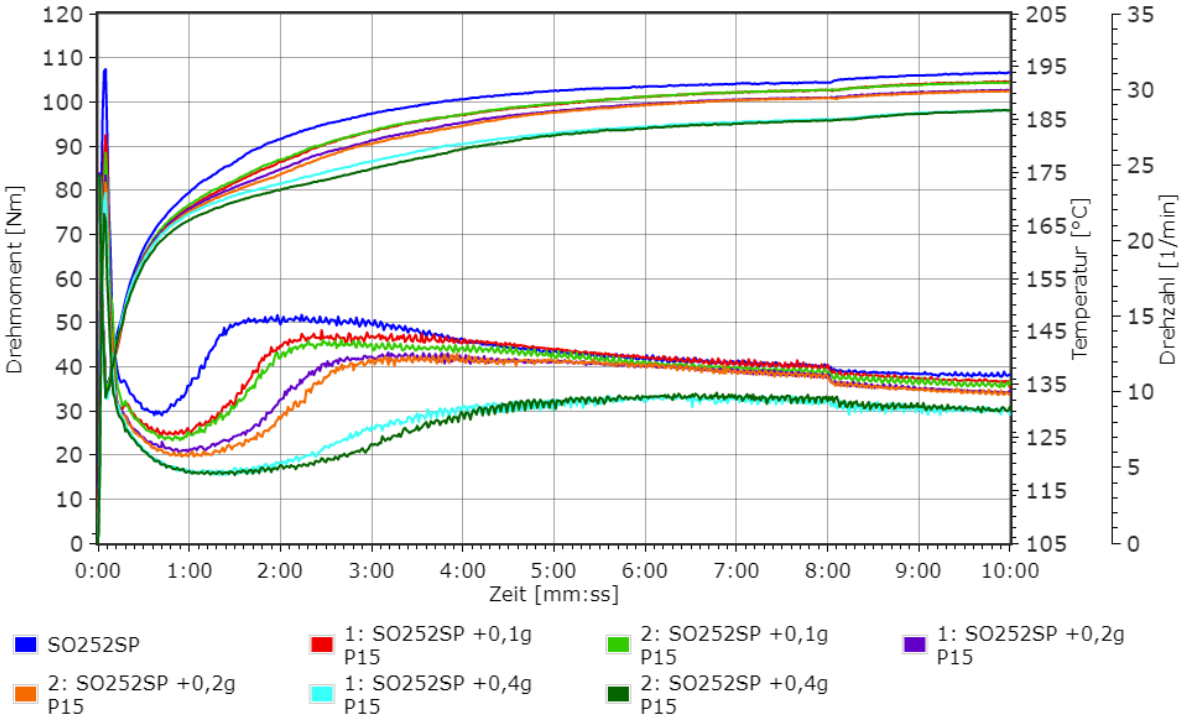


Result

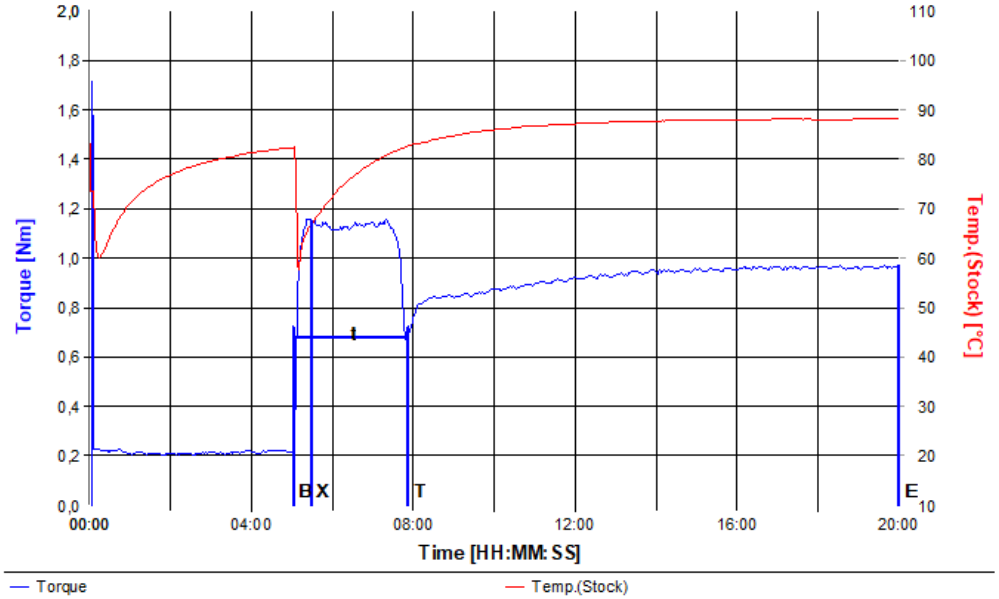
Name	Value
Fusion Time t (A-X)	00:21 mm:ss
Decomposition Time tD (A-D)	09:51 mm:ss
Stability Time (X-D)	09:30 mm:ss

THE BRABENDER PLASTOGRAM – EVALUATION OF A MIXER TEST

HOW CAN THE CURVES DIFFER?



PLASTICIZER ABSORPTION IN COMPLIANCE WITH DIN 54802-1



TORQUE-RHEOMETER

METASTATION DRIVE UNIT SERIES

MetaStation 4E

Power: 4 kW

Torque: 200 Nm

Speed: 185 min^{-1}

Temperature control

MetaStation 8E

Power: 8 kW

Torque: 400 Nm

Speed: 200 min^{-1}

Temperature control

MetaStation 8

Power: 8 kW

Torque: 400 Nm

Speed: 200 min^{-1}

MetaStation 16

Power: 16 kW

Torque: 400 Nm *

Speed: 400 min^{-1} *

*Also with 500 Nm /275 min^{-1}

WHAT DOES THE METASTATION MEASURES?

- Modular torque rheometer for testing the processability of thermoplastics, thermosets and elastomers

WHY USING A BRABENDER MIXER?

Ensure certainty raw material quality

- Have confidence in the excellence of plastics, rubber, and other raw materials throughout the entire value chain, from the initial reception of raw materials to the precise control of production processes
- Adhere to key international standard methods and comply with specifications of your business partners

WHY USING A BRABENDER MIXER?

Guarantee optimum final products and processes

- Determine the optimal applications for your raw materials by thoroughly assessing their processing characteristics
- Take proactive measures to prevent production issues stemming from raw materials with suboptimal properties
- Mitigate risks associated with compromised product quality, machine downtimes, waste generation, customer complaints, and dissatisfaction
- Ensure the stability of your production processes

METABRIDGE

STANDARD BRABENDER INSTRUMENT SOFTWARE

Browser-based

Modern & standardized design for many Brabender devices. Easy and flexible data access via a web browser, supports 12 languages and more on request.

Location-independence

Monitor measurements live from any location and retrieve results from any desktop or mobile device – being in the lab, in the office or on the go.

Efficient workflows

Endorses a variety of norms and standards, tailored methodologies and profiles, as well as the establishment of reference curves and correlations.

METABRIDGE

STANDARD BRABENDER INSTRUMENT SOFTWARE

Automatic data transfer

Transmits values measured from one Brabender instrument to another, e. g. moisture content or water absorption, saving time and reducing human errors.

Upgrades old devices

Retrofit existing devices with USB connection via MetaBridge Standalone and enjoy the latest software advancements.

Efficient servicing

Remote maintenance and feedback for quick assistance. Automated email notifications with built-in service history and scheduling.

QUALITY ASSURANCE

Comparison & correlation

- The reference curve feature allows to monitor material quality and check whether the specifications have been met.
- Compare a multitude of measurements with the Correlations add-on feature

EvaluationEditor

- This add-on feature enables you to create your own evaluations and perform them automatically after your measurement.
- Additional evaluation points can give you a deeper analytical understanding of your measurements

Energy based mixing

Energy (SME) allows a better comparison with other mixers. The SME values is more unbiased and points such as speed, sample quantity, blade geometry.

Enhanced sensor technology

Record real mass temperature as well as torque on the mixing blades for high consistent measurement results and high-quality products.

MEASURING EXTRUDER OVERVIEW

Single Screw

- 19 mm single screw
- 30 mm single screw
- Attachment and stand-alone

Twin Screw

- Conical twin screw
- Parallel counter rotating

Application

- Die head
- Downstream equipment
- Accessories

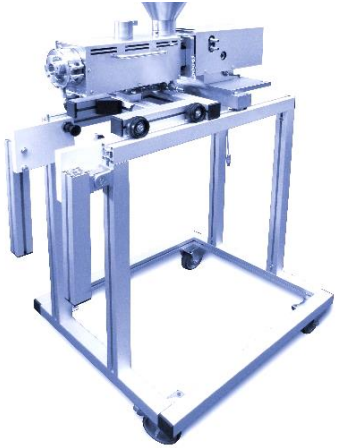
EXTRUDER SCREWS OVERVIEW

CTSE screws

19/25 D screws

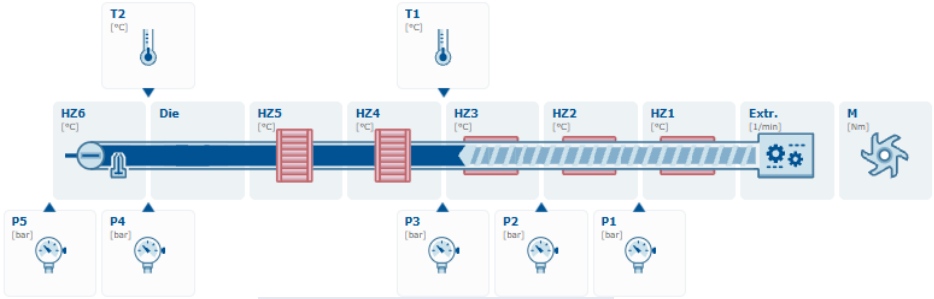
WHY USING A MEASURING EXTRUDER?

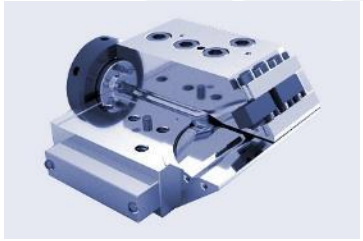
- Raw material and recipe development
- Material testing
- Quality control parallel to production
- Optimization of the production process
- Laboratory-scale production of samples for further investigation



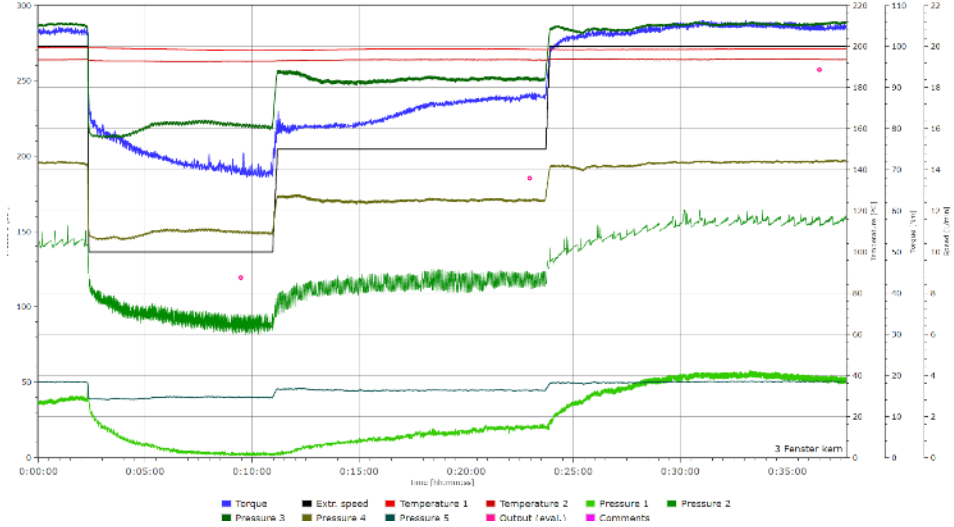
METABRIDGE

THE EXTRUSION PROCESS ALWAYS UNDER CONTROL





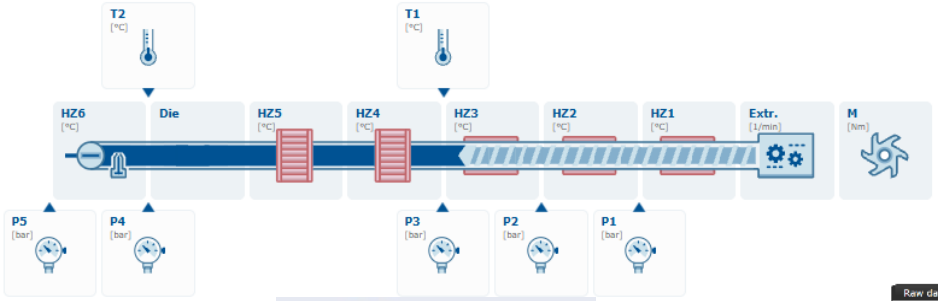
Time-resolved process monitoring

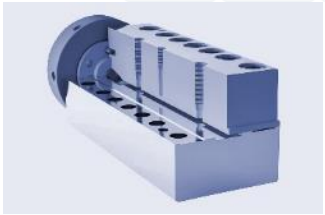


- Pressure and torque development
- Take-off speeds
- Inline-viscosity measurement
- Results of the optical quality analysis on extruded films

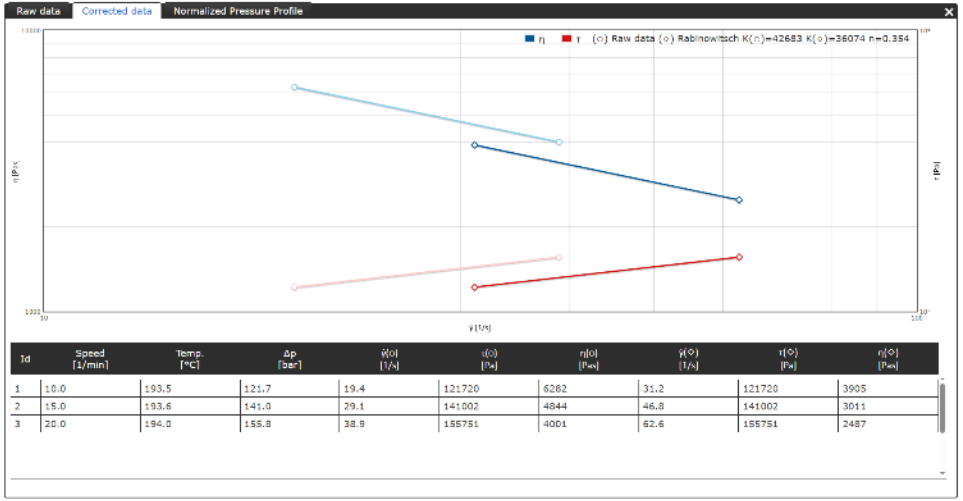
METABRIDGE

THE EXTRUSION PROCESS ALWAYS UNDER CONTROL





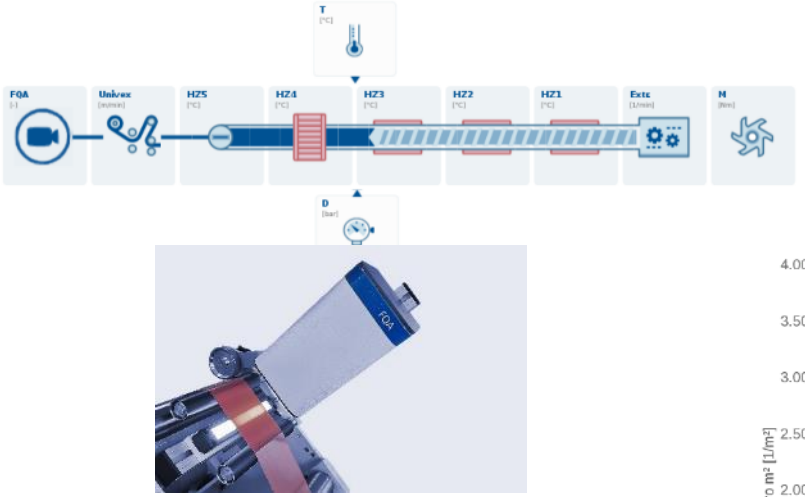
Evaluation of viscosity measurement



- Measured raw data e.g. pressure difference and temperature
- Calculated values for shear stress, shear speed and viscosity
- Corrected values and graphic evaluation

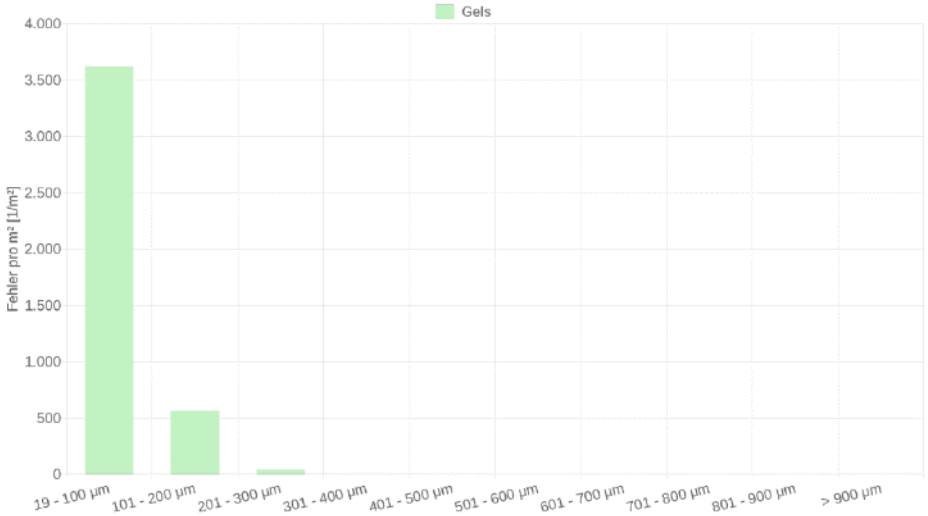
METABRIDGE

THE EXTRUSION PROCESS ALWAYS UNDER CONTROL



- Measurement of film defects in different size classes
- Distinction between black specs, gels, holes and fisheyes
- Graphical and tabular evaluation

Film inspection with FQA



Thank you for your attention!