



## **Rheology Solutions**

*Rheology Solutions is the sole Australian distributor of this product range and we welcome the opportunity of discussing your application requirements.*

*We hope the information you are seeking is contained within this file.  
If you have any questions, or require further information please contact us.  
We look forward to being of further service.*

*Regards from the Team at Rheology Solutions.*

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**Thermo Scientific  
Measuring Mixer and Extruder System**

**HAAKE PolyLab OS  
Open System**





## Powerful process engineering for efficient material and process development

If comprehensive material characterization during the development of innovative products is important to you, Thermo Scientific Solutions open new possibilities with the flexible, open-concept HAAKE PolyLab™ OS rheometer platform.

The Thermo Scientific system provides you with process-relevant material data including:

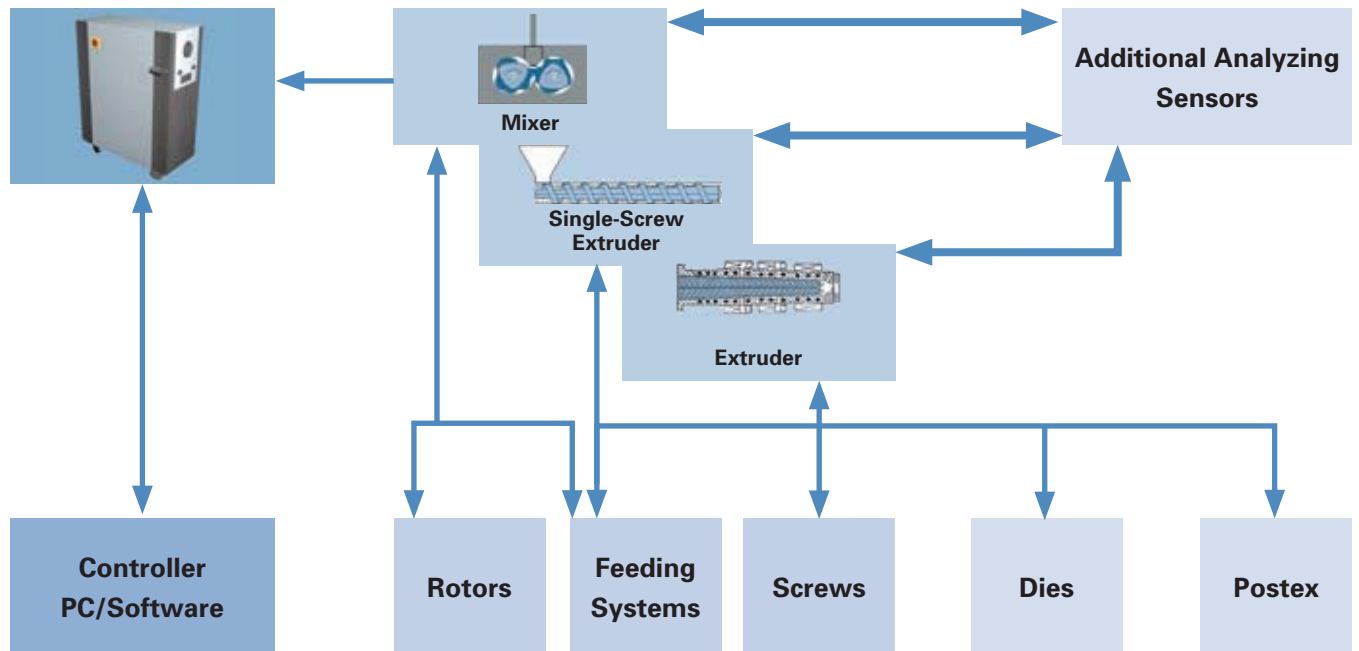
- Melting behavior
- Influence of additives
- Temperature stability
- Shear stability
- Melt viscosity

Furthermore, this Thermo Scientific rheometer supports you in process modeling activities such as:

- Compounding polymers with additives to reduce flammability, viscosity, etc.
- Scale-up extrusion processes by using different L/D ratios to extrapolate to your master process line.
- Simulating master processes using only as little as 50 g of material to optimize extrusion or mixing in respect to temperature and shear profile.
- Extrusion of strands, profiles or films in combination with rheological or optical measurements.

Consequently, you can optimize your process parameters, create test specimens or perform quality control on incoming and outgoing goods with regard to viscosity, dispersion or plasticizing behavior. With over 50 years of extensive experience in material characterization through our Thermo Scientific product lines, our professionals are available worldwide to support you in the efficient development of your material and pilot processes.

# Thermo Scientific HAAKE PolyLab OS-System



## RheoDrive

The basic unit of the Thermo Scientific HAAKE PolyLab OS system comprises all elements of a torque rheometer that are needed to drive the measuring system (precise speed controller) and to monitor the torque (accurate torque sensor) needed to process the test material.

- **Modularity**

System architecture on the basis of an open industry standard for flexible connection of different sensors and systems

- **Ease of operation**

Fast and simple connection of measuring attachments without changing application and operating software

- **Remote controller**

Operate the system from a distance and observe the entire test from a different location

- **Service & reliability**

Reduce down-times with remote diagnostics and have the ability to change out components with pre-calibrated replacements

- **Return on investment (ROI)**

Time-saving instrument usage and meaningful results relative to the application increase product quality and reduce development time

## Measuring system

The Thermo Scientific measuring systems can be connected quickly to the RheoDrive and are equipped with a specific measuring, control and evaluation technology for the particular application.

Movable measuring attachments facilitate:

- **Handling** of heavy and hot parts (mixers, extruders, dies)
- **Integrated heating & cooling** to reduce plug-in connectors and thus the risk of wrong connections
- **Quick adaptation** of the system to simulate new process designs
- **True "plug & measure"** concept through multifunctional coupling in mechanical and electrical respects with an automatic software recognition system
- **Investment into the future**  
Open device concept ensures adaptability to future development needs

## Peripheral devices

Thermo Scientific peripheral devices such as feeding systems, application-specific screws, mixer rotors or extruder downstream equipment combine different modules to a complete downsized production line for the testing or small-scale production of new materials:

- **Extrudate cooling baths**
- **Take-off units**
- **Blown film unit tower**
- **Inspection systems**
- **Feeders**
- **Pelletizers**
- **Melt pumps**
- **Capillary rheometers**

# Thermo Scientific HAAKE PolyLab OS – RheoDrive

## Experience combined with the latest technology

The RheoDrive component of the HAAKE PolyLab OS system is state-of-the-art in respect to technology, connectivity and reliability. It controls all Thermo Scientific measuring systems and monitors the results via host computer with proprietary software for Windows XP. Two RheoDrive (RD) versions are available. The RD 7 version has a 7 kW motor and is used primarily for standard "600" mixer and single-screw (19/25) experiments, whereas the more powerful RD 16 version with a 16 kW motor is recommended for twin-screw experiments with the "24 mm PTW".



To test a material a defined speed (torque) is applied through a measuring system (mixer, extruder) and the material's response is measured as torque. The torque measurement is performed via a special transducer developed for the HAAKE PolyLab OS system that uses the proven measuring principle of high-resolution sensors of modern rotational rheometers. This provides high measuring accuracy combined with very high stability of the recorded signals. The optional multi-range torque sensor allows data gathering from very low to very high torque values without having to exchange transducers. If only informative torque values are needed, as in some extruder experiments, the standard data channel with motor current (calibrated to torque) may be sufficient.



### More flexibility through “Plug & Measure”

The system architecture of the Thermo Scientific HAAKE PolyLab OS platform follows an open industry standard, which allows the connection of a variety of sensors and measuring systems. The standardized CANopen bus, a standard in the automotive industry, replaces the traditional instrument firmware. This guarantees a stable environment and the integration of external sensors to measure, e.g. electrical conductivity of a polymer melt during mixing, monitor the concentration of additives or humidity by means of optical spectroscopy (NIR), etc.

### Special features

- Integrated measuring and control electronics
- Non-contact signal transmission
- High reliability for continuous operation
- High power (16 kW) and high speed (550 rpm) drives

The "PolySoft" application software runs under Microsoft XP with pull-down menus and "drop and drag" technology.

Torque measuring range			
Type	Torque measuring range	Resolution	Accuracy *
Motor current	400 Nm	1.0 Nm	5% FSD**
Torque transducer	400 Nm	0.1 Nm	0.15% FSD**
Dual range torque transducer	120/400 Nm	0.01/0.1 Nm	0.045/0.15% FSD**

Speed Specifications			
Type	Speed range	Resolution	Torque
RheoDrive 7 kW	280 min <sup>-1</sup>	0.1 min <sup>-1</sup>	300 Nm
RheoDrive 16 kW	550 min <sup>-1</sup>	0.1 min <sup>-1</sup>	400 Nm

\* Repeatability: same user, same sample and same instrument

\*\* FSD = Full Scale Deflection



# Thermo Scientific HAAKE PolyLab OS – RheoDrive



## Communication made easy

The RheoDrive's measuring and control dialogue is achieved through the integrated CANopen bus, which communicates with all connected systems and sensors. A USB or optional TCP/IP interface connects to the host computer.

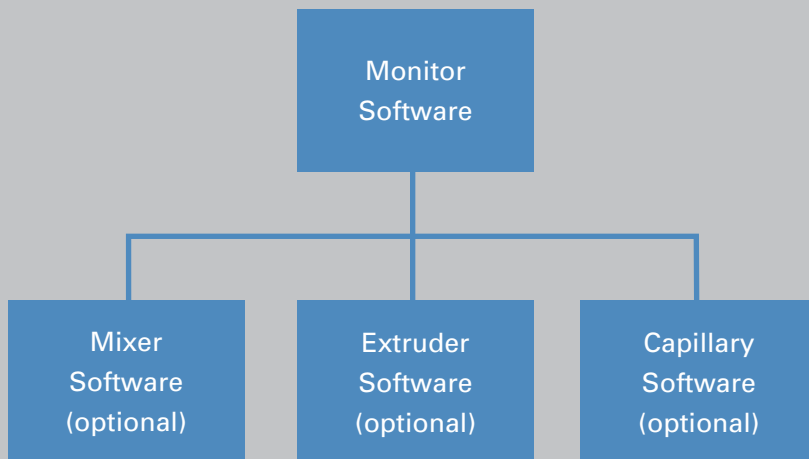
"Plug & measure" is optimal for anybody who does not want to bother with interfaces and software settings. This principle allows the fastest exchange of sensor units in the market and the reliable connection with known and unknown devices, often needed for advanced research environments. "Plug & measure" also guarantees the connection of sensors that may not yet be developed but will be needed in the future for existing polymer testing systems. This ensures that the PolyLab OS platform preserves your investment.

Once a measuring attachment such as an extruder, mixer or compounder is docked onto the RheoDrive component, the integrated control module recognizes the configuration and automatically sets all device-related limits and characteristics values. The measuring ranges of the sensors are loaded automatically, just like the visualization of the measuring sensor is identified for measurement and calibration. The coded identification of the respective measuring attachment guarantees correct interaction between system components.

The Windows-based "PolySoft" software suite is the user interface comprised of several modules based on the monitor software. This time-saving software is included in the standard version of the RheoDrive.

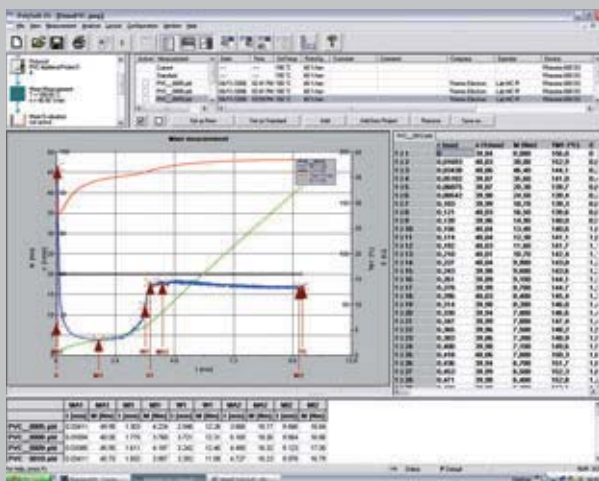


The monitor software allows access to all control functions and measured data in the "Run Mode". It also defines the setup of the measuring systems if not automatically recognized. This manual operation is used to find optimum process parameters (speed, temperature) for new and unknown materials. If the response of the test material is understood, a test procedure can be programmed to run measurements automatically using the mixer or capillary software with integrated data evaluation. Different user level settings can be defined to set up tests or only to run measurements.

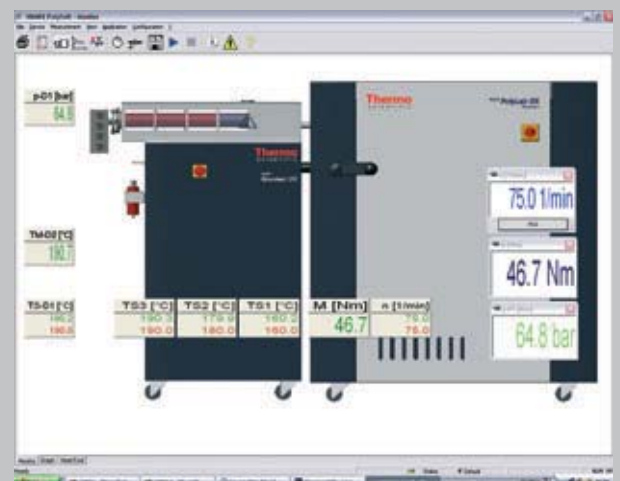


### It's main features are

- Job stream function for automatic tests and data evaluation as a time saver
- Customer-defined user levels to secure data integrity
- Data dump to MS Excel to further process data
- Visualization of installed system and actual test runs
- "Hot plugging" of measuring systems to enhance flexibility
- Remote supervision of a test run with an internet browser



Mixer Software



Monitor Software



# Thermo Scientific HAAKE PolyLab OS – Measuring Mixer

## Mixing, kneading, compounding and plasticizing

In conjunction with the HAAKE PolyLab OS system's powerful RheoDrive, a comprehensive range of flexible Thermo Scientific measuring mixers to handle a range of different applications is offered. A typical mixer test is run at a defined speed (shear rate) versus time, and the material's response is recorded as torque. The mixing chamber is temperature-controlled precisely by independent heating and cooling zones, but due to the frictional heat in the mixing bowl, a change in the material's melt temperature is observed and recorded as measuring signal. This "Rheogram" (torque, melt temperature vs. time at constant speed) is characteristic for different materials or blends and often used as a "fingerprint" in Quality Control for incoming or outgoing product inspection. Different additives in type and concentration can be measured and quantified objectively through the melting behavior, consumed energy or melt viscosity (recorded torque).

## Typical investigations

- Testing the melting and degradation behavior of polymer melts
- Quantifying viscosity when adding nano-particles or other additives
- Testing the gelation- and plasticizing behavior of PVC dry-blends
- Measuring the flow- and curing behavior of thermosetting plastics
- Characterizing the influences of different additives such as carbon black, fillers, lubricants, accelerators or sulphur for rubber mixtures
- Recording the masticating and vulcanizing behavior of elastomers
- Measuring the oil absorption of carbon black
- Quantifying the absorption of DOP for PVC dry-blends
- Measuring the stable torque in regard to individual and combined influences of fillers and additives such as stabilizers, lubricants and color pigments
- Testing high performance plastics to check processability
- Performing electric conductivity measurements for rubber mixtures



Depending on the application, the Thermo Scientific Rheomix series measuring mixers are configured as follows:

- Exchangeable rotors with different geometries as standard
- Standard 3-piece measuring chamber for easy cleaning (front plate – center bowl – back stand)
- Conical mixer bowl and rotors for thermosetting plastics (easy removal of the cured material)
- Large measuring chamber for producing approx. 500 g
- Air cooling and/or liquid temperature control
- Pneumatic or manual feeding
- Gas volume sensor
- Special surface treatments against wear or chemically aggressive materials

Different and new applications may require special setups that should be discussed with our application specialists. This will ensure the best measuring system for your site based on the comprehensive variety of available accessories for this product line.



### Technical Specifications

Item	Rheomix 600	Rheomix 610	Rheomix 540	Rheomix 3000	Rheomix 3010
Chamber volume	120 cm <sup>3</sup>	120 cm <sup>3</sup>	130.6 cm <sup>3</sup>	625 cm <sup>3</sup>	625 cm <sup>3</sup>
– with rotors	69-90 cm <sup>3</sup>	69-90 cm <sup>3</sup>	58-100 cm <sup>3</sup>	310-541 cm <sup>3</sup>	310-541 cm <sup>3</sup>
Material	Stainless steel DIN 1.4301				
Gear ratio	3:2 (optional 2:3)				
Max. speed	250 min <sup>-1</sup>	250 min <sup>-1</sup>	250 min <sup>-1</sup>	250 min <sup>-1</sup>	250 min <sup>-1</sup>
Max. torque	160 Nm	160 Nm	160 Nm	300 Nm	300 Nm
Max. temperature	400°C (opt. 500°C)	350°C	400°C (opt. 500°C)	400°C	350°C
Temperature control	3 zones electric heating and air cooling	Heated with thermal liquid, circulator required	3 zones electric heating and air cooling	3 zones electric heating and air cooling	Heated with thermal liquid, circulator required

# Thermo Scientific HAAKE PolyLab OS – Measuring Extruder



## Individual applications require special solutions

The proven single-screw laboratory extruders deliver reliable data captured during the extrusion process to verify process parameters (speed, energy, temperature) for unknown materials or to manufacture smaller quantities of a new polymer (as strands, sheets, pellets, blown films) during R&D. The extruders are equipped with measuring ports for melt pressure and melt temperature to study the process parameters along the extruder barrels. These barrels are available in different lengths (length/diameter ratio). A die can be connected to the end of the extruder barrel to form the polymer melt as strand or film. Special rheological dies (slit, rod, x-die) allow the determination of shear- and elongational viscosity at defined shear rates. A variety of Thermo Scientific screw geometries to customize the extrusion process with different compression ratios, venting and mixing sections is offered. Wear-reduced screws and barrels increase the lifetime of the system. Standard feeders for pellets and special feeding systems for powders, pastes, liquids or highly viscous rubber complete the set up.

## The following tests are typically performed with these laboratory extruders

- Testing melting behavior
- Testing individual and combined influences of additives (stabilizer, lubricant) and functional additives (anti-oxidation, UV-stabilizers, pigments and fillers)
- Extrudability of newly developed materials
- Manufacturing homogeneous melts
- Manufacturing films, foils, strands and profiles for optical and mechanical testing as well as outdoor exposure tests
- Measuring rheological behavior (viscosity, elasticity)
- Foam extrusion

## Typical applications for single-screw extruders

- Extrusion of PVC compounds
- Blown films
- Cast films
- Rheological testing with special dies
- Extrusion of ceramic materials or PIM-feedstocks

## Specifications and applications

Plasticizing and extrusion with single-screw measuring extruders

A variety of Thermo Scientific single-screw extruders is available for diverse applications:

Item	Rheomex 19/10	Rheomex 19/25	Rheomex 19/33
Screw diameter	19.05 mm (3/4")	19.05 mm (3/4")	19.05 mm (3/4")
L/D	10	25	33
Material	Stainless steel nitrided DIN 1.8550		
Max. temperature	450°C	450°C	450°C
Max. pressure	700 bar	700 bar	700 bar
Max. speed	250 min <sup>-1</sup>	250 min <sup>-1</sup>	250 min <sup>-1</sup>
Max. torque	160 Nm	160 Nm	160 Nm
Heating zones	1	3	4
Cooling	Air	Air	Air
Application	Profile extrusion and rheological tests on unvulcanized rubber or elastoplastics	Profile and sheet extrusion, rheological tests for standard thermoplast materials	Extended barrel and screws for special applications e.g. foaming.
Options	Separate controllable feed roller for rubber	Additional sensor ports, back force sensor, wear resistance material, chemical resistance material	Additional sensor ports, back force sensor, wear resistance material, chemical resistance material

# Thermo Scientific HAAKE PolyLab OS Docking Station



## Mobile bench for measuring mixers and measuring extruders

When existing measuring mixers and extruders need to be upgraded with newer torque rheometer drives and software, the modular Thermo Scientific HAAKE Docking Station OS is the right accessory to use.

## Protect your measuring procedures

The OS Docking Station is a mobile bench that is compatible with new and old measuring mixers and measuring extruders as far back as the '80s. New mixers and extruders may be similar in appearance but may not give identical test results to older models. The OS Docking Station can be calibrated to ensure that old systems correlate with new ones.



## Applications:

- Mobile bench for Thermo Scientific HAAKE Rheocord mixer 600 and Rheocord mixer 3000
- Docking station for existing single-screw extruders
- Adapter bench for TW 100 conical twin screw extruder
- Modular bench to integrate mixers and extruders of different brands



## Compatibility

The mobile OS Docking Station serves as a bench for existing measuring mixers and measuring extruders. Any system can be connected that can be accommodated by the two screws that secure the mixer/extruder. Torque adaptation to the HAAKE PolyLab OS rheometer is accomplished via a special coupling specific to the mixer model (see table). The temperature controllers for up to four heating zones plus air cooling are already integrated into the docking station.



### Technical Specifications

Dimensions (L x W x H)	40 x 50 x 103 cm
Weight	50 kg
Electrical power	from RheoDrive base unit
Heating zones	4 standard (more optional)
Electrical heating/ air cooling	3 sections
Maximum temperature	450°C*
Temperature resolution	0,1 K
Maximum torque	300 Nm*
Maximum speed	200 min <sup>-1</sup> *

\* Can be limited by the mixer/extruder itself

Supported Mixer & Extruder	Year	Coupling
Rheomix 600 / 610 / 540	= 1990	557-1126
Rheomix 600 / 610 / 540	< 1990	557-1143
Rheomix 3000 / 3010	= 1990	557-1125
Rheomix 3000 / 3010	< 1990	557-1143
Rheomex 102 / 104 / 252 / 302	= 1990	557-1125
Rheomex 102 / 104 / 252 / 302	< 1990	557-1128
Conical twin-screw extruder TW100	< 1990	557-1141
Other models	- - -	on request



Docking Panel Connections



# Thermo Scientific HAAKE PolyLab OS – Measuring Extruder

## Continuous compounding with twin-screw extruders

Thermo Scientific twin-screw laboratory extruders have a proven record in continuous compounding with feed-dosing of different additives (liquid or solid) along the extruder barrel. The combination of a twin-screw extruder unit with additional sensors offers the ability to measure material properties of the melt during processing. The following properties and data can be derived from an experiment or test run in the early part of the lifecycle of a new product:

- Viscosity and flow behavior of the compound
- Extrudability and scale-up data
- Predictions for the injection molding process
- Morphology of polymer and nano-composites
- Recycling properties and re-usability of the polymer
- Influence of screw geometry on processability
- Decomposition of biopolymers



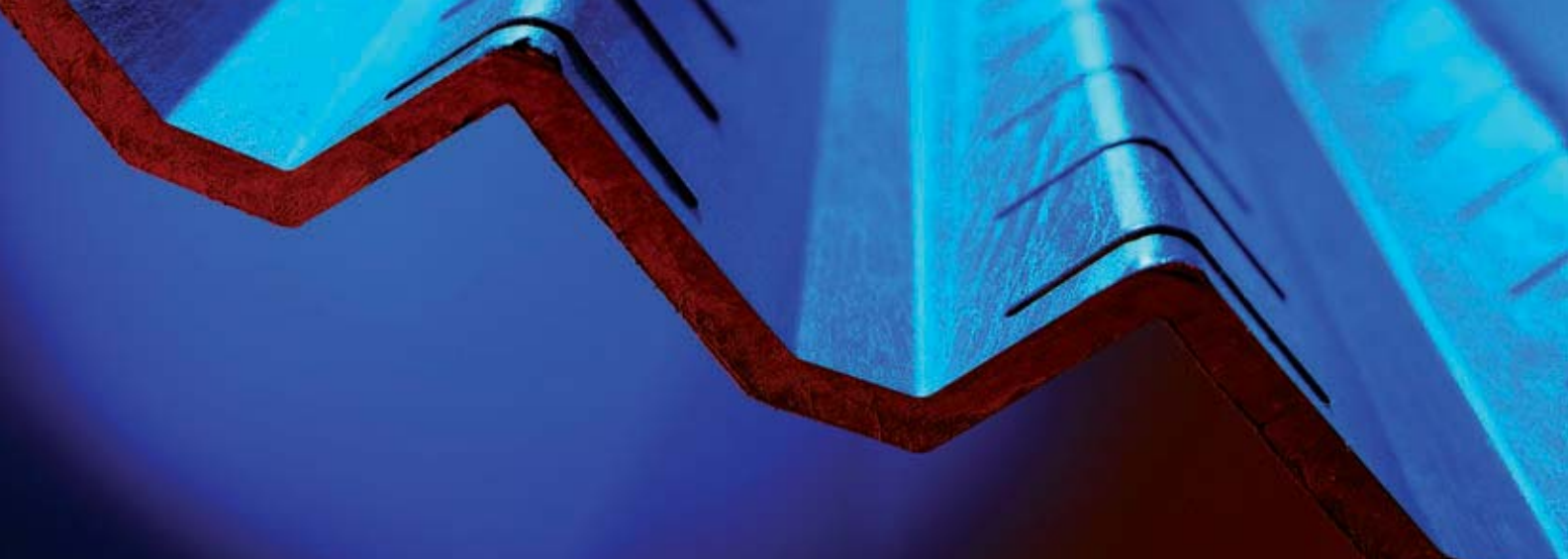


## Typical applications for twin-screw extruders

- Compounding of master batches
- Filling and reinforcing plastics
- Metering additives and venting volatile components
- Food processing
- Color matching of powder coatings
- Processing high performance and engineering polymers
- Extruding and mixing ceramic compounds
- Integrated rheometry with add-on melt pump and rheological dies

A variety of twin-screw extruders is available for these applications:

Item	PTW 16/25	PTW 16/40	PTW 24/28	PTW 24/40	CTW 100
Screw diameter	16 mm	16 mm	24 mm	24 mm	Conical
L/D	25	40	28	40	--
Screw setup	Variable	Variable	Variable	Variable	3 options
Gear ratio	1:5.4	1:5.4	1:2	1:2	1:1
Rotating direction	Co	Co	Co	Co	Counter
Max. screw speed	1100 min <sup>-1</sup>	1100 min <sup>-1</sup>	1100 min <sup>-1</sup>	1100 min <sup>-1</sup>	250 min <sup>-1</sup>
Max. temperature	350°C (opt. 400/450°C)	350°C (opt. 400/450°C)	350°C (opt. 400/450°C)	350°C (opt. 400/450°C)	450°C
Max. pressure	100 bar	100 bar	100 bar	100 bar	700 bar
Max. screw speed	1100 min <sup>-1</sup>	1100 min <sup>-1</sup>	1100 min <sup>-1</sup>	1100 min <sup>-1</sup>	250 min <sup>-1</sup>
Max. torque	130 Nm	130 Nm	180 Nm	180 Nm	200 Nm
Heating zones	7	10	7	10	3
Cooling	Convection	Convection	Internal water circuit	Internal water circuit	Air
External heaters	2	2	2	2	2
Feeding zone	Cooled	Cooled	Cooled	Cooled	Cooled
Additional Feeding/ Venting	2 Top	3 Top	2 Top, 1 Side	3 Top, 2 Side	--
Sensor ports	(1/2" UNF)	(1/2" UNF)	(1/2" UNF)	(1/2" UNF)	2 (1/2" UNF)
Options	15 L/D extension, additional feeding ports, additional sensor ports	Additional feeding ports, additional sensor ports	Additional feeding ports, additional sensor ports	Additional feeding ports, additional sensor ports	Backforce sensor, additional sensor ports, venting dome



### Simulating production conditions in the pilot plant

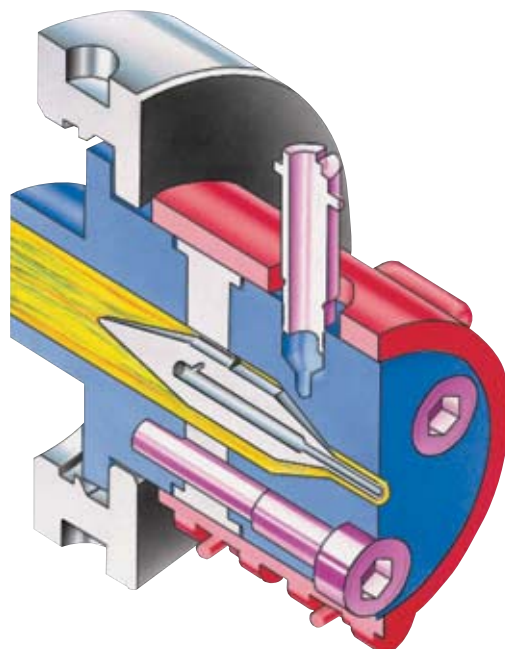
Dies and post-extrusion units are used in addition to extruders for testing the rheological characteristics and processability of polymers and for producing laboratory test samples. Dies enable the defined geometries for profiles, films or rheological measurements. The Thermo Scientific post-extrusion HAAKE Postex can transport the extruded material downstream and prepare it for further tests. Both dies and Postex units closely resemble their larger-scale "big brothers" to ensure production-like testing is guaranteed. Integrated measuring sensors further enhance the application possibilities in the laboratory or pilot plant.

### Measuring dies in laboratory applications

Measuring dies create profiles of a defined geometry to make special test specimens that may be inspected with other techniques or to simulate a production process such as film blowing, wire coating or catheter extrusion. Temperature and pressure probes in the die monitor the behavior of the sample online. The flow geometries accommodate the behavior of different polymer types during extrusion. A variety of dies is available for the range of Thermo Scientific extruders:

- blown film
- flat film
- strand
- pipe/tubing
- fibre/rod
- wire coating
- screen life (filter test)
- catheter

The PolyLab OS System can be transformed into a powerful extrusion capillary rheometer when used together with rheological dies. Rheological data such as shear stress and viscosity functions can be evaluated. These are of great importance for the design of injection molds, extruders and extruder screw design. The shear rate ranges experienced during polymer processing can be fully covered using both rod and slit capillary dies.

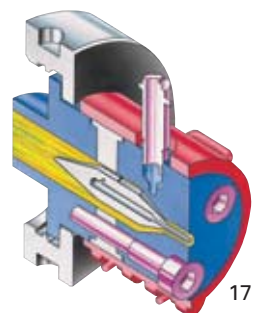
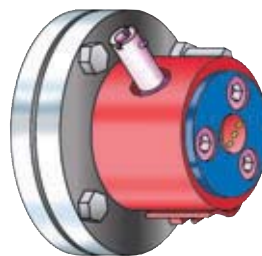
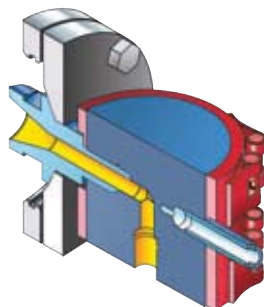


General Description	Sheet, Tape & Ribbon Die 25/50/100/150	Horizontal Rod Die / Vertical Rod Die	Multistrand Die Three Strands	Catheter Die
	<p>These dies produce sheets of different width and thickness. The optimized flow channel produces a ribbon of homogeneous output. The flexible die lip option enables the on-site adjustment of the sheet thickness as well as an optimization of the diameter.</p>	<p>The rod die produces a single strand for inspections or pelletizing. The inter-changeable nozzles on the horizontal rod die vary not only in diameter but also in length to supply different pressure ranges and die swell information.</p>	<p>In a pelletizing application it is sometimes of great advantage to have a high output rate while maintaining a sort strand and slower output speed. This is the dedicated application of the multi strand die.</p> <p>When combined with the HAAKE waterbath and pelletizer, the complete lab-scaled pelletize line can be set up.</p>	<p>The catheter die is designed for tubes with diameters of about 2 to 8 mm. This die is ideal for producing capillary and catheter tubes.</p> <p>The process is supported by an air supply in the inner tube to prevent a collapsing of the small tubes.</p>

## Specifications

Extrudate	Sheet 25/50/100/150	Dia $\varnothing$ 1 - 6 mm	3 holes $\varnothing$ = 3 mm	Tubes
Material	1.4301	1.4571/1.4112	1.4571	1.1412
Heater (Watt)	500/1000/1250/1800	250/280	160	200
Max. Temperature	360°C	450°C	450°C	450°C
Measuring Ports	1	2 / 2	-	0
Dimension	W 25/50/100/150 mm H 0.2 - 2.5 mm	Dia $\varnothing$ 1.0/1.5/2.0/3.0/ 4.0 /5.0/6.0		Di: 1.5 mm to 7.0 mm Da: 2.0 mm to 8.0 mm Standard Di/Da: 2.4/4.5 mm

## Graphical Information



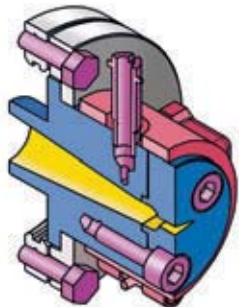
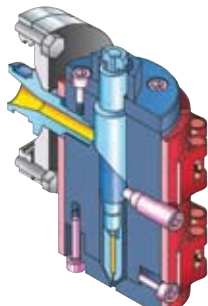
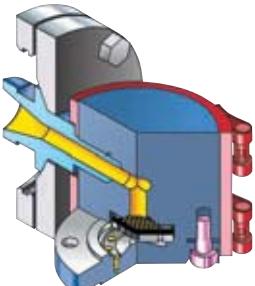




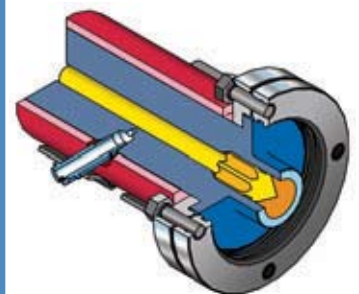
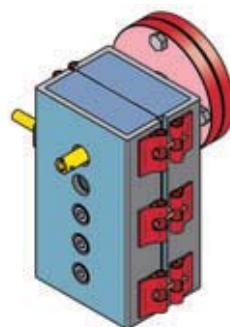
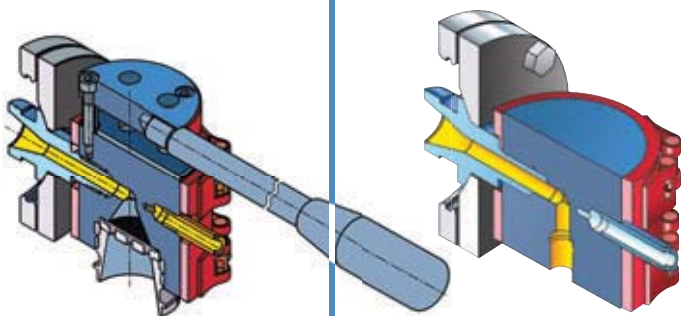
General Description	Garvey Die	Wire Coating Die	Spinning Die
	<p>The Garvey die adheres to ASTM 2320 and can be used to examine the flow behavior of material, especially rubber, to continuously fill the different angles of the die. Its shape simulates the typical design of tire building blocks such as the thread and apex or parts of the side wall.</p>	<p>The wire coating die forms a constant coat on wires in different diameters. The die utilizes an adjustable mandrel to provide a fine tuning of the concentricity of the coating.</p> <p>In combination with the wire coating take-off it forms a complete lab-scaled processing unit.</p>	<p>The spinning die enables the simulation of a fibre spinning process in a lab scale. The standard die extrudes 10 fibres with an initial diameter of 0.2 mm. By exchanging the spinning-plate, other geometries are possible.</p>

**Specifications**

Extrudate	Gravey profile	-	-
Material	1.4305	1.4571	1.4571
Heater (Watt)	250	500	280
Max. Temperature	450°C	450°C	450°C
Measuring Ports	-	2	2
Dimension		for wires up to Ø 2.0 mm Coating up to 1 mm Thickness of coated wire max Ø 4 mm	Number of holes: 10 Diameter: 0.2 mm

Graphical Information			
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Filter Die	Rod Capillary Die	Slit Capillary Die	Pipe & Tubing Die
<p>The filter die is suitable for testing colorants in the form of color concentrates (master batches) in all polymers used for extrusion and melt-spinning processes.</p> <p>The design follows the EN standard 13900-5. The pressure increase before of a standard-ized melt filter is measured, from which the FPV (Filter Pressure Value) is calculated thus indicating the dispersion quality of the master batch.</p>	<p>This die is designed to measure the absolute viscosity of polymers. It provides a tool with interchangeable capillaries. The pressure is measured directly before the capillary entrance. The nozzles are wear reduced for long life reproducibility and the testing of filled polymers and ceramics. Depending on testing material and nozzles, shear rates between 50 - 200,000 1/s can be achieved.</p>	<p>This die enables a measurement of pressure gradient and melt temperature directly within the slit capillary. Thus the absolute viscosity of a polymer can be determined.</p> <p>Different geometries are available to adapt the die to the shear rate and the viscosity range. Depending on the geometry and testing material shear rates of 10 - 1,000 1/s are possible.</p>	<p>The tubing die is designed for tubes with outer diameters of about 10 to 15 mm.</p>
-			Tubes
1.4112	1.4571	1.4112	1.4571
280	400	800	200
450°C	450°C	450°C	450°C
2	2	4	0
	Ø 1.0/1.2/1.5/2.0	x 20 mm	Di: 5 mm to 12 mm Da: 10 mm to 15 mm Standard Di/Da: 9/12 mm



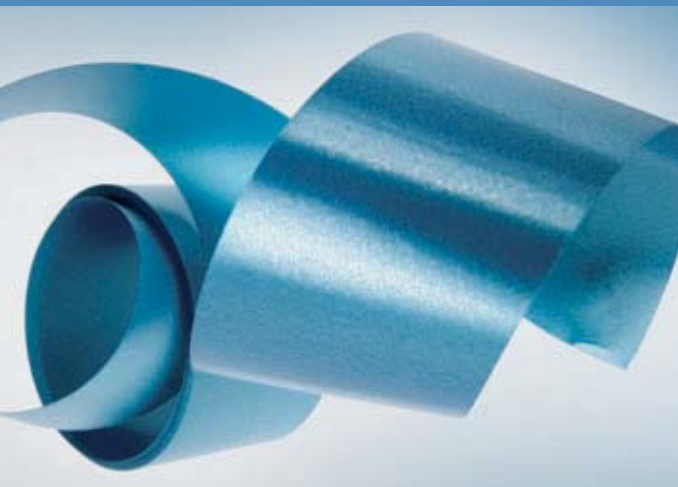


# Thermo Scientific HAAKE PolyLab OS – Postex



## Postex = Post-Extrusion

The handling of the often hot and still formable extruded material is an important part of extrusion testing. This greatly influences the material characteristics and surface finish. These tasks are carried out by the Postex systems to ensure that your requirements for the extruded material are fulfilled. Apart from the defined take-off and preparation of extrudate for further analysis, Postex systems also enable the laboratory and processing technician to carry out tests in conditions similar to those experienced during production. The production of small batches of finished products is a frequent application for the Thermo Scientific Postex systems, especially when alterations to the formulation and product processing need to be evaluated.



## The Postex family consists of

- Blown film take-off
- Sheet, tape and ribbon take-off
- Wire coating take-off
- Cooling water bath
- Conveyor belt
- Pelletizer/face-cut pelletizer

# Thermo Scientific HAAKE PolyLab Blown Film Die / Blown Film Take-Off



## Blown film die

The blown film die is designed as a vertical annular slit die which forms a thin walled polymer tube. Air is introduced via a hole in the center of the die to blow up the tube like a balloon.

### Blown film die features:

- Variable ring gap width for quick and individual test adjustment, as well as easy and rapid cleaning
- Measurement of pressure and melt temperature directly within the die allows for an accurate examination of the melt conditions

## Cooling ring

The cooling ring is designed to cool down the inflated molten polymer film in a defined manner. The freezing process of the film can thus be accurately controlled.

### Cooling ring features

- continuously adjustable air flow rate for exact control of the cooling process for each specific application
- air flow in radial or axial direction for optimal film cooling
- labyrinth manifold within the cooling ring for evenly dispersed cooling across the film surface

## Technical Specifications

Blown Film Die:	
Ring diameter	25.0 mm (35.0 mm)
Pin diameter	24.0 mm (34.0 mm*)
Gap width	0 - 0.8 mm
Measuring ports	2
Max. temperature	480°C
Cooling Ring:	
Inner diameter	48 mm

Blown Film Take-off:	
Take-off speed	0 - 12 m/min
Motor capacity	115W
Mains connection	230 V +/-10%, 50/60Hz
Dimensions (L x W x H)	100 x 58 x 195 cm
Weight	approx. 74 kg

\* Available on special request

## Blown film take-off

The blown film take-off transports the extruded film in an upward direction, continually cooling, until it passes through, collapsing guide, made from round wooden bars. The film is guided up to the nip rolls where the tube is flattened to create a 'lay-flat' tube of film.



# Sheet and ribbon post extrusion haul-off system



The Thermo Scientific sheet and ribbon haul-off system can be used to accurately and continuously draw extruded sheet/ribbon/tape material from an extrusion process in a defined manner. The intelligent design allows for simplistic handling via single-side mounted rolls with variable height allowance for precise alignment to extrusion profile dies. Polished, liquid temperature-controlled chill rolls form a smooth and consistent product, while spring-loaded, rubberized pull rolls ensure proper tension and material draw.

## Films produced with this system can be evaluated for:

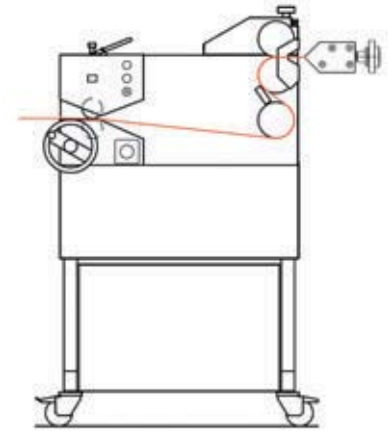
- small-scale production simulation
- surface finish characteristic
- pigment dispersion
- transparency
- color distribution
- homogeneity/consistency
- gel particulates
- contamination and/or occlusions
- long-term material behavior  
(weatherability, Xenon test, etc.)

## Applications:

- Profile Extrusion
- 2D Extrusion
- Sheet/Film Extrusion
- Three-Roll Stack
- Small-Scale Sheet/Film Production

## The Technology

The Thermo Scientific sheet and ribbon haul-off system is a fully functional, stand-alone type unit which can be combined with either laboratory or pilot plant extrusion lines. The sheet and ribbon haul-off features the following:



### Chill Roll Block

- two polished, chrome plated chill rolls; optional third nip (chill) roll
- provides extrudate with a smooth, consistent finish
- adjustable roll gap to the nip roll
- enables production of sheet/ribbon/tape material with a constant thickness up to 3 mm
- chill rolls allow for temperature control of material via separate liquid temperature control system (not included)
- versatile system allows functionality with a wide variety of materials
- all rolls are directly driven to eliminate frictional slippage
- variable speed range to allow for adaptation to extruder output capacity

### Pull Roll Block

- spring-loaded rubberized pull rolls
- adjustable speed ratio of the chill rolls to ensure film tension (0-10%)
- allows for compensation of uneven profiles, especially in start-up
- pull roll gap can be adjusted
- possibility for individual haul-off settings

### Winder (optional)

- optional winder with lateral traction
- allows for winding/collection of produced sheet/ribbon/tape
- automatic winder speed compensation
- eliminates necessity for diameter-dependent speed adjustments

### Speed Control

- electronic speed control
- manual or computer controlled-speed setting with data logging
- precise control for exceptional handling in start-up and test completion
- high resolution in low speed range
- elimination of 'jerking' at start-up, even at low haul-off speeds

### Handling

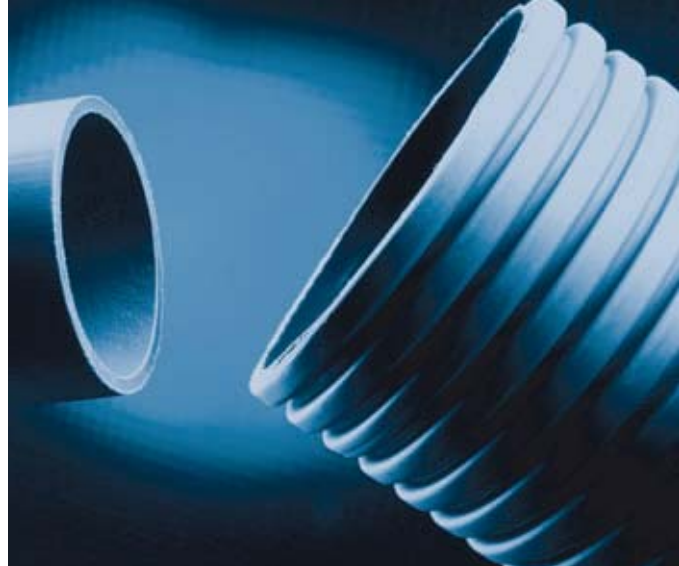
- mobile and compact unit
- variable height allowance for precise alignment to extrusion profile dies
- easy to use in the laboratory
- integrated drive unit
- ergonomic design
- operator-intuitive, fully integrated control electronics

## Technical Specifications

### Sheet and Ribbon Haul-off System

Roll diameter	110 mm
Roll width	200 mm
Roll surface	chrome – highly polished
Max. temperature	120°C or 200°C
Take off speed	0 - 10 m/min
Main supply	230V +/-10 % 50 - 60Hz
Max. current	6 A
Dimensions (L/W/H)	570/1130/720 mm
Weight	165 kg

# Better products through innovative sensors



## Modern sensors for online characterization

Sensors with CAN bus can be connected directly to the PolyLab OS system, and sensors without CAN open bus can be integrated using a special adapter to convert the analog measuring signals.

## Dynamic rheological spectrum (PAV)

A new rheometer sensor that implements dynamic squeeze flow with a piezoelectric actuator. With this sensor it is now possible to record over four decades of frequency of the material spectrum of a polymer melt in a few minutes. The specific advantage over conventional devices is the small size of the rheometer and the user-friendly, quick-connection made possible via a pressure sensor port (1/2" UNF).

## Color measurement on-line

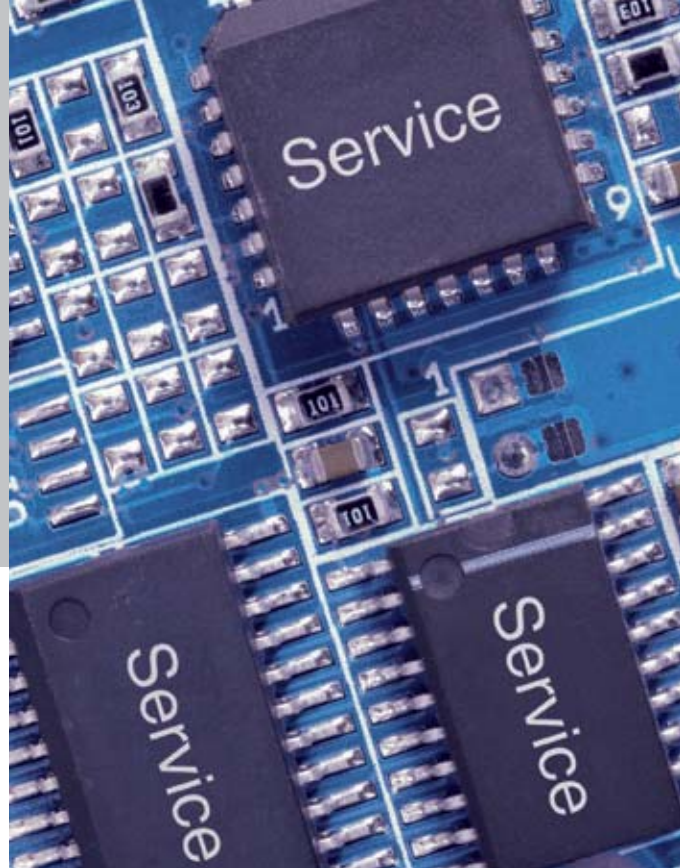
An optical color sensor delivers readily color-metric information ( $L^*$ ,  $a^*$ ,  $b^*$ ) online in the melt with the help of a UV/VIS spectrometer. The intelligent software correlates color data online and avoids time- and labor-intensive laboratory analyses of the finished product.

Torque sensor	Viscosity, degradation, energy consumption
Pressure sensor	Extrudability, flow resistance
Temperature sensor	Melt temperature, frictional heat
Conductivity sensor	Electric conductivity of compound
Gas volume sensor	Gas evolution during processing
PAV sensor (squeeze-flow rheometer)	Rheological spectra, MW, MWD
Optical spectroscopy (NIR)	Concentration of additives, humidity
Color sensor	Color code ( $L^*$ , $a^*$ , $b^*$ )

## Optical spectroscopy with chemo-metric software (NIR)

Optical methods often used in the laboratory can now be transferred to the processing environment (e.g. to an extruder or mixer). Near infrared spectroscopy (NIR) or Raman Spectroscopy are the preferred methods to analyze polymers during processing. This testing delivers on-line data about the changes in concentration and purity of additives or humidity during material processing.





### **Remote monitoring**

The monitoring of a running test series via web browser on a PC or handheld organizer (PDA) is possible with this powerful Thermo Scientific rheometer platform, as is the definition and composition of the entire test setup in a "job stream". These tasks can then be executed automatically by the software. The "job stream" includes the setup, the test run, and any desired data evaluation and report output. Alarms, error messages and hints for the operator are displayed automatically via pop up windows. Consequently, safe test runs can be guaranteed, along with substantial flexibility and information for laboratory personnel.



### **More safety**

Instrument downtime during process development can have serious cost consequences both in terms of costly repairs and project delays. Remote diagnosis of the HAAKE PolyLab OS System by trained engineers can determine when an on-site service call is needed for preventive maintenance. This can eliminate machine failure and speed the problem-solving process to reduce costs. The PolyLab OS System incorporates a comprehensive log- or history function that stores all alarm/error messages with real-time data in order to be able to reconstruct events. Log data can be read out via safe network connections or mailed directly to the support center. The support center can either correct the problem remotely or ensure that on-site service is provided. Calibrated assemblies can be shipped immediately and be replaced easily by the user or local engineers. Downtime risk is reduced dramatically to ensure project deadlines are preserved.

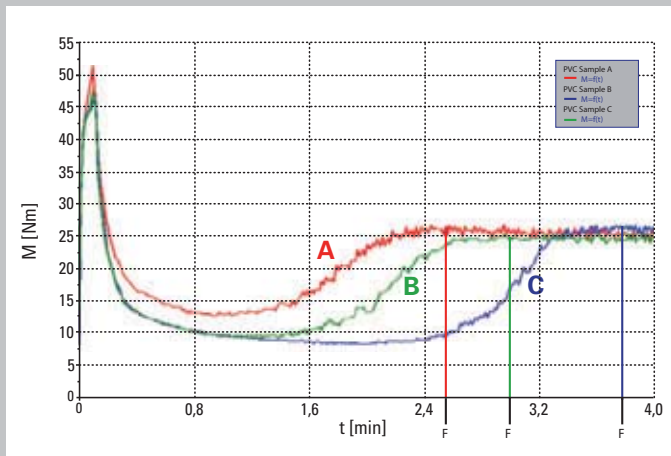


# Mixer measurements

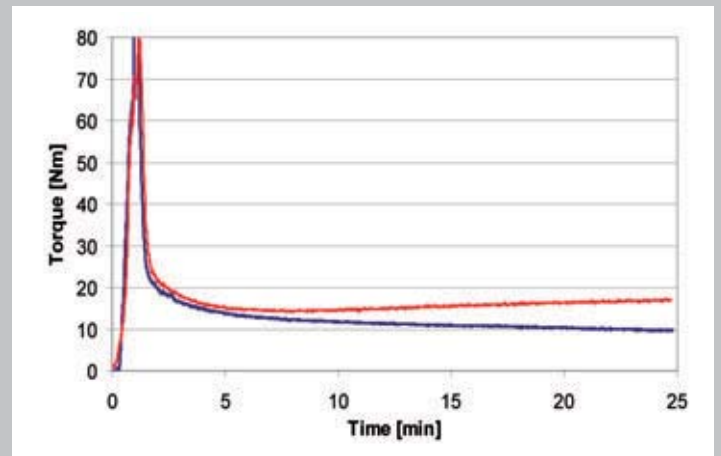


Laboratory Mixer

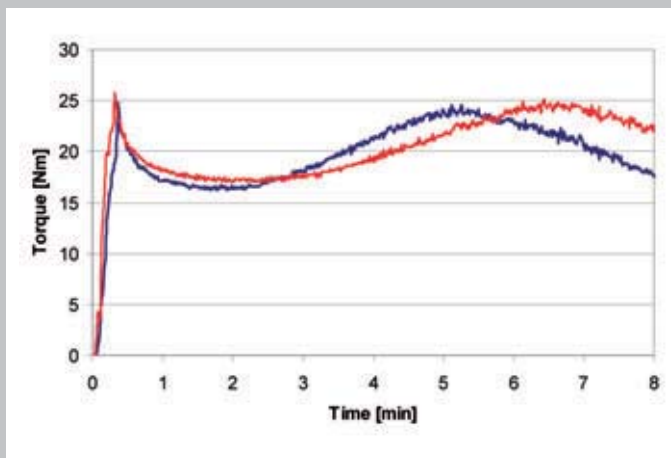
Small laboratory mixers are traditionally used to mix and/or measure the viscosity of a 40-70 g mixture as a function of time and temperature with different shaped rotors. Typical examples are PVC dry blend mixing, PVC degradation test, rubber/carbon black mastification, cross-linking of polymers, curing of resins, thermosetting properties



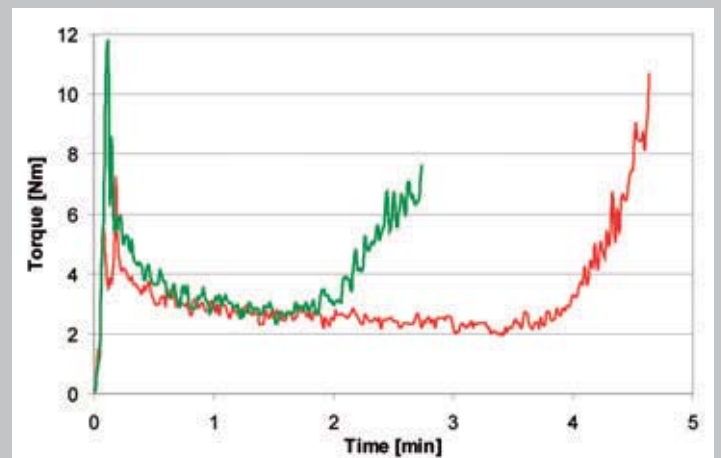
Comparison of PVC samples A,B,C having different content of additives.



Influence of Stabilizer on Polyamide PA6 (blue curve – no stabilizer).



Rubber-Compounds Batch 1 and 2 with the same Mooney Viscosity.

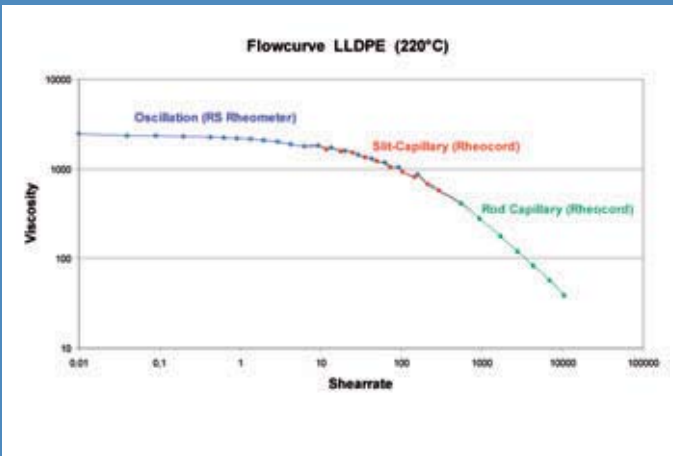


Cross linking of resin at 120°C of 2 samples.

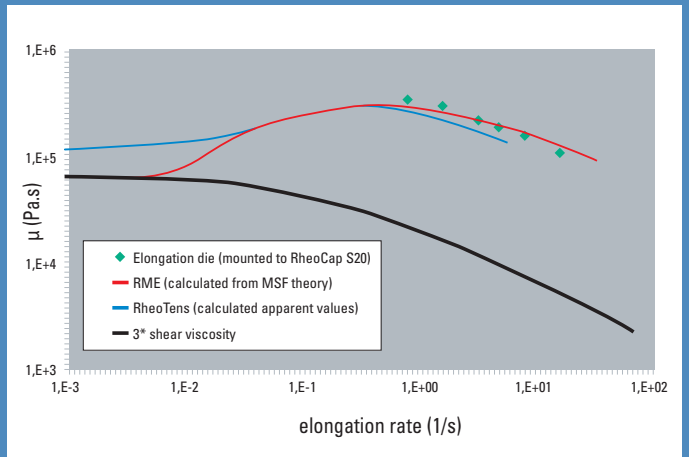
# Extruder measurements



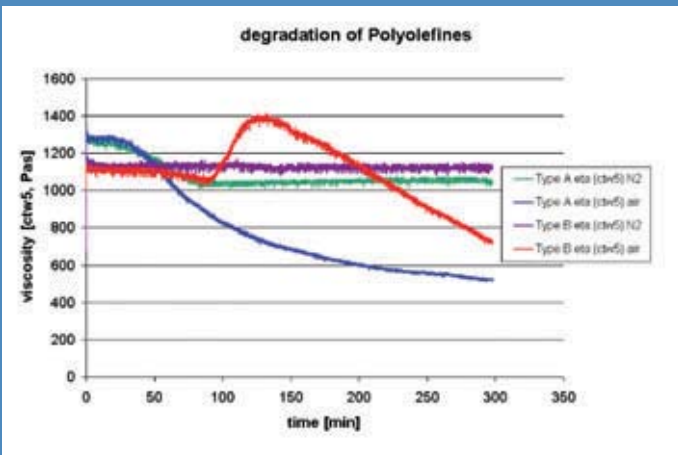
Extruders are melting and pumping polymers under pressure and shearing action of the screw through a die (at the end of the extruder) to form a solid material as film, strand or fibre. This extrudate is used as test specimen (cut with a pelletizer) or analyzed for defects and inhomogenities. The online measurement is reduced to processing power (torque), temperature and pressure but can be extended with optional inspection systems for content of components and humidity (NIR), color to detect degradation (UV-VIS) or video film inspection system with graphical analysis.



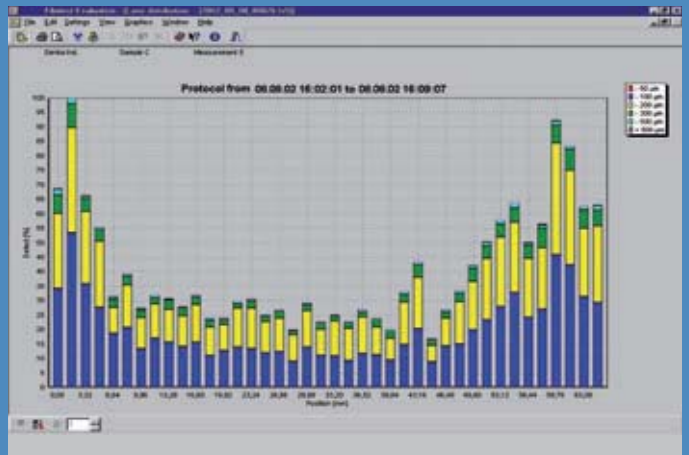
Flow behaviour of LLDPE over a wide range of shear using an oscillating rheometer and slit / capillary die on the extruder.



Extruder and melt pump to feed the X-die (elongation die) with test material. The elongational- and shear viscosity is monitored as a function of shear rate.



Stability test in re-circulating extruder of polyolefine samples with N2 purging (stable) and degradation.



Optical analysis of extruded film using image analysis software.



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