



coatmaster

**Job Coating Process
Optimisation**
Torsten Schwarz



Coating thickness as a central parameter

- Coating thickness of the paint/powder influences color, opacity, haptics, mechanical and chemical properties
- Too thin layers lead to rejects and customer complaints
- Too thick layers increase material consumption and energy costs
- Coating process is subject to many influencing factors such as velocity distribution of air flow and field distribution
- Changes in ambient conditions (humidity, temperature, air pressure,...) and aging/wear lead to process deviations
- The lack of continuous process documentation leads to uncertainty in product quality



Coating costs and coverage

Pulverlacktyp - Powder coating type	Polyester	
Durchsatz - Throughput	m ² /a	300.000
Preis - Purchase price	EUR/kg	5,00
Trockenfilmdichte/Spezifisches Gewicht (1,30-1,70) - Specific Gravity	g/cm ³	1,50
Nutzungsgrad - Utilisation rate	%	94,00
Reduzierung der Schichtdicke um - Reduction of the layer thickness by	µm	10,00
Schichtdicke - Coating thickness (Ø 60-80 µm)	µm	
Verbrauch - Quality required	g/m ²	
Ergibigkeit - Coverage	m ² /kg	
Verbrauch - Consumption	t/a	
Kosten pro beschichtetem Quadratmeter - Costs	EUR/m ²	
Pulverlackkosten gesamt - Total powder coating costs	EUR/a	
Differenz/Ersparnis - Difference/Savings	%	
Pulverlackkosten gespart - Powder coating costs saved	EUR/a	

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IDEAL
60
95,74
10,44
28,72
0,48
143.617,02
0,00
0,00

Coating costs and coverage

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IDEAL	>
60	80
95,74	127,66
10,44	7,83
28,72	38,30
0,48	0,64
143.617,02	191.489,36
0,00	0,25
0,00	47.872,34

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Differenz/Ersparnis - Difference/Savings	%	
Pulverlackkosten gespart - Powder coating costs saved	EUR/a	

IDEAL	>	>
60	80	100
95,74	127,66	159,57
10,44	7,83	6,27
28,72	38,30	47,87
0,48	0,64	0,80
143.617,02	191.489,36	239.361,70
0,00	0,25	0,40
0,00	47.872,34	95.744,68

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Pulverlackkosten gesamt - Total powder coating costs	EUR/a	
Differenz/Ersparnis - Difference/Savings	%	
Pulverlackkosten gespart - Powder coating costs saved	EUR/a	

IDEAL	>	>	>
60	80	100	120
95,74	127,66	159,57	191,49
10,44	7,83	6,27	5,22
28,72	38,30	47,87	57,45
0,48	0,64	0,80	0,96
143.617,02	191.489,36	239.361,70	287.234,04
0,00	0,25	0,40	0,50
0,00	47.872,34	95.744,68	143.617,02

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Schichtdicke - Coating thickness (Ø 60-80 µm)	µm		10	60	80	100
Verbrauch - Quality required	g/m ²		15,96	95,74	127,66	159,57
Ergibigkeit - Coverage	m ² /kg		62,67	10,44	7,83	6,27
Verbrauch - Consumption	t/a		4,79	28,72	38,30	47,87
Kosten pro beschichtetem Quadratmeter - Costs	EUR/m ²		0,08	0,48	0,64	0,80
Pulverlackkosten gesamt - Total powder coating costs	EUR/a		23.936,17	143.617,02	191.489,36	239.361,70
Differenz/Ersparnis - Difference/Savings	%			0,00	0,25	0,40
Pulverlackkosten gespart - Powder coating costs saved	EUR/a		23.936,17	0,00	47.872,34	95.744,68

Operating costs and economic efficiency

- This includes throughput and surface quality as well as wear and yield of the powder
- In addition, there are factors such as dry film density, the degree of utilization of the application, the consumption of chemicals for pretreatment, and the costs of electricity, gas, compressed air, and fresh air
- Other aspects include the cost of maintenance, repair and service flexibility of the equipment supplier
- The calculation example in the adjacent table shows how the estimation of the operating costs could look like and how the profitability of a plant is to be determined
- It can also provide guidance on areas where changes and/or optimization are needed

Durchsatz: 300.000 m ² /Jahr - Arbeitstage: 220/Jahr - Arbeitszeit: 8h/Tag			
Personalkosten	4 Mitarbeiter (MA)	50.000,00 Euro/Jahr MA	200.000,00 Euro
	1 Hilfskraft	35.000,00 Euro/Jahr	35.000,00 Euro
Gesamt			235.000,00 Euro
Lack	3000 kg (5,00 Euro/kg)		Verzinsung Kapital 10% 1500,00 Euro
Pulverlackkosten			
Durchsatz	300.000 m ² /a		
Pulverlacktyp	Polyester		
Preis	5,00 Euro/kg		
Trockenfilmdichte	1,55 g/cm ³		
Schichtstärke	60 µm		
Nutzungsgrad	94%		
Verbrauch	98,936 g/m ²		
Kosten pro beschichtetem Quadratmeter	0,49 Euro/m ²		
Pulverlackkosten gesamt			148.404,26 Euro
Kapitalkosten der Investition			
Pulveranlage	600.000,00 Euro		
Anlagenbau	2.400.000,00 Euro		
Bauseitige Kosten	250.000,00 Euro		
Gesamtkosten Investition	3.250.000,00 Euro		
Abschreibungsdauer	10 Jahre		
Zins	10%		
Kapitalkosten pro Jahr			361.111,11 Euro
Entsorgungskosten (pauschal)			2.000,00 Euro
Chemikalienverbrauch (pro beschichtetem Quadratmeter)			
Putz-/Schmiermittel	0,0015 Euro		450,00 Euro
Entfettung und Phosphat	0,105 Euro		31.500,00 Euro
Entsorgung des Verdampfer-Schlammes	0,015 Euro		4.500,00 Euro
Raumkosten: Stellfläche/Vorbereitungsfläche			
Raum	400 m ²	4,00 Euro/m ² und Monat	19.200,00 Euro
Energiekosten/Betrieb			
Strom	500 kWh	0,13 Euro/kWh	114.400,00 Euro
Gas/Öl	26,5 l/h	0,30 Euro/l	13.992,00 Euro
Druckluft	180 Nm ³ /h	0,10 Euro/Nm ³	31.680,00 Euro
Frischwasser	0,35 m ³ /h	2,30 Euro/m ³	1.416,80 Euro
Instandhaltung/Wartung			
Pauschal	5.000,00 Euro		5.000,00 Euro
Verschleißteilkosten Pulveranlage	3%		18.000,00 Euro
Verschleißteilkosten Anlagenbau	0,50%		12.000,00 Euro
Zubehör			
Haken, Stopfen etc. (Pauschale)	5.000,00 Euro		5.000,00 Euro
Sonstige Kosten			
Versicherung			20.000,00 Euro
1 Kfz			10.000,00 Euro
Gesamtkosten			1.035.154,20 Euro
Kosten / m²			3,45 Euro

Survey

Are manual coating thickness measurements carried out in your coating line?

- Yes, before the curing-/ drying process in the line
- Yes, after the curing-/ drying process in the line
- Yes, in the quality assurance laboratory
- No, the system is fully automated and optimally adjusted
- Not at the moment, but is interesting and in planning

Typical quality assurance

- Delayed coating thickness measurement
- Reject and loss of quality
- High consumption of coating material

> 2 h



Optimum quality assurance

- Early coating thickness measurement in the process (type. 5s)
- Minimum waste and the best possible quality
- Saving in coating material



Advantages of non-contact coating thickness measurement

At a glance



Produce in a controlled way.

Detect and correct deviations early in the process and avoid rejects and rework.



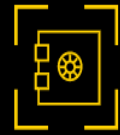
Increase the quality.

Produce precision coatings with high accuracy and set new quality standards.



Ensure the quality.

Document all steps of the production process seamlessly for you and your customers.



Save material.

Reduce material consumption by up to 30%. This protects your resources and the environment.

Requirement for non-contact measurement

Technology in comparison	Request
Non-contact	Yes
Work distance	> 10 cm
Distance tolerance	> ± 1 cm
Angle tolerance	> $\pm 45^\circ$
Geometry independence	Yes
All colors	Yes
Measuring surface (diameter)	1-10 mm
Measuring range	1-1.000 μm
Measuring time	< 300 ms
Measurement of moving parts	Yes

Requirement for non-contact measurement

Technology in comparison	Request	Air ultrasound
Non-contact	Yes	Yes
Work distance	> 10 cm	20 mm
Distance tolerance	> ± 1 cm	± 1 mm
Angle tolerance	> ± 45°	± 5°
Geometry independence	Yes	only flat parts
All colors	Yes	Yes
Measuring surface (diameter)	1-10 mm	5 mm
Measuring range	1-1.000 µm	10-100 µm
Measuring time	< 300 ms	5s
Measurement of moving parts	Yes	No

Requirement for non-contact measurement

Technology in comparison	Request	Air ultrasound	Photothermal
Non-contact	Yes	Yes	Yes
Work distance	> 10 cm	20 mm	30 mm
Distance tolerance	> ± 1 cm	± 1 mm	± 3 mm
Angle tolerance	> ± 45°	± 5°	± 20°
Geometry independence	Yes	only flat parts	Yes
All colors	Yes	Yes	no white / some do (UV)
Measuring surface (diameter)	1-10 mm	5 mm	0.1 mm
Measuring range	1-1.000 µm	10-100 µm	20-150 µm
Measuring time	< 300 ms	5s	3s
Measurement of moving parts	Yes	No	No

Requirement for non-contact measurement

Technology in comparison	Request	Air ultrasound	Photothermal	ATO
Non-contact	Yes	Yes	Yes	Yes
Work distance	> 10 cm	20 mm	30 mm	2 - 120 cm
Distance tolerance	> ± 1 cm	± 1 mm	± 3 mm	± 1 - 20 cm
Angle tolerance	> ± 45°	± 5°	± 20°	± 70°
Geometry independence	Yes	only flat parts	Yes	Yes
All colors	Yes	Yes	no white / some do (UV)	Yes
Measuring surface (diameter)	1-10 mm	5 mm	0.1 mm	1-10 mm
Measuring range	1-1.000 µm	10-100 µm	20-150 µm	1-2.000 µm
Measuring time	< 300 ms	5s	3s	20 – 2.000 ms
Measurement of moving parts	Yes	No	No	Yes

coatmaster Product line

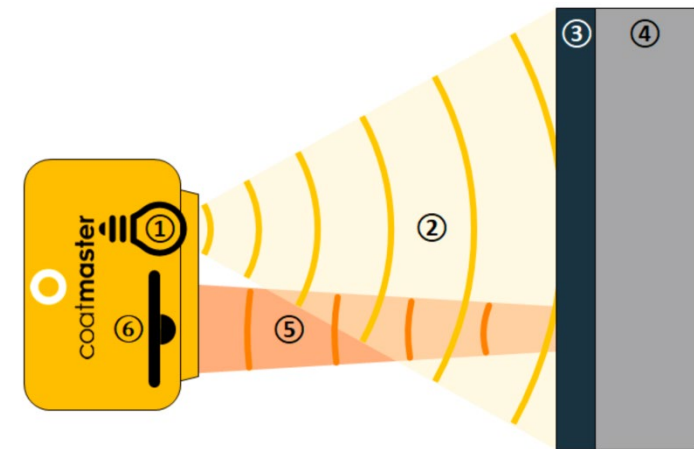
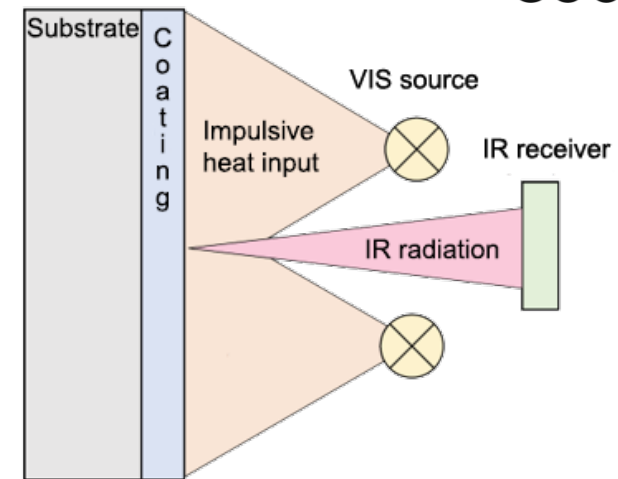


Principle of operation

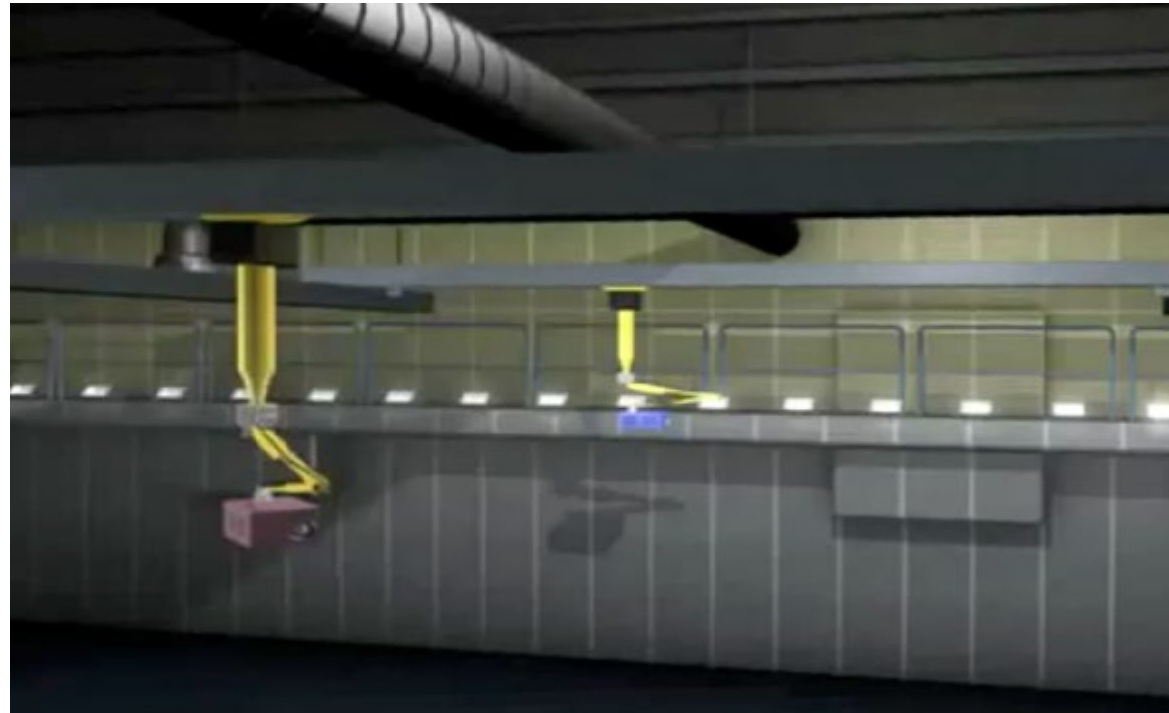
Advanced Thermal Optics ATO

- Short-term warming of the coating by light impulse
- Non-contact detection of the surface temperature with Infrared sensor
- Surface temperature subsides with a characteristic dynamic
- Evaluation of measurement data with proprietary algorithms

Measure in the process without destruction and without interruption.



Advanced Thermal Optics ATO



coatmaster Flex

Mobile coating thickness gauge

Handheld

- Point measurement of coating thickness
- No integration necessary
- Easy to use
- Ready to measure immediately - no calibration required for most applications
- Immediate process and quality control incl. documentation



High-quality, impact-resistant housing material for use in industrial environments

Optimally balanced Handle position for fatigue-free work

Quickly exchangeable High-performance brand Standard battery with 18V technology



coatmaster

coatmaster Flex

Mobile coating thickness gauge

Handheld

Intuitive operation through clear user interface, High-resolution, graphic colour LCD display

High-precision measurement optics

Durable flash lamp

Simple measurement at the Push button



Cancel button


coatmaster

Integrated WLAN module

On / Off button

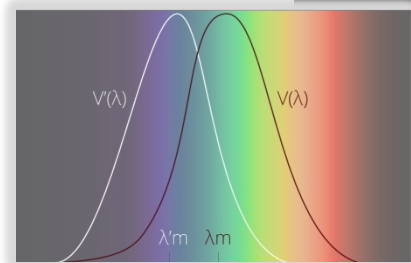
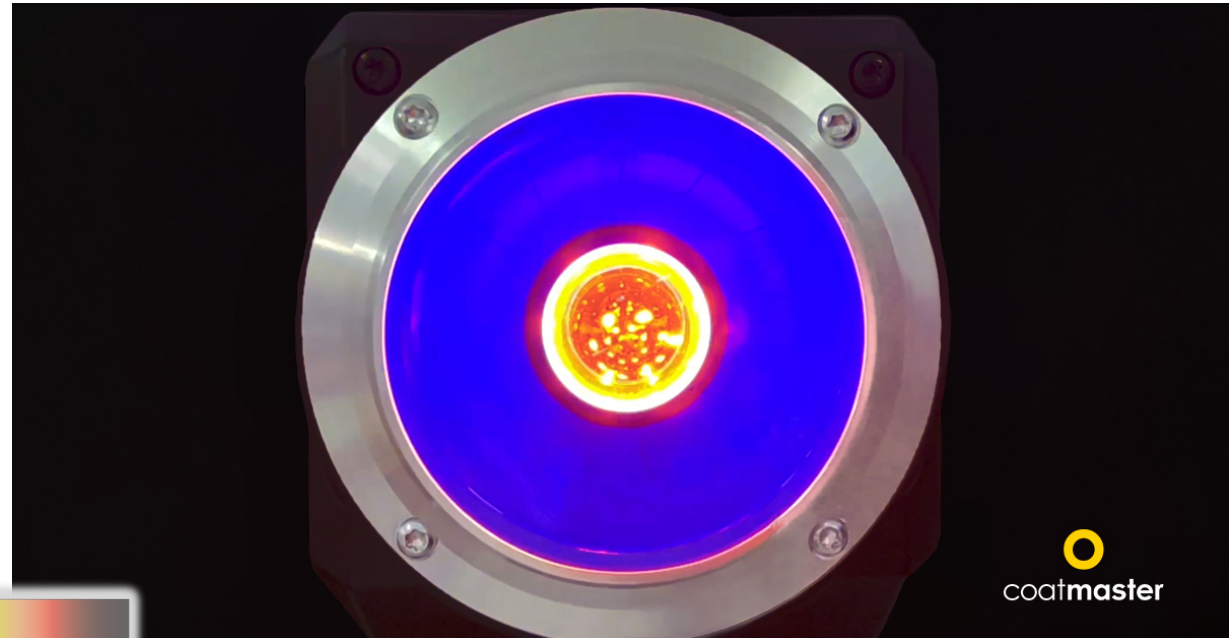
Intuitive four-button operation with confirmation button, one-handed menu navigation



SpectralBlue® - Technologie

Principle of operation

- Reduction of the light effect by 99.9
- Optimization of detection optics
- Improved measurement performance
- Retrofitting of older devices possible!



Compatible with fire alarm system

- List of compatible flame detectors is constantly being expanded
- Last update 21/03/10:
- STS: FL 7-64, 8-64 and 9-64
- Minimax: FMX 5000 UV, YMX 5000 FMX EX 90° IR
- Total Walther: UV-03
- SpectralBlue®-IR recommended for older flame detector modules!

- Thank you very much for the good cooperation!

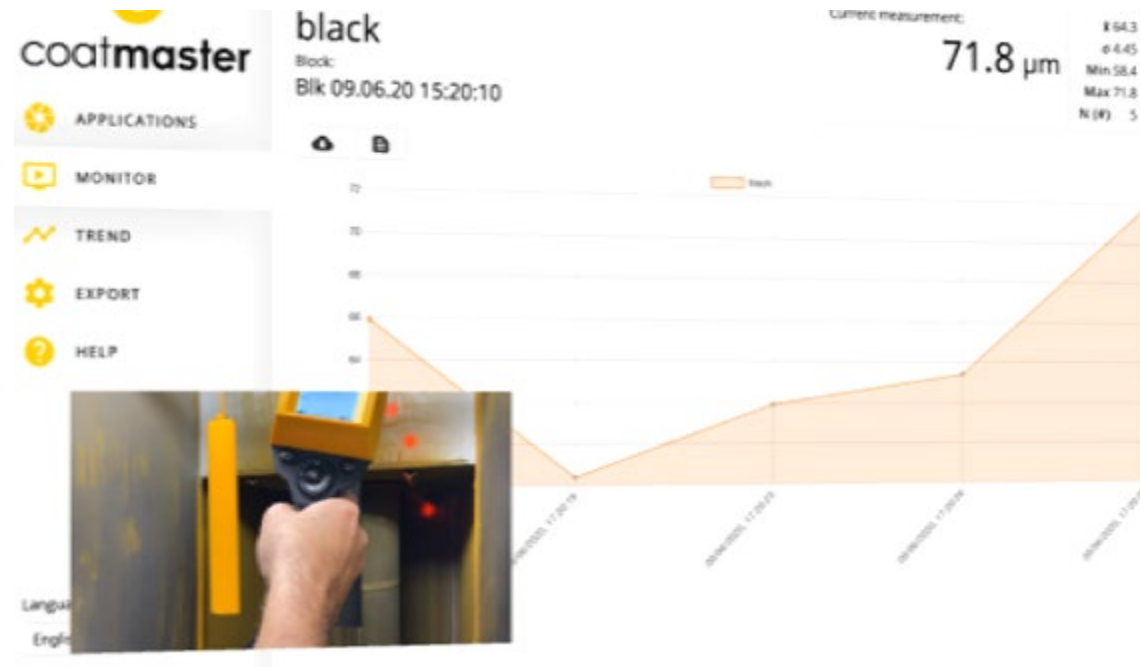


Honeywell  **STS**  **tyco**

Application example



Real-time measurement



Measurement protocol



Measurement protocol



Test company
Test address

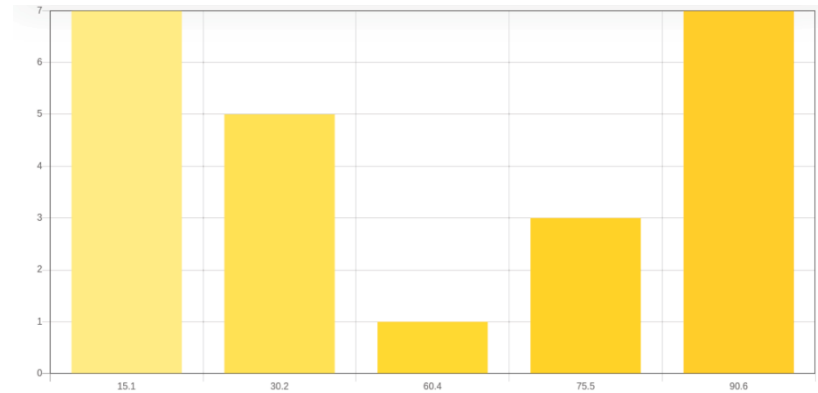
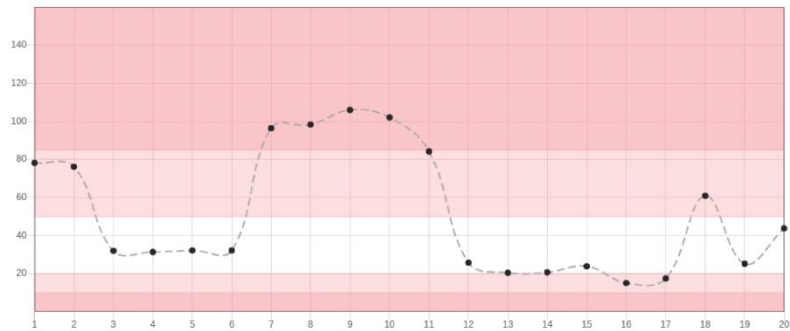
Application:
RAL 7035

Block:
Lot 1234

First measurement:
10/22/2020, 1:54:44 PM
Last measurement:
10/27/2020, 1:59:11 PM



\bar{x} 57.6
 σ 34.1
Min 15.1
Max 106
N (#) 23
N below 2
N above 11

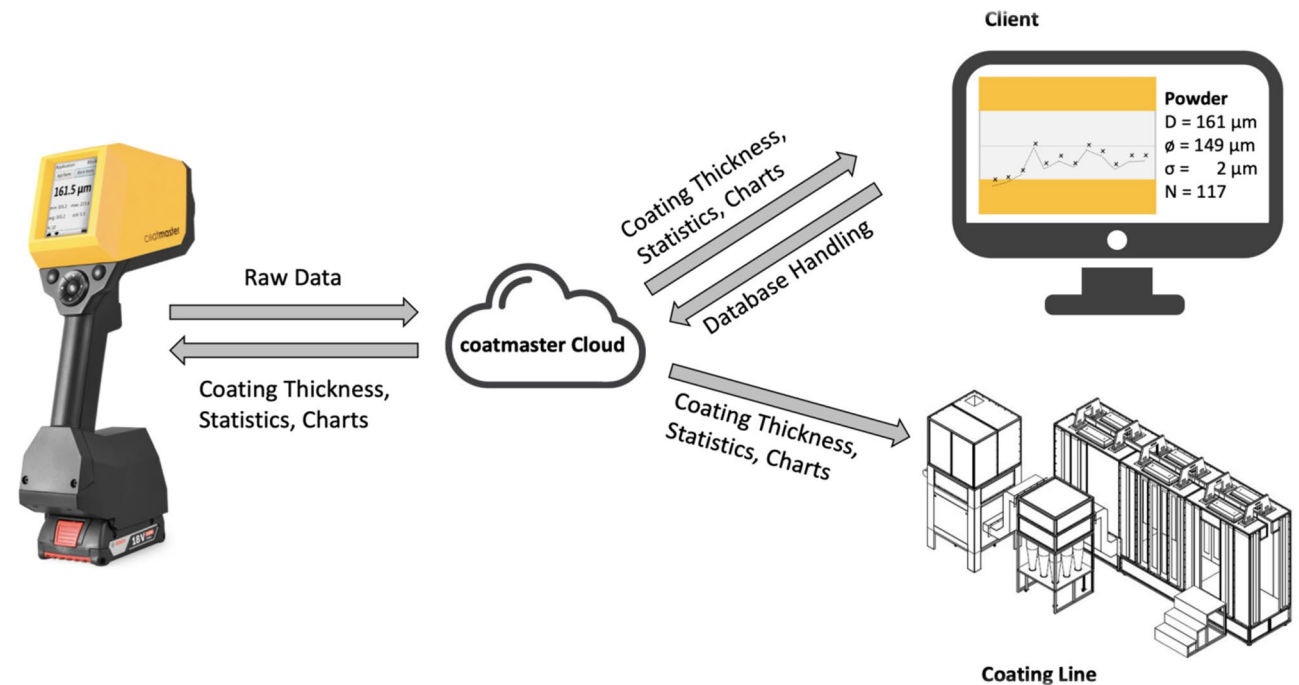


Date	Thickness
10/22/2020, 3:56:09 PM	78.2
10/22/2020, 3:56:11 PM	76.1
10/22/2020, 3:56:15 PM	32.0
10/22/2020, 3:56:18 PM	31.4
10/22/2020, 3:56:21 PM	32.2
10/22/2020, 3:56:25 PM	32.2
10/22/2020, 3:56:44 PM	96.4
10/22/2020, 3:56:45 PM	98.3
10/22/2020, 3:56:45 PM	106.0
10/22/2020, 3:56:49 PM	102.0
10/27/2020, 2:58:19 PM	84.2
10/27/2020, 2:58:22 PM	25.8
10/27/2020, 2:58:29 PM	20.5
10/27/2020, 2:58:33 PM	20.7
10/27/2020, 2:58:41 PM	23.9
10/27/2020, 2:58:45 PM	15.1
10/27/2020, 2:58:52 PM	17.5
10/27/2020, 2:59:01 PM	60.9
10/27/2020, 2:59:06 PM	25.2
10/27/2020, 2:59:11 PM	43.8

Test company
Test address

Advantages at a glance - Industry 4.0 ready

- Measurement of wet and dry coating
- Fast measurement for process control
- Online data availability in real time for ERP-/ control systems
- Connection to PLC for process visualization
- Push information from the ERP system for specification the production number
- Live measurement display
- Quality Report / Measurement Protocol



Survey

What advantages of non-contact coating thickness measurement are in the foreground for you?

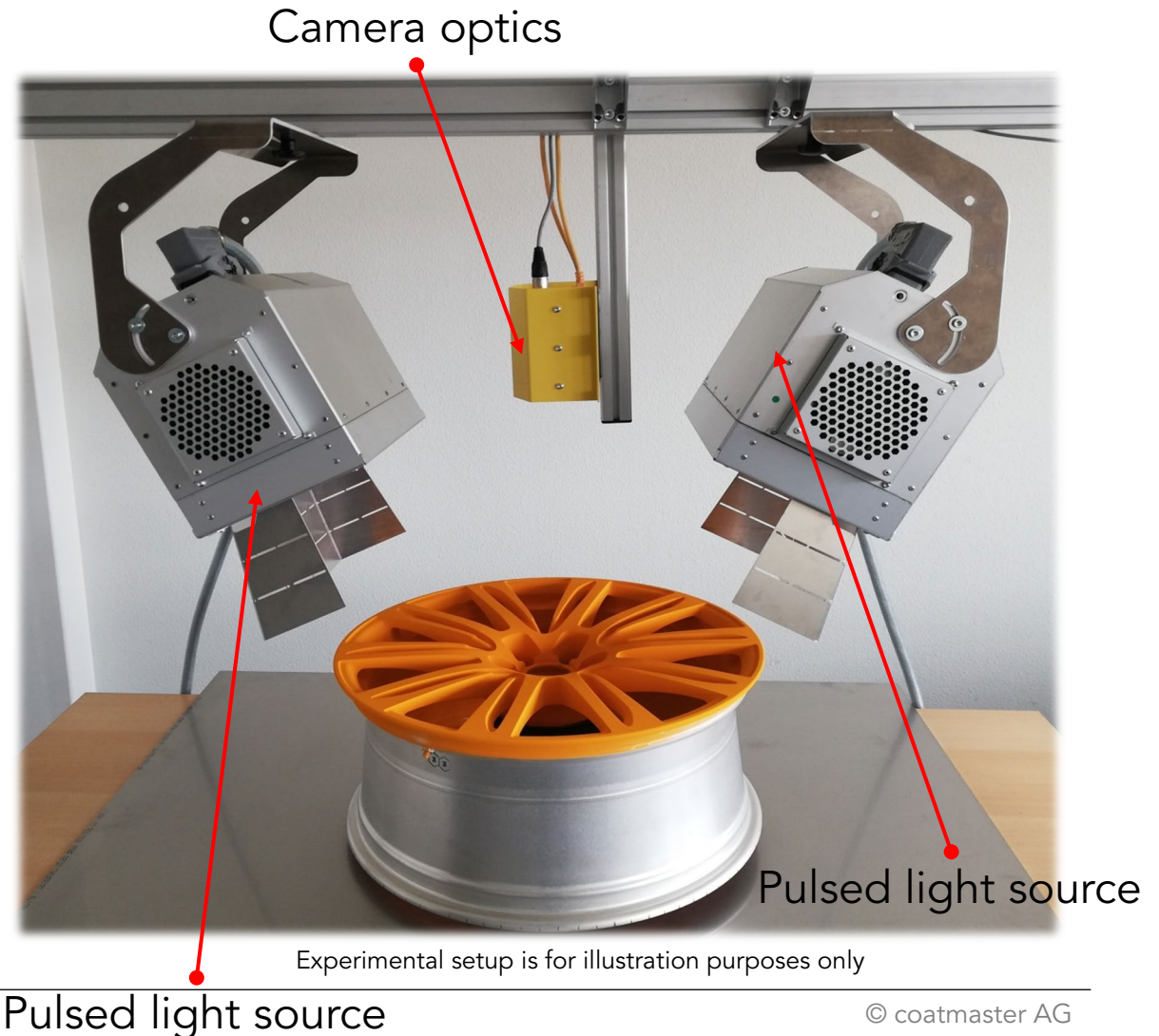
- Saving of coating material
- Automated documentation
- Process optimization
- Avoidance of rejects
- Increasing the efficiency of the coating system

coatmaster 3D

Stationary lcoating thickness gauge

Industrial continuous use

- Areas massive detection of layer thickness with immediate determination of the coating distribution
- Uncomplicated integration (non-traversing)
- Operation via Windows software
- Complete process and quality control incl. documentation



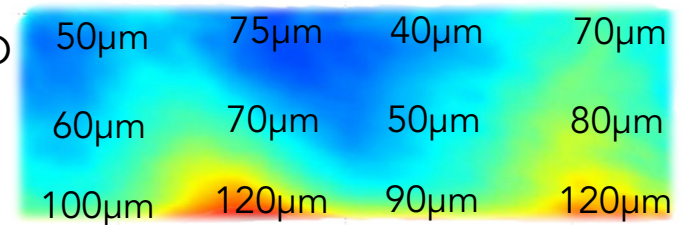
Why measure location-resolved coating thickness?

- Coating thickness distribution on extended surfaces is inhomogeneous (fluid dynamics and electrostatics)
- High safety margins are applied, rejects are detected late and quality defects are accepted
- A single point measurement in the line often has a low (incomplete) significance due to the coating thickness variation on the component
- Uncertainty in the coating process

conventional



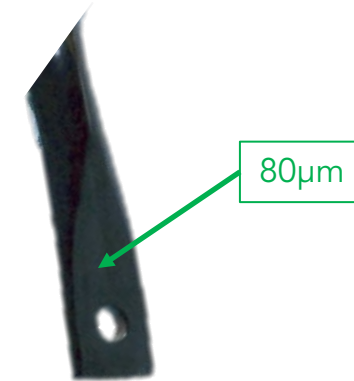
coatmaster 3D



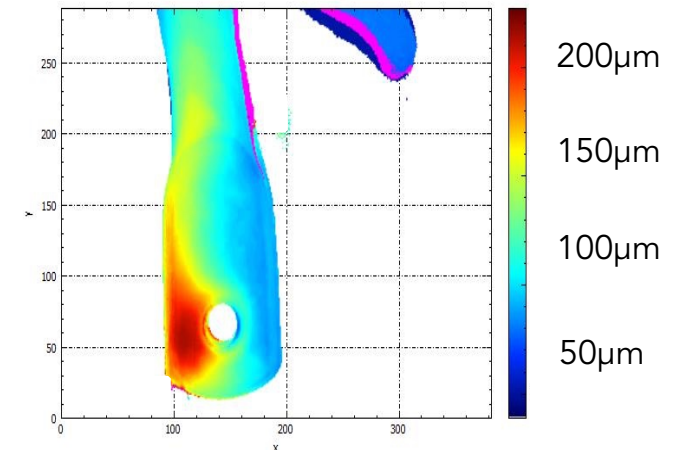
Why measure imaging coating thickness?

- Coating thickness distribution is made visible
- Applied coating quantity (application efficiency) and standard deviation (homogeneity ratio)
- Relief and support of staff through early and complete information
- Coating thicknesses on inclined surfaces, edges and recesses are also precisely detected
- Easy integration, automated measurement, Angle tolerance (+/- 80 degrees, +/- 20 cm)
- Carrying the measuring head not always necessarily due to short measuring time (few 100 ms) and software algorithms

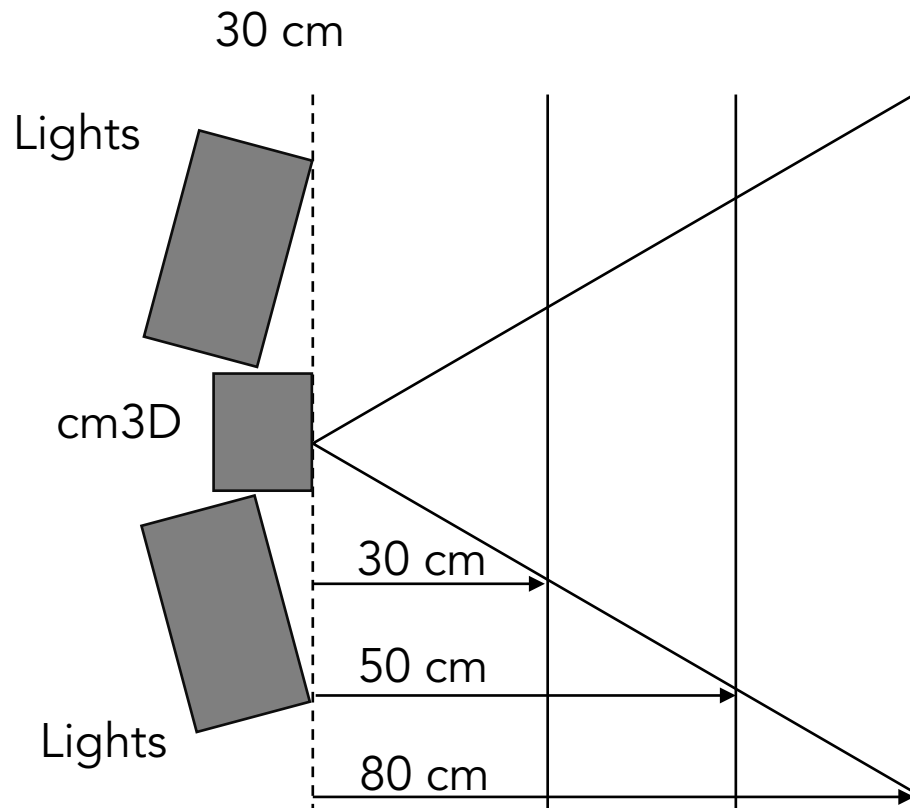
conventional



coatmaster 3D



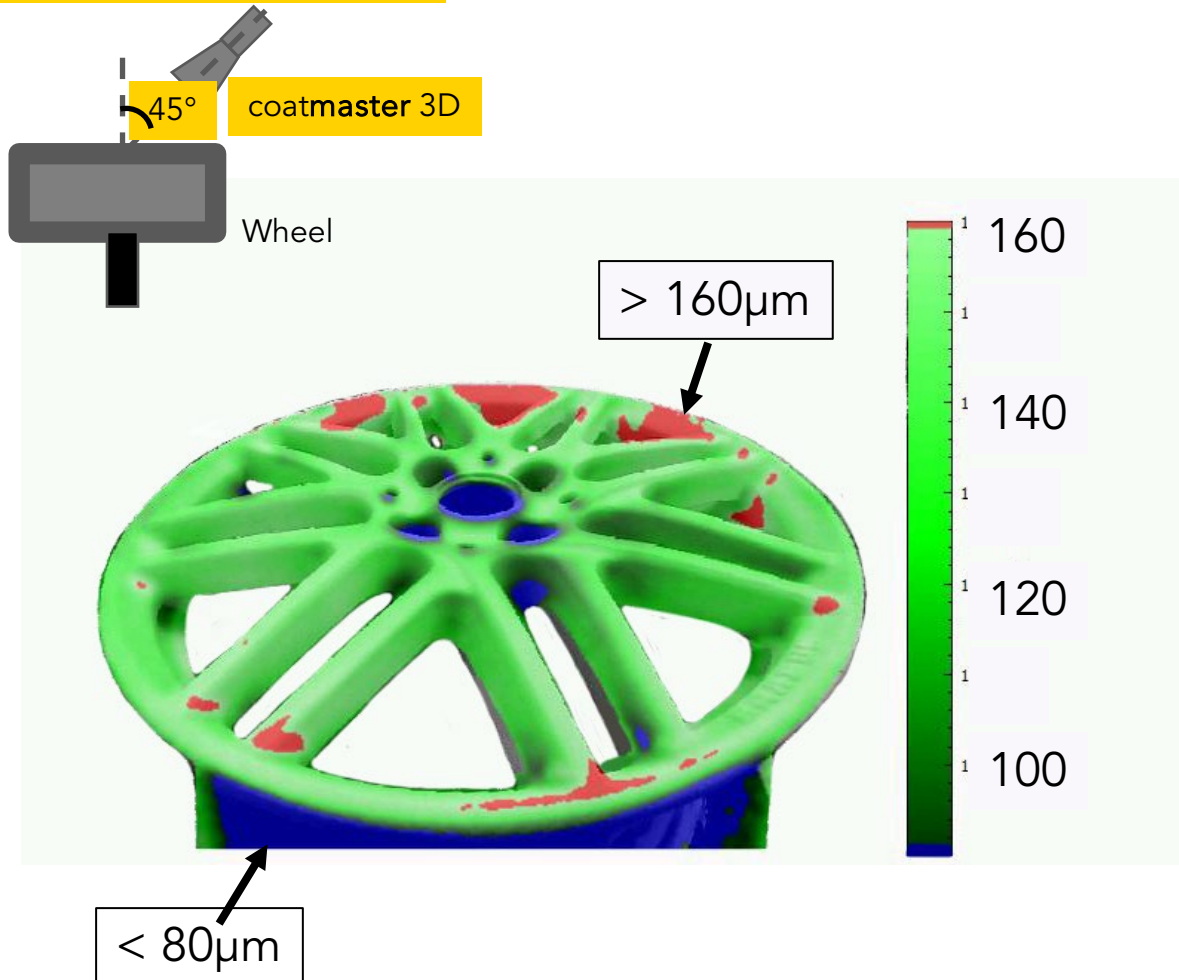
Local resolution and measuring field (80° lens)



- **Distance: 30 cm**, Width: 490 mm, Height: 305 mm, Pixel Size: 0.9 mm, 2x2 Pixels: 1.8 mm
- **Distance: 50 cm**, Width: 820 mm, Height: 505 mm, Pixel Size: 1.5 mm, 2x2 Pixels: 3 mm
- **Distance: 80 cm**, Width: 1330 mm, Height: 820 mm, Pixel Size: 2.5 mm, 2x2 Pixels: 5 mm

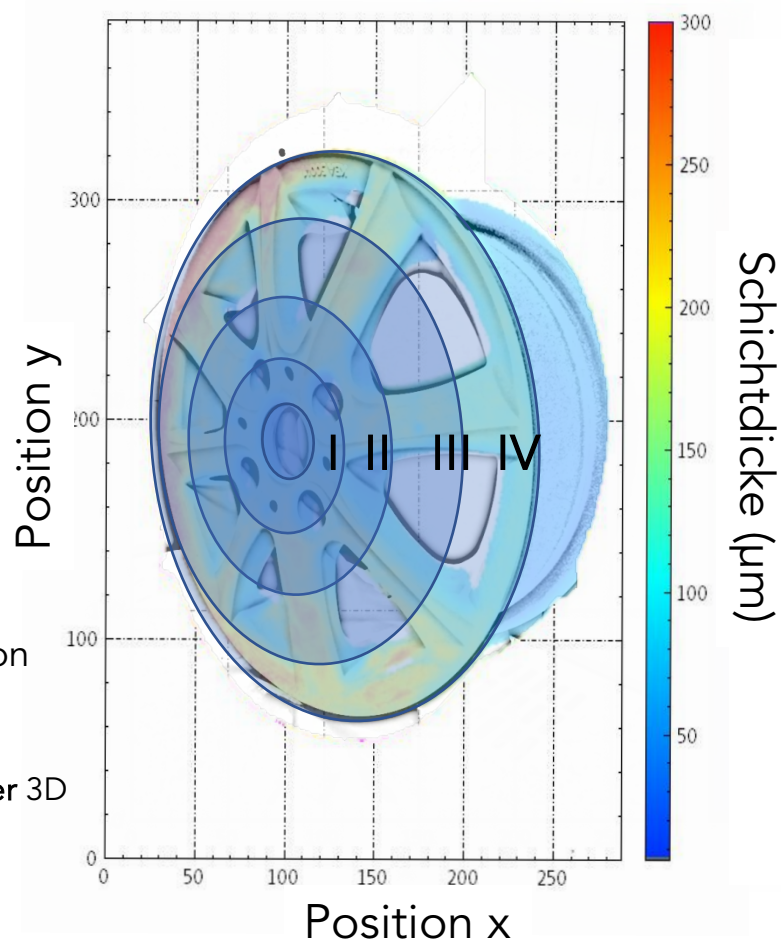
Error display in the coating thickness image

Measuring configuration

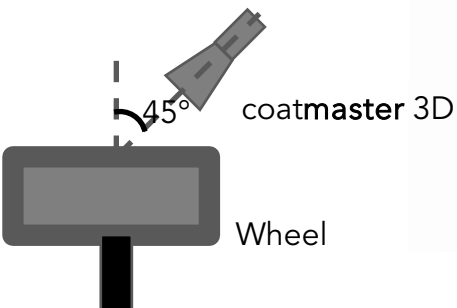


- Targeted adaptation of the gun arrangement and movement (e.g. sine optimization)
- Safely lowering average coating thickness
- Targeted detection of under- and over coatings
- Detection of coating equipment problems

Statistical analysis



Measuring configuration



- Optimization of coating thickness (average) and layer homogeneity (standard deviation)
- Statistical analysis of the coating thickness distribution according to component geometry (circle rings or rectangle)
- Synchronization with ERP and plant control

I:	AVG	200	STD	31	MIN	150	MAX	302	(µm)
II:	AVG	154	STD	21	MIN	131	MAX	212	(µm)
III:	AVG	130	STD	20	MIN	108	MAX	165	(µm)
IV:	AVG	98	STD	17	MIN	45	MAX	83	(µm)

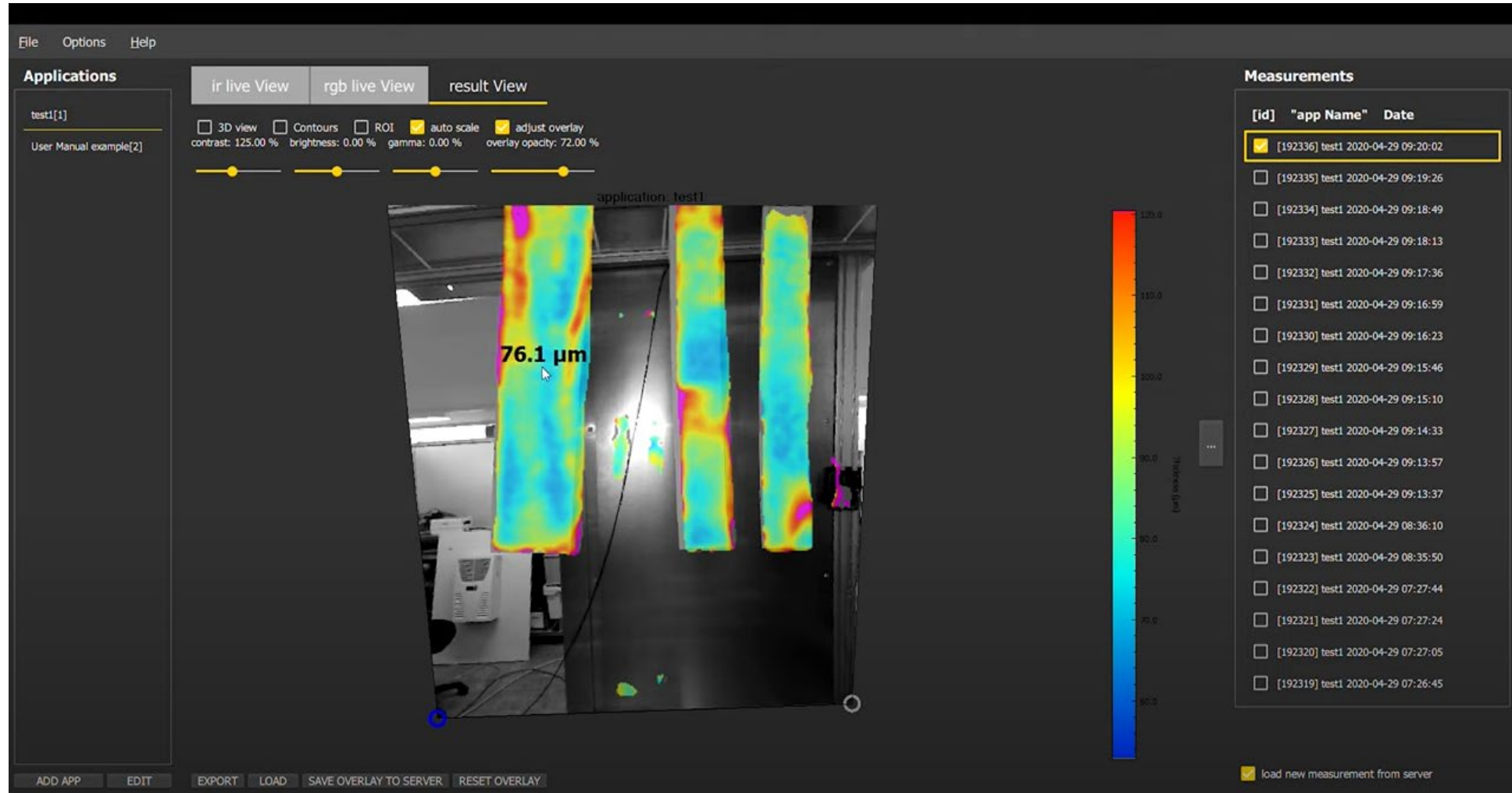
Application example

Location-resolved measurement with
coatmaster 3D Inline

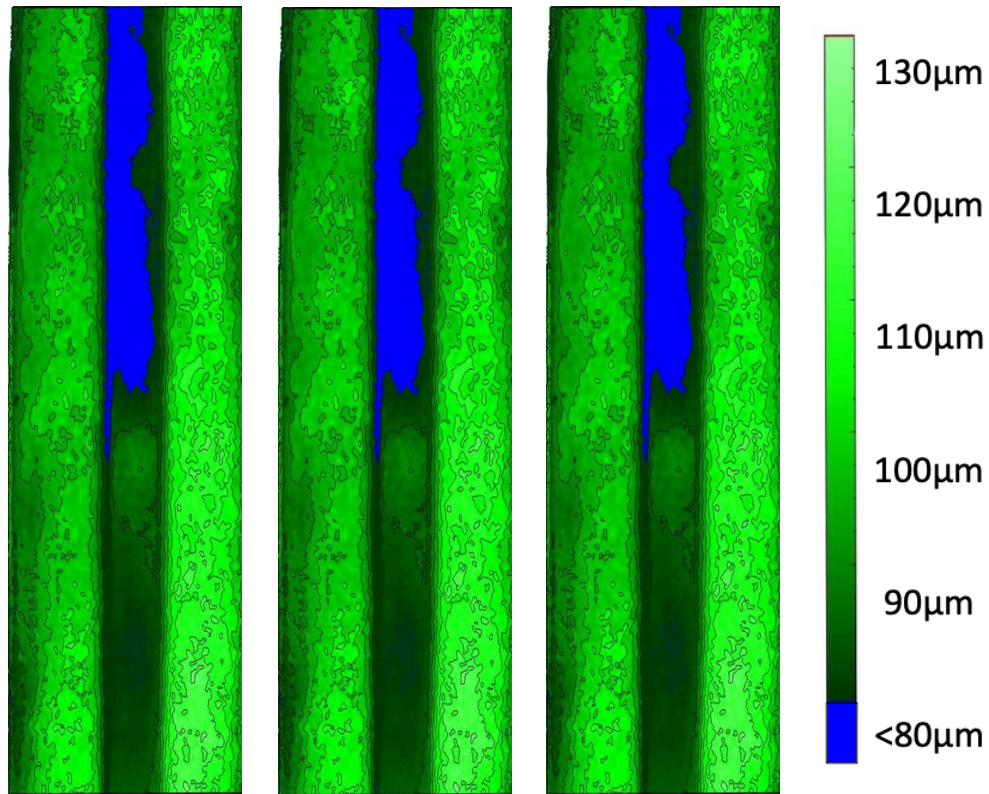


- Also for simple product geometries
- New quality key figure of coating homogeneity
- Cost-effective integration
 - Simple modular principle
 - Measuring areas of 1.5m x 1m and larger
 - No object detection
 - Easy movement technology
 - No calibration
 - No teaching of measuring points

Application example

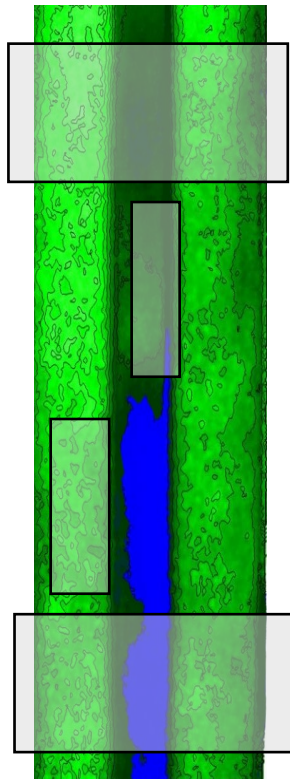


Case study: Powder coating in vertical plants (automated)



- Full information about coating thickness distribution
- 100,000 measuring points with mm resolution
- User-friendly information display

Case study: Powder coating in vertical plants (automated)



ROI 1:AVG: 90 μ m, STD: 28 μ m,
Min: 55 μ m, Max: 130 μ m

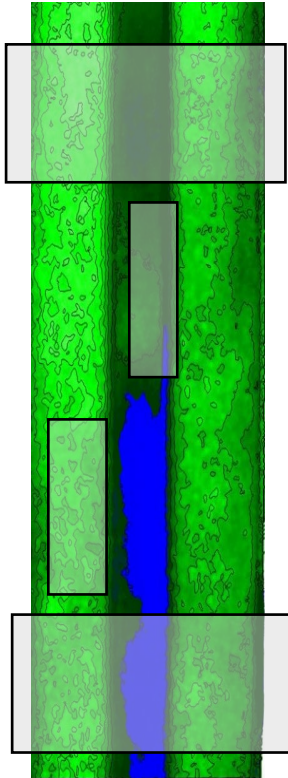
ROI 2: AVG: 60 μ m, STD: 3 μ m,
Min: 55 μ m, Max: 65 μ m

ROI 3: AVG: 110 μ m, STD: 6 μ m,
Min: 105 μ m, Max: 120 μ m

ROI 4: AVG: 100 μ m, STD:
16 μ m, Min: 90 μ m, Max: 123 μ m

- ROI=Region of interest
- Information about
 - AVG: Average
 - STD: Standard deviation (homogeneity)
 - MIN: Minimum coating thickness
 - MAX: Maximum coating thickness

Case study: Powder coating in vertical plants (automated)

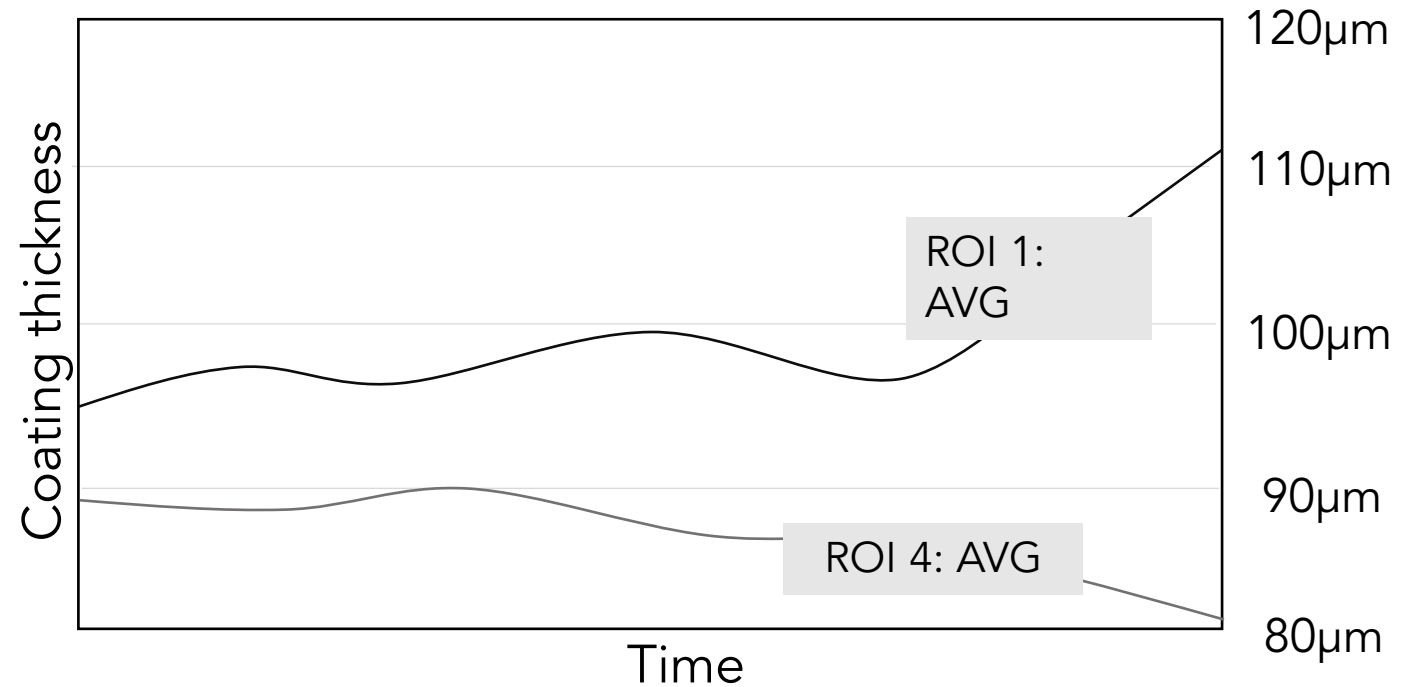


ROI 1:AVG: 90 μ m, STD: 28 μ m,
Min: 55 μ m, Max: 130 μ m

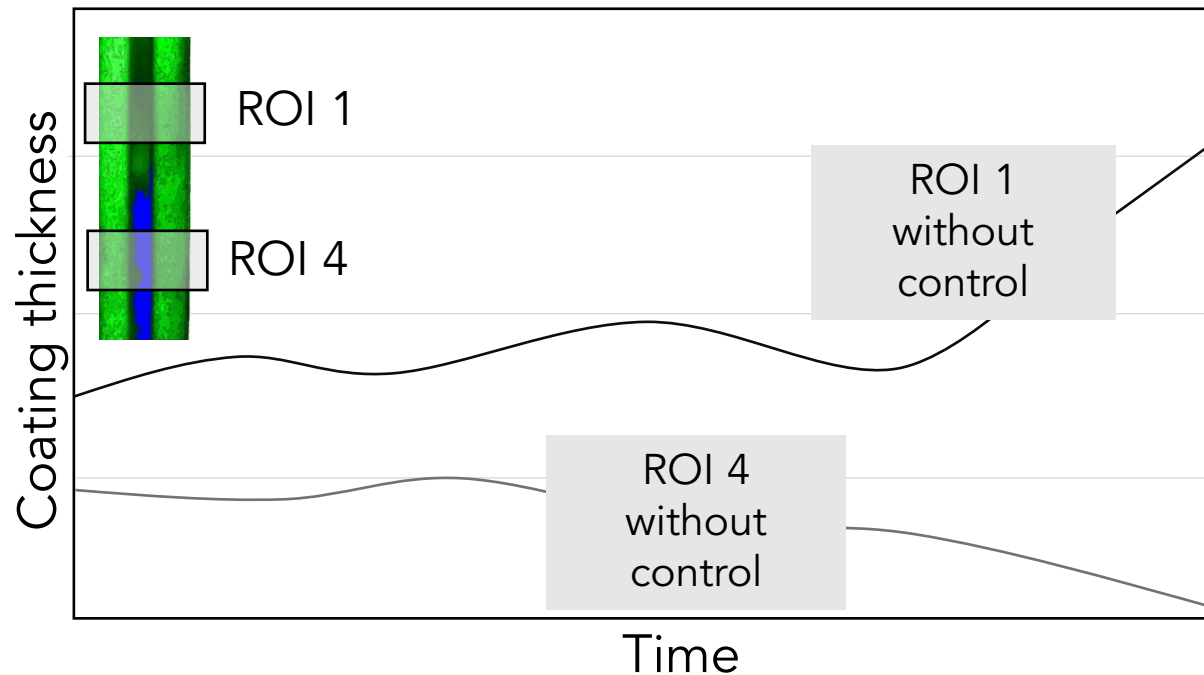
ROI 2: AVG: 60 μ m, STD: 3 μ m,
Min: 55 μ m, Max: 65 μ m

ROI 3: AVG: 110 μ m, STD: 6 μ m,
Min: 105 μ m, Max: 120 μ m

ROI 4: AVG: 100 μ m, STD:
16 μ m, Min: 90 μ m, Max: 123 μ m

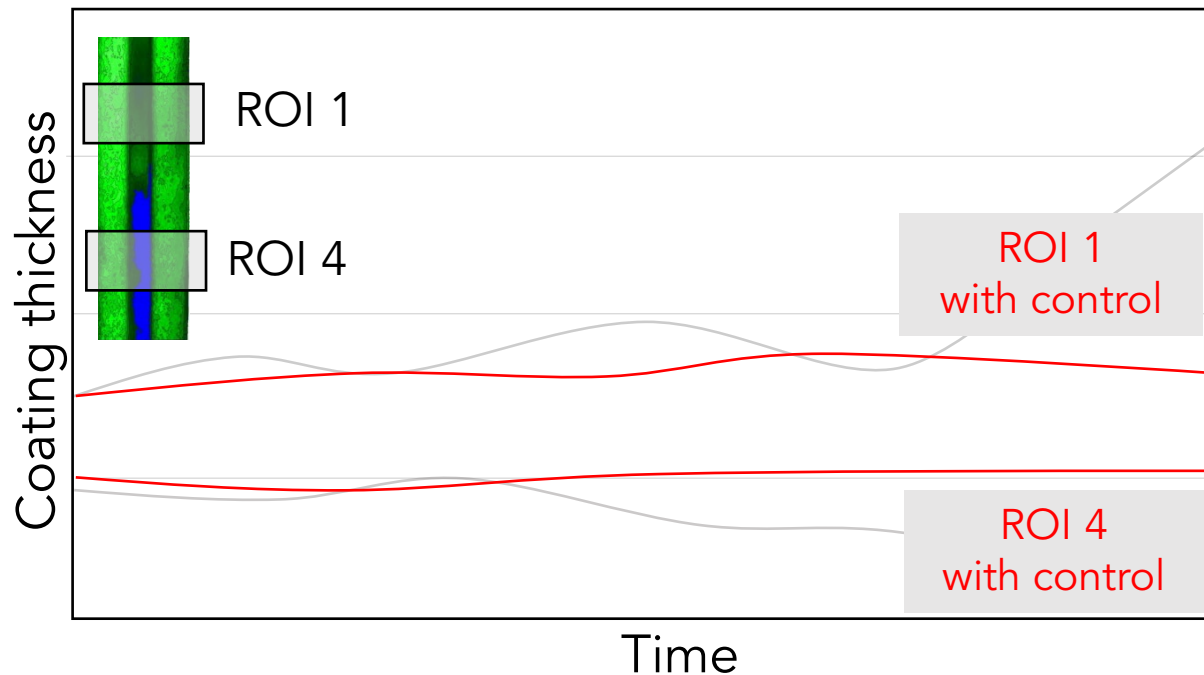


Case study: Powder coating in vertical plants (automated)



- Without control, coating thickness drifts
- Increased powder consumption or rejects

Case study: Powder coating in vertical plants (automated)

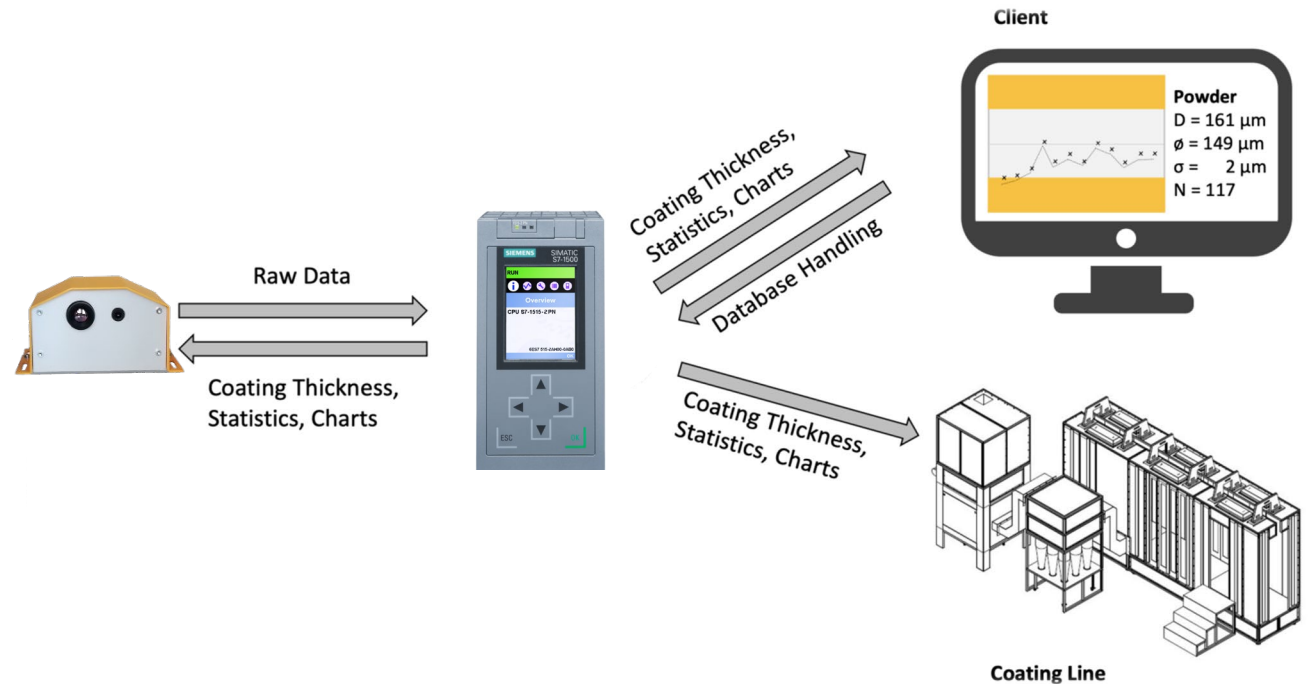


- With control constant coating thickness
- Minimum powder consumption
- Avoidance of rejects
- Advantages: Powder savings, process reliability and automated documentation

Advantages at a glance - Industry 4.0 ready



- Measurement of powdery and dry coatings
- Fast measurement for process control
- Complete measurement of large areas
- Direct data availability for ERP/control systems
- Connection to PLC for process visualization
- Automation of coating
- Intuitive documentation and statistical analysis



Survey

For which application is the imaging coating thickness measurement of interest for you?

- In the laboratory
- In the production line
- Both for the laboratory and in the production line
- For none of the above-mentioned areas

Your benefits

Summary



Produce
in a controlled way.



Increase
the quality.



Document
seamlessly.



Save
Material.



Check complex
shaped parts.



Measure layer
thicknesses on
rough surfaces.



Check a wide
variety
of materials.



In-Line
in real time.



coatmaster



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