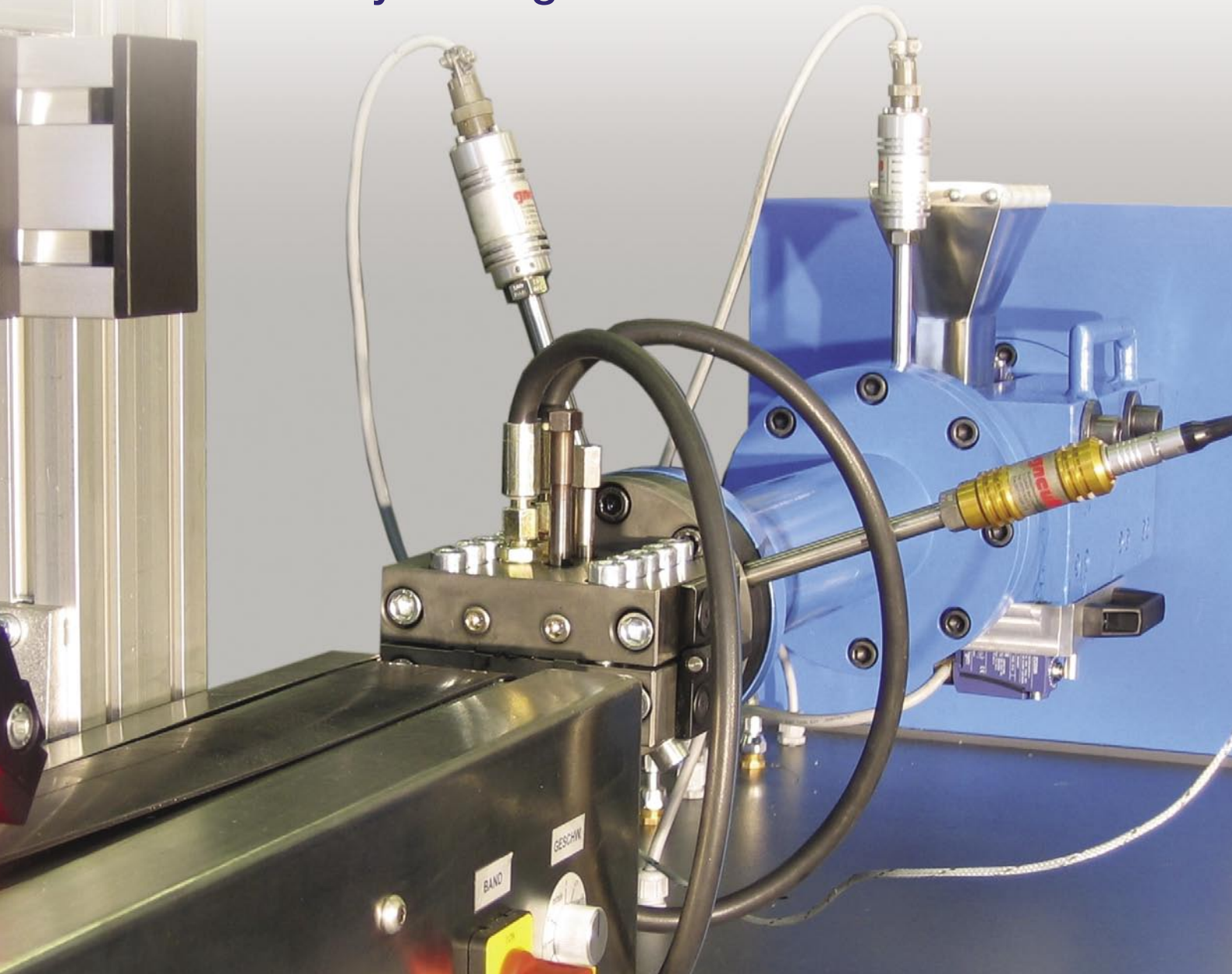


Quality control in the mixing room: ES 30 Quality Testing Extruder



Reliable quality test results

At the end of the production process, quality control tests frequently show significantly higher scrap rates than the average of 1% recorded in the mixing room. Current mixing room test methods are not always sufficient to safely detect potential problem compounds prior to their further processing. The Harburg-Freudenberger ES 30 Quality Testing Extruder provides considerable improvements in quality control in the mixing room.



ES 30 Quality Testing Extruder

The compact ES 30 Quality Testing Extruder system consists of a Laboratory Extruder, Rheometer, and the Profile Control PRC 20/40 surface roughness analyzer, the latter supplied by Pixargus GmbH.

The problem with current test methods used in the mixing room is that only 1% of compounds [1] are recognized as defective. However during further production processes significantly higher scrap levels are frequently recorded.

In many cases this can be related directly to poorly mixed or defective compounds that cannot be detected, in time, in the mixing room, with current test methods.

The ES 30 Quality Testing Extruder from Harburg-Freudenberger includes

- Compound surface roughness analysis
- Extrusion Rheometer data

for quality control in the mixing room.

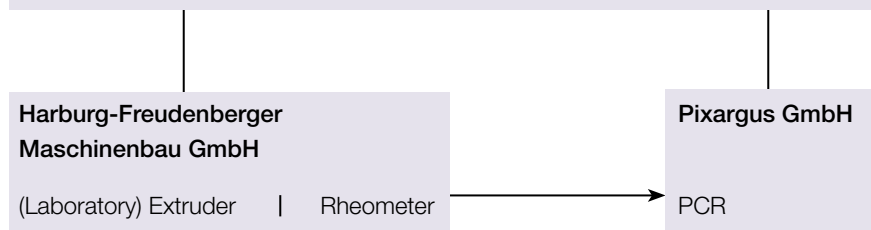
These methods are extremely sensitive [1-3] and are thus able to significantly improve the standard of quality control in the mixing room.

ES 30 Quality Testing Extruder

A joint development from Harburg-Freudenberger Maschinenbau GmbH and Pixargus GmbH consisting of:

- Extruder and optional Rheometer as separate systems from Harburg-Freudenberger
- PCR 20/40 as a separate system from Pixargus

The combination of three systems produces a comprehensive compound quality control system.



Laboratory Extruder

Compact design and construction

The extruder plasticizes the compound to be tested and extrudes a rubber strip. If setting parameters are known, tests can be completed within normal mixing cycle times, eg. within three minutes.

The extruder die includes exchangeable inserts and can be temperature controlled. Depending on the compound, small technical adjustments can be made to the die to extrude various strips for the optimal determination of the surface roughness.

Temperature Control Units and measuring equipment are placed inside the body of the compact ES 30 Quality Testing Extruder. The extruder feed section is equipped with a feed roll that can be removed for cleaning if required.

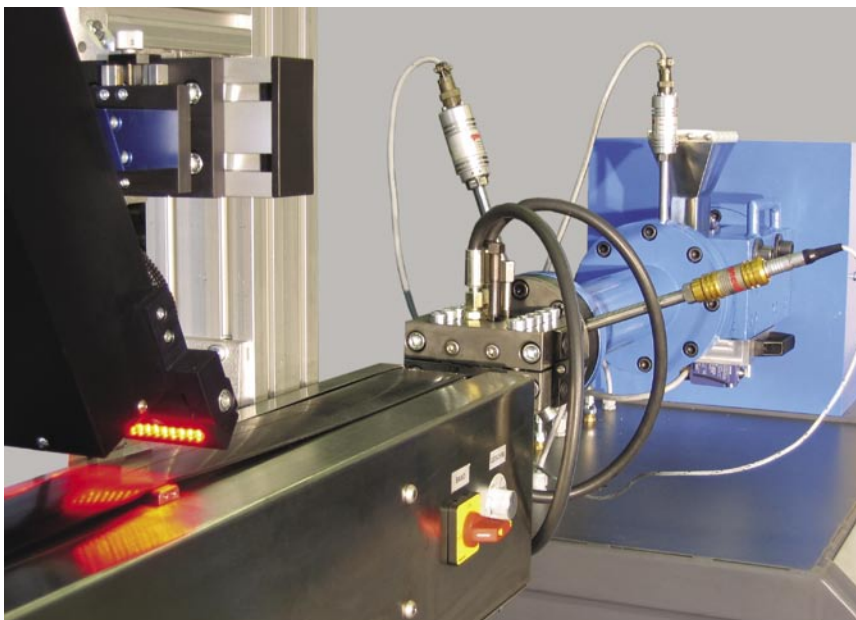
The extruder screw is temperature controlled and the extruder housing has a special, high dynamic, temperature probe in the feeding and metering zones, providing very short reaction times and accurate measurement.

The ES 30's screw design ensures the minimal use of compound and the L:D ratio of 18:1 guarantees stable machine operation. The benefits of this are:

- optimum temperature homogeneity in the compound
- minimum pulsation during extrusion
- a wide range of compounds can be processed

The ES 30 Quality Testing Extruder simulates the realistic deformation speeds of downstream processing procedures, for example extrusion. Thus the informational value of the rheological data measured is maximized. This is not the case for other test methods currently employed in the mixing room.

In use the ES 30 displays relevant process data such as screw speed, operating and compound temperatures and pressures. For further analysis the data can be retrieved through a standard interface. Benefit: Implementation of a documentation system is significantly improved.



Specifications

Screw diameter	mm	30
L : D Ratio		18
Effective length of strip	mm	540
Speed range	min ⁻¹	0 – 50
Rated motor power	kW	5,5

Surface roughness analysis

The surface roughness analysis is made through a camera system. An extruded rubber strip is analyzed for any surface defects (recesses and/or bulges) and these are statistically evaluated and quantitatively displayed in selectable size ranges.

The minimum measurable size of a defect is approx. 30 µm. As the human eye can only resolve down to approximately 100 µm, the efficiency of a purely manual visual examination system is clearly exceeded.

The probability that a non-dispersed particle in the strip can be detected on the surface is very high due to the width/thickness ratio of the extruded strip. Non-dispersed particles can result in scrap products in downstream production processes or finished products and surface roughness correlates directly to the dispersion quality of a compound.

Subsequently this methodology is of interest in applications where high surface quality is required as well as for the general determination of the dispersion level.

The ES 30 Quality Testing Extruder is ideal for the improvement of compound control, as the level of dispersion is one of the most significant criteria for compound quality. The system can be used for compound development as well as for the optimization of mixing cycles.

The ES 30 analysis's a larger and therefore more representative proportion of the batch within normal mixer cycle times. However none of the test compound is wasted and it can be returned to the production process following the roughness analysis.

Extrusion Rheometer

The ES 30 Quality Testing Extruder can also be used to carry out a rheological compound characterization. For this purpose the standard slit die can be upgraded to a Rheometer die [2, 3].

The principle is based on calculating shear stresses and shear rates by means of the pressure gradient and volume flow rate in the slit die flow channel.

The flow rate in the slit die flow channel can be changed by opening a bypass, while maintaining the same compound history.

Therefore two sets of measured values can be derived from one test run. As to date a Newtonian Plateau has not been measured in rubbers, two values are generally sufficient to describe shear viscosity within the entire shear rate. For subsequent processing the information and in particular the constancy of this factor is significant.

The European Research Project "Mini Derucom" [1,2] describes the benefits of a Quality Testing Extruder by deploying the surface roughness analysis and the Extrusion Rheometer.

- [1] Limper, Keuter: Quality Assurance in the Rubber Mixing Room; Dr. Gupta Verlag, Ratingen
- [2] Review of European Rubber Research in Practice - Mini Derucom and Prodesc; Conference Proceedings of the International Conference, held on January 9 - 10th 2002, Paderborn, Germany.
- [3] Glabisch, Holzmüller, Limper: Chargenprüfung von Kautschukmischungen mittels eines Extrusionsrheometers in: Mischungsherstellung der Elastomerverarbeitung, VDI Verlag GmbH, Düsseldorf 1998

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Harburg-Freudenberger Maschinenbau GmbH
Gummimischtechnik
Asdorfer Straße 60 • 57258 Freudenberg • Germany
Postfach 11 80 • 57251 Freudenberg • Germany
Tel.: +49 2734 491 - 0 • Fax: +49 2734 491 - 150

Harburg-Freudenberger Maschinenbau GmbH
Kautschuktechnik • Speiseöltechnik
Seevestraße 1 • 21079 Hamburg • Germany
Postfach 90 05 52 • 21045 Hamburg • Germany
Tel.: +49 40 77179 - 0 • Fax: +49 40 77179 - 325

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