Malvern Panalytical
a **spectris** company

EPSILON 4
POLYMERS, PLASTICS & PAINTS

INCREASE YOUR POLYMER **PRODUCT CONSISTENCY**

Highly repeatable and simple operation

Your customers demand superior consistency of polymer properties regardless of production time and place. The Epsilon 4, an energy dispersive X-ray fluorescence (EDXRF) benchtop spectrometer, provides elemental analysis with superior repeatability and accuracy, enabling you to produce more consistently.

Ease-to-use measurement procedures, limited utility requirements of the spectrometer and unique calibration solutions, enable direct and accurate analysis by process operators without requiring analytical training.

The Epsilon 4 delivers reliable results for months without recalibration. Therefore, you can fully focus on product quality for your customers.

Epsilon 4's value for polymers, plastics and paints

- Unmatched analytical precision and accuracy
- Unique calibrations solutions that last for years
- Easy to use with minimal training
- Less than 1 € / analysis cost of operation
- Minimum downtime and maintenance
- Non-destructive analysis
- Low utility requirements for at-line analysis
- Elemental screening of unknown samples

Process control
Fast and trace-level analysis of elements like titanium, silicon, calcium and phosphorus for improved product consistency

Final quality control
Epsilon 4 can be used for a final inspection to ensure quality and composition. Products of different shapes and thicknesses are analyzed in large sample mode.

Raw material inspection
Quality control and RoHS compliancy of incoming materials, like virgin- and recycled polymers, additives, filters and fibers.

Claim analysis
"FingerPrint' software can aid in quickly identifying 'friend from foe', which enables product verification. The Epsilon 4's sensitivity makes it a real detective.

Coatings and thin materials
In combination with the multi-layer analysis package Stratos, composition and thickness of coatings and thin materials are precisely determined.
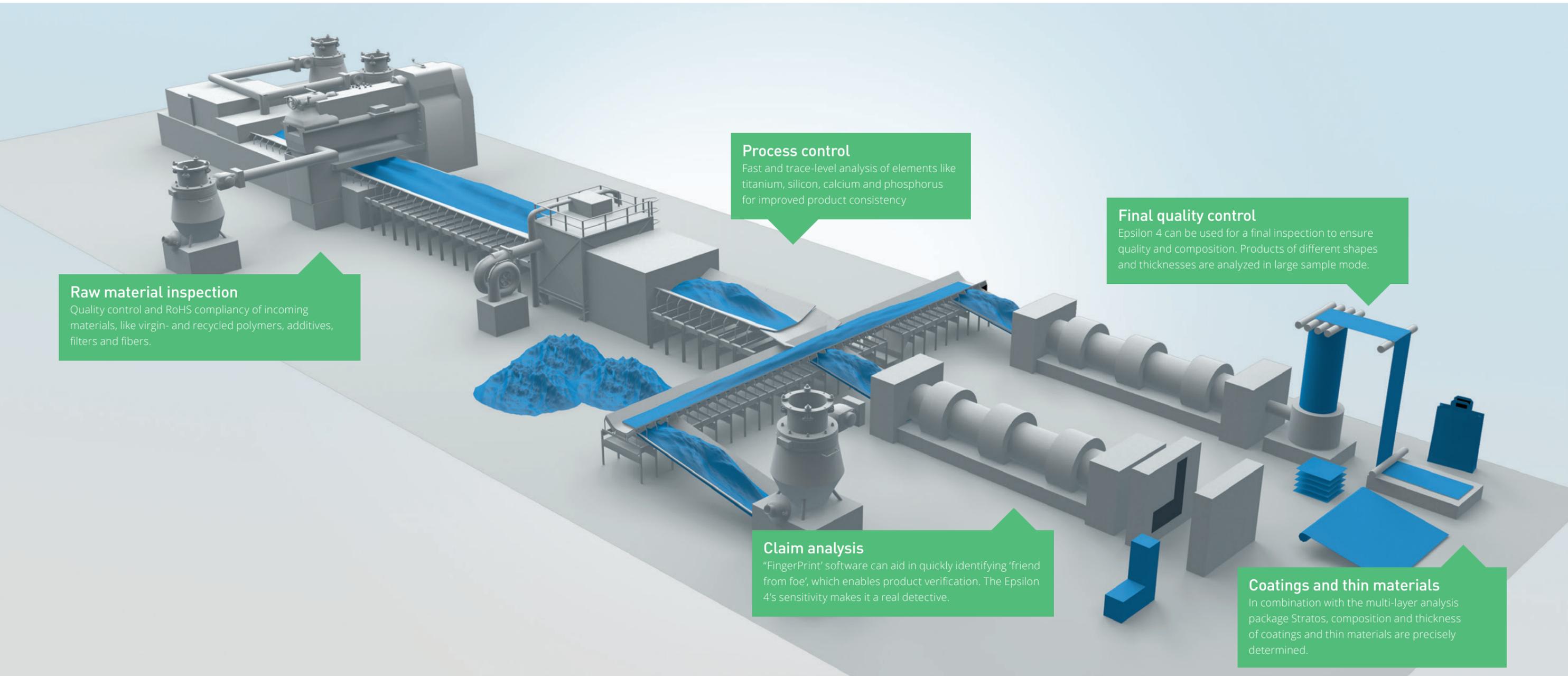
ACCURATE AND REPRODUCIBLE ANALYSIS OF ADDITIVES AND CATALYST RESIDUES

The Epsilon 4 in combination with our unique ADPOL solution enable trace analysis required to ensure the best product quality and consistency.

A set of reference materials for the analysis of additives and catalyst residues in polyethylene (ADPOL), was used to set up calibrations for 9 elements on Epsilon 4. The total measurement time per standard was 13 minutes. The results of the calibration are shown in *Table 1*, and a part of an XRF spectrum for Ti and Ca is shown in *Figure 1*. The spectrum illustrates the high sensitivity of Epsilon 4, which enables the system to detect traces of elemental residues.

Table 1. Calibration details

Element	Concentration range (ppm)			RMS* (ppm)	Correlation	LLD (ppm)
Na	0.5	–	189.0	18.3	0.9705	26
Mg	1.0	–	561.0	27.7	0.9923	8
Al	0.5	–	385.0	4.6	0.9996	2
Si	10.0	–	778.0	6.7	0.9998	2
P	5.0	–	94.0	5.0	0.9899	1
S	5.0	–	98.0	2.7	0.9972	1
Ca	0.5	–	200.0	2.2	0.9996	0.7
Ti	0.5	–	112.0	0.7	0.9998	0.2
Zn	0.5	–	198.0	0.9	0.9999	0.2

* RMS: The more accurate calibrations have the smaller RMS values.
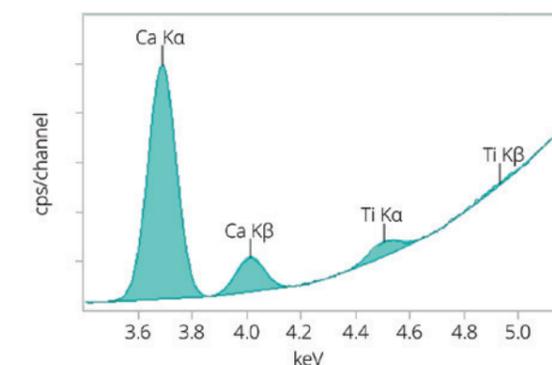

Figure 1. Spectra obtained for titanium and calcium. This standard contains 5 ppm Ti and 200 ppm Ca.

Repeatability

To test the accuracy and precision of the application and spectrometer, an ADPOL standard was measured over 4 days consecutively. The repeatability is illustrated graphically in *Figure 2* and each measurement took only 60 seconds.
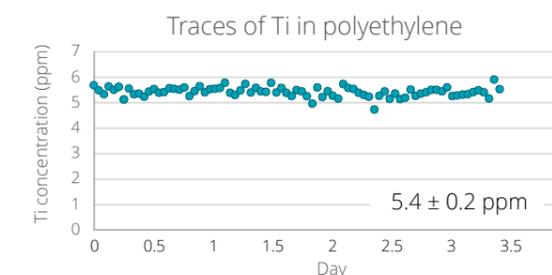

Traces of Ti in polyethylene

5.4 ± 0.2 ppm

Figure 2. Repeatability test of 5 ppm Ti in an ADPOL standard, measured over 4 days. Each measurement took only 60 seconds.

ADPOL
Our unique and well-established polymer solution

A set of reference materials has been developed for the analysis of additives and catalyst residues in polyethylene (ADPOL), in collaboration with DSM. The ADPOL set consists of 5 different standards including a blank and each standard consists of 4 discs. The standards cover the elements and concentration ranges normally required for the calibration of important additive elements in plastic and polymers, such as Na, Mg, Al, Si, P, S, Ca, Ti and Zn.

THE POWER OF **BENCHTOP XRF**

Combining the latest excitation and detection technologies and smart design, the analytical performance of Epsilon 4 approaches the one of more powerful and floor-standing spectrometers. Selective excitation and careful matching of the X-ray tube output to the capabilities of the detection system underlie the system's outstanding performance.

Epsilon 4 - Highly flexible analytical tools suitable for a wide range of applications:

- 10-watt version - used for elemental analysis (F - Am) in areas from R&D through to process control
- 15-watt version - used for extended light- element capabilities (C - Am)
- 15-watt version – used for higher sample throughput in challenging environments (F – Am)

Reduce helium consumption
The high performance of Epsilon 4 enables many applications to be operated in air atmosphere, without longer overhead time and costs involved for helium or maintenance of the vacuum system. When measuring in air, low-energy X-ray photons characteristic of sodium, magnesium and aluminium, are sensitive to variations in air pressure and temperature. Built-in temperature and air pressure sensors compensate for these environmental variations, ensuring excellent results whatever the weather.

Calibrated for years
A low-drift X-ray tube and an automatic drift correction system give compliant results for years without the need for re-calibration. This results in a more efficient use of the system and less cost for calibration maintenance.

Online remote support
In the unlikely event of the Epsilon 4 needing specialist attention, an on-line diagnostic facility is available in the local service centers. Problems can be diagnosed, and in many instances corrected, directly on-line. This significantly reduces system downtime and cuts maintenance costs to a minimum.

Accurate results
Our unique high-performance, metal-ceramic X-ray tube, specifically designed and manufactured for Epsilon 4, ensures high quality and reliable results. Flexible voltage settings from 4.0 to 50 kV and a maximum current setting up to 3.0 mA can be used to define application-specific excitation conditions that optimize the performance across the periodic table.

Ultimate light-elemental performance
With the optional SDD^{Ultra} detector, Epsilon 4 enables ultra-light element analysis of even carbon, nitrogen and oxygen.

Quality results through mature software
Accurate and precise results are obtained through advanced spectrum processing and state-of-the-art correction and quantification algorithms.

Safety guaranteed
Epsilon 4 complies with the latest Machinery Directive, CSA, IEC, EMC, Vollschutz norms and standards for protection and radiation safety to guarantee a safe instrument for the operator.

Unattended operation
The unique combination of a 10-position removable sample changer with spinner enables the automatic processing of sample batches without the need for operator attention. Continuous rotation of the sample during measurement minimizes any errors caused by non-homogeneity or surface irregularities within individual samples and provides more accurate results. Automatic transfer of data to a central location gives you access to the latest results.

Fast and sensitive
Fast measurements are achieved by using the latest silicon drift detector technology that produces significantly higher intensities.

Unique detector electronics enable a linear count rate capacity to over **1,500,000 cps** (with 50% deadtime) and a count rate independent resolution typically better than 135 eV for better separation of analytical lines in the spectrum.
This allows the Epsilon 4 spectrometer to run at full power and therefore realizes a much higher sample throughput compared to traditional EDXRF benchtop instruments.
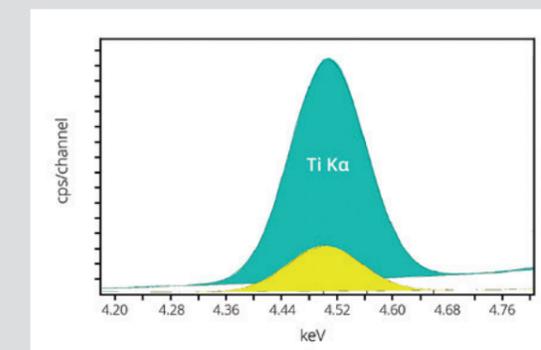
Five times higher intensities for titanium obtained with Epsilon 4, in comparison with its predecessor Epsilon 3^{XLE}

FAST, REPRODUCIBLE ANALYTICAL METHOD

Compared to other analytical techniques XRF requires little or no sample preparation

XRF is an ideal means of determining the chemical composition of all kinds of material.
Measurements in Epsilon 4 are carried out directly on the solid material (or liquid) with little to no sample preparation. There is no need for dilution or digestion and therefore no disposal of chemical waste.

Epsilon 4 spectrometers can handle a large variety of sample types weighing from a few milligrams to larger bulk samples. Samples can be measured as:
· Solids
· Pressed powders
· Loose powders
· Liquids
· Fused beads
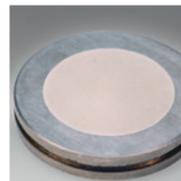· Slurries
· Granules
· Filters
· Films and coatings

LIQUIDS   **SOLIDS**   **POWDERS**

TAILORED SOLUTIONS THROUGH EXPERTISE

Experienced Malvern Panalytical staff will work in close cooperation with you to provide training and a wide range of consultancy services, including tailored analytical programs and procedures (SOP), balancing throughput and accuracy while minimizing setup and running costs, and specialist analysis.

Access to the right calibration samples is key in XRF. Malvern Panalytical helps in obtaining or creating the standards you need. We provide total solutions including standards for several key applications. For the plastic & polymer industry we developed unique calibration solutions to accurately analyze for additives and catalyst residues (ADPOL), toxic elements (TOXEL) and to ensure RoHS compliancy (RoHS). We can also generate suites of in-house standards by certifying your materials through our ISO 17025 certified analytical services.

Sample preparation, although typically straightforward for XRF, is an important factor in the overall analytical precision and accuracy. Sample preparation needs to be quick, robust and reproducible, and the choice of sample preparation technique starts with your requirements and materials.

Combine XRF with the analytical solutions Malvern Panalytical offers, like near infrared spectroscopy, particle size analysis and X-ray diffraction. Our experts are ready to support our users to get a full understanding of their samples and process.

Malvern Panalytical can advise you which approach suits best given your material types and analytical requirements. Tap into our knowledge network through our global Expertise Centers to optimize your complete analytical process, including sample preparation methods and equipment.

Our aim is to make Epsilon 4 an essential part of your polymer, plastic or paint production process

The added value for you is what drives us:
· The largest support network in the industry
· Training programs customized to your needs
· Reference materials
    · *Certified reference materials (CRMs)*
    · *Synthetic reference materials tailored to your requirements*
· Analytical services
    · *Certify your samples through our ISO 17025 certified laboratory*
· Consultancy
    · *Norm compliance*
    · *Laboratory information management*
    · *Process automation*
    · *Standard operating procedures*
    · *Interlaboratory standardization*

ENHANCE YOUR ANALYSIS THROUGH SOFTWARE OPTIONS

Five industry software options are available to further enhance the capabilities of Epsilon 4: Omnian, Stratos, Oil-Trace, Enhanced Data Security and FingerPrint. These dedicated options add new functional dimensions to benchtop spectrometry and take the hard work out of regulatory compliance.

Elemental screening
OMNIAN

Malvern Panalytical's powerful Omnian software is ideal when there is no conventional calibration established for materials that require analysis. When faced with non-routine samples or materials for which there are no certified reference materials, Omnian provides excellent insight into the elemental composition.

Designed to provide fast and reliable quantification, Omnian's advanced fundamental parameters (FP) algorithm automatically deals with the analytical challenges posed by samples of widely differing types.

MEASURE IT IN YOUR OWN LANGUAGE

1. Load your sample

2. Select required method

3. Enter relevant sample information

4. Just click Measure
      测量
      測定
      Mesurer
      Messung
      Mesure
      Zmierzyć
      Medida
      Измерить
      Médir

Multi-layer analysis
STRATOS

Stratos features an algorithm which enables simultaneous determination of chemical composition and thickness of layered materials. The software provides a rapid, simple and non-destructive means of analyzing coatings, surface layers and multi-layered structures.
Accurate results are achieved by using conventional bulk standards, or reference samples whose composition and layer structure differ from those of the unknowns.

Pass/Fail analysis
FINGERPRINT

FingerPrint is a material type confirmation routine that uses a rapid statistical analysis of the spectrum for a simple PASS/FAIL answer. Spectra used for the FingerPrint routine can also be used for conventional compositional determination for a more complete diagnostic analysis.

WHY CHOOSE **MALVERN PANALYTICAL**?

We are global leaders in materials characterization, creating superior, customer-focused solutions and services which supply tangible economic impact through chemical, physical and structural analysis.

Our aim is to help you develop better quality products and get them to market faster. Our solutions support excellence in research, and help maximize productivity and process efficiency.

Malvern Panalytical is part of Spectris, the productivity-enhancing instrumentation and controls company.
www.spectris.com

SERVICE & **SUPPORT**

Malvern Panalytical provides the global training, service and support you need to continuously drive your analytical processes at the highest level. We help you increase the return on your investment with us, and ensure that as your laboratory and analytical needs grow, we are there to support you.

Our worldwide team of specialists adds value to your business processes by ensuring applications expertise, rapid response and maximum instrument uptime.

· Local and remote support
· Full and flexible range of support agreements
· Compliance and validation support
· Onsite or classroom-based training courses
· e-Learning training courses and web seminars
· Sample and application consultancy
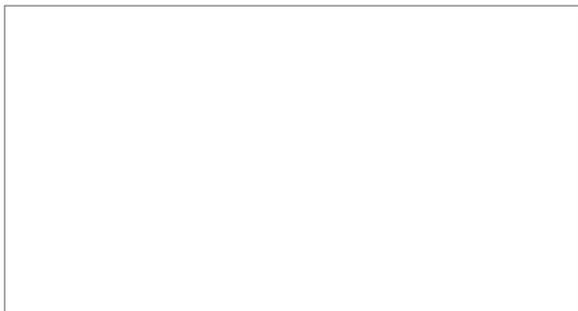
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