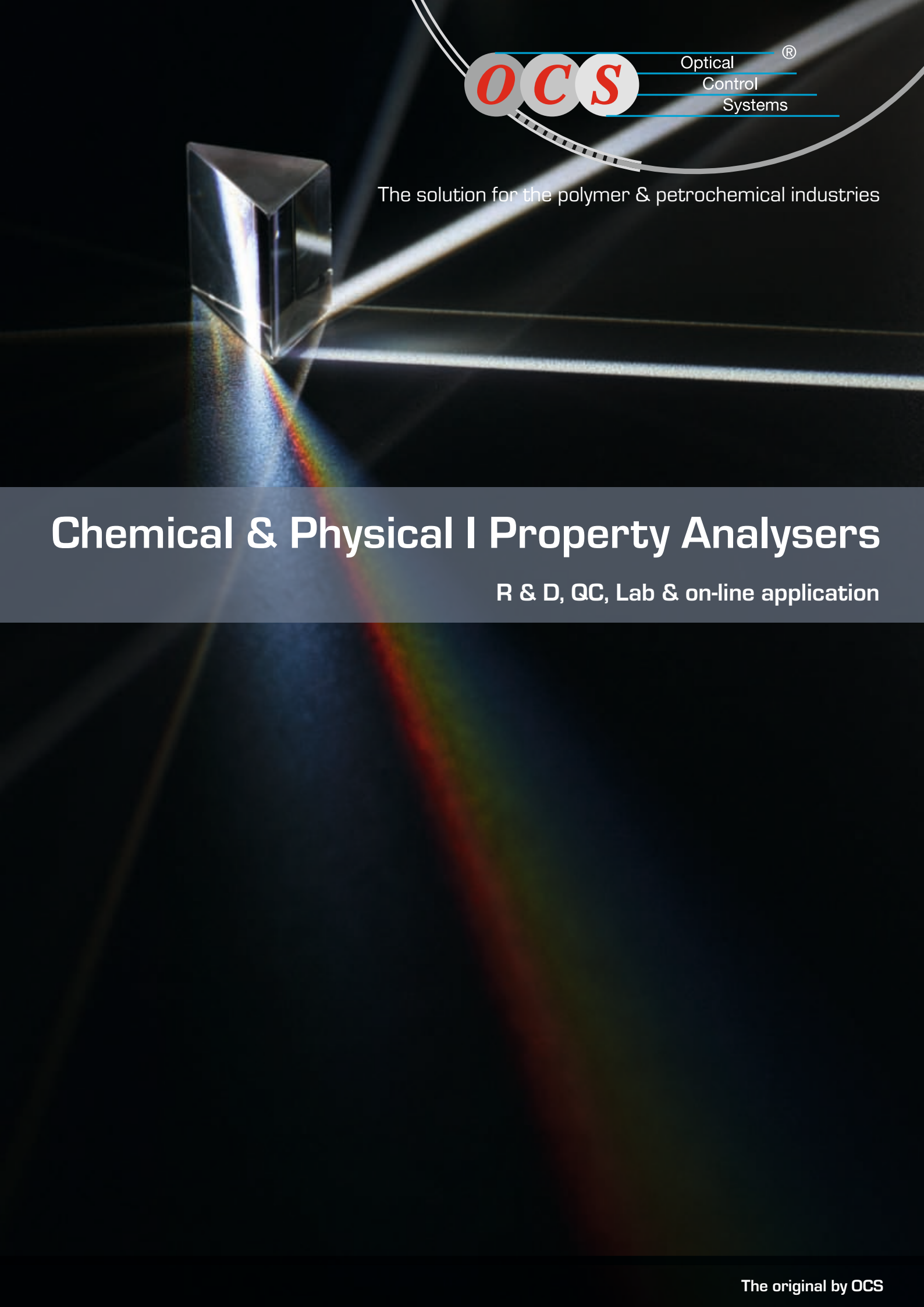


Optical Control Systems®

The solution for the polymer & petrochemical industries

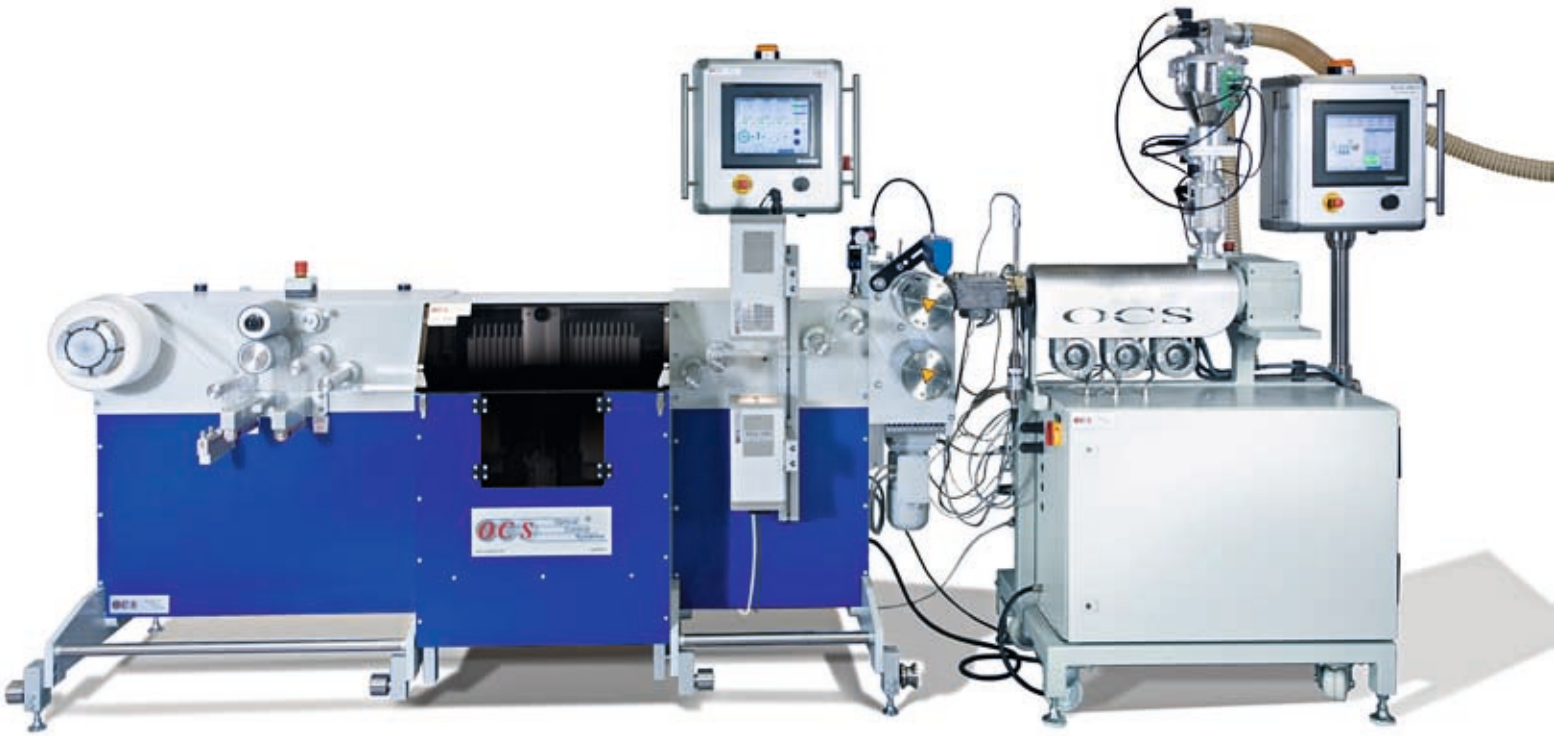
# Chemical & Physical I Property Analysers

## R & D, QC, Lab & on-line application

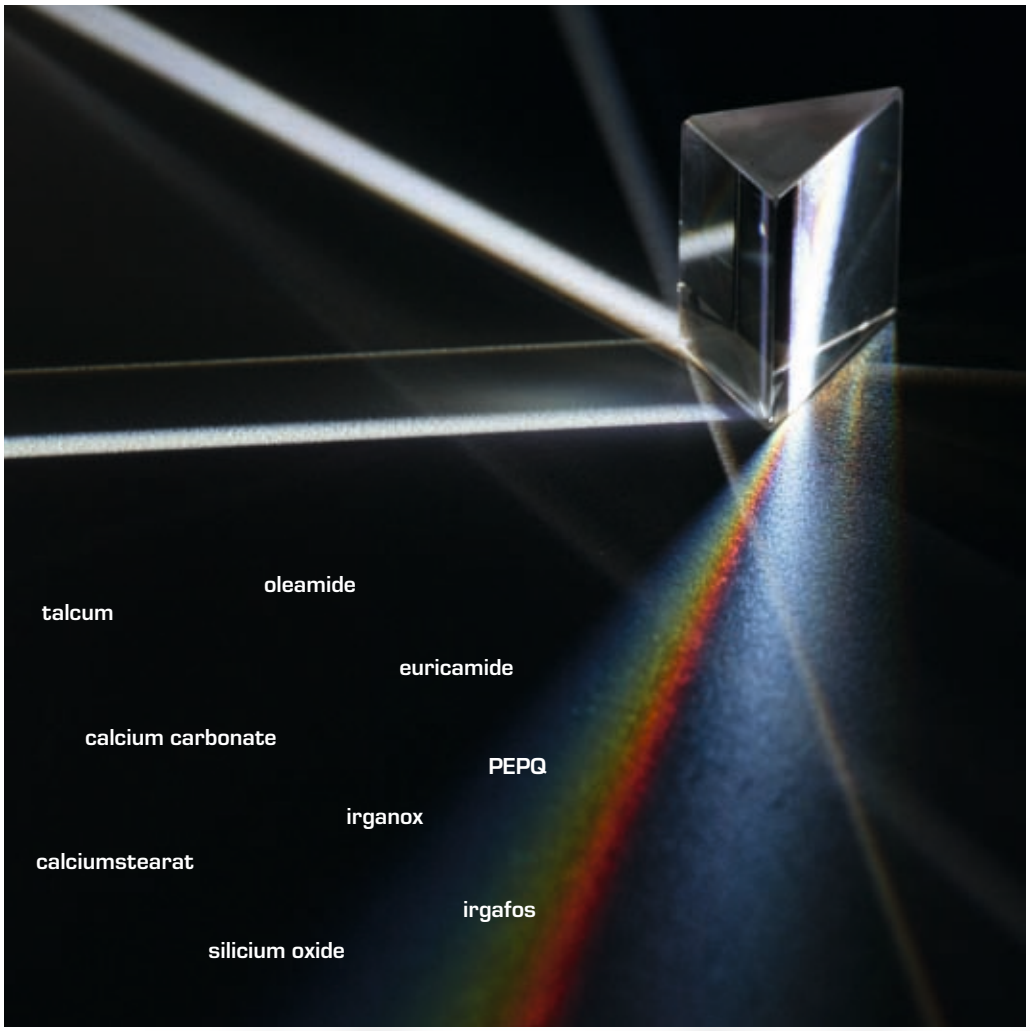
The original by OCS

# On-line FT-Infrared spectroscopy system APLAIRS®

APLAIRS® (Analysis of Plastics by InfraRed Spectroscopy) is a spectroscopic technology, applied in the modern plastic industry, to measure real time additives, co-monomer composition as well as some chemical properties during the production of the base resin. For state of the art process as well as quality control, the APLAIRS® system, is an absolute requirement in modern plastic production facilities. With a better precision and a faster analysis time, this single technology replaces most of the conventional off-line quality control (QC) methods. For process control, in addition to melt index and in homogeneity, the APLAIRS® system generates real time very useful complementary analytical data. For example, for products with a similar melt index and a different additive package, APLAIRS® will be able to accurately monitor type changes. In addition, the technology offers tools for monitoring real time co-monomer incorporation. Physical property such as density in polyethylene can be determined real time, with a better precision than the off-line column gradient or Archimedes methods. The technology provides early warning in erroneous master batch preparation, which in many cases avoids huge customer claims. As this technology replaces many conventional QC methods, savings in labour cost are considerable. The APLAIRS® system is fully automated and no people are needed to run the system.



# Additive & density measurement




## Measuring principle

A continuous flow of cast or blown film runs through a special infrared sampling section of the APLAIRS® system, which is equipped with an FTIR spectrometer and controlled by dedicated software.

APLAIRS® focuses on film measurements, although infrared spectroscopy can also be applied to melt samples. Measuring in the film has more advantages than measuring in the melt:

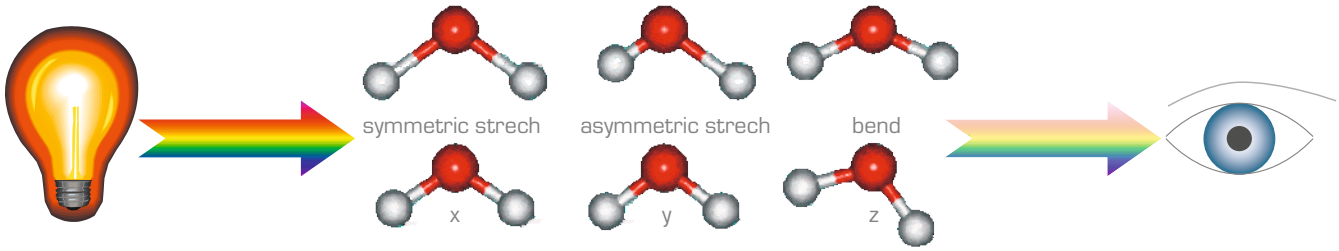
Films are closer to the end product and for that reason a direct link is made with standard QC Analysis.

Physical properties not only depend on chemical components but also on the morphology of the resin.

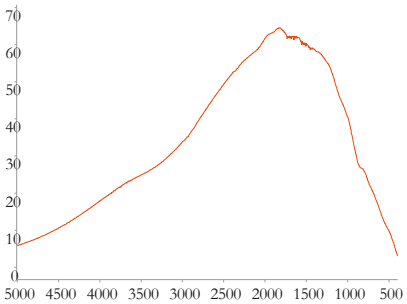
The morphology and chemical information concealed in the spectra can be abstracted by APLAIRS® and linked with physical test data.

Thickness of films can be accurately determined. In addition, it is possible to determine the composition and thickness of different layers in co-laminates. Other analytical techniques such as gloss and haze measurements can be far easier linked to a film line, making the assembled configuration inexpensive.

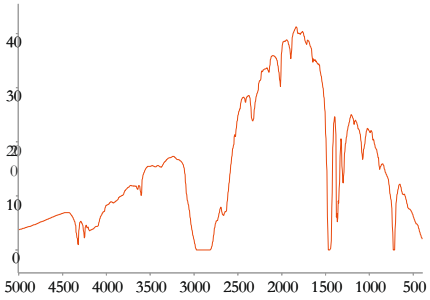
# Interaction of IR Light with molecules




Initial Energy Spectrum

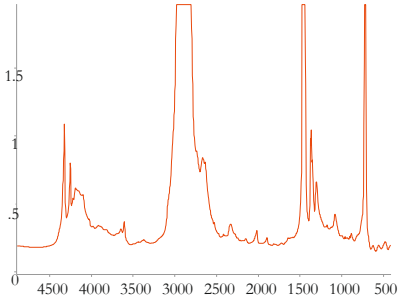



Transmission Spectrum




Absorbance Spectrum

$A = b \varepsilon C$




## APLAIRS® software

The APLAIRS® software is an essential part of the technology package. It offers the application and prediction of calculated multivariate calculation models. These calibration models can be calculated with an optionally available software tool. This offers sophisticated tools for the analytical specialist to develop tailored calibration models, as well as easy to understand and fool proof menus for the operators.

With the calibration model development package regions in the spectrum can be selected and processes to such an extent that relevant multivariate data is correlated with QC data. By incorporating a selection of so called calibration spectra of samples with known QC data, the relevant spectral data is abstracted and mathematically pre-processed and linked with the QC data to form calibration models. These calibration models can be used in the real-time mode to predict the relevant QC data of the specific product.

During the real-time analysis various QC parameters are displayed on the computer screen and history data is available for process or quality control.

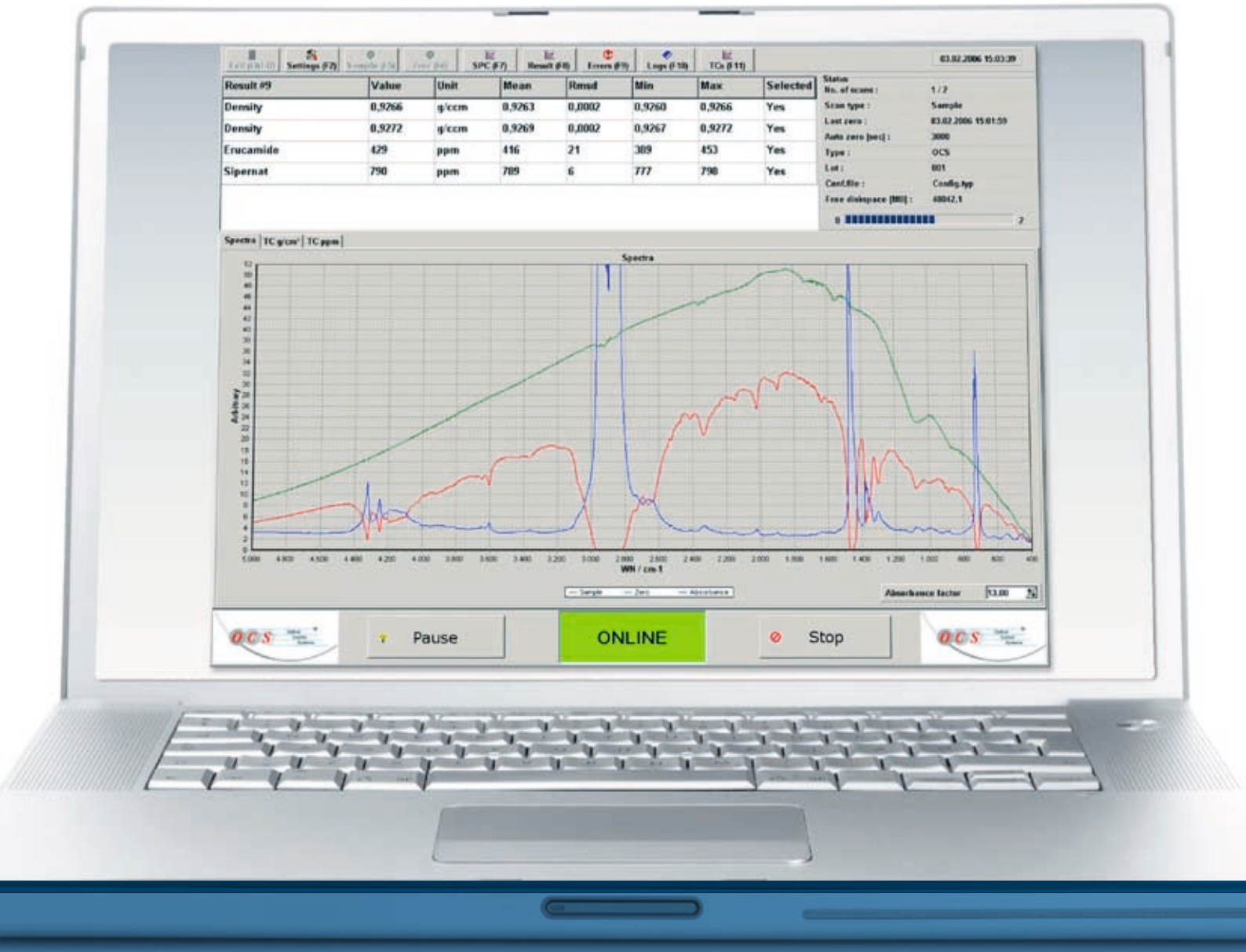
In many applications the QC data is sent to the process computer allowing panel operators to follow the process and quality people to follow the quality of the process. Depending on customer requirements the QC data can be further processed to LIMS (Laboratory Information Management Systems) for the generation of quality reports. If required spectral data can be stored during upsets or any defined process, allowing trouble shooters to research certain events. During standard operation the software is monitoring many features in the background and if desired the software can trigger alarms if certain events require special attention or operator intervention.

## Modular quality analysis & economical impact

The technology offers a platform for adaptive quality control and the QC parameters to be determined are totally dependent on the desire of the customer. Once a certain QC parameter prediction has been developed others can be added on without the investment of any hard or software. For example if one has developed a QC prediction calibration model of an additive like calcium carbonate, a next additive can be added on and so forth.

There are many customers who have established a whole range of QC predictions with one APLAIRS® unit, i.e. additives like euricamide, oleamide, talcum, calcium carbonate, calciumstearat, silicium oxide, PEPQ, irganox, irgafos, etc, but also chemical composition like attacticity-, ethylene- and carbonyl content as well as physical properties such as density or parameters like thickness. There are examples of QC calibration predictions of more than 20 QC parameters with one instrument.

Considering the versatility of the technology, it is obvious, that one investment will pay off big time if many QC parameters are incorporated and hence replacing laborious off-line QC methods. The APLAIRS® system with its vast field of applications has been applied in many fields: LDPE, LLDPE, HDPE, PP, ABS, PS, PET, EVA, PC etc. Especially in the production environment the instrumentation can really make the difference in terms of quality monitoring. The impact is tangible in many fields. With the technique there will be less customer complaints, the quality of the product will be more consistent, type changes can be followed with greater ease, extra eyes are provided for process control and safe guarding of various processes, labour cost is reduced significantly and the technology also provides a powerful tool for root cause analysis. Typically the investment of one APLAIRS® unit is paid off in less than one year.




## APLAIRS® based on following basic principles:

- Reliable, robust and extremely precise FTIR spectroscopy for quality control in an industrial process environment
- Enhanced processing capabilities by the exploitation of state of the art hardware FFT processing
- Full automated computer control of spectral acquisition, background recording, instrument control performance monitoring, alarming and computer interfacing with process host
- Modular quality analysis. Conventional as well as multivariate based analysis can be applied and any customer specific analysis can be incorporated in the software
- Configuration of user specific product types and related time resolved statistical processing with flow chart display for process monitoring and control
- Process optimisation by measuring physical property

## APLAIRS® can be used for the following applications:

- Chemical composition of the material: from analytical functional groups to analysis of co-polymer composition
- Determination of additives, i.e. antioxidants, slip agents, UV-Absorbers, stabilisers, fillers, processing aids or other
- Determination of the film thickness for a single- or a multi layer
- Determination of the physical properties like for example the density in polyolefins

# On-line Thickness Measurement System TM9


The on-line Thickness Measurement System TM9 was designed for the continuous thickness measurement of running strips of film for laboratory and production line.

The measuring system uses an incremental length gauges. The film runs between two independent measuring wheels, respectively one is fixated. The second wheel, and also the force it exerts on the film, is variably adjustable by using a spring. The thickness measurement of a film is due to the distance measuring between both wheels, seized by the connection of a sensor and the movable wheel.

The measurement can be accomplished in certain distinct adjustable amounts (every second) and the results are averaged over a certain, also distinct adjustable length. Thereby the thickness of a film is displayed in µm.
Furthermore the TM9 was constructed to optimise the production of film. To meet this requirement it is optimally used in combination with the OCS measuring extruder (ME) and OCS' chill roll and winder unit (CR9/WU9) which are optionally endued integrated infrared spectroscopy.
The TM9 can be controlled, mounted on the CR9, by the same PC as the film surface inspection system FSA100. So the same software which receives information from the FSA100 camera, processes sensor information from the TM9 – as a result the user is simultaneously supplied with all necessary data of possible modifications in thickness and of surface during the film control process.

Moreover, for ease of abridgement, there is the feasibility to print out the different measuring results in the same protocol.


## Performance Characteristics

- On-line measurement
  Measurement can be taken during running production
- Operation
  Distance measurement by incremental measuring sensor
- Control
  VFD-Display
  4 control buttons
- Modular architecture
  Simple possibility of adaption
- Adjustable averaging

## Technical Data

- Measuring
  Resolution: 1 µm
  Range: up to 5000 µm
  Time: 0,1 sec.
- Measuring principle
  Incremental measuring sensor for distance measurement
- Averaging
  0,1 – 10 sec
- Device interface
  Serial interface RS 232, RS 485
  MODBUS RTU protocol
- Size dimension
  [l, w, h] 17,5 x 19,5 x 36
  Weight approx. 12 kg
- Power supply
  115 V AC – 230 V AC, 50/60 Hz
- Temperature
  10 – 40 °C

Optional

- Computer
  Industrial Intel®Core™ 2 Duo
  Up-to-date-technology
- Software
  Operating system Windows XP Professional (latest technology)
- Physical interfaces
  [DC per external server]
  Ethernet 10/100/1000 M Base T, USB, RS 485, RS 232, digital & analogue I/O
- Communication protocol
  [DC per external server]
  MODBUS RTU, MODBUS TCP/IP, OPC, SQL, file transfer, PROFIBUS
  Implementation to other Fieldbus-Systems possible

Technical alterations are subject to change without prior notice

# On-line Haze Measurement System Gamma12


The functional measurement principle of Gamma12 complies with the standard ASTM 1003. The measurement sample is passed across the opening in an integrating sphere so that parallel light can pass through the sample into the sphere. The intensity of the scattered light can be collected using a high-precision sensor by means of the dispersion of the transmitted beam. Beams with dispersion angles exceeding a standardised value cannot leave the sphere through the exit and are reflected by the sphere surface. The intensity of the scattered light is measured after multiple reflections within the integrating sphere.

The intensity of the total light transmitted can be determined by measuring with the sphere exit closed. The haze value is calculated from the ratio of the scattered light and the total transmitted light.

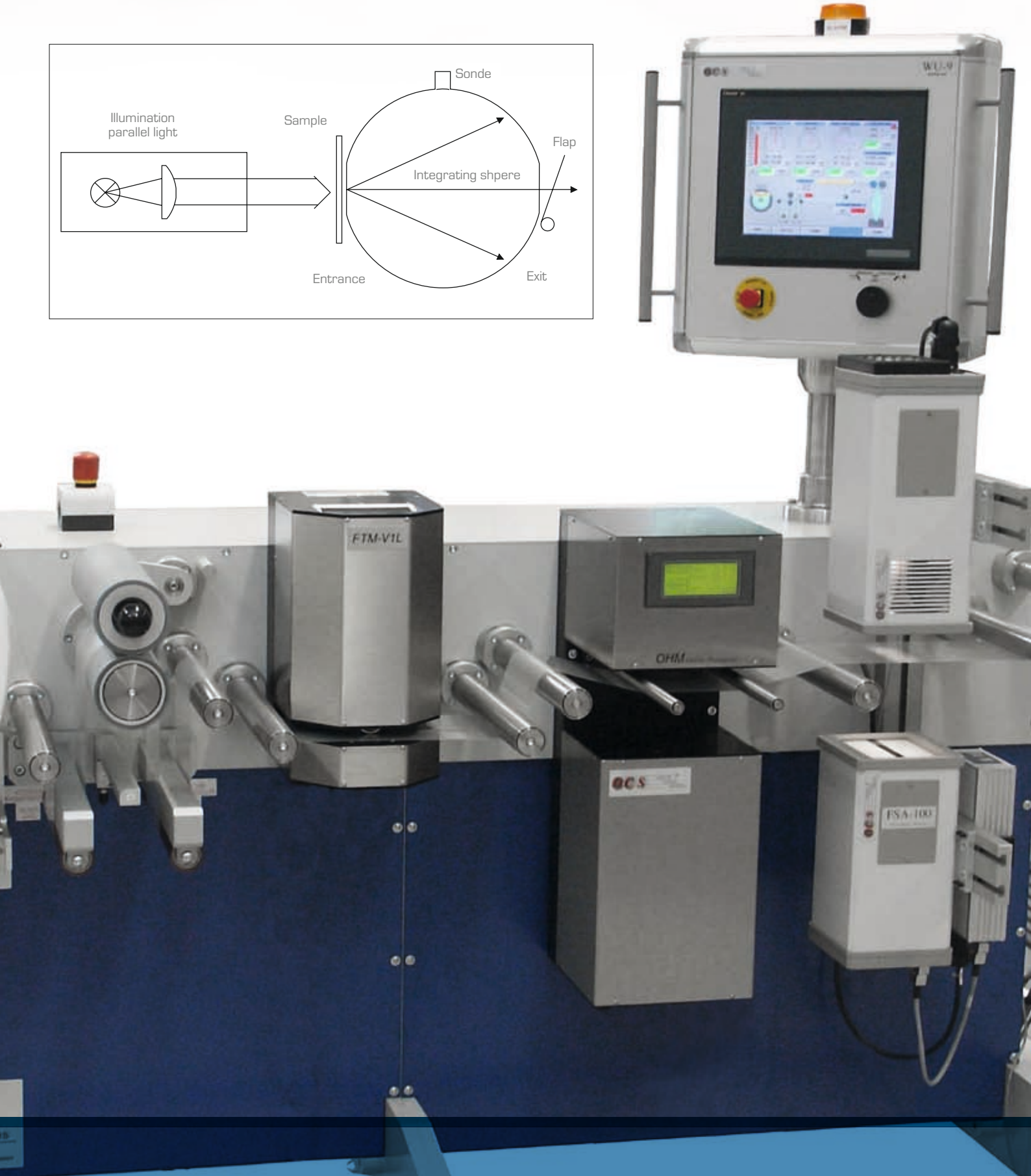
In addition to the haze, the transmittance of the sample is measured. This is derived from the ratio of the total transmitted light and the intensity of the illumination. The measurements are shown on-line on a display as percentages and therefore provide an objective indication of quality instead of a visual subjective assessment.

The measurement results can be documented and analysed with high-performance software tools owing to the link via Ethernet interface.


## Performance Characteristics

- **On-line measurement**
  Measurement can be taken during running production
- **Control**
  Graphic touch panel
- **Optimum lighting technology**
  Modulated LED light source in order to avoid temperature- and ambient light influence
- **Multi-point calibration**
  Simple multi-point calibration
- **Fault diagnosis**
  System monitoring by means of a continuous self-test of the hardware components
- **Easy touch**
  Simple menu-guided desktop controlled by graphic touch panel
- **Signal processing**
  Use of modern LOCK-IN amplifier technology
- **Data interface**
  Data transfer and remote control via Ethernet interface and MODBUS TCP protocol
- **Open database**
  The protocol data can be converted into all standard data formats (Access, Excel, etc.)

Sonde
Illumination
parallel light
Sample
Flap
Integrating shpere
Entrance
Exit


FTM-V1L
OHM
FSA-100


## Technical Data

- Standard
  ASTM D 1003–95
- Measurement
  Area Ø 22mm
  Accuracy ± 0.2%
  Range haze 0.0 % to 100.0 %
  Range transparency 0.0 % to 100.0 %
- Spectral adaptation
  CIE standard spectral value function V (λ)
  under standard light type C
- Device interface
  Ethernet 10/100 M Base T
  MODBUS TCP protocol
- Size dimension
  [l, w, h] 27,5 x 22 x 63 cm
  Weight approx. 25 kg
- Power supply
  115 V AC – 230 V AC, 50 Hz/60 Hz
- Temperature
  10 – 40 °C

Optional

- Computer
  Industrial Intel®Core™ 2 Duo
  Up-to-date technology
- Software
  Operating system Windows XP Professional
  (latest technology)
- Physical interfaces
  [DC per external server]
  Ethernet 10/100/1000 M Base T, USB,
  RS 485, RS 232, digital & analogue I/O
- Communication protocol
  [DC per external server]
  MODBUS RTU, MODBUS TCP/IP, OPC, SQL,
  file transfer, PROFIBUS
  Implementation to other Fieldbus-Systems
  possible
- Remote control
  Via RS 232

Technical alterations are subject to change
without prior notice

# On-line Gloss Measurement System GM5

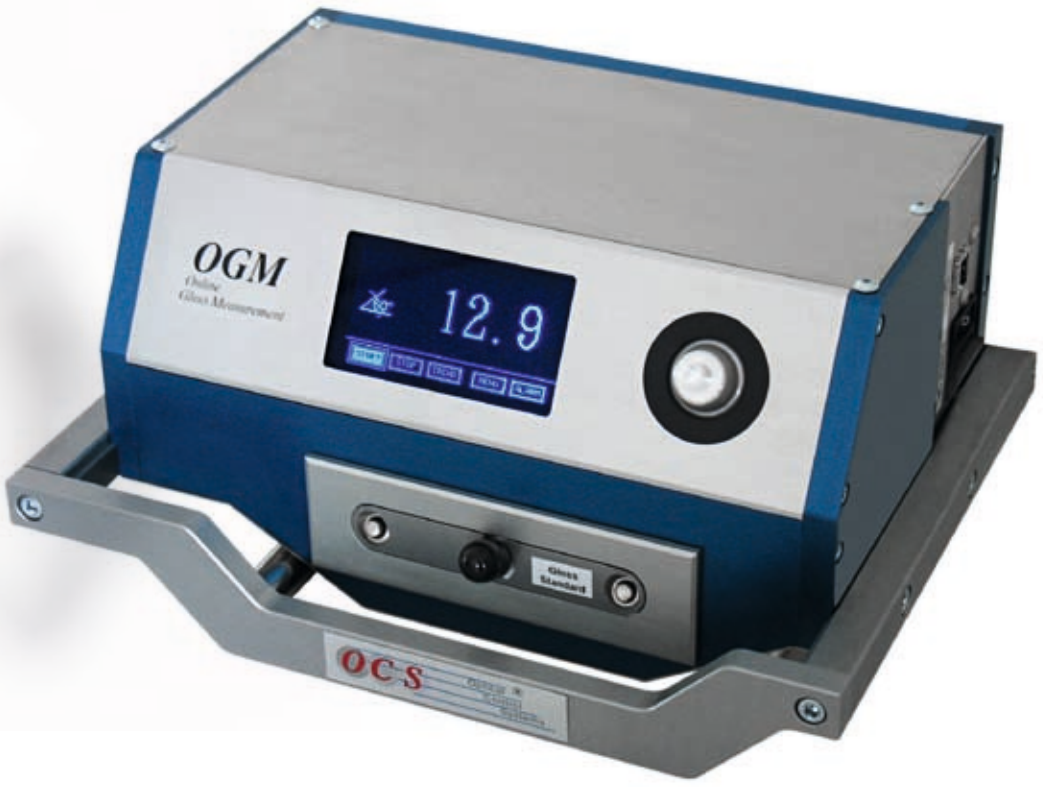
The gloss measurement system GM5 was designed for an everlasting and precise control of film gloss properties and is used in laboratory as well as on production lines.

It detects the particular gloss characteristics of films by using their differential ability to reflect light, according to the knowledge that films are not to be endued of the same reflection force. It measures specular reflection. A special LED lighting unit lights the running film. A photo-detector collects the beams of coherent light which is glossed back and measures the quantity of gloss on a continuum from matt to illustrious. The user achieves only one result in GU (Gloss Units).

The measurement process is automatically controlled by background measuring and calibration. Furthermore the sensor signals are digitised after analogue processing.

Moreover, the gloss measurement was constructed to optimise the film production. To meet this requirement it can be optimally used in combination with OCS` measuring extruder (ME) and chill roll/winder unit (CR9/WU9). By mounting the GM5 on the CR9/WU9 it can be controlled by the same PC like other OCS quality control add ons, e.g. FSA100 and Gamma12. The same software which receives information from FSA 100 surface measurement processes sensor information from thickness and gloss measurement- as a result the user is simultaneously supplied with all necessary data during the film inspection process.

OCS gloss measurement is certified under ASTM D 523, DIN 67530, EN 14086. ASTM D 2457




## Performance Characteristics

- On-line measurement
  Measurement can be taken during running production
- Control
  Rotary encoder and graphic panel
- Optimum lighting technology
  Modulated LED light source in order to avoid temperature- and ambient light influence
- Integrated reference standard
  Automatic calibration process
- Fault diagnosis
  System monitoring by means of a continuous self-test of the hardware components
- Data interface
  Data transfer and remote control via Ethernet interface and MODBUS TCP protocol

## Technical Data

- Measuring angle
  60° : DIN 67530
  45° : EN 14086
  45° : ASTM D 2457 (0 – 150 GU)
- Measuring
  Range 0 – 200 Gloss units (GU)
  Speed 1/sec
  Area 3 cm²
- Indicator's resolution
  0,1 Gloss unit (GU)
- Averaging
  1 – 50 sec
- Lighting
  Special LED lighting
- Detector
  Silicon photo detector
  Spectral evaluation V (λ)
- Device interface
  Ethernet 10/100 M Base T
  MODBUS TCP protocol
- Size dimension
  (l, w, h) 16 x 31,5 x 32,5 cm
  Weight approx. 13 kg
- Power supply
  115 V AC – 230 V AC, 50/60 Hz
- Temperature
  10 – 40 °C


Optional

- Computer
  Industrial Intel®Core™ 2 Duo
  Up-to-date-technology
- Software
  Operating system Windows XP Professional
  (latest technology)
- Physical interfaces
  [DC per external server]
  Ethernet 10/100/1000 M Base T, USB,
  RS 485, RS 232, digital & analogue I/O
- Communication protocol
  [DC per external server]
  MODBUS RTU, MODBUS TCP/IP, OPC, SQL,
  file transfer, PROFIBUS
  Implementation to other Fieldbus-Systems
  possible

Technical alterations are subject to change
without prior notice

*»Inspired synergy«*

*OCS*

OCS on-line equipment is very well known in the polymer industry world wide. Basis is long time experience in using modern process analysis and process control. These methods are founded on interdisciplinary technical rules as process technology, optical and physical fundamentals and analytical know-how.

By using OCS on-line analytical, the polymer process is ameliorated (process capability is definitely increased), the quality grows as well as the constancy, and the economy of the plant is also significantly increased.

With a highly skilled and innovative team of development and production engineers, OCS offers top-class technology and know-how worldwide- always up to date because of systematic research and development work.

Europe, USA, Canada, South America, Asia and Australia: Leading suppliers in the petrochemical and polymer industry benefit from the use of OCS products.

GE PLASTICS
SABIC
LYONDELLBASELL
BOROUGE/BOREALIS
INEOS
BRASKEM
CLARIANT
INDIAN OIL
ARYA SASOL
NEXANS
QAPCO
PETROCHINA
DUPONT
EXXONMOBIL
TOTAL
DSM
BASF
REPSOL
ARKEMA
NOVA
CABOT
MITSUI
MITSUBISHI
RÖHM & HAAS
SOLVAY
JAPAN POLYETHYLENE
TETRA PAK
DOW
BAYER

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