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POWDER COATINGS
Architecture

AkzoNobel

Your imagination
starts with our finish

Digitalizing Surface Texture in Powder Coatings

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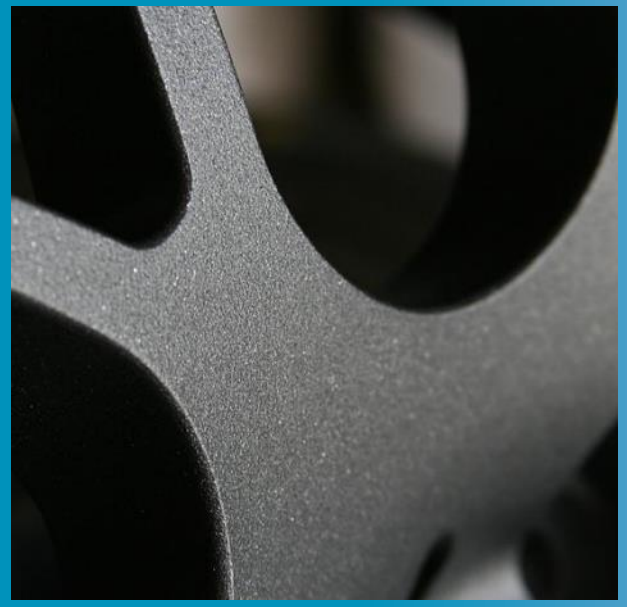
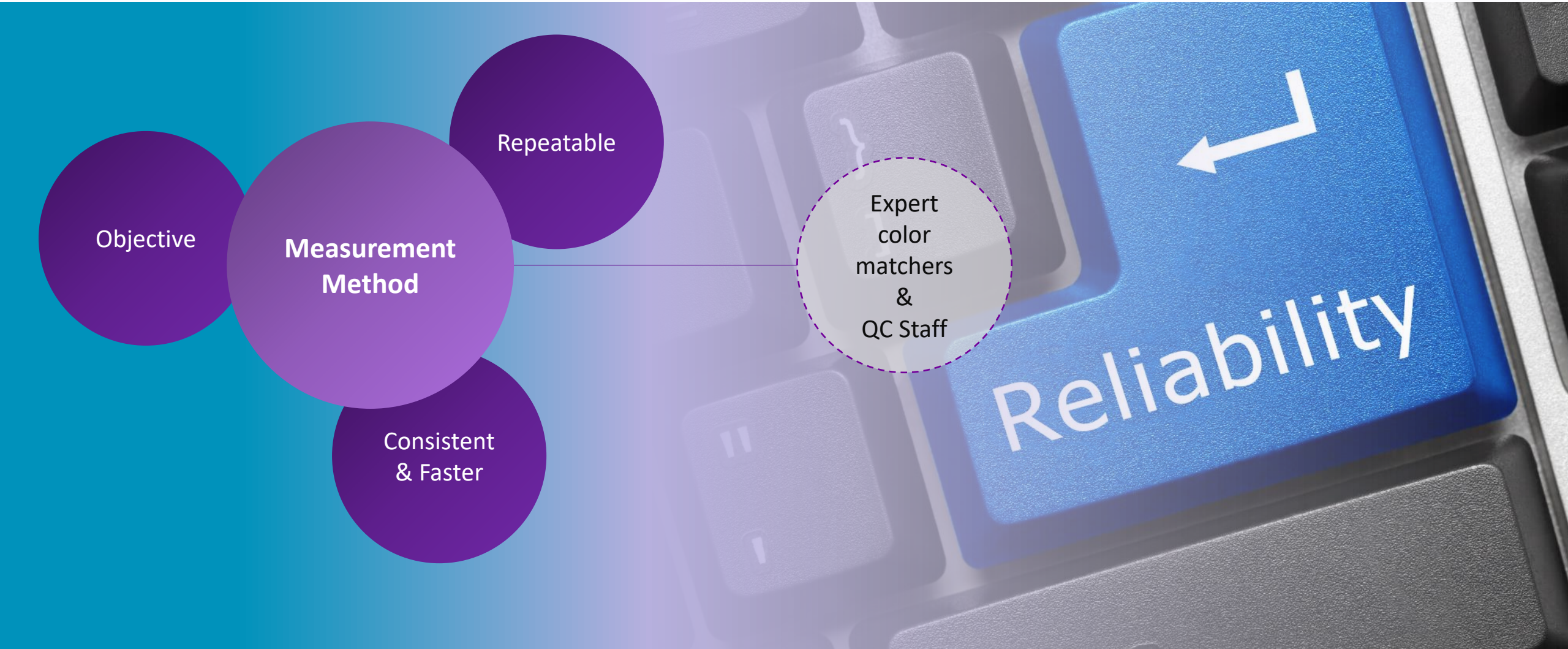
AkzoNobel Coatings, Inc.

How do texture powder coatings look like typically?




Why is this important?

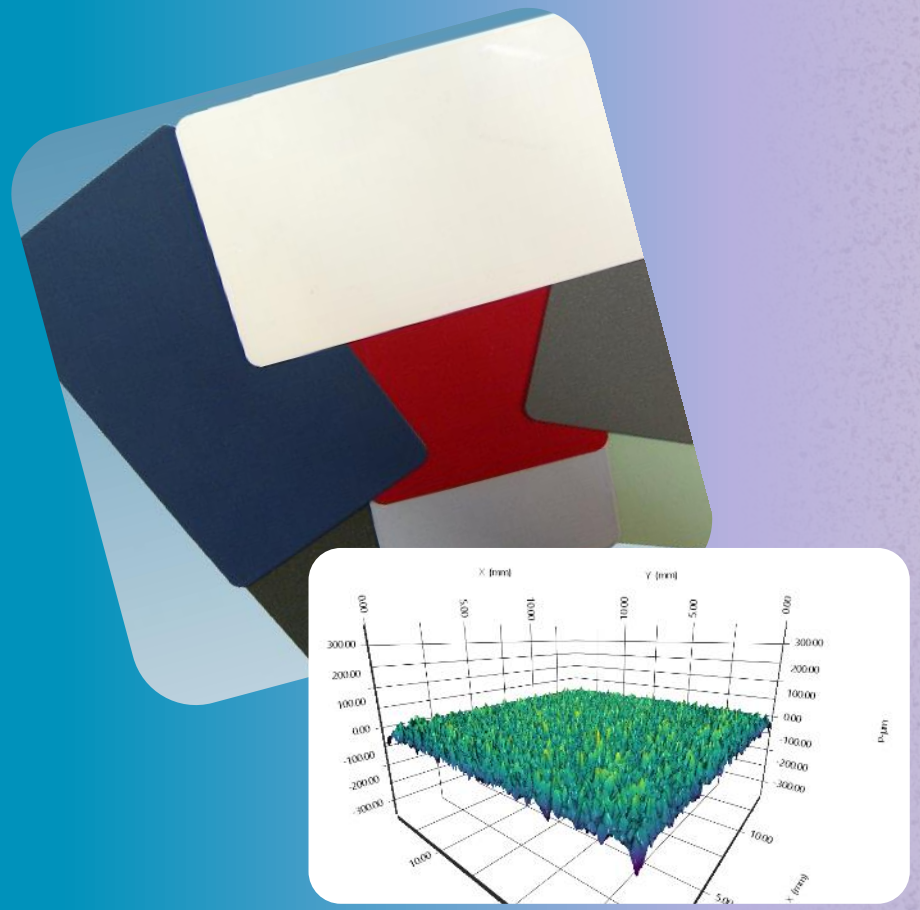


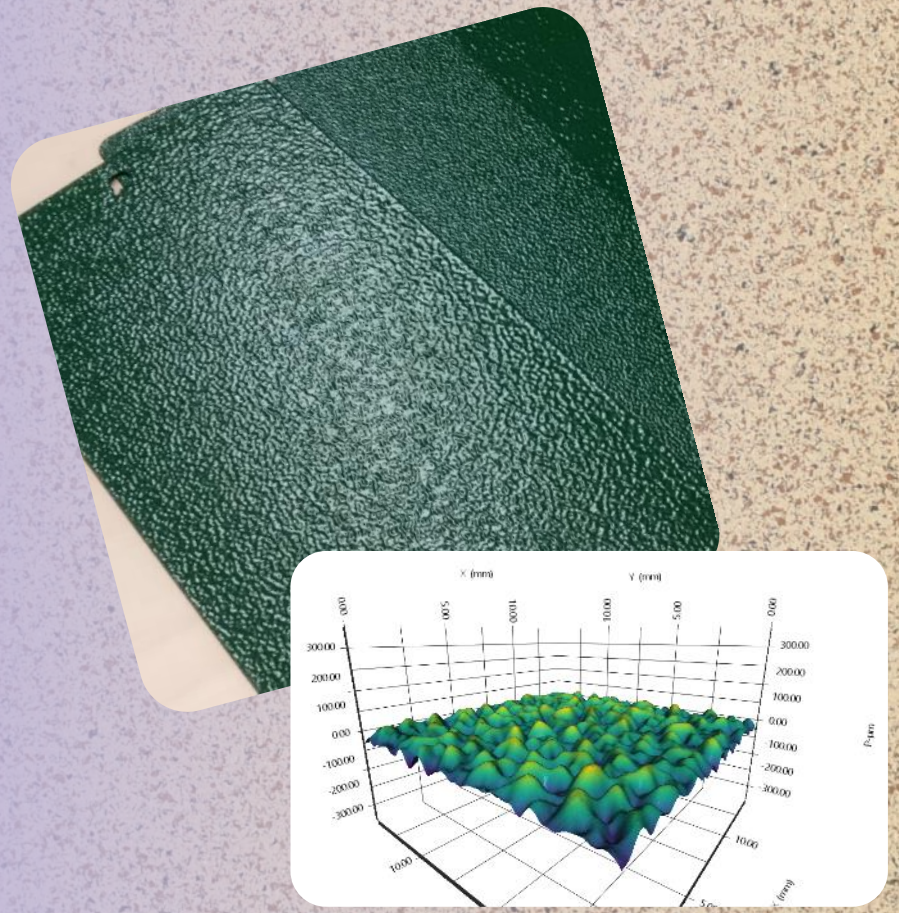
Identify Surface Texture

- Collect as many panels as possible
- Look at panels and try to describe what you see
- Define a procedure for visual assessment
- Carry out visual assessment and do analysis
- Check observer agreement
- Check whether researchers are consistent with observers from QC
- Measure all the panels
- Model the correlation between visual and instrumental data

How can we describe a Surface Texture?

Distinction between fine and coarse texture





How can we describe a Procedure for Assessment?

Light cabinet, D65

Pass or Fail (Color, Gloss, Texture)

Set Nr	obs1	obs2	obs3	obs4	obs5	obs6	obs7	obs8	obs9
50	0	1	1	0	1	0	0	0	0
51	1	1	0	1	1	1	1	1	0
52	0	1	1	0	1	0	0	0	0
53	0	1	1	1	1	1	1	1	0
54	0	1	1	1	1	1	0	1	0
55	0	1	1	1	1	1	1	1	0
56	1	1	1	1	1	1	1	1	1
57	1	1	1	1	1	1	1	1	1
58	1	1	1	0	1	1	1	1	1
59	0	1	1	0	1	1	1	0	0
60	0	1	0	1	0	1	1	0	0
61	0	1	0	0	0	1	1	0	0
62	0	0	1	0	0	1	1	0	0
63	0	1	1	1	1	1	1	1	1
64	1	1	1	1	1	1	1	1	0
65	1	1	1	1	0	1	1	1	1
66	0	1	0	1	0	1	1	0	1
67	1	1	1	1	1	1	1	1	1
68	0	1	0	0	0	1	1	0	0
69	0	1	1	0	0	1	1	0	0
70	0	1	1	0	1	1	1	1	0
71	0	1	0	0	0	0	0	0	0
72	0	0	0	0	0	1	1	0	0
73	1	1	1	1	1	1	1	1	0
74	0	1	0	0	0	0	0	0	0
75	0	1	0	0	0	1	1	1	0

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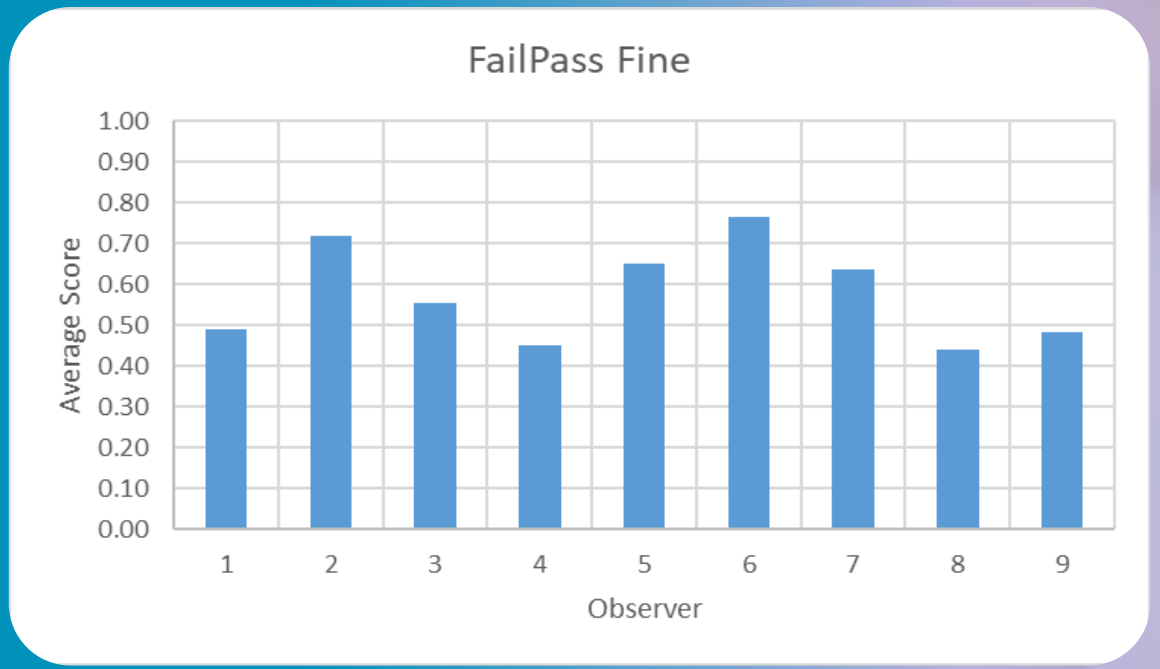
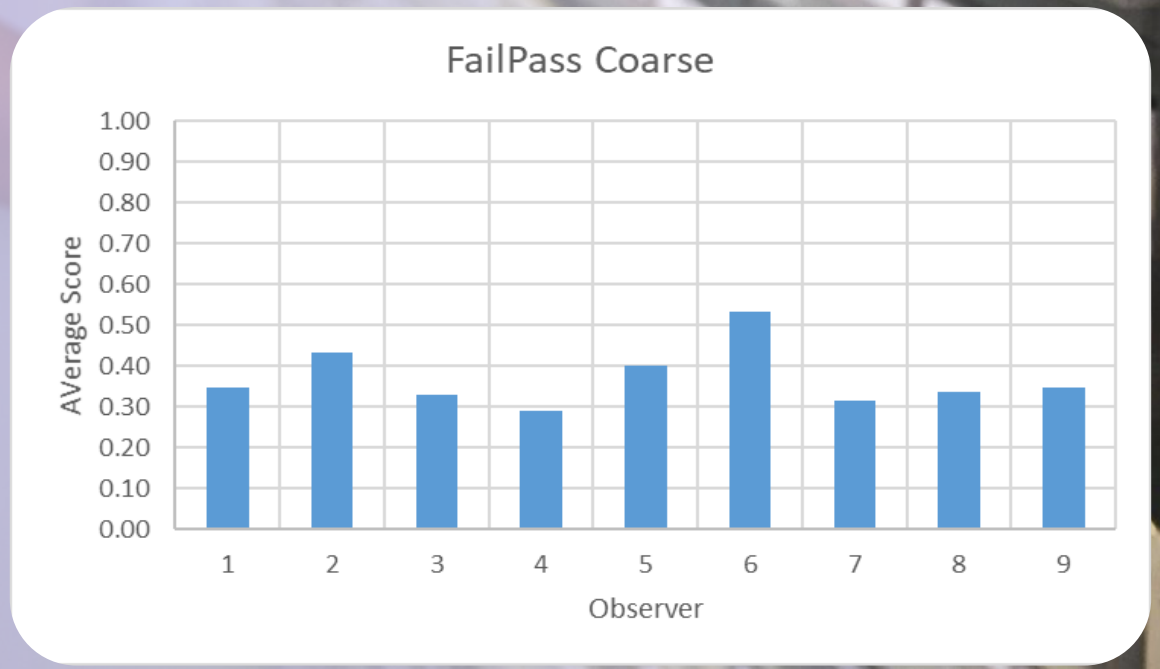
Observer Agreement

x-axis: observer 1 to 9. y-axis: average score.
average fail-pass score: 0.3 means that in 3 of 10 cases the observer gives a pass

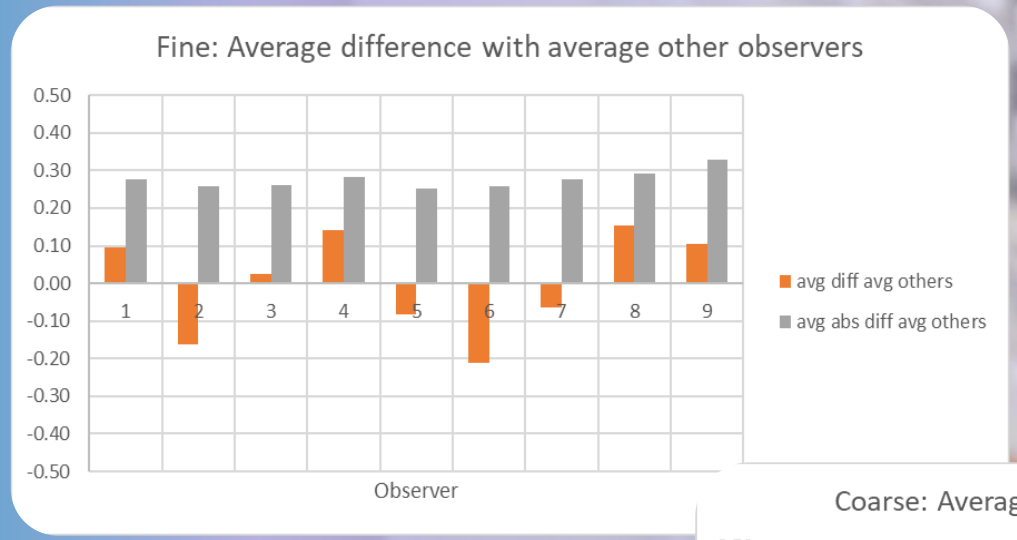


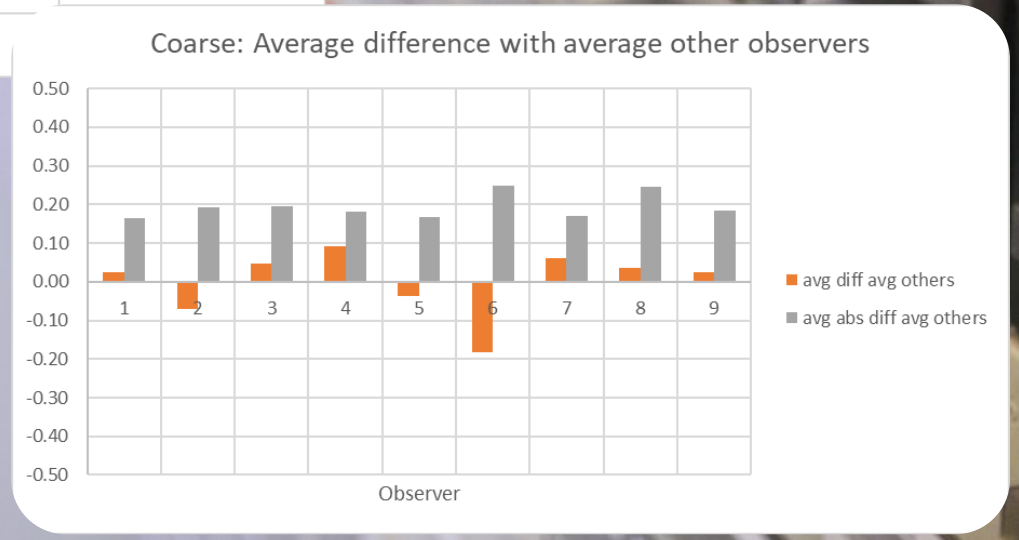


Observer Agreement

Orange: average difference with average of other observers: positive means that the observer is stricter, the larger the value the stricter the observer. Zero means that the observer is sometimes stricter and sometimes more relaxed.

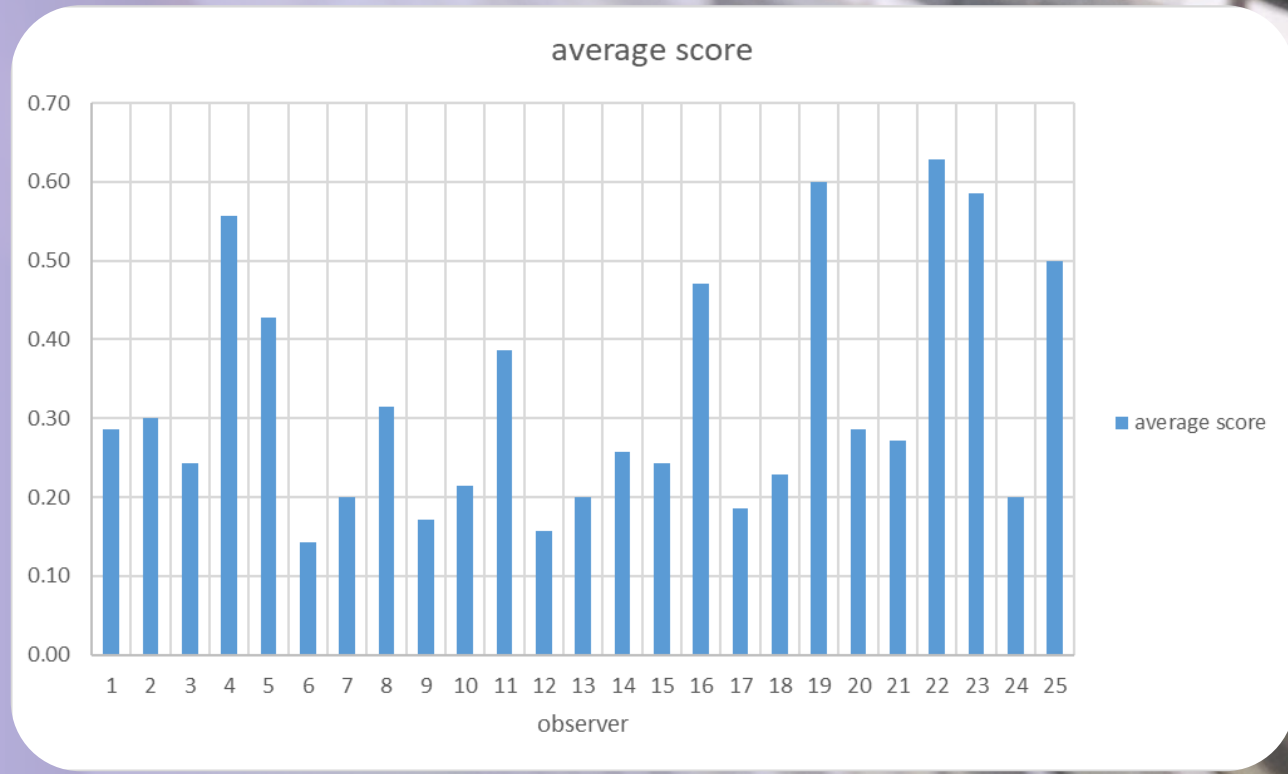
Grey: average absolute difference with average of other observers: 0.2 means that in 1 of 5 cases the observer disagrees with the other observers





Agreement between QC and Research

16 QC observers and 9 research observers
x-axis: observer 1 to 25.
y-axis: average score.
average fail/pass score: 0.3 means that in 3 of 10 cases the observer gives a pass.



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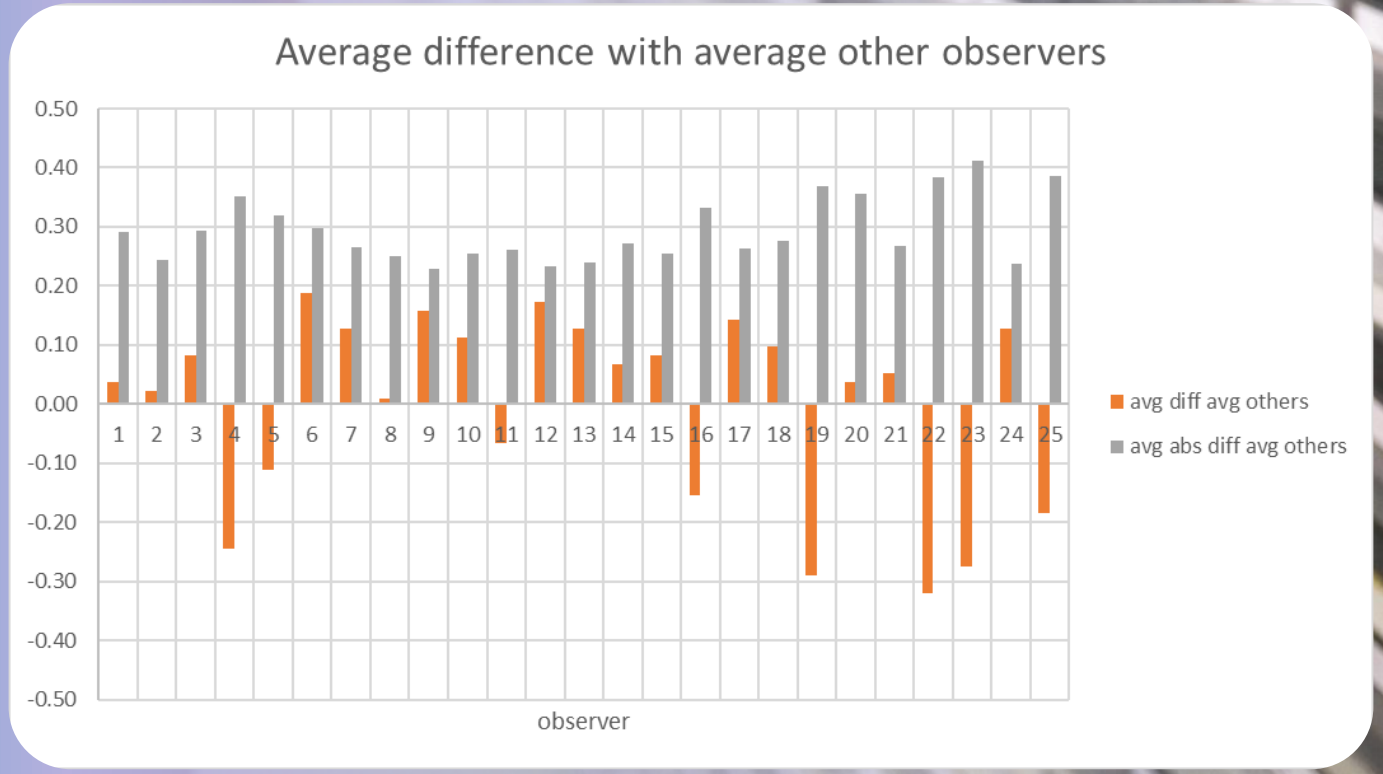


Identify Surface Texture

- Scoring table
- High Agreement pairs for testing
- Medium Agreement pairs for verification
- Disagreement pairs are not used

k9	p9	Cump9	Agreement
9	0.002	0.000	High
8	0.018	0.002	High
7	0.070	0.020	Medium
6	0.164	0.090	
5	0.246	0.254	
4	0.246	0.500	
3	0.164	0.746	
2	0.070	0.910	Medium
1	0.018	0.980	High
0	0.002	0.998	High

Identify Surface Texture

fine passfail			
Y	170	34%	
MY	52	11%	
G	149	30%	
MN	26	5%	
N	96	19%	
	493		266

coarse passfail			
Y	69	22%	
MY	23	7%	
G	48	16%	
MN	24	8%	
N	144	47%	
	308		213

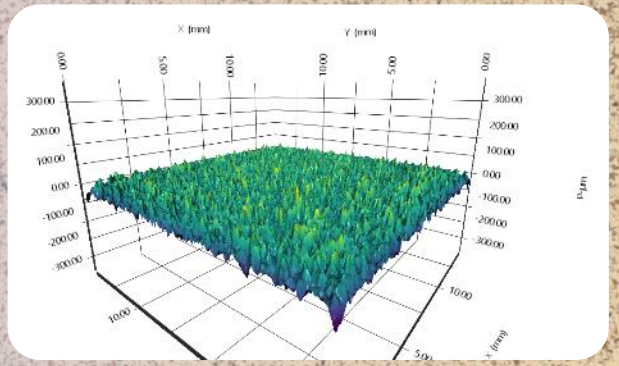
Spectro2profiler

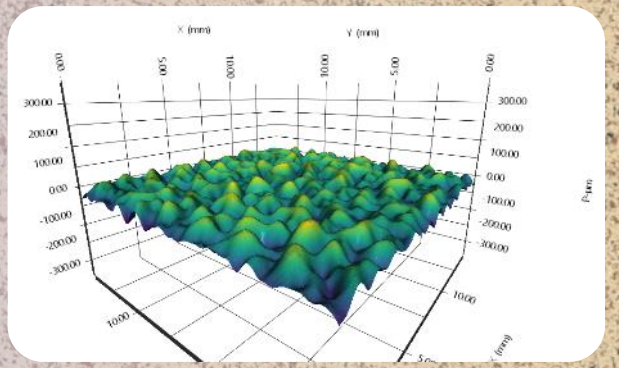
Picture courtesy of BYK-Gardner GmbH

- Measures topography based on photometric stereo technique
- Also color and gloss
- Easy-to-operate
- Live preview
- Measurement in seconds

Identify Surface Texture

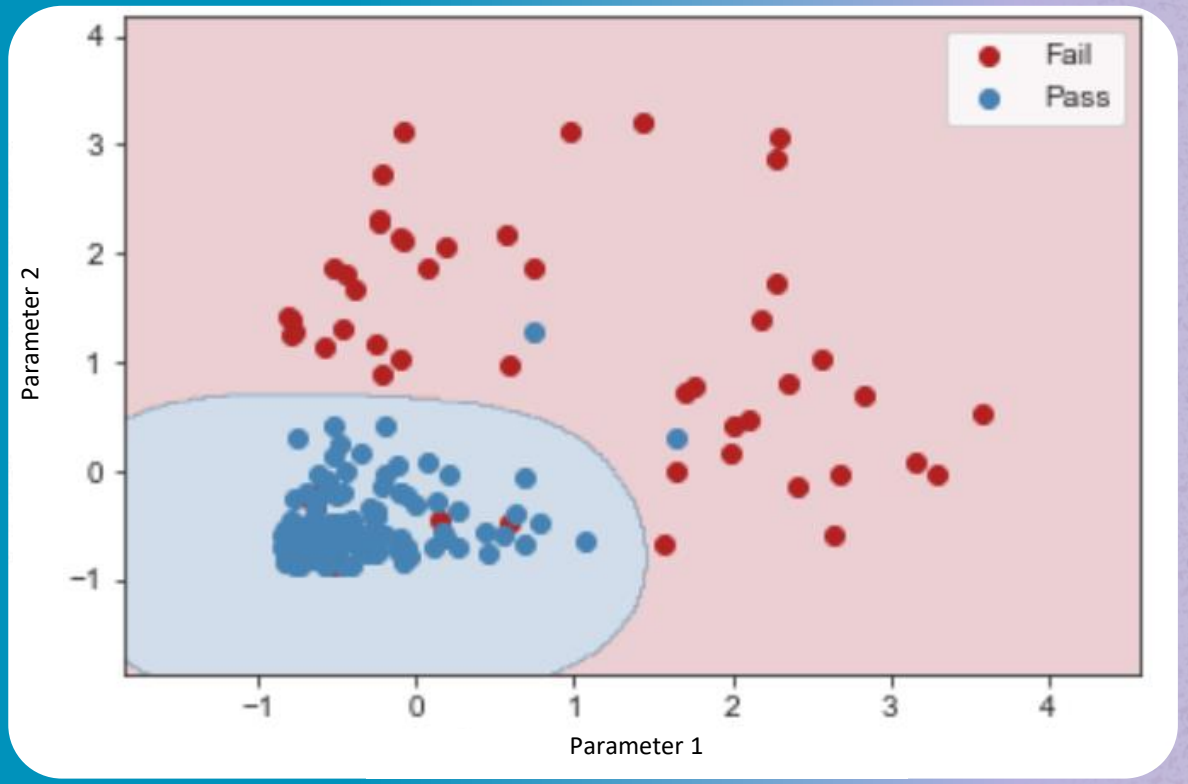
- We searched literature for methods to extract information from images
- We opted for the following approaches:
  - Segmentation
  - Transfer Learning
  - Local binary patterns
  - Edge-based features
- We focused on 34 features from the images
- We investigated the best combinations of 2 and 3 features
- We applied SVM to derive the model



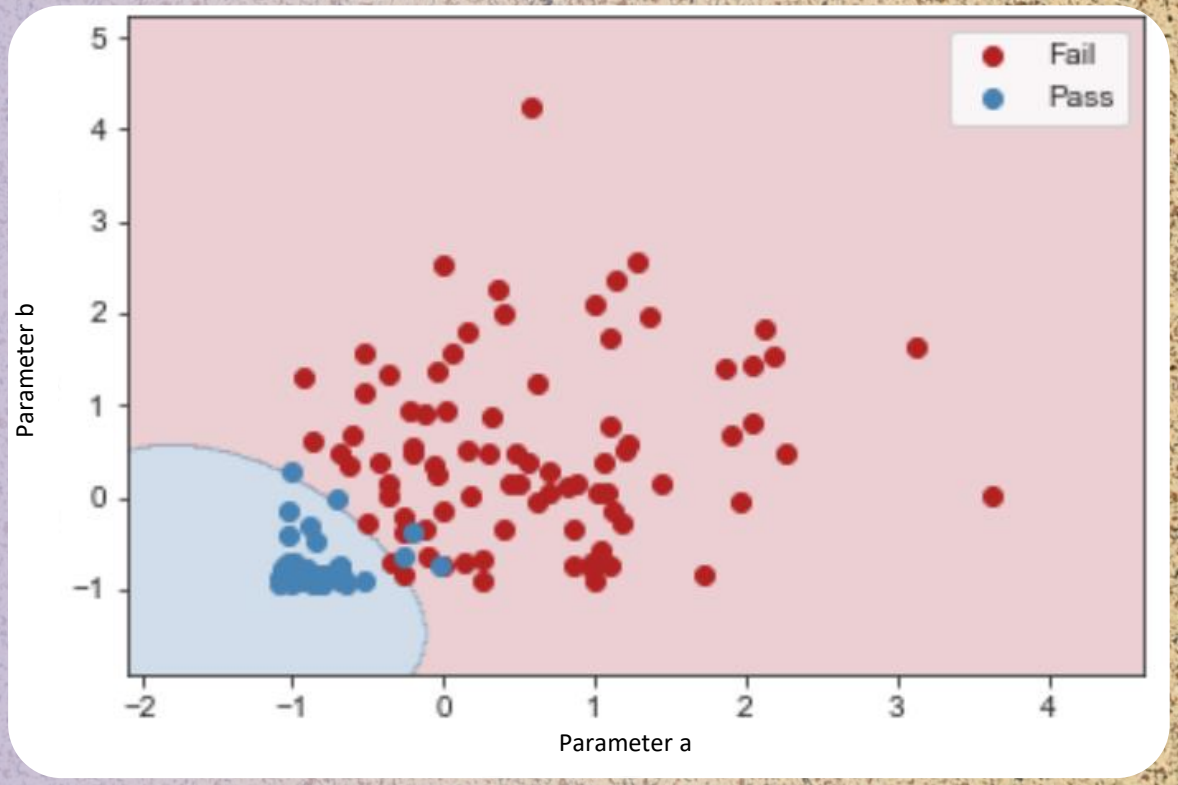


Identify Surface Texture

Fine structures



Coarse structures



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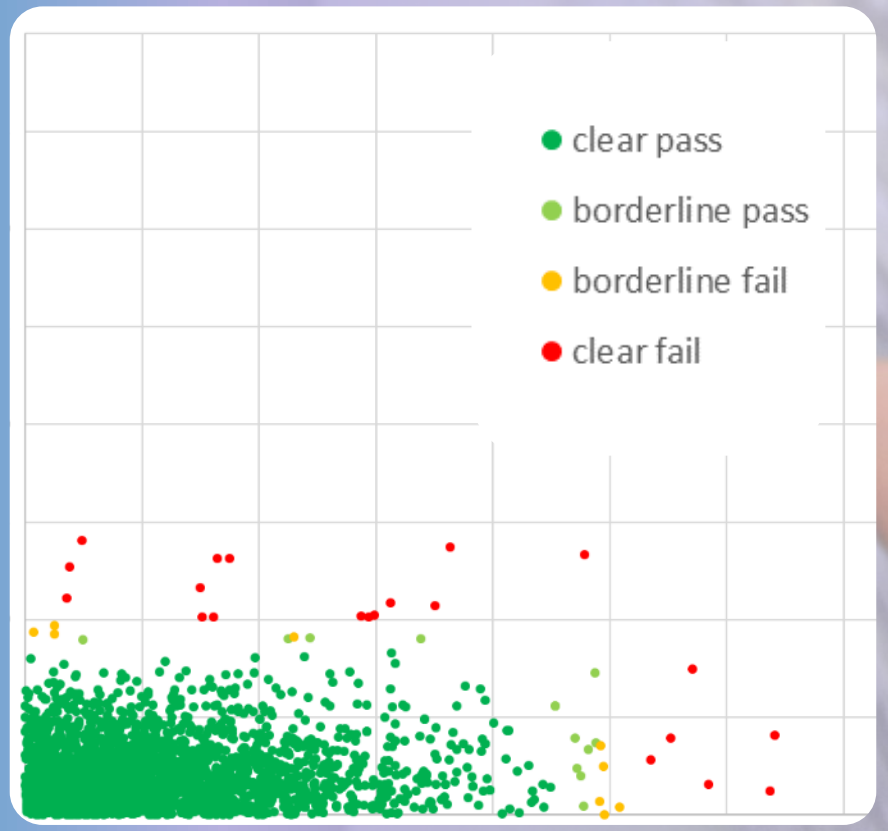
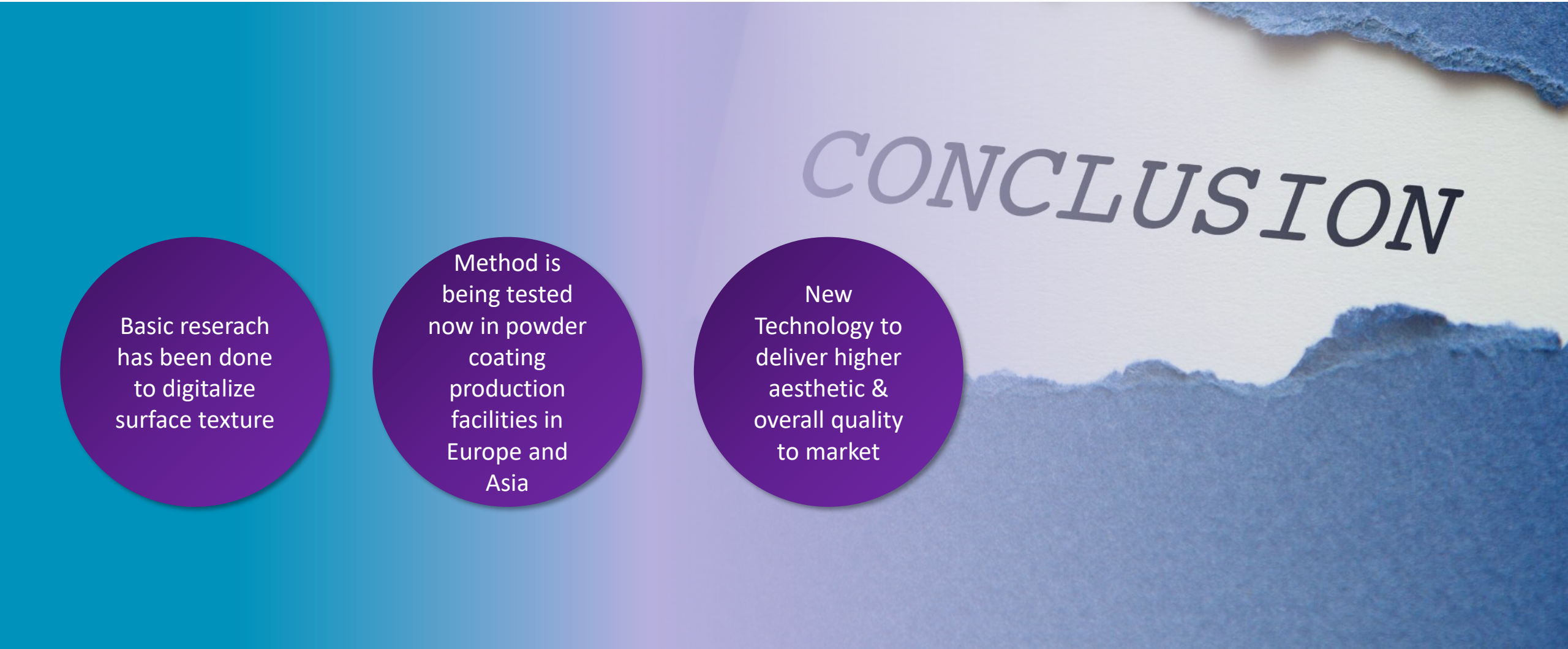
QC Trial on Fine Textures

- 2500 comparisons
- 200 colors
- 217 batches



Conclusion



Basic reserach has been done to digitalize surface texture

Method is being tested now in powder coating production facilities in Europe and Asia

New Technology to deliver higher aesthetic & overall quality to market

Questions?

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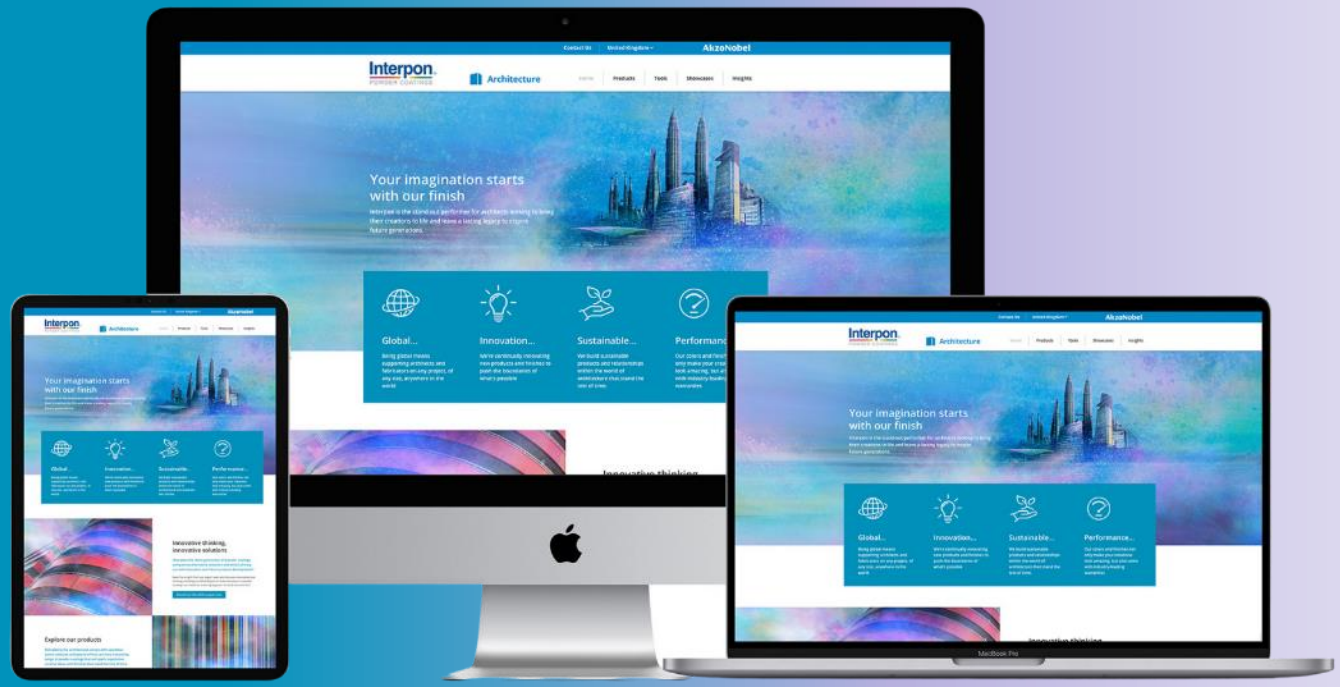

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