



- rheotalk special issue

# Polymer Industry feature

## polymer industries

Rheology Solutions offer material characterisation solutions to measure, monitor and provide reproducible data for quality control, development and production applications that will improve performance within the polymer industries.

### Services

An extensive range of technical articles have been produced specific to the challenges found within the polymer industry, these include:

- Quality Control in the Polymer Industry. Introduction to cutting edge technologies and their application in the polymer industry. *Rheo 023*
- Rheology for the Rubber and Elastomer Industries. Introduction to the influences of rheological and process parameters and methods for their measurement. *Rheo 024*
- Laboratory and Process Quality Control Techniques for Polymer Manufacturing and Polymer Process Industries. *Rheo 376*

- Tim's Top Tips – Explanation and Evaluation of Compounding. *Rheo 289*
- Tim's Top Tips – Explanation and Evaluation of Processability. *Rheo 290*
- Tim's Top Tips – Explanation and Evaluation of Sharkskin. *Rheo 291*
- Tim's Top Tips – Explanation and Evaluation of Die Swell. *Rheo 292*
- Tim's Top Tips – How to Measure Flow and Viscosity Curves. *Rheo 364*
- Tim's Top Tips – How to Measure Thixotropy. *Rheo 366*
- Tim's Top Tips - How to Measure Yield Stress. *Rheo 368*

Additionally, an information kit – Rheology Solutions for the Polymer Industries is available. Copies of the technical papers and the solutions kits are available on request from Rheology Solutions.

### Products

Polymer processing includes unit operations such as compression, injection and blow moulding and extrusion through a variety of dies. Specifically for the polymer industries, materials characterisation is of critical importance (including fluid related issues like sedimentation, time related structural

decay or build-up and post-cure issues like strength of compression or extension) for prediction and management of sharkskin, melt fracture, calendering, die swell, melt homogeneity and short- and long-term dimensional stability of extrudates or moulded parts. These processes depend on fluid rheological parameters such as viscosity, viscoelasticity, creep and recovery, and solid material properties such as behaviour under various compressive and extensional loading conditions. Extensional flow properties dominate processes where stranding occurs and influences time, quality and energy requirements.

Material characterisation parameters are reliable pointers for polymer performance and are critical factors for processability and product quality. Measuring these parameters will improve process and product performance within the polymer industries.

Rheology Solutions exclusively offers a range of instruments and equipment that can be used to quantify rheology related challenges specific for polymer applications. ●

● product focus

## Modular Torque Rheometer with Measuring Mixer

polymer industries

The Thermo Scientific HAAKE PolyLab QC with Rheomix 600 mixing chamber is temperature controlled.

The HAAKE PolyLab QC is a new modular torque rheometer which can be connected to an interchangeable measuring mixer, single screw extruder or conical twin-screw extruder.

A typical mixer test is run at a defined rotor speed (shear rate). The material's response to the shear is recorded as torque and displayed versus time.

Although the temperature of the mixing chamber is constantly controlled, the material's melt temperature during a test may rise due to the shear introduced. The recorded "Rheogram" (torque and melt temperature vs. time at constant speed) is characteristic for different material types and blends. It can be used as a fingerprint in quality control for outgoing and incoming product inspections. As changes in torque are related to

structural changes in the material, a Rheogram can be used to investigate and verify reactions of different additive types or concentration on the samples melting behaviour.

The HAAKE PolyLab QC Rheomix 600 is used to investigate:

- The melting and degradation behaviour of polymers
- Viscosity when adding nano particles or other additives
- Gelation and plastification behaviour of PVC dry-blends
- Flow and curing behaviour of thermosetting plastics
- The influence of different additives such as carbon black, fillers, lubricants, accelerators and sulphur for rubber mixers
- Masticating and vulcanising behaviour of elastomers
- Oil adsorption of carbon black
- Adsorption of DOP for PVC dry blends
- Torque in regard to individual and combined influences of fillers and additives
- Processability of plastics
- Electric conductivity measurements for rubber mixers ●



HAAKE PolyLab QC with Rheomix 600 floor model

● product focus

## Modular Torque Rheometer with Twin-Screw Extruders

polymer industries

The Thermo Scientific HAAKE PolyLab QC with the HAAKE CTW 100 QC twin-screw extruder is used for continuous compounding and plasticising is the ideal extruder in the HAAKE PolyLab QC system.

This is a counter rotating conical twin-screw compounder, with intermeshing screws, that will give well-defined residence time for faultless production of process-critical polymers.

The gentle but intensive dispersing capabilities are ideal to mix additives and pigments. Dies and downstream ancillaries are compatible with the 19/25 QC-D single-screw extruder.

### Applications

- Testing of the plasticising behaviour
- Testing the performance of additives and fillers
- Measuring of the melt temperature and pressure along the barrel to optimise process parameters
- Provide a homogeneous and constant flow melt
- Production of strands, sheets, cast and blown films
- Extrusion of ceramics and feed stock
- Melt rheology

### Features

- Rod dies & water bath for strand extrusion
- Sheet & ribbon dies
- Blown film dies & take off tower
- Filter test

The HAAKE PolyLab QC is available as a bench or floor model. ●



HAAKE PolyLab with extruder shown as a bench model unit

● product focus

# HAAKE MARS III – Modular R&D Grade Rheometer

polymer industries

The innovative Thermo Scientific HAAKE MARS III system has been designed for flexibility and meets the most demanding requirements in research and development with an architecture that permits integration of custom modules.

The concept is designed to meet today's and future rheology needs while protecting prior accessory investments.

### Key Features:

- Temperature modules with enhanced temperature control accuracy and expanded temperature module range for applications like starch and polymers
- Comprehensive accessory range to meet individual measuring needs like simultaneous measurements of rheology and optical properties, new measuring geometries and sample protection

- Optimised frame and easy handling due to quick-fit connections, user-friendly display and control panel
- Improved low-torque performance for sensitive samples
- Investment protection with compatibility for predecessor accessories
- Performance upgrade option allows existing HAAKE MARS customers to benefit from latest developments
- Multi-lingual Thermo Scientific HAAKE RheoWin software with fully automatic measuring and evaluation routines for professionals and beginners

### Application-specific solutions for Polymers:

- Controlled Test Chamber from -150°C to 600°C
- Solid Clamps for DMA tests
- SER tool for elongation measurements
- Disposable measuring geometries and sample loading tool for pellets
- RheoScope Module for observation of polymer melting behaviour
- Additional Software tools such as TTS, Spectrum, MWD ●



Thermo Scientific HAAKE MARS III System

● product focus

# Modular Twin-Screw Extruder

polymer industries

The Thermo Scientific EuroLab 16XL bench top twin-screw extruder is used for research, development, quality control, and small-scale production.

Prepare small or different samples in a short time with a minimum of product waste.

From sample batches of 50 grams up to outputs of 10 kg/h, the bench mounted 16 mm EuroLab XL twin-screw extruder is the heart of a complete compounding and sample preparation system. The segmented screw configuration with modular and extendable barrel design delivers flexibility for the full range of polymer processes.

A horizontally split barrel of 25:1 L/D can be changed to 40:1 with a bolt on, plug and play extension. Once attached, the extension is automatically recognised by the EuroLab 16XL and the heating controls appear on the touch screen. The segmented top barrel half is constructed in modules and is easy to reconfigure and clean. Barrel segments are available for feeding solids and liquids or for venting.

Secondary feeders and vacuum pumps can form part of the system.

A rugged, colour touch-screen interface incorporates real-time trending as standard. An option is available to log data on a remote computer for analysis and archiving. Also offered is a PLC control with real-time trending display and recipe storage to preset extruder parameters for repeatable process conditions. The advanced heater algorithm delivers precise temperature control. A low maintenance, brushless 2.5 kW motor drives the screws at 1000 rpm.

### EuroLab 16XL

- Versatile extruder - R&D, quality control and small scale production
- Extendable barrel delivers flexibility for full range of polymer processes ●

Thermo Scientific EuroLab Bench Top Twin Screw Extruder 16XL





*Optical Control Systems PS25C  
Pellet Inspection system*

## ● product focus **Pellet Scanner**

polymer industries

The OSC PS25C inspection system is used to analyse transparent and opaque pellets.

The pellets are inspected with a high-resolution 3-CCD-chip colour camera for impurities, foreign bodies, or colour deviations. The testing material is fed into the appliance through a hopper. Feeding can be automated by means of an extension module, e.g. a multi-hopper system or an online hopper. Moreover, an accurate colour measurement in a special measurement chamber can be carried out by means of colour spectrometry CM2 (option). The pellets are conveyed as one layer over the inspection zone via a vibrating channel. After the optical evaluation the contaminated pellets can be separated into a different container (sorting unit option). Measuring errors are eliminated by use of numerous additional optical components. There is no colour dependency as with many other optoelectronic appliances. A high level of efficiency is achieved by powerful image

processing software. The synchronisation of the transport system with the image processing offers a major contribution to the reproducibility of the measurement results.

Optimum adaptation in laboratory operations or in measuring stations is a paramount factor in the quality control. Installation in the bypass guarantees production monitoring and rapid reaction to any occurrences. The system provides a variety of individual configurations, which guarantees an improved adaptation to specific requirements. The measuring is stored in a test report to enable future analysis. The recorded images and measured data can be observed on a screen during the measuring process. The results can be shown and printed in tables or graphs.

Along with a pure inspection of pellets the system can also be used to record, file and document. Each defined deviation is recorded in the measurement protocol via a multidimensional characteristics vector with an error map. The system can be adapted exactly to the respective requirements with the help of the extensive software packages. ●

## ● product focus **Pellet, Shape, Size Distribution (PSSD)**

polymer industries

The OCS PSSD is a modular inspection system for the rapid analysis & classification of the size and shape of granules or resin.

The pellets which are to be inspected are moved by the vibrating table and are measured individually in the free fall between the camera and the light source. This universal measurement principle enables the system to analyse up to 50 kg granules per hour, depending on the granule size and its bulk density. The use of a high resolution CCD camera with automatic controllable lighting offers a continuous reproducibility of the measured results. This instrument can analyse granules and particles from 70 µm upwards (20 µm option), independent of their colour. The optimal operation in a laboratory environment,

as well as in an online measurement station is a paramount factor in the quality control. For example, when installed in a bypass of the production line, this system will allow for a fast response to production problems. The measured data are stored in a control protocol on the image processing computer to enable future analysis, and this data can be transferred to the control room. During the measurement process, the images and the stored data are displayed in real time on the monitor. The results can be shown in a table or in a graphic and can be printed as well. Not only can this instrument perform a precise analysis and classification of the granules, it can also be used for recording, archiving and documentation purposes. Each variation of the pellets shape, size, diameter, elongation, roundness, roughness and/or convexity will be recorded in the measurement protocol on a multidimensional characteristics vector with an error map. ●



*Optical Control Systems  
PSSD Modular Inspection System*



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