Event Proceedings

AWA
Alexander Watson Associates

AWA Silicone Technology Seminar 2014

March 19 - Amsterdam, the Netherlands

Platinum Sponsor:

The Biofore Company

UPM

Introduction

Dear Sir/Madam,

It was our pleasure welcoming you at the **AWA Silicone Technology Seminar 2014.** Your participation was highly appreciated and we hope that the event was beneficial for you and your organization.

Included, please find the proceedings of the event. We would like to thank our sponsors and speakers for their valuable contribution to the program and making this industry platform possible.

Platinum Sponsor: UPM

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We welcome and thank you for your comments and suggestions for improvement as they contribute to further developing our event format. If you have not provided your comments yet, please complete the feedback form at the end of this document and submit it to us.

Thank you again for your participation in the seminar. We wish you all the best and look forward to welcoming you again at one of our future events.

Do not hesitate to contact us if you have any queries.

With kind regards,

AWA Conferences & Events

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SEMINAR PROGRAM – Wednesday March 19, 2014 ***(Please click the conference title to view the presentation)***

Name: Hardi Döhler

Title: Innovation Management Radiation Curing

Company: Evonik Industries AG

Company Profile: **EVONIK Industries AG**

Annual turn over: € 13,4 billion
Headquarter(s): Essen, Germany
Key Operation(s): Evonik - the creative industrial group from Germany - is one of the world's leading specialty chemicals companies.
Number of employees: 33.300 (2012)
Application markets: UV curable silicones for
filmic or paper release liner
as used in labels, linerless labels, tapes…

Quality of release coatings with 5 Roller Coaters

EVONIK INDUSTRIES

Quality of release coatings with 5 Roller Coaters

Content

- Some words about TEGO® RC Silicones
- What is influencing the release force
- Silicone coverage
- Coater head setting of a 5 roller coater

TEGO® RC Silicones

When thermal silicones have to give up...

TEGO® RC Silicones will provide a solution for you!

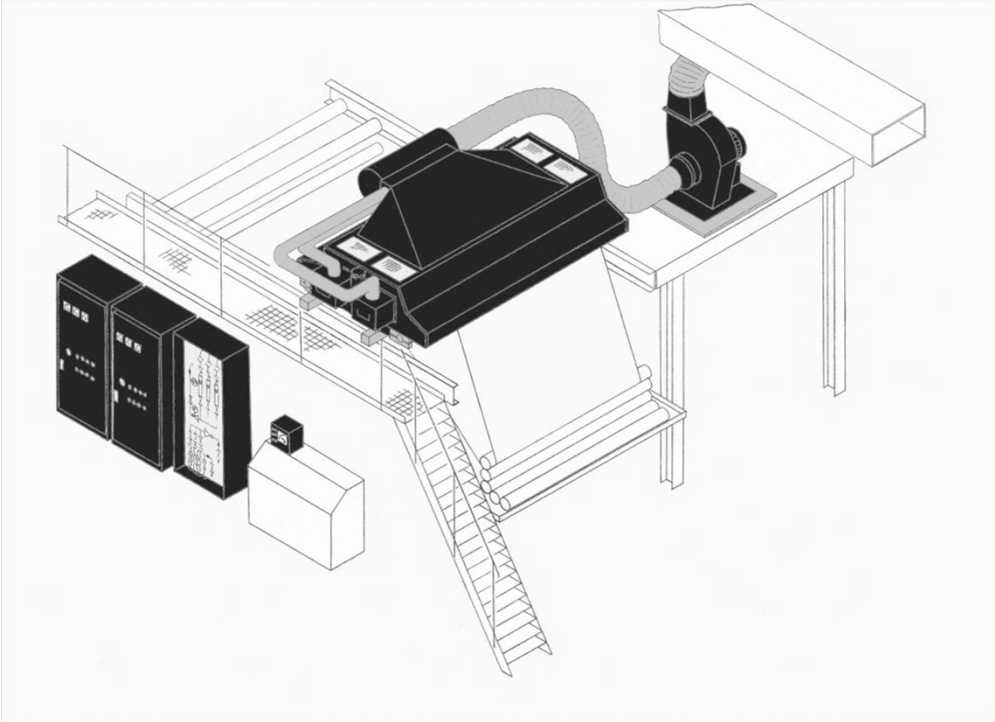
- Use of heat-sensitive films
  - PE, PP, PET, PVC
- Absolute paper lay flat
  - coated craft paper like CCK, PEK
- Cost reduction
  - down gauging films and papers
- Environmentally friendly production
  - low energy consuming, no solvents

TEGO® RC Silicones

- Aluminium & Foils
- Foams
- Non-Woven & Textiles
- Office papers
- Printed Surfaces
- PVC
- Recycled Materials
- Renewable Films
- Thermal Papers
- Thinnest Films

TEGO® RC Silicones

Easy to Handle Machinery



Compact construction,
easy retrofitting

Approx. 1.3 m in web direction,
less floor space

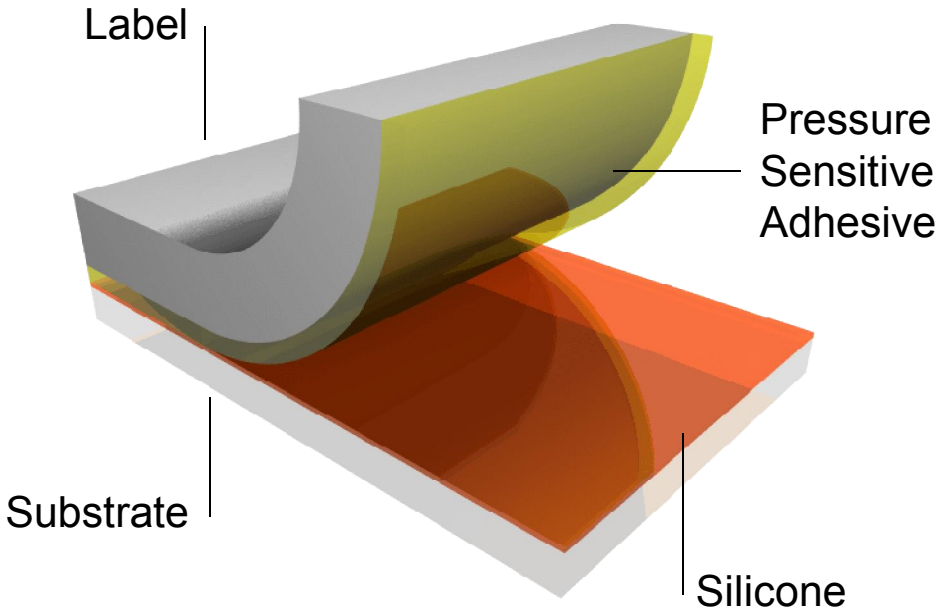
Low equipment investment

Extremely short start-up times
(< 5 min.)

Less silicone waste, less rejects of substrate

Release – What is effecting the release

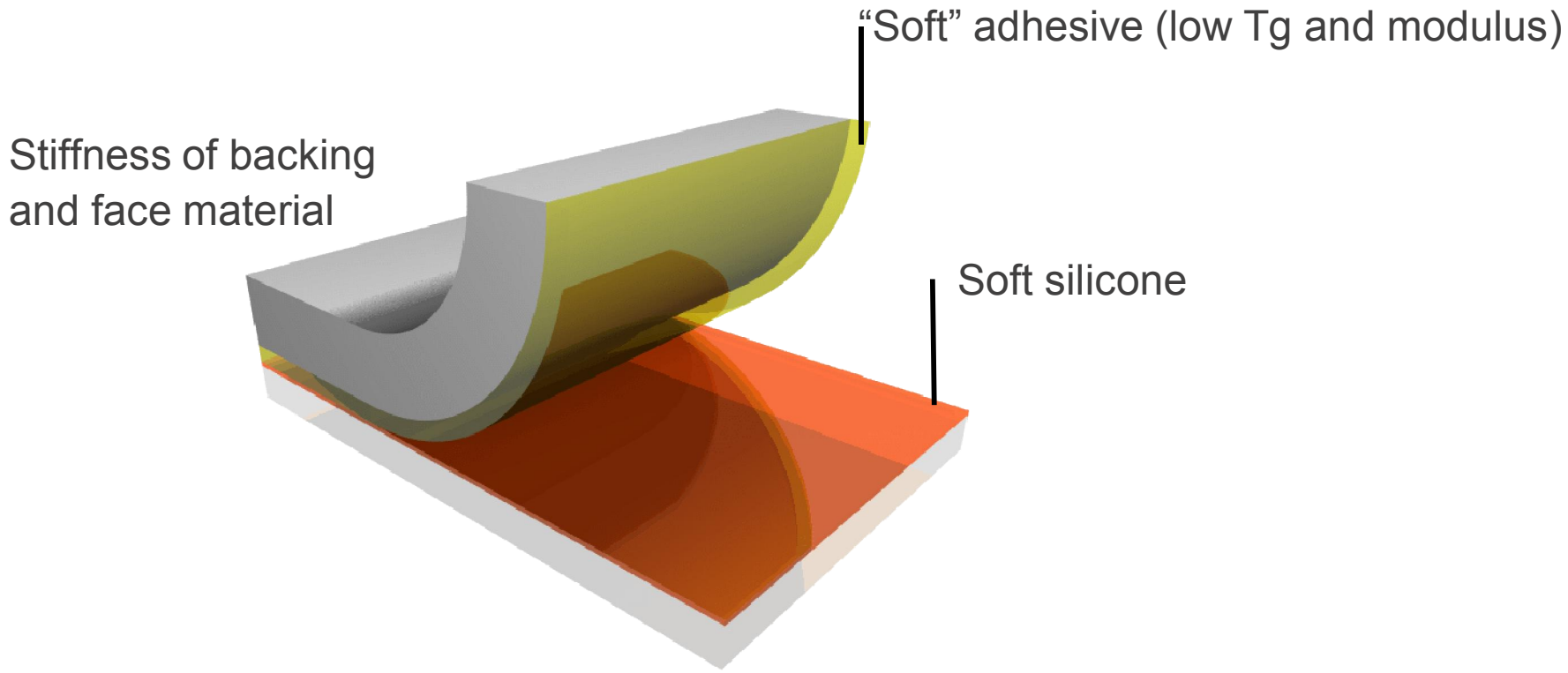
Release is always a combination of **silicone adhesive separation** and **energy dissipation**



Release – Energy Dissipation

Mechanical energy dissipation

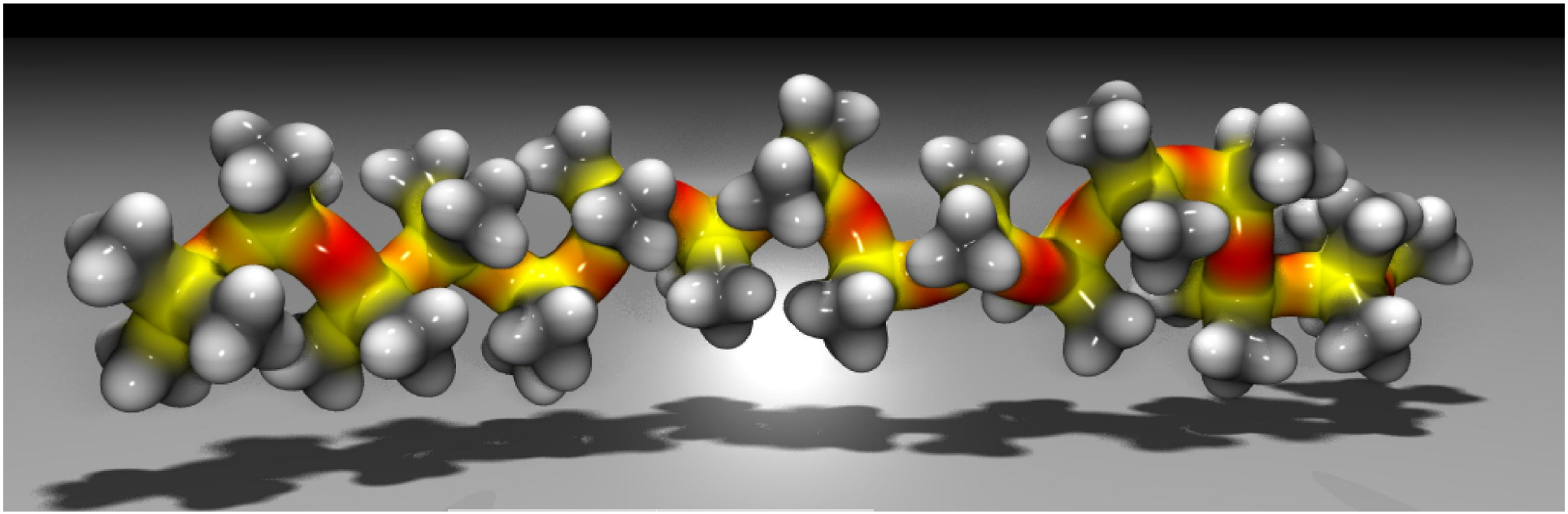
"Bulk mechanical response of the non-rigid components"



Release is influenced by the test set up and label construction, this is often disregarded as a contributor to release force

Release – Attractive Forces

Silicone release coatings have very low surface energy

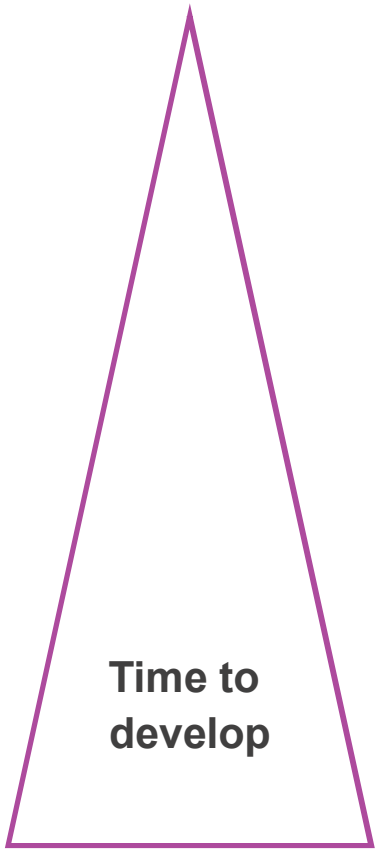


	Carbon	Silicone
Surface Energy [mN/m]	BoPP 32	18-22
	LDPE 27	

⇒ very low interfacial adhesion

Release – Attractive Forces

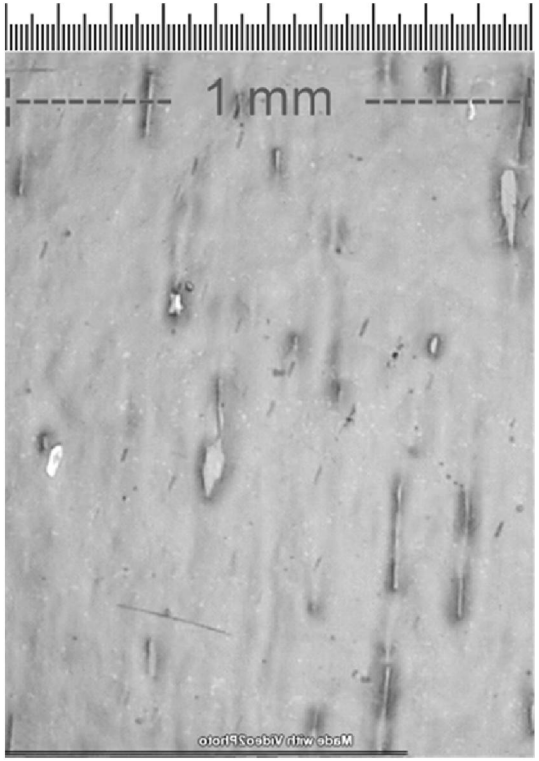
Silicone adhesive interactions (interface chemistry)



Mechanical adhesion	Full contact: Adhesive flow into cavities
Van der Waals forces	Wetting: Van der Waal force vary with distance
Orientation, rotation effects	Identical surface tension segments face each other
Physical entenglement	Diffusion: PSA and Silicone chains can mingle
Chemical reactions	If any: Time and temperature driven

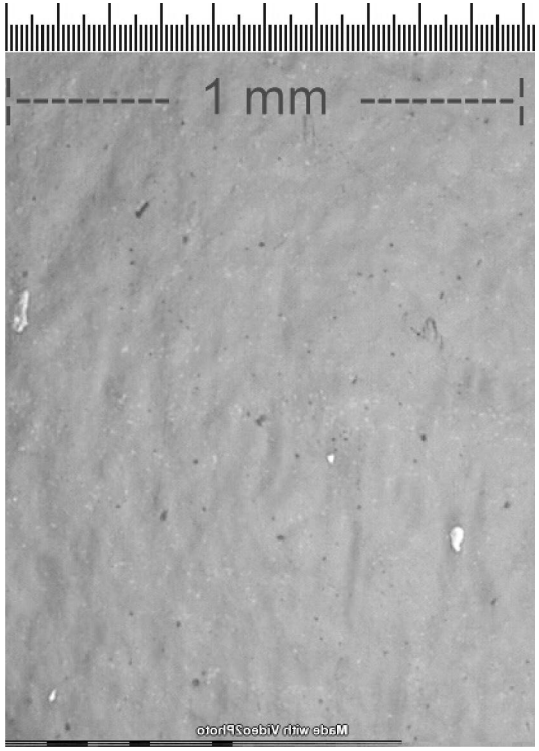
Release – Attractive Forces

Silicone adhesive interactions (interface chemistry)



Pinholes expose substrate

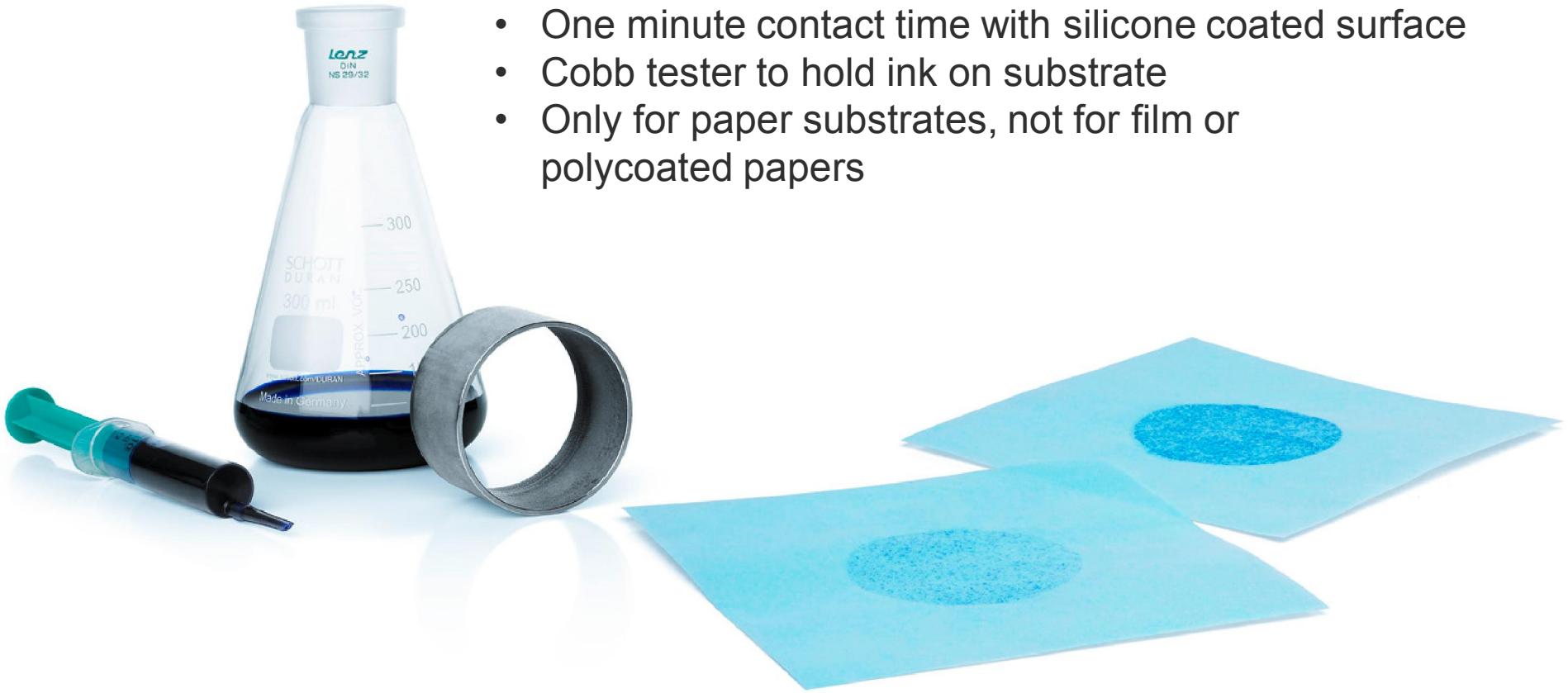
- **Mechanical adhesion**
- **Van der Waals forces**
- **Orientation, rotation effects**
- **Physical entenglement**
- **Chemical reactions**



This is why silicone coverage is so important

Dye Stain Test for Silicone Coverage of Paper Substrates

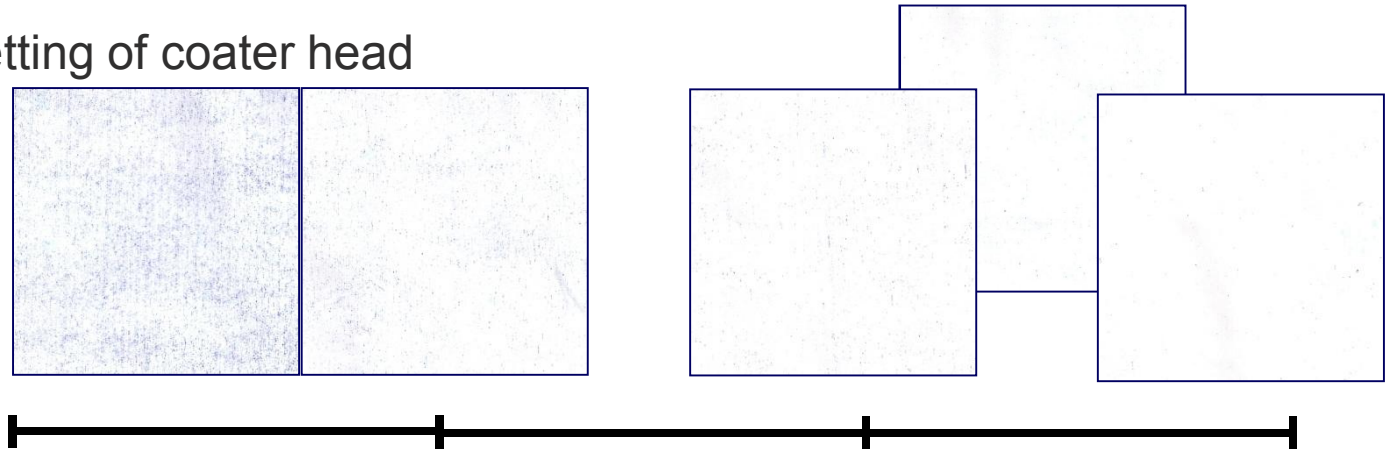
- Test ink e. g. 0.1 % Methylene blue in water
- One minute contact time with silicone coated surface
- Cobb tester to hold ink on substrate
- Only for paper substrates, not for film or polycoated papers



Dye Stain Test for Silicone Coverage of Paper Substrates

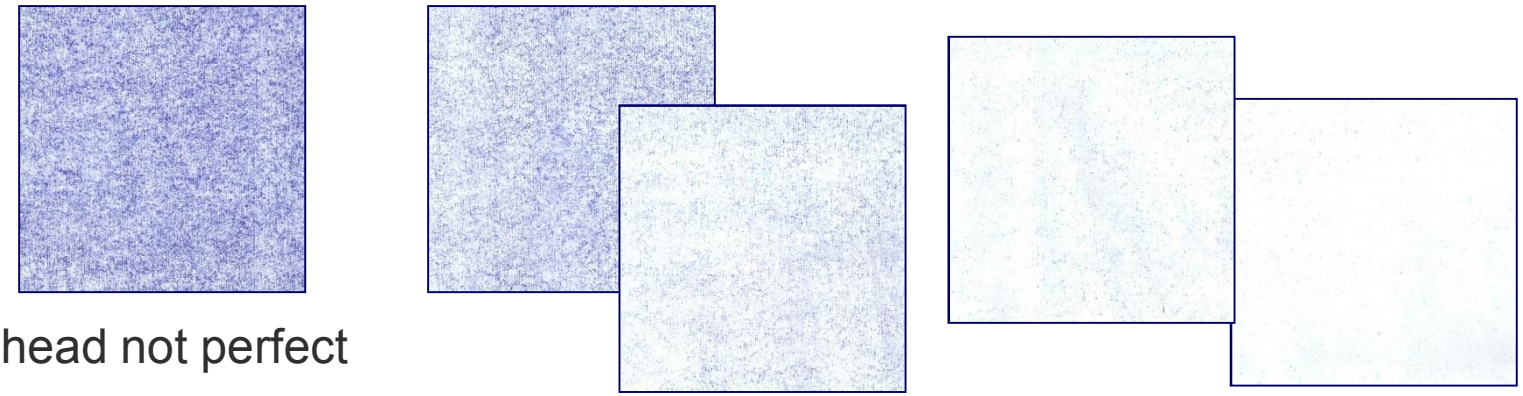
Dye Stain Test vs Coat Weight

Good setting of coater head



low coat weight

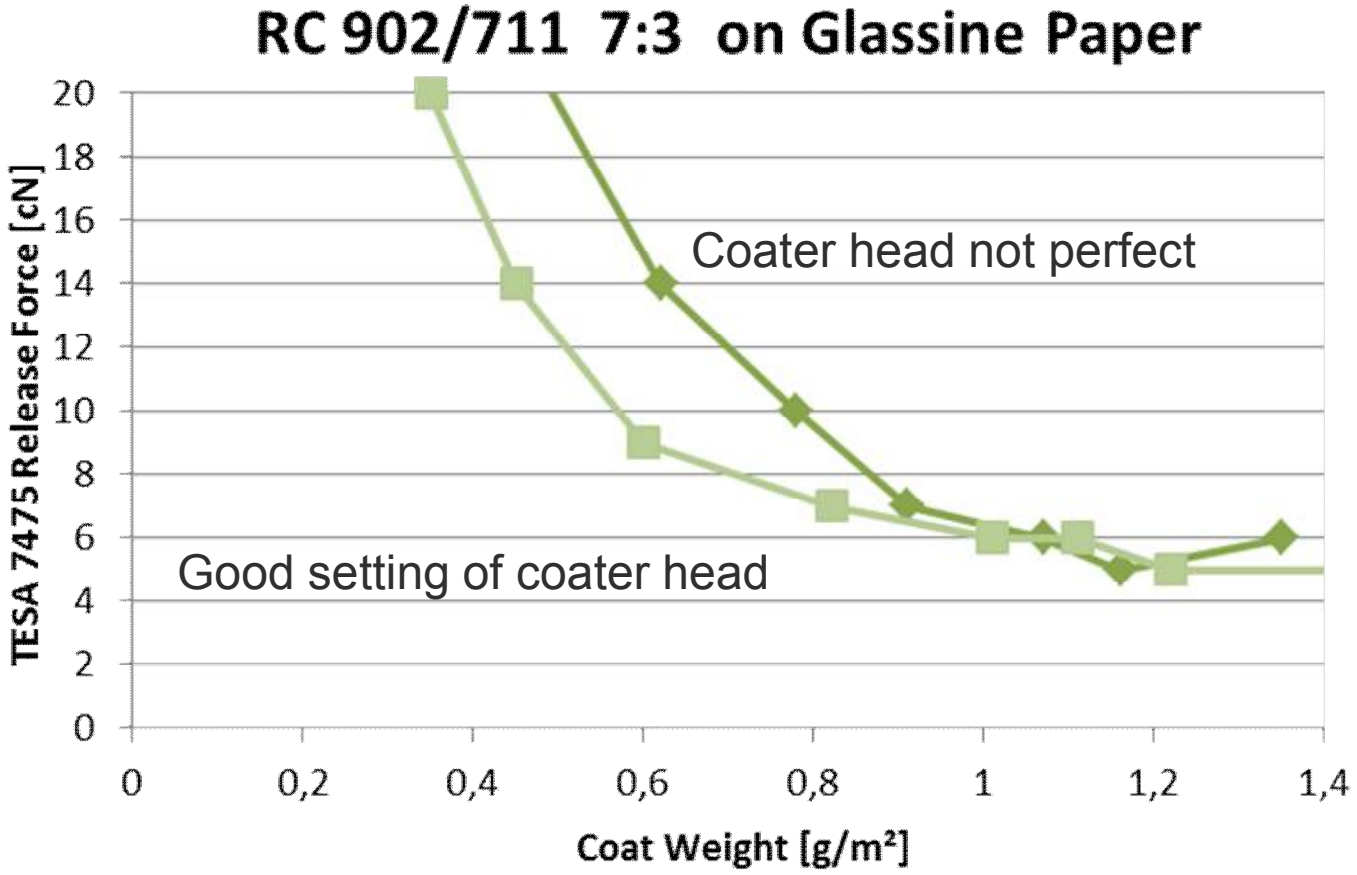
high coat weight



Coater head not perfect

Dye Stain Test for Silicone Coverage of Paper Substrates

Release vs Coat Weight



Microscope for Silicone Coverage on Filmic Substrates

Type of Microscope

- Coaxial illumination
  (transmitted light)
  40-60 times magnification

Portable microscope

- Model 2054-40-CIL, ~ 1000 €

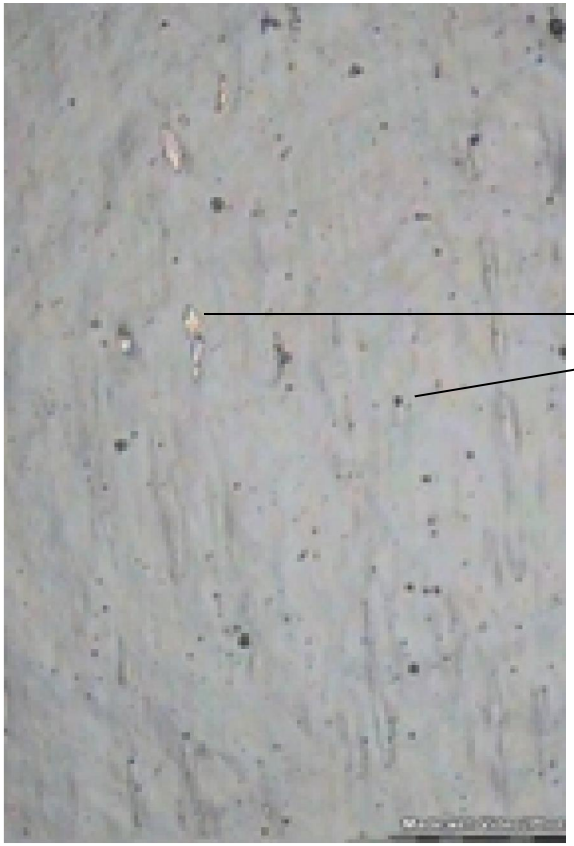
Further advantages with

- Polarised light
- Stereo microscope
- Camera interface

Coater head setting

High coat weight is no guarantee for good coverage!

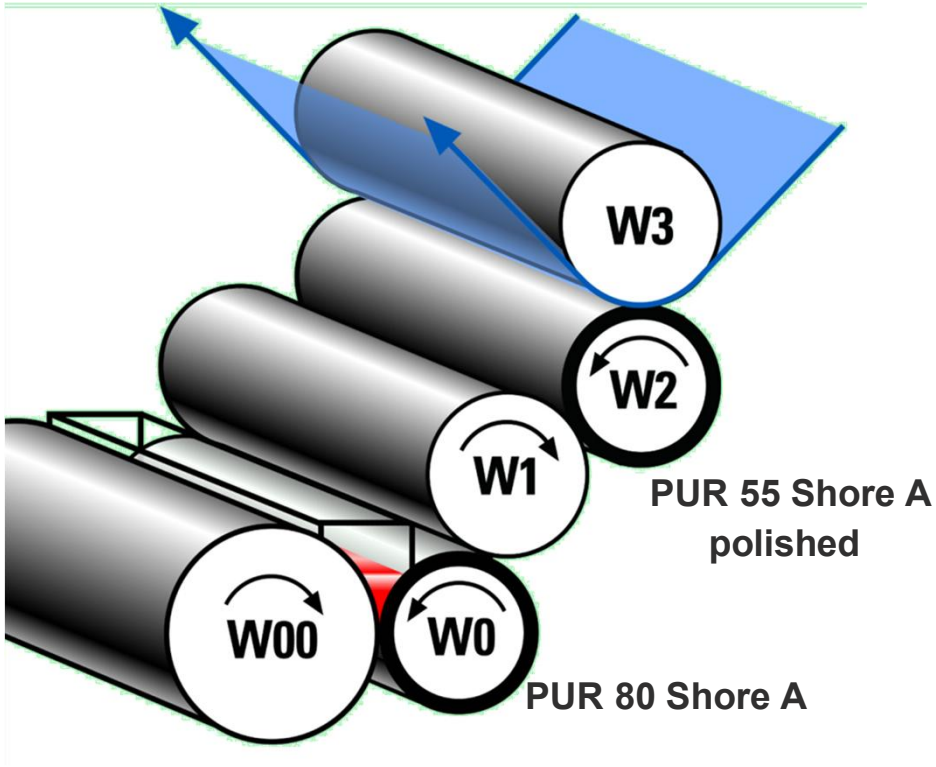
1,75 g/m² **0,31 g/m²**



950 x 1430 µm

Coater head setting

5 Roller Coater (naming as used by Polytype / CH)



W00, W1, W3 chrome plated steel

Coating quality depends on

Roller W2 quality

- highly polished for best results

Silicone viscosity

- optimum range 200-500 mPas
- silicone temperature up to 60°C

Heat control

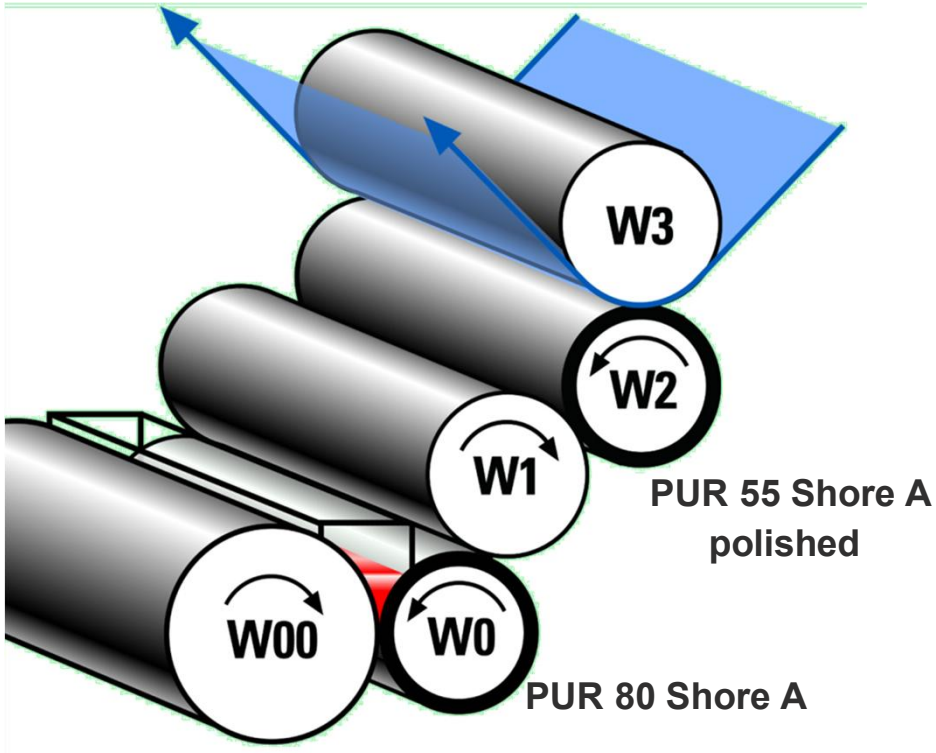
- friction results in heat

Silicone mixing in nip

- to uniform air bubbles

Coater head setting

5 Roller Coater (naming as used by Polytype / CH)



W00, W1, W3 chrome plated steel

Plenty of things to play with

4 nips - 4 footprint [FP]
5 rollers - 5 speeds [v]

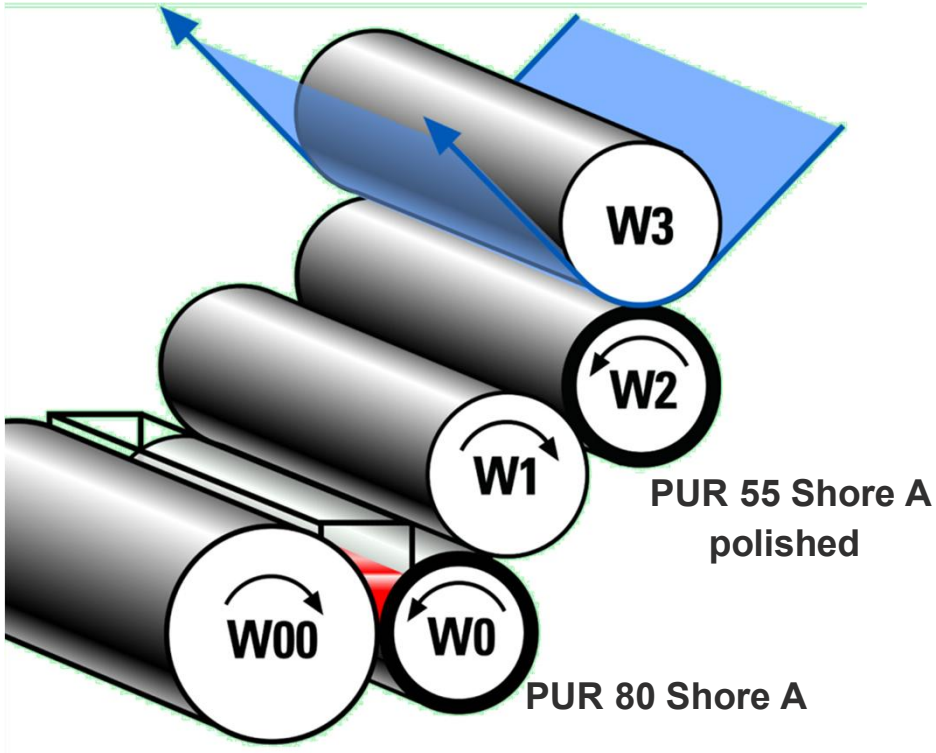
The following values are for guidance only and indicate trends.

Roller hardness and diameter will influence the actual settings.

Coater head setting

5 Roller Coater (naming as used by Polytype / CH)

Coating trials with RC902/711 70:30 on 50µm BoPP

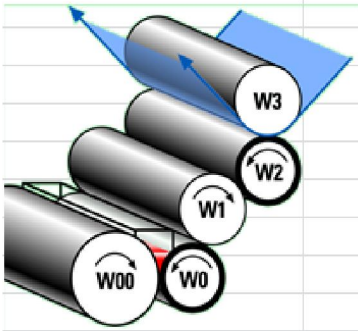


W00, W1, W3 chrome plated steel

V-Nr.	Standard
Setting	(16)
Speed [m/min]	200,0
v W00 [m/min]	3,0
v W0 [%]	12,0
v W1 [%]	70,0
v W2 [%]	102,0
FP W00/W0 [mm]	15,5
FP W0/W1 [mm]	5,5
FP W1/W2 [mm]	4,5
FP W2/W3 [mm]	10,5

Coater head setting

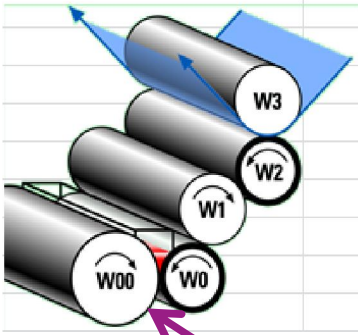
V-Nr.	Standard	100/04
Setting	(16)	16
Speed [m/min]	200,0	200,0
v W00 [m/min]	3,0	3,0
v W0 [%]	12,0	12,0
v W1 [%]	70,0	70,0
v W2 [%]	102,0	102,0
FP W00/W0 [mm]	15,5	15,5
FP W0/W1 [mm]	5,5	5,5
FP W1/W2 [mm]	4,5	4,5
FP W2/W3 [mm]	10,5	10,5
Silicone Coat Weight [g/m2]		1,03



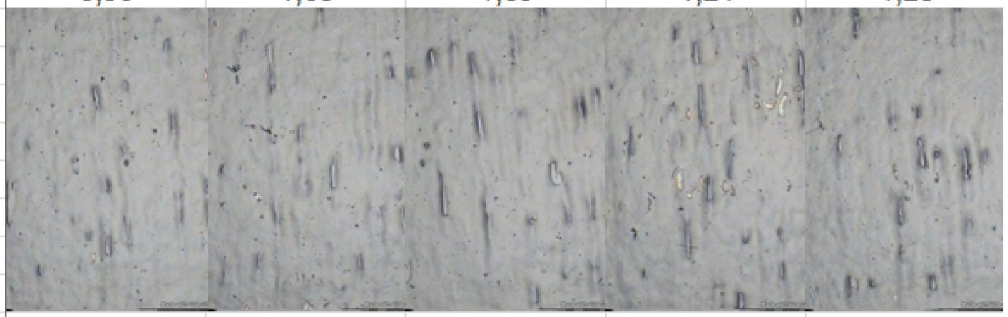
Coater head setting

V-Nr.	Standard	100/04	100/04	100/04	100/04	100/04
Setting	(16)	17	16	18	19	20
Speed [m/min]	200,0	200,0	200,0	200,0	200,0	200,0
v W00 [m/min]	3,0	2,0	3,0	5,0	10,0	15,0
v W0 [%]	12,0	12,0	12,0	12,0	12,0	12,0
v W1 [%]	70,0	70,0	70,0	70,0	70,0	70,0
v W2 [%]	102,0	102,0	102,0	102,0		
FP W00/W0 [mm]	15,5	15,5	15,5	15,5		
FP W0/W1 [mm]	5,5	5,5	5,5	5,5	5,5	5,5
FP W1/W2 [mm]	4,5	4,5	4,5	4,5	4,5	4,5
FP W2/W3 [mm]	10,5	10,5	10,5	10,5	10,5	10,5
Silicone Coat Weight [g/m2]		0,96	1,03	1,09	1,24	1,28

little impact on coat weight
no impact on quality



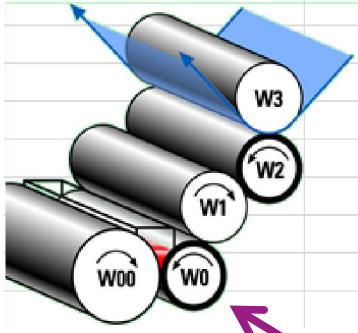
speed

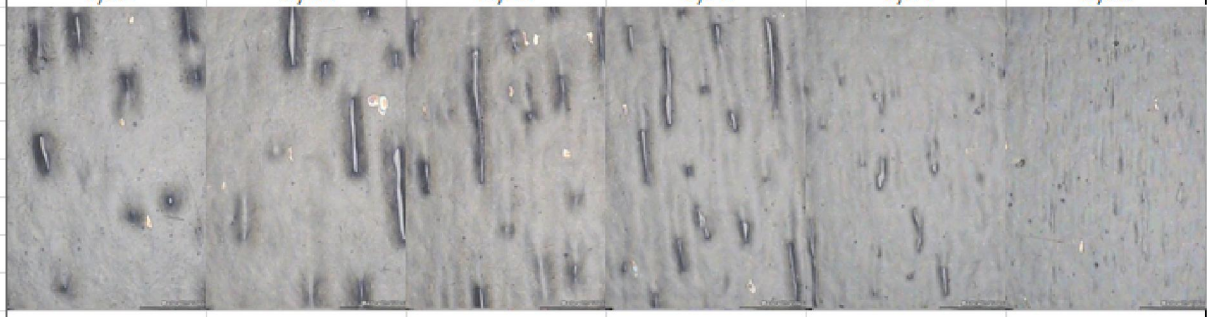


Coater head setting

V-Nr.	Standard	101/01	101/01	101/01	101/01	101/01	101/01
Setting	(16)	14	15	16	17	18	19
Speed [m/min]	200,0	200,0	200,0	200,0	200,0	200,0	200,0
v W00 [m/min]	3,0	3,0	3,0	3,0	3,0	3,0	3,0
v W0 [%]	12,0	30,0	25,0	20,0	15,0	10,0	5,0
v W1 [%]	70,0	70,0	70,0	70,0	70,0	70,0	70,0
v W2 [%]	102,0	102,0	102,0	102,0			
FP W00/W0 [mm]	15,5	8,5	8,5	8,5	8,5	8,5	8,5
FP W0/W1 [mm]	5,5	5,5	5,5	5,5	5,5	5,5	5,5
FP W1/W2 [mm]	4,5	4,5	4,5	4,5	4,5	4,5	4,5
FP W2/W3 [mm]	10,5	10,5	10,5	10,5	10,5	10,5	10,5
Silicone Coat Weight [g/m2]		4,32	3,42	2,50	1,70	1,04	0,39

high impact on coat weight



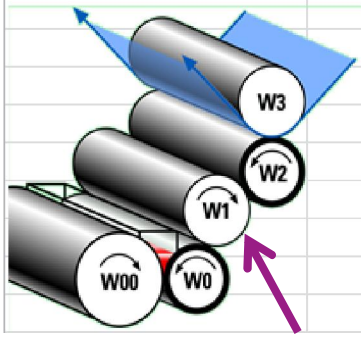


speed

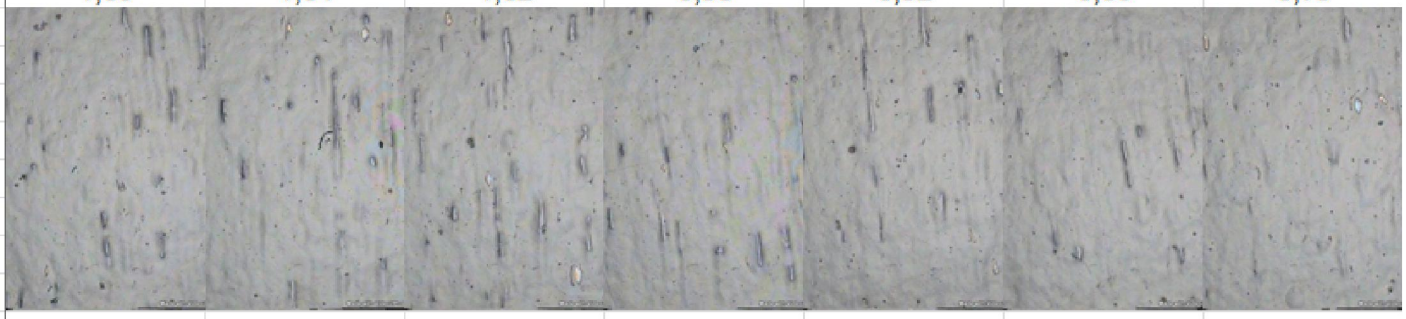
Coater head setting

V-Nr.	Standard	100/04	100/04	100/04	100/04	100/04	100/04	100/04
Setting	(16)	31	32	33	34	35	36	37
Speed [m/min]	200,0	200,0	200,0	200,0	200,0	200,0	200,0	200,0
v W00 [m/min]	3,0	3,0	3,0	3,0	3,0	3,0	3,0	3,0
v W0 [%]	12,0	12,0	12,0	12,0	12,0	12,0	12,0	12,0
v W1 [%]	70,0	90,0	80,0	70,0	60,0	50,0	40,0	30,0
v W2 [%]	102,0	102,0	102,0	102,0	102,0	102,0	102,0	102,0
FP W00/W0 [mm]	15,5	15,5	15,5	15,5				5,5
FP W0/W1 [mm]	5,5	5,5	5,5	5,5				5,5
FP W1/W2 [mm]	4,5	4,5	4,5	4,5	4,5	4,5	4,5	4,5
FP W2/W3 [mm]	10,5	10,5	10,5	10,5	10,5	10,5	10,5	10,5
Silicone Coat Weight [g/m2]		1,05	1,04	1,02	0,98	0,92	0,86	0,79

little impact on coat weight
little impact on quality



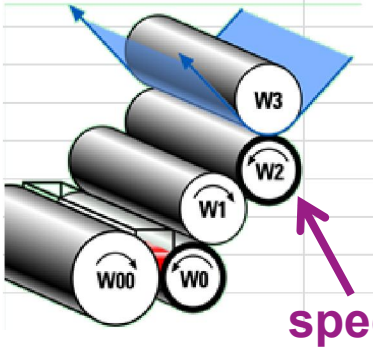
speed

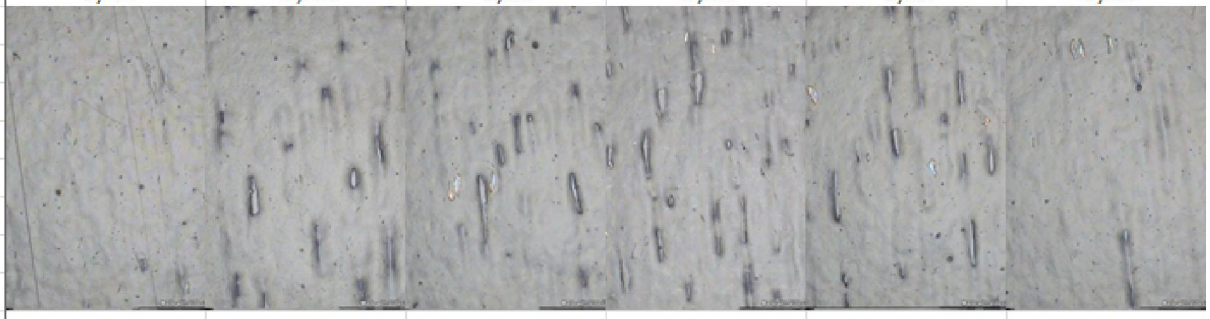


Coater head setting

V-Nr.	Standard	100/04	100/04	100/04	101/04	100/04	100/04
Setting	(16)	27	28	24	10	29	30
Speed [m/min]	200,0	200,0	200,0	200,0	200,0	200,0	200,0
v W00 [m/min]	3,0	3,0	3,0	3,0	3,0	3,0	3,0
v W0 [%]	12,0	14,0	14,0	**15,0**	**13,0**	14,0	14,0
v W1 [%]	70,0	70,0	70,0	70,0	70,0	70,0	70,0
v W2 [%]	102,0	110,0	105,0	102,0	102,0	95,0	90,0
FP W00/W0 [mm]	15,5	15,5	15,5	15,5			
FP W0/W1 [mm]	5,5	5,5	5,5	5,5			
FP W1/W2 [mm]	4,5	4,5	4,5	4,5			
FP W2/W3 [mm]	10,5	10,5	10,5	10,5	**10,0**	10,5	10,5
Silicone Coat Weight [g/m2]		1,22	1,20	1,35	1,08	1,23	1,23

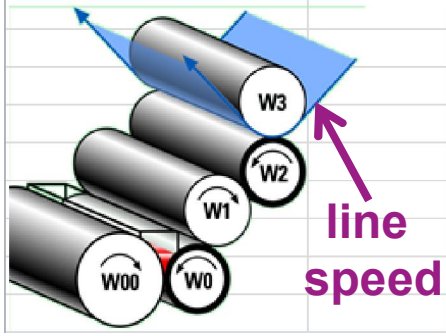
high impact on quality
differential speed is important





Coater head setting

V-Nr.	Standard	101/04	101/04	101/04
Setting	(16)	20	21	22
Speed [m/min]	200,0	50,0	100,0	200,0
v W00 [m/min]	3,0	3,0	3,0	3,0
v W0 [%]	12,0	13,0	13,0	13,0
v W1 [%]	70,0	70,0	70,0	70,0
v W2 [%]	102,0	102,0	102,0	102,0
FP W00/W0 [mm]	15,5	15,0	15,0	15,0
FP W0/W1 [mm]	5,5	5,5	5,5	5,5
FP W1/W2 [mm]	4,5	4,5	4,5	4,5
FP W2/W3 [mm]	10,5	10,5	10,5	10,5
Silicone Coat Weight [g/m2]		0,58	0,90	1,13



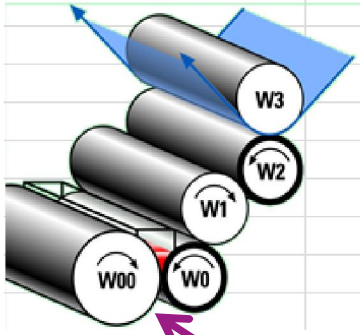
high impact on coat weight
high impact on quality

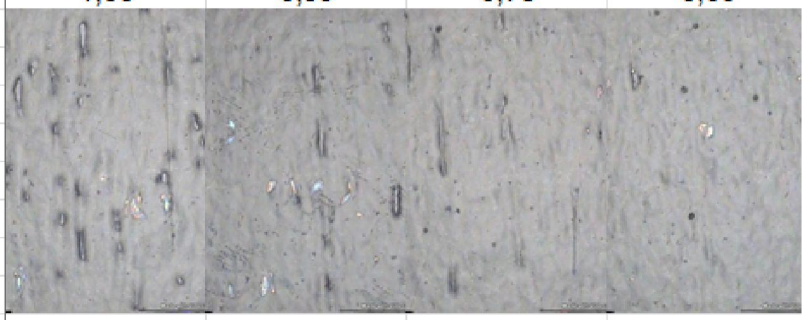
Line speed changes need adaption on v W0 for coat weight and v W2 and FP W2/W3 for coverage

Coater head setting

V-Nr.	Standard	101/04	101/04	101/04	101/04
Setting	(16)	1	2	3	4
Speed [m/min]	200,0	200,0	200,0	200,0	200,0
v W00 [m/min]	3,0	3,0	3,0	3,0	
v W0 [%]	12,0	10,0	10,0	10,0	
v W1 [%]	70,0	70,0	70,0	70,0	
v W2 [%]	102,0	102,0	102,0	102,0	102,0
FP W00/W0 [mm]	15,5	5,0	10,0	15,0	20,0
FP W0/W1 [mm]	5,5	5,5	5,5	5,5	5,5
FP W1/W2 [mm]	4,5	4,5	4,5	4,5	4,5
FP W2/W3 [mm]	10,5	10,5	10,5	10,5	10,5
Silicone Coat Weight [g/m2]		1,30	0,99	0,78	0,66

impact on coat weight
but not as pronounced as v W0





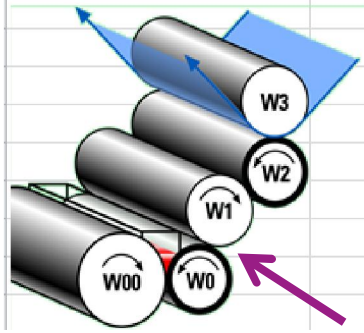
footprint

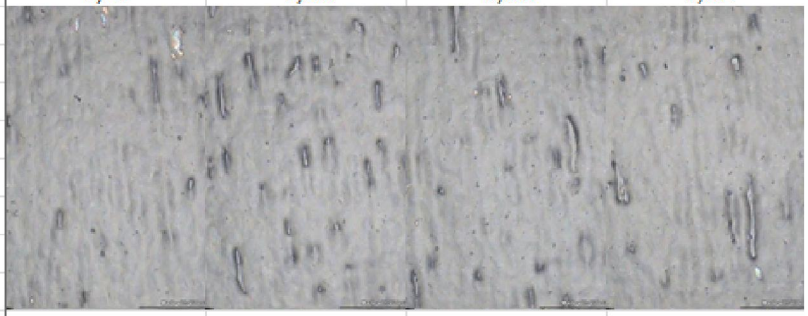
Coater head setting

V-Nr.	Standard	101/04	101/04	101/04	101/04
Setting	(16)	5	6	7	8
Speed [m/min]	200,0	200,0	200,0	200,0	200,0
v W00 [m/min]	3,0	3,0	3,0	3,0	
v W0 [%]	12,0	15,0	15,0	15,0	
v W1 [%]	70,0	70,0	70,0	70,0	
v W2 [%]	102,0	102,0	102,0	102,0	
FP W00/W0 [mm]	15,5	15,0	15,0	15,0	
FP W0/W1 [mm]	5,5	3,0	6,0	9,0	12,0
FP W1/W2 [mm]	4,5	4,5	4,5	4,5	4,5
FP W2/W3 [mm]	10,5	10,5	10,5	10,5	10,5
Silicone Coat Weight [g/m2]		1,27	1,30	1,30	1,32

little impact on coat weight
little impact on quality

same with FP W1/W2



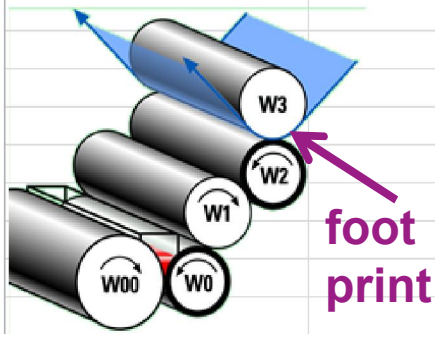


footprint

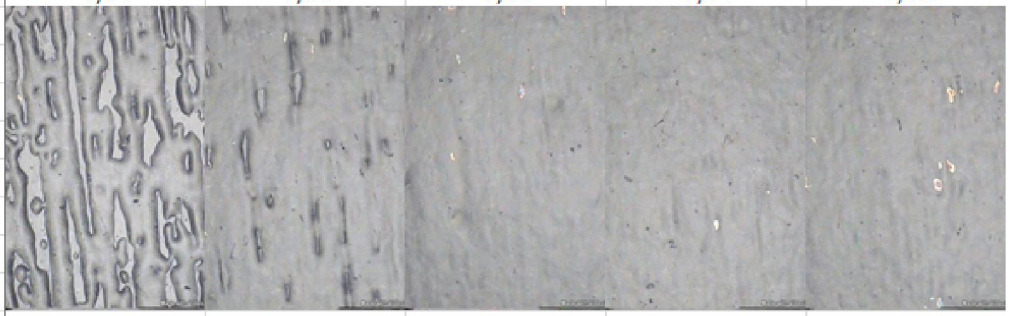
Coater head setting

V-Nr.	Standard	101/04	101/04	101/04	101/04	101/04
Setting	(16)	9	10	11	12	13
Speed [m/min]	200,0	200,0	200,0	200,0	200,0	200,0
v W00 [m/min]	3,0	3,0	3,0	3,0		
v W0 [%]	12,0	13,0	13,0	13,0		
v W1 [%]	70,0	70,0	70,0	70,0	70,0	70,0
v W2 [%]	102,0	102,0	102,0	102,0	102,0	102,0
FP W00/W0 [mm]	15,5	15,0	15,0	15,0	15,0	15,0
FP W0/W1 [mm]	5,5	5,5	5,5	5,5	5,5	5,5
FP W1/W2 [mm]	4,5	4,5	4,5	4,5	4,5	4,5
FP W2/W3 [mm]	10,5	5,0	10,0	15,0	20,0	25,0
Silicone Coat Weight [g/m2]		1,08	1,08	1,11	1,14	1,13

high impact on quality



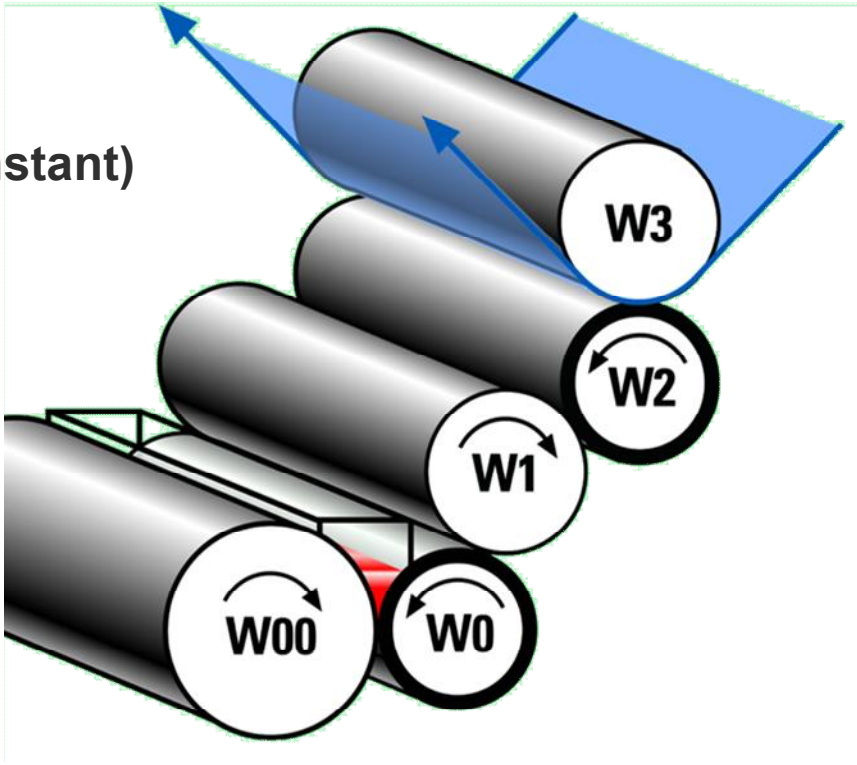
foot print



Coater head setting

Most important controls with 5 Roller Coater to control coat weight:

- **Keep silicone viscosity constant**
- **Keep roller temperature constant**
- **Foot print of W00-W0 (best to keep constant)**
- **Speed roller W0 (best to change)**



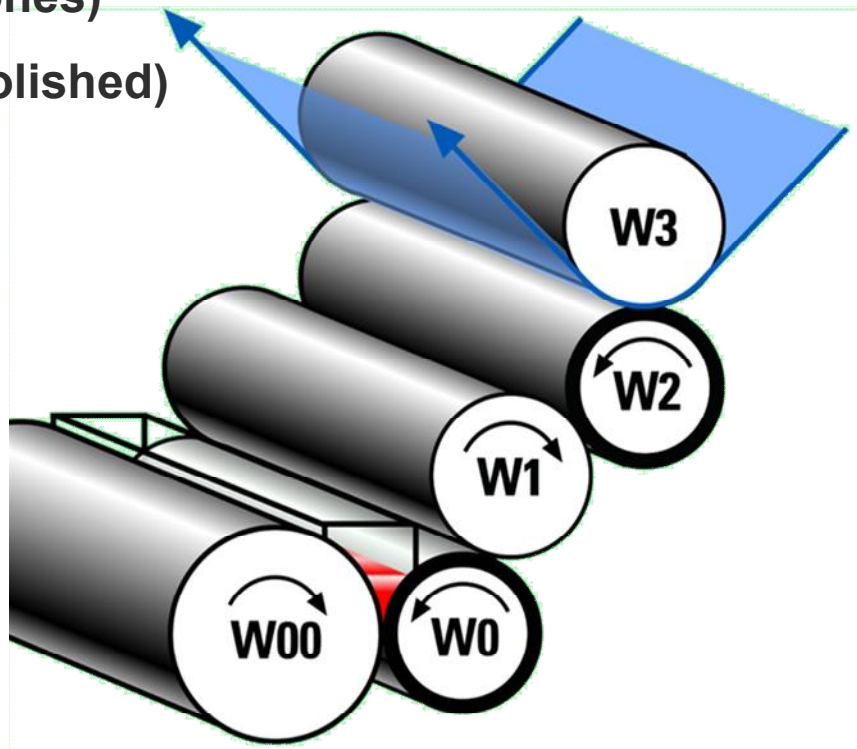
Coater head setting

Most important controls with 5 Roller Coater for <u>good coverage</u>:

- **Viscosity of silicone (heat up RC Silicones)**
- **Smoothness of the applicator roller (polished)**
- **Ratio of foot print applicator to web and differential speed**

  smooth film: high differential with low FP

  papers: high FP with low differential



Please note: Some coaters may have problems with the engine torque for sufficient footprint/ differential speed setting.

TEGO® RC Silicones – Pilot Lines

Headquarters in Essen / Germany

Global sales (●) and distribution network

Production facilities for RC Silicones (●)

RC Technical Service Centres (●)

TEGO® RC Silicones – Pilot Lines

RC Technicum Essen / Germany

- Silicone coating / UV drying
- Adhesive inline coating
  - dispersion acrylics
  - hotmelts & UV hotmelts
- Inline / offline process
- Max. 500 mm working width
  - roll width 520 mm
  - outer Ø 600 mm
- Max. 100 m/min. line speed
- Production of
  - release liners
  - tapes
  - label laminates

TEGO® RC Silicones

For more information please visit our website

www.evonik.com/tego-rc

On our web site you´ll find a video about footprint measurement:

http://www.tego-rc.com/product/tego_rc/en/products-services/technical-services/test-facilities/pages/default.aspx

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