teknek

An ITW Company

Teknek Web Cleaning

Agenda

- About Teknek
- Contamination issues
- Contact cleaning principles
- Applications
- Competition
- New Web Cleaner
- Summary
- Questions

About Teknek

Who are we?

- Company formed 1984
- Acquired by ITW (Illinois Tool Works) in July 2011.
  - $18billion sales
- Inventors & world leaders in the manufacture & design of roller contact cleaning systems
- Global footprint
- Distribution world-wide
- Over 20,000 machines manufactured and delivered to diverse range of industries
- Produces its own cleaning rollers & adhesives
  - 10,000 cleaning rollers per year
  - Design and Produce in UK, adhesive centres in UK, USA & UK
  - Use around 1.2 million sq. metres of adhesive product per year

現代的な製造設備

Unique Capabilities

- Highly Integrated
  - Only contact cleaning to produce own rubber and adhesive rollers
  - Only contact cleaning company to design and manufacture own machines.
- Engineering Resource
  - More employees in engineering than some contact cleaning companies in total
- Lean thinking
  - Teknek is one of the most forward thinking companies in the contact cleaning world

Best Cleaning

In house manufacture and testing – repeatable process

Testing to FINAT standards

FTIR Equipment

Roller manufacture

Laboratory

Issues

Issues

- Particles of contamination on substrates cause defects in processes used in Flat Panel Display manufacturing and Organic and Flexible Electronics

- Defects cause significant yield loss

- Removal of particles is essential for high functionality and reliability

The Contamination Problem

- Machine Downtime
- Scrap Material
- Re-Work
- Poor Yields
- Lost Revenue
- Poor Quality
- Late Deliveries
- Lost Customers

Issues

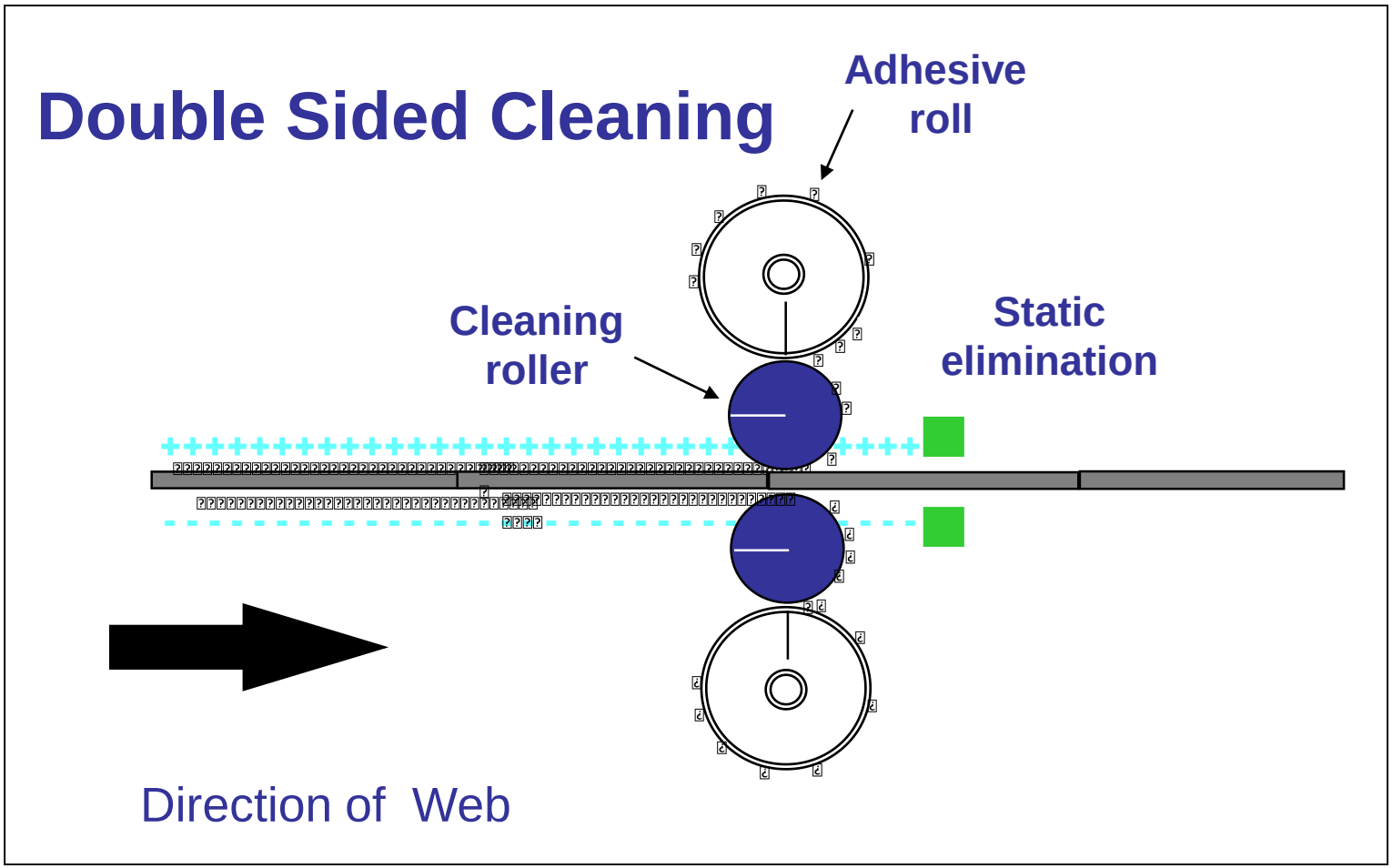
- Smaller, lightweight electronic devices
- Thinner material
- More flexible material
- New types of materials
- Static sensitive devices
- Changes in dimensions

Technology Drivers

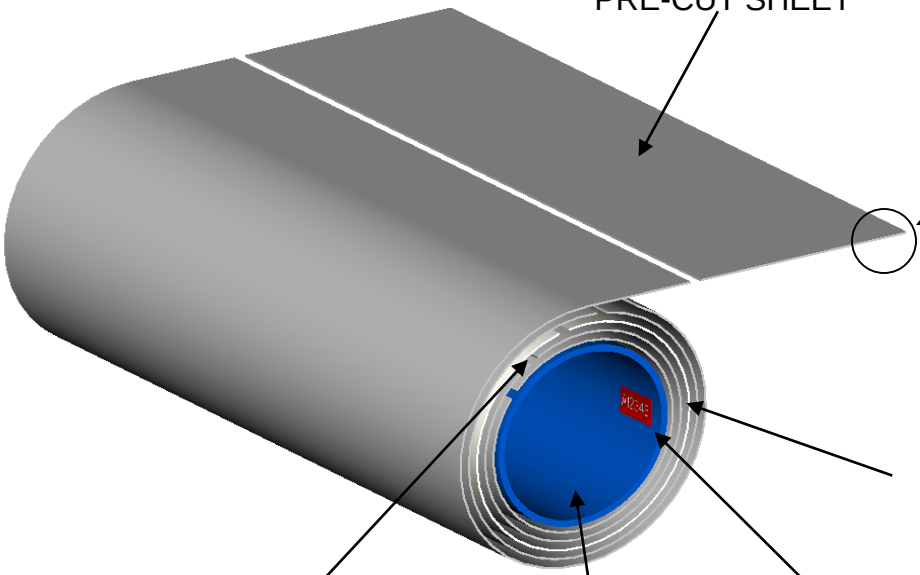
- Films are getting thinner – easier to damage by particles in the wind of the roll
- Coatings are getting thinner – even nanoscale particles can cause pinholes
- The functional requirements on coatings are becoming more demanding

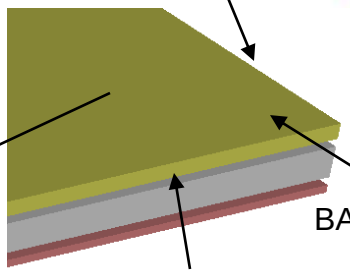
Cleaning Technologies

Teknek Transfer Technology



Teknek Engineered Adhesive Roll





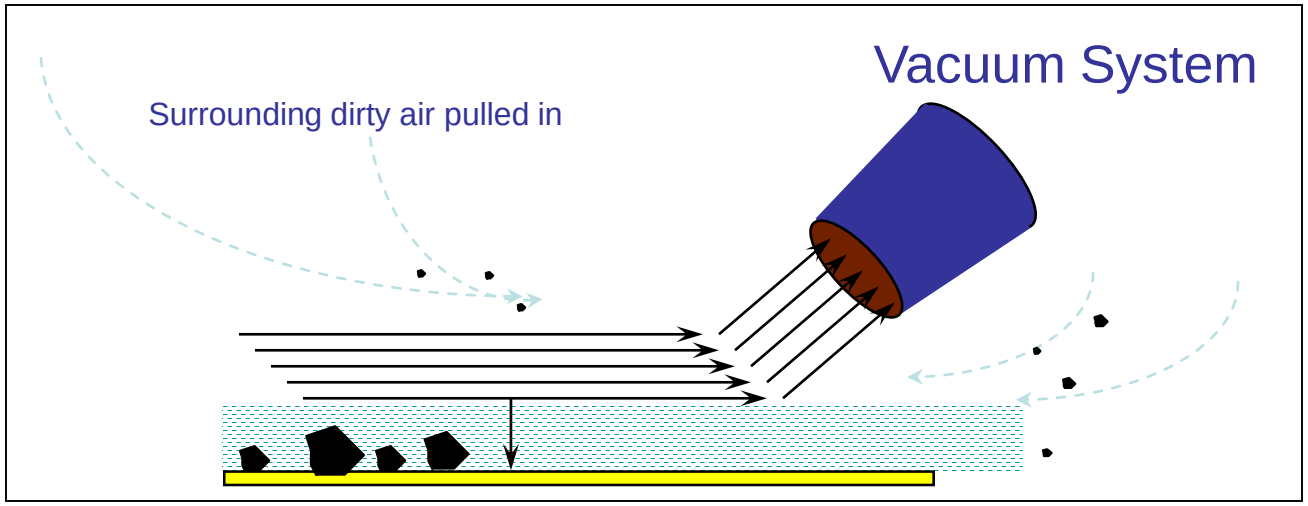
60 LAYERS
(20M ADHESIVE PAPER)

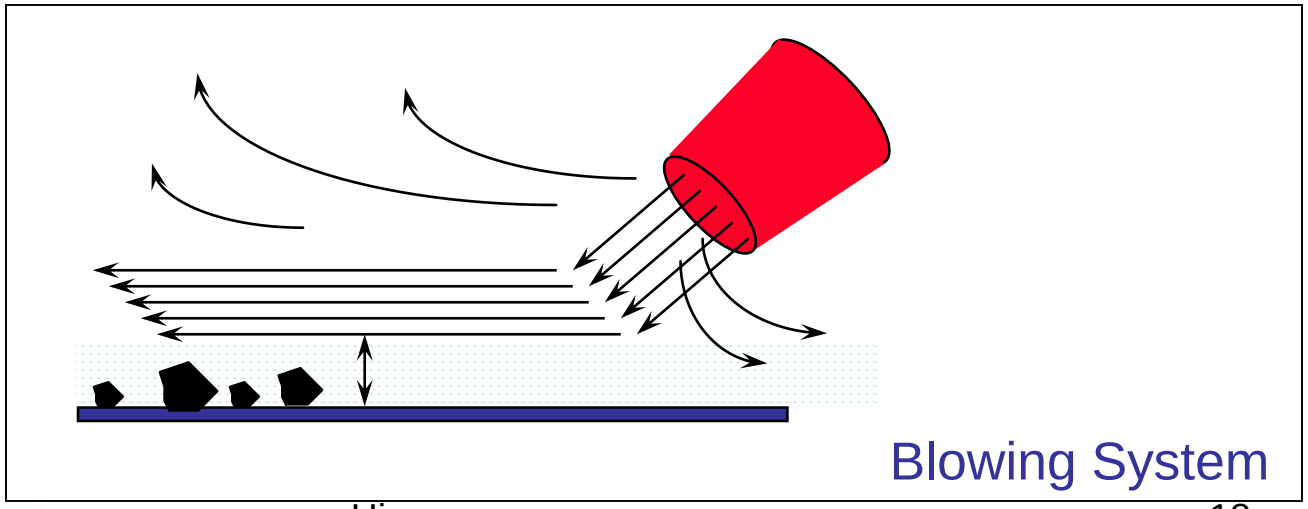
OVERLAP OF
PRE-CUT SHEETS

HIGHIMPACT
POLYSTYRENE
CORE

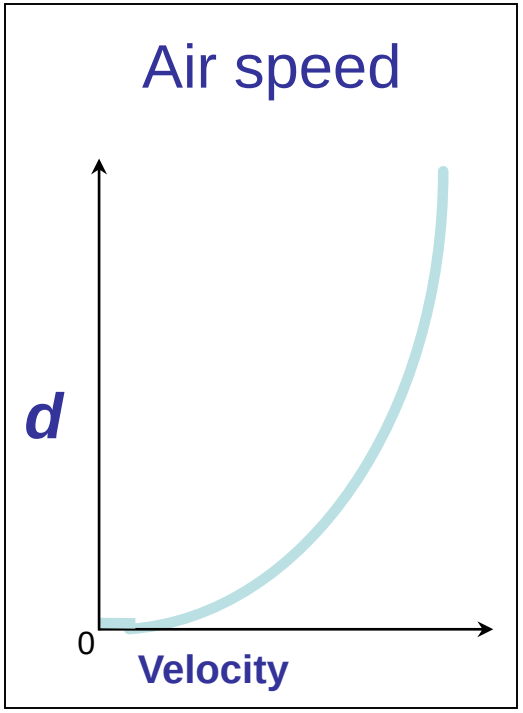
BATCH LABEL

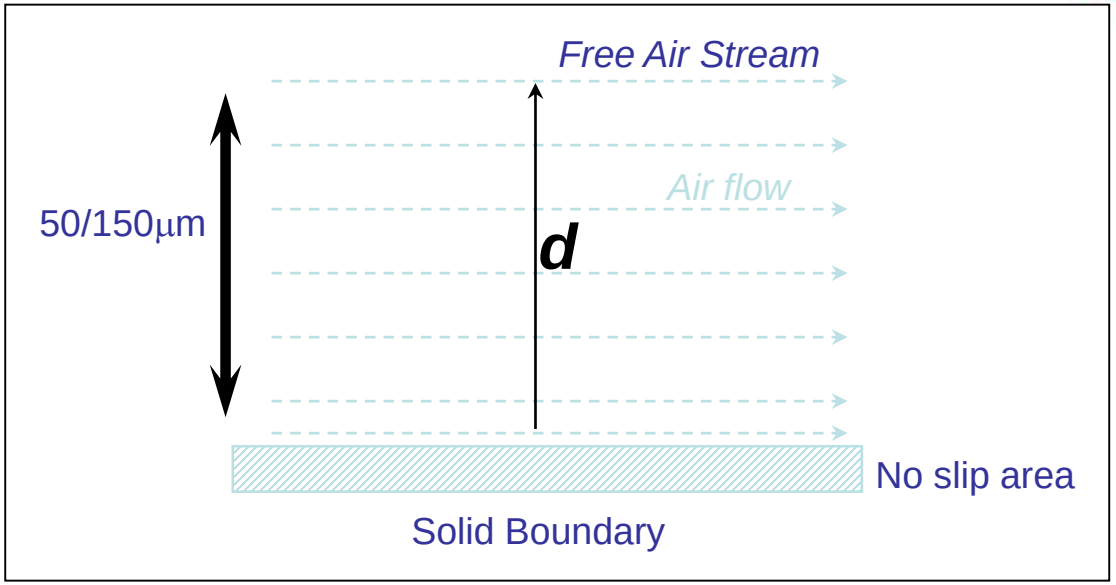
Air System

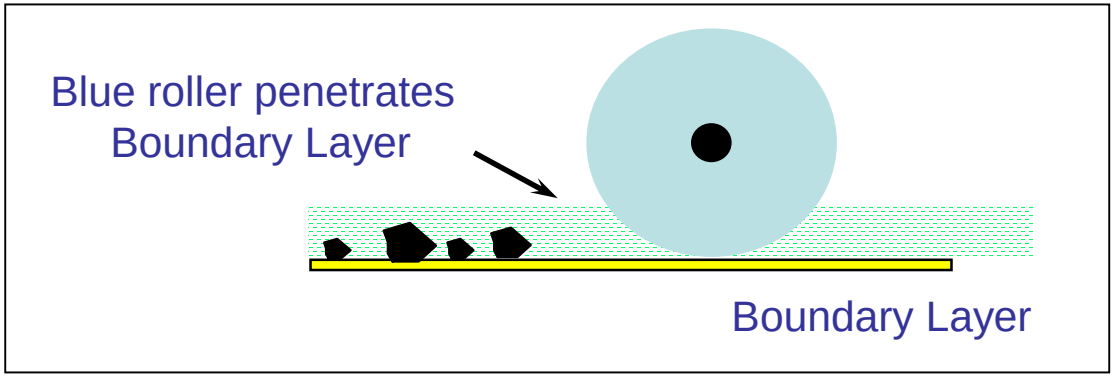




The Boundary Layer



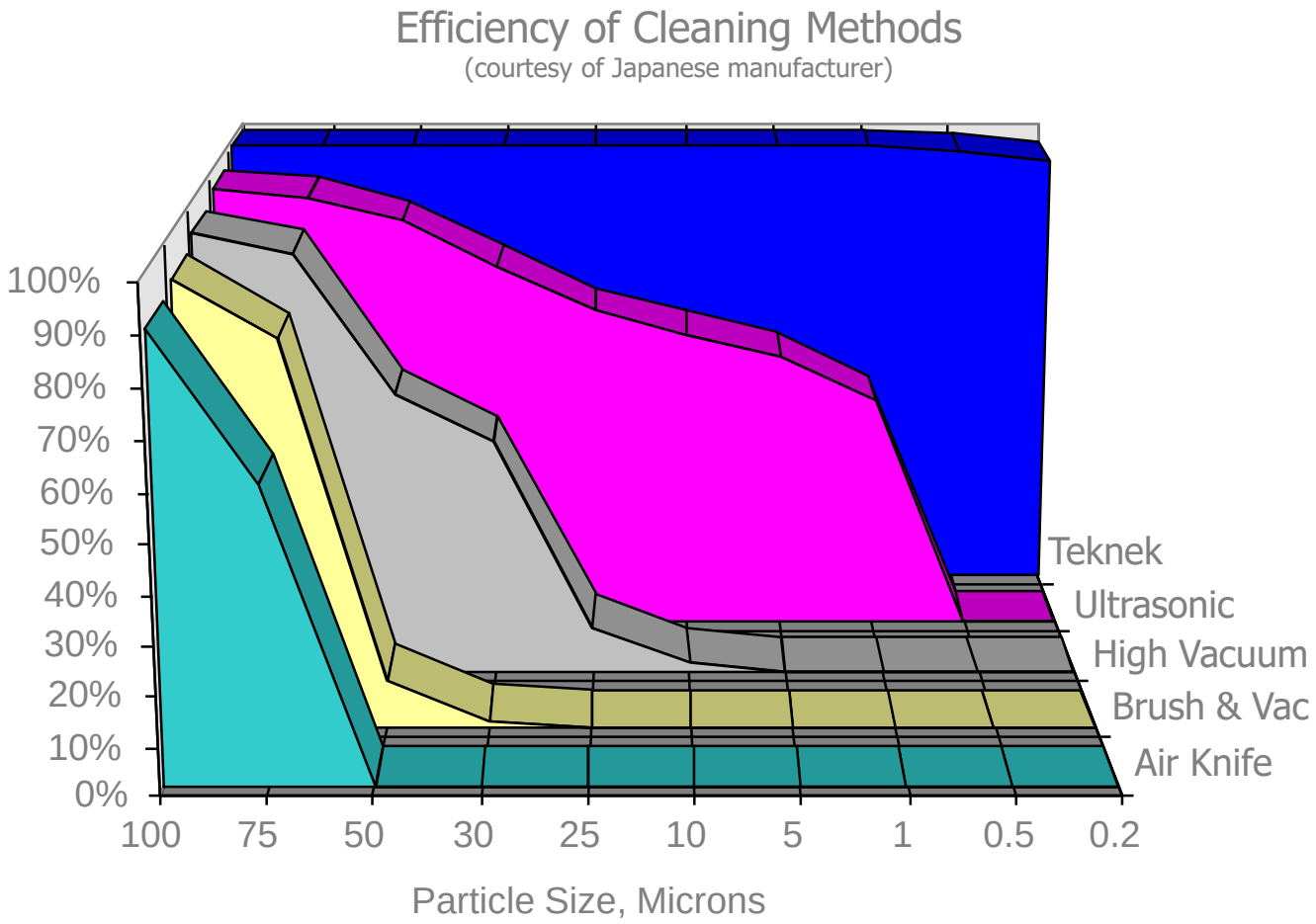




Summary - Cleaning Technology

Cleaning Method	Brush	Ultra Sonic	Air Blower	Vacuum	Roller
Penetrate Boundary Layer	NO	NO	NO	NO	YES
Removal down to 1 micron	NO	NO	NO	NO	YES
Analysis of Contamination	NO	NO	NO	NO	YES
Adapts to Web Movement	NO	NO	NO	NO	YES
Noisy	YES	YES	YES	YES	NO
Large Footprint	YES	YES	YES	YES	NO
Ducting, Filters	YES	YES	YES	YES	NO
Simple Installation	NO	NO	NO	NO	YES
High Maintenance Cost	YES	YES	YES	YES	NO

Best Cleaning



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Teknek transfer

Best Cleaning

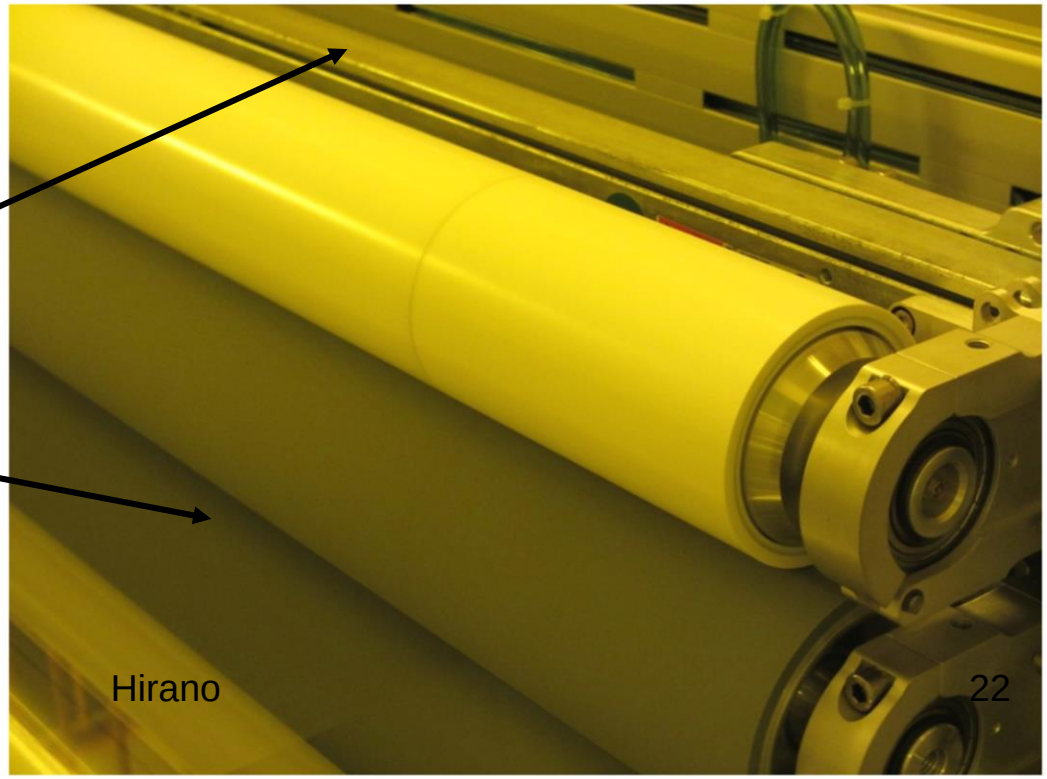
Customer example :- Teknek machine replaced a roller only turret system Cleaning PET. This provided a **30% decrease** in faults

(see graph on next slide)

粘着ロールにて異物が補足出来ていることを確認。

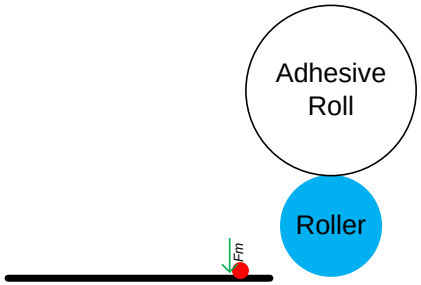
Confirmed that foreign particles are transferred to adhesive rolls

PET**端面** PET edge face



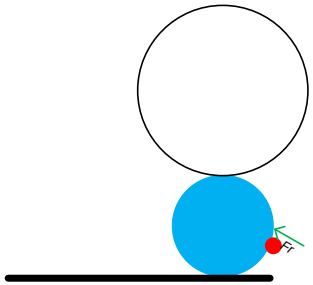
Science of Contact Cleaning

Mechanics of Contact Cleaning



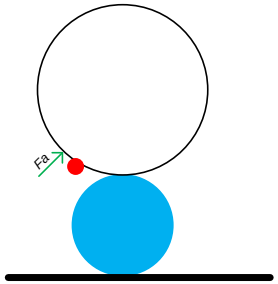
Particle is attached to Customer Material

Particle is held onto Material by force = Fm



Particle is removed onto roller

Particle is removed as Roller Force >Material force
Fr > Fm



Particle is removed onto adhesive

Particle is removed as Adhesive Force > Roller Force
Fa > Fr

Cleaning only works if

Fa > Fr > Fm

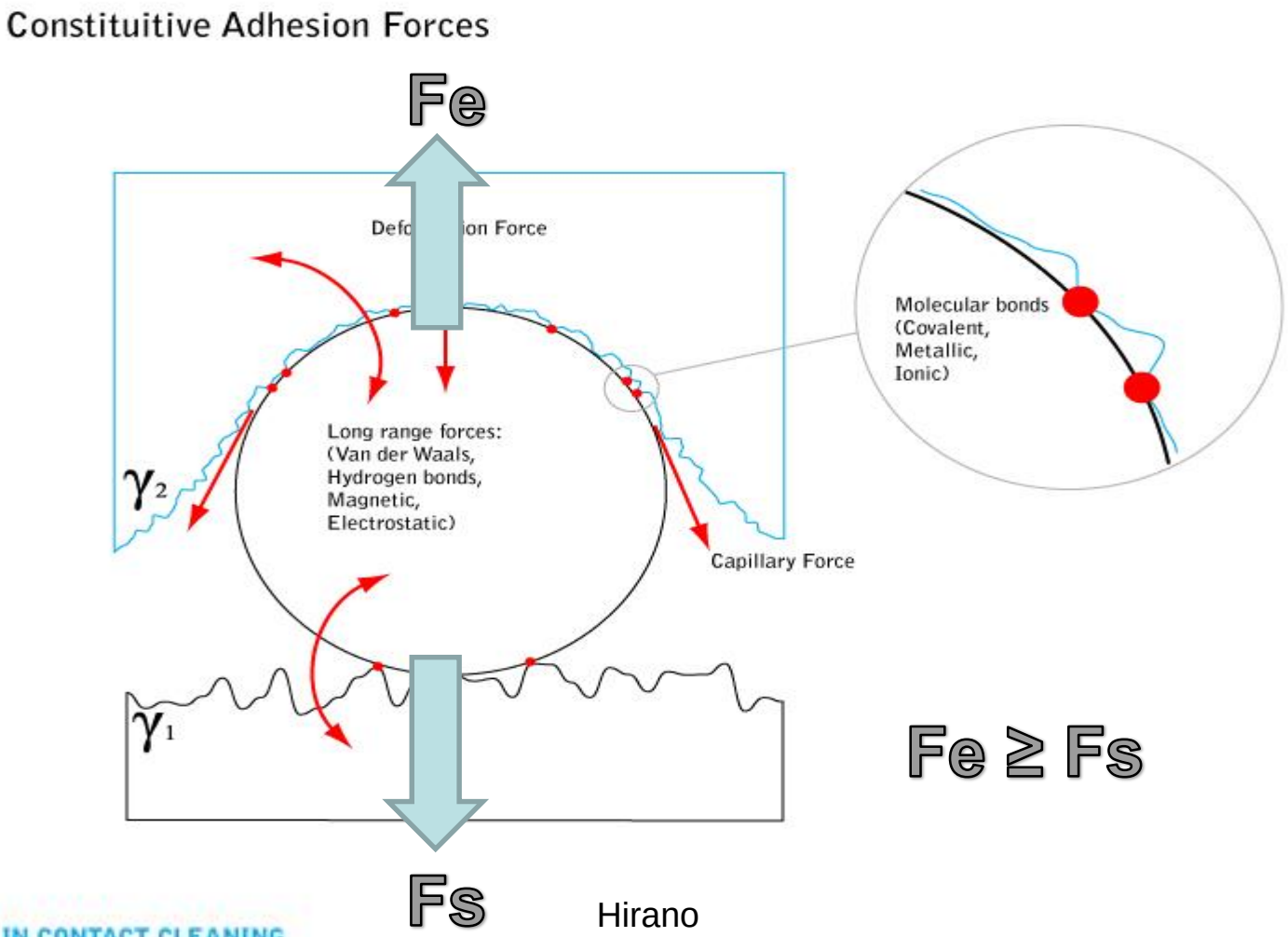
Balance of forces

- Adhesive force between the elastomer and the particle must be greater than the force between the particle and the substrate
- The adhesive force between the particle and the adhesive must be greater than that between the roller and the particle

Adhesion Forces

- Adhesion describes how a particle and a surface are held together
- A number of different forces will act together to produce the adhesion force combination
- Two bodies in contact, an attractive force occurs that requires a mechanical load to separate them
- Strength of adhesion is determined by how strong the interactions are

Cleaning Scenario

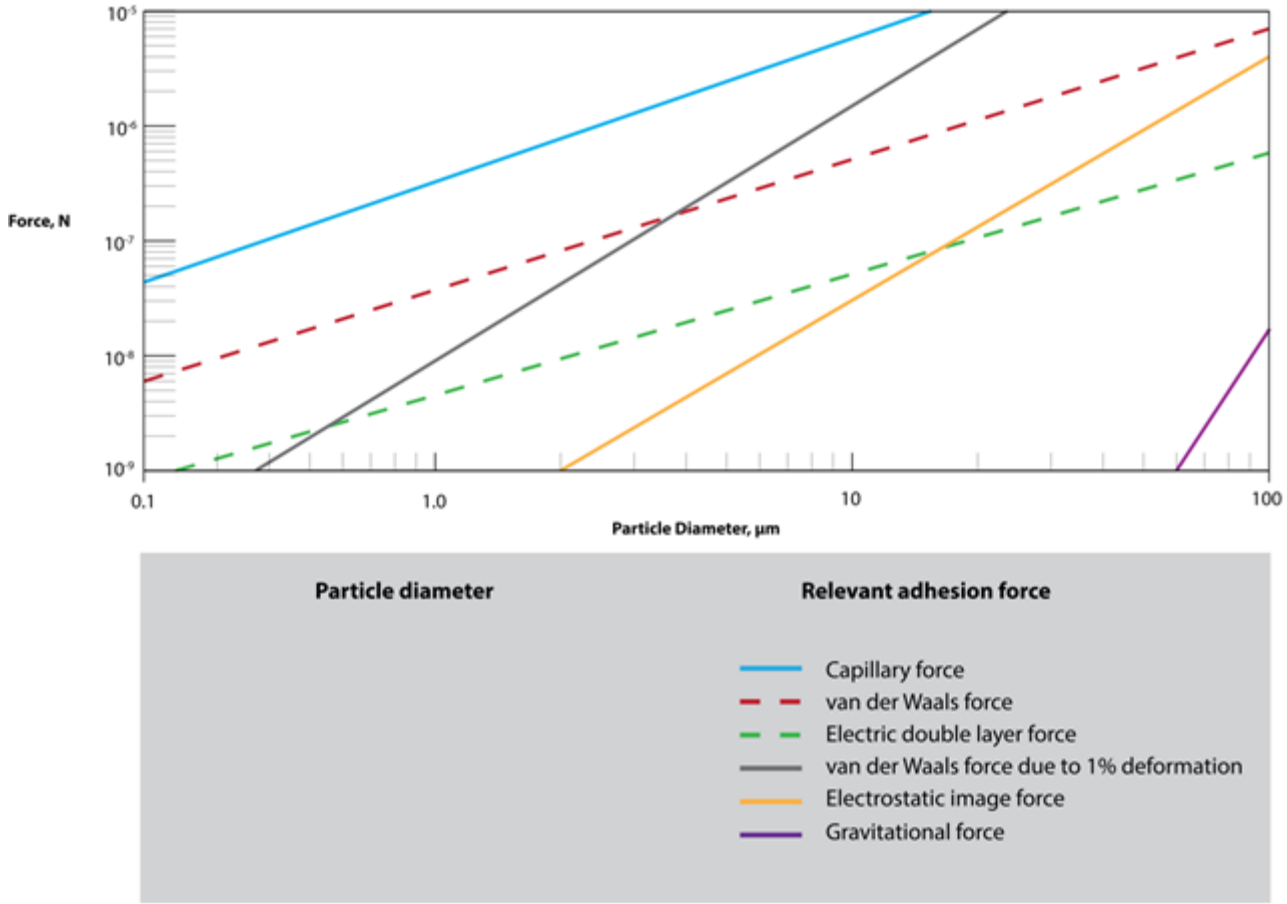


Fe ≥ Fs

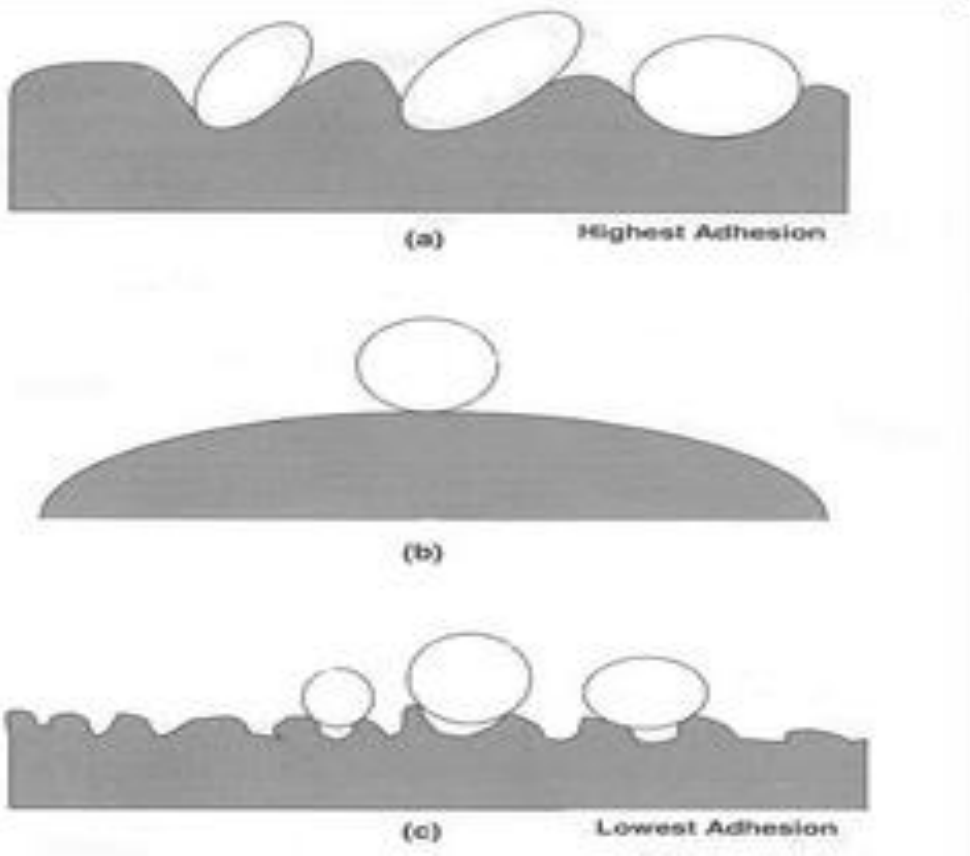
Adhesion forces

- At least 15 types of adhesion force, including 38 variables
- Analysis done on the force equations and variables
- Two key variables identified, namely particle size and contact area

Conceptual Model



Contact Area



Initial Research

- Focus on measuring adhesion forces
- Using AFM
- Particle size 10micron
- Particle types – Silica, gold and polystyrene latex
- Substrates – Elastomers and standard films

Macro-Adhesion Measurments

Rubber	Cu	Steel	Kapton	PET	PC
Soft	1.17	3.26	0.51	2.55	2.37
Panel	1.49	3.32	0.81	2.63	1.07
Film	0.63	0.81	0.34	1.68	1.4
F3	0.11	0.11	0.11	0.85	0.12
Nano	0.08	0.04	0.07	0.75	0.34

Micro-Adhesion Measurements

Elastomer	Silica	Gold	Polystyrene
Soft	752+/-147	951+/-69	1027+/-109
Panel	848+/-113	823+/-160	847+/-214
Film	866+/-145	1152+/-125	1177+/-82
F3	1076+/-420	746+/-329	813+/-393
Nano	803+/-443	285+/-161	1073+/-629

Elastomer properties

	Macro Roughness (Ra)	AFM Scan 1	AFM Scan 5	AFM Scan 10	Adhesion
Standard Nanocleen	0.5	6	130	200	461
Modified Nanocleen	2.6	13	162	264	693
Standard UTF	0.38	7	23	95	847
Modified UTF	3.84	32	180	290	2563

Substrate Adhesion

	Polypropylene		Polyester		Polycarbonate		Polyimide		Copper foil	
Average Adhesion Force (nN)	Sample 1	Sample 1	Sample 2	Sample 2	Sample 3	Sample 3	Sample 4	Sample 4	Sample 5	Sample 5
	Side 1	Side 2	Side 1	Side 2	Side 1	Side 2	Side 1	Side 2	Side 1	Side 2
10 µm PS	1023	675	2274	680	1676	1898	1611	4063	524	2229

Shore Hardness vs PPU

Surface Energy Friendly

- Coating and High Spec printing applications require precise control of Surface Energy. This is measured in Dynes and is analogous with surface tension in liquids
- Traditional contact cleaning rollers reduce Dyne levels by as much as 7 Dyne.
- Nanocleen™ reduces the same material by around 1 dyne - 85% less impact making it ideal for sensitive coating and printing processes

Dewetting

De-wetting – Fish Eye on gold coated film

Static Field Strength

Position	Field Strength	Field Strength
	Original (V)	Modified (V)
Elastomer roller (Entrance)	200	20
Elastomer roller (Exit)	500	20
Adhesive roll (Entrance)	2500	90
Adhesive roll (Exit)	3000	60

Triboelectric Charge Transfer

Material	nC/J
Nano Elastomer	+60
Glass	+25
Epoxy PCB	-32
Polyimide	-70
Panel Elastomer	-72

Cleaning Efficiency

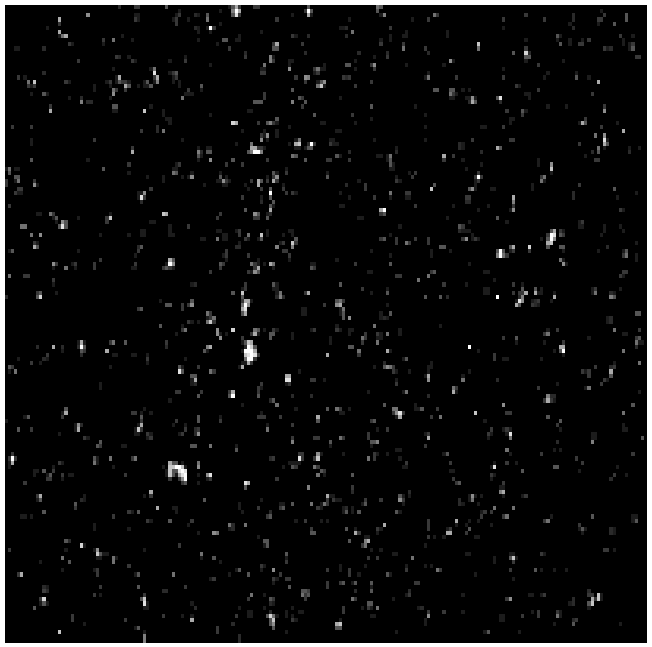


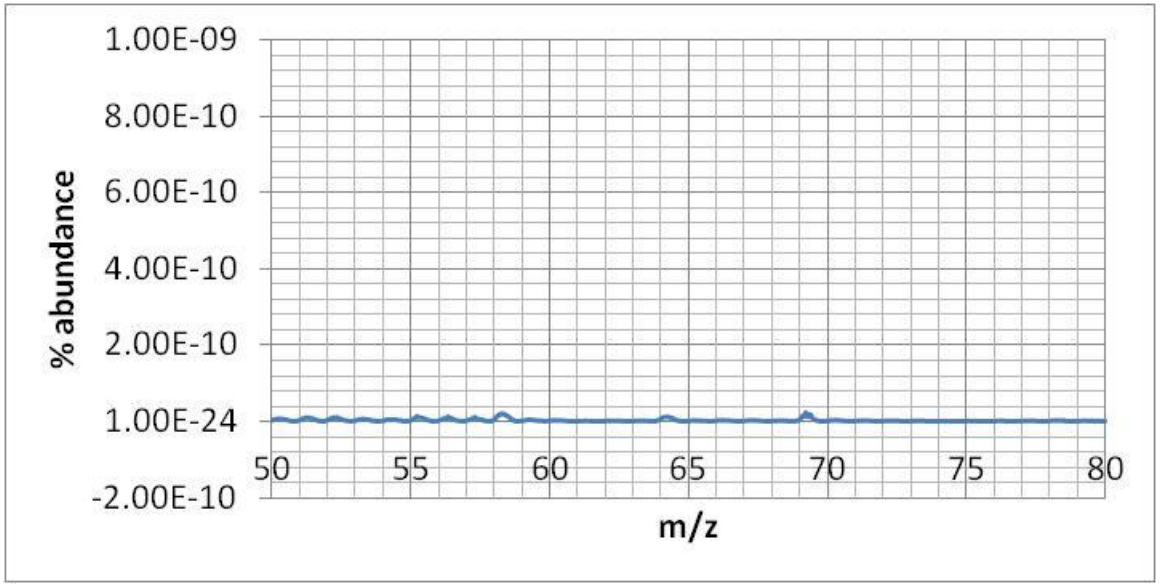
Photo Before cleaning 4972: 1354 particles/photo

Photo after cleaning 4975: 15

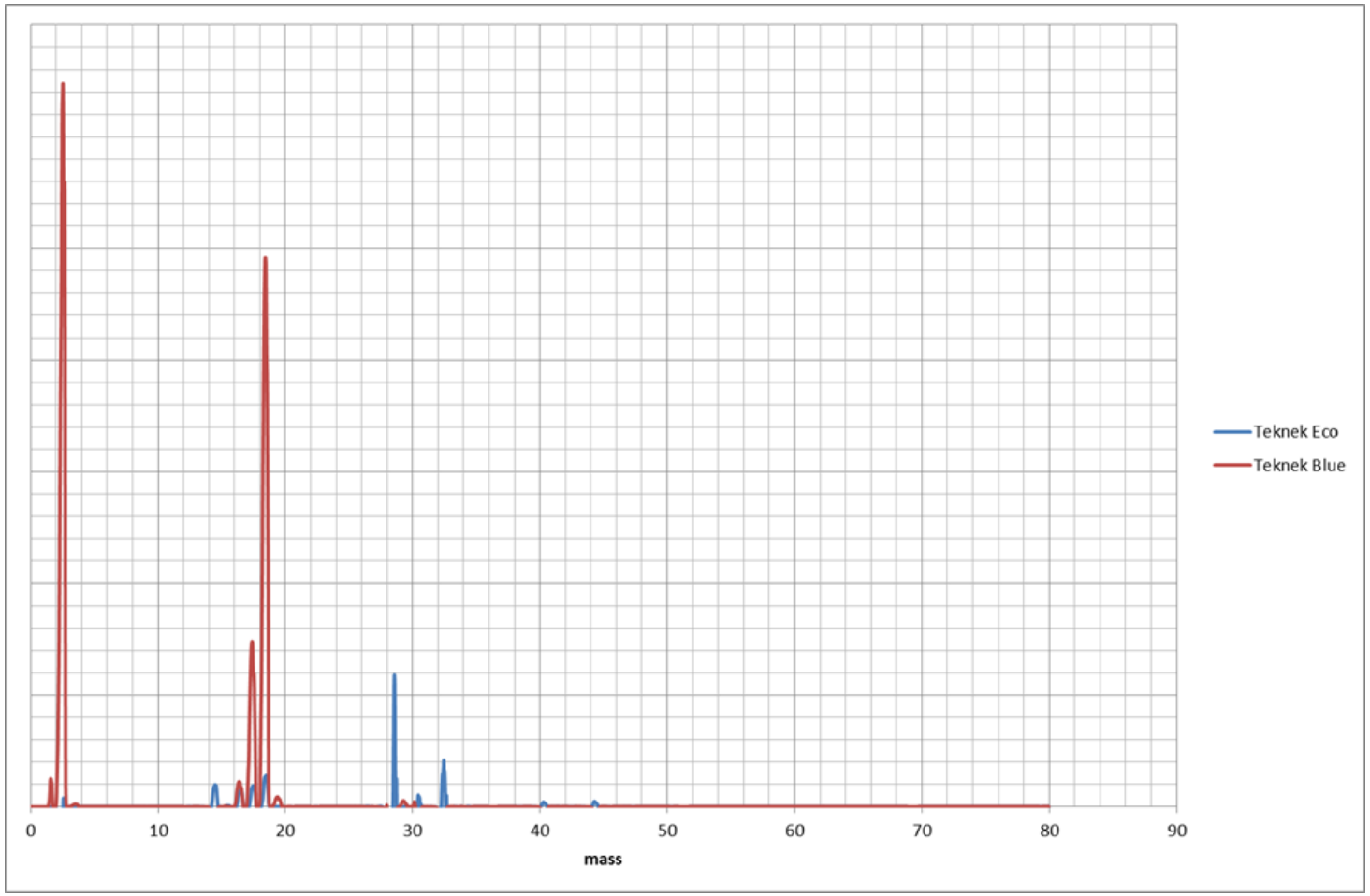
Outgassing Test

- Scud Vacuum System 032
- 2 small rollers
- 2 sheets adhesive
- Pumped down to 1E-7 mbar
- Time in vacuum 66 hours
- Each sample weighed before and after.

Nanocleen RGA



Adhesive Roll RGA



Research Findings

- Soft rubber is not best
- Smooth rollers are not best
- Applied pressure is not related to cleaning effectiveness
- Contact angle is affected by some materials
- Recontamination from many rollers takes place
- Cleaning in High Vac is possible

Research Driven

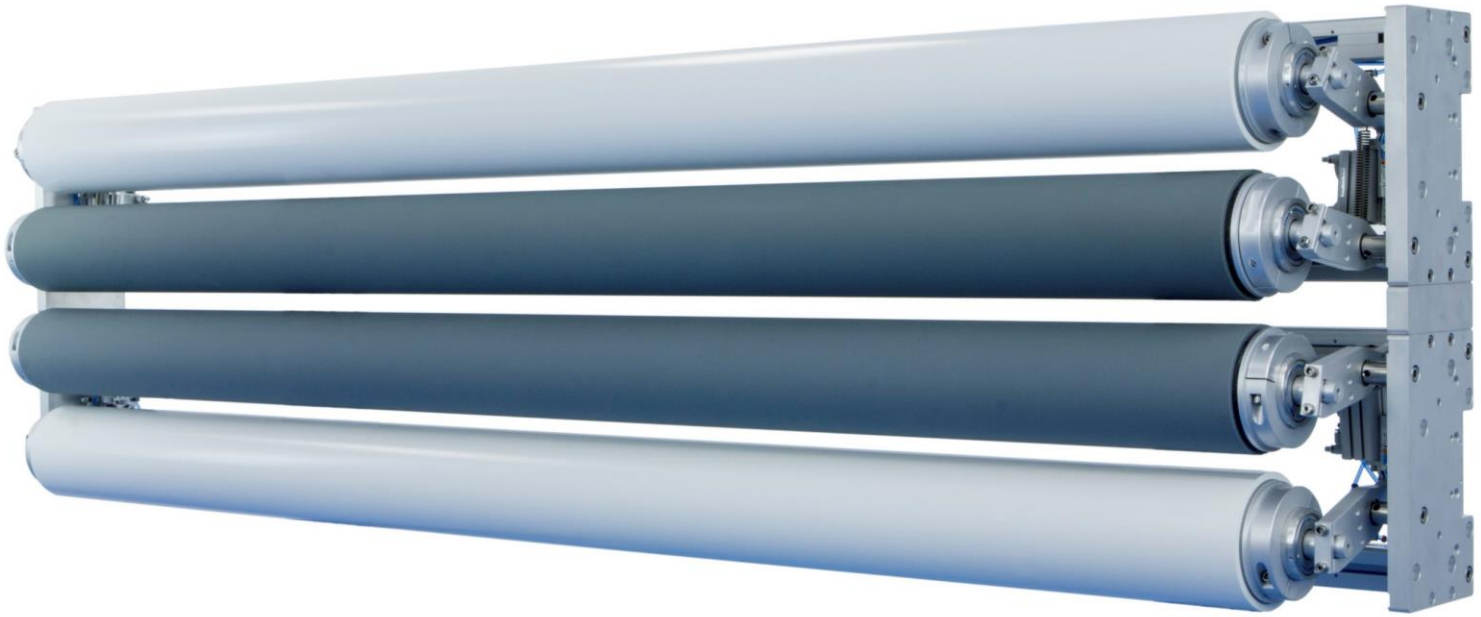
#	Project Title	Partners
A	HiQSurf	DuPont Teikin Films, Plastic Logic, Centre for Process Innovation, Teknek
B	Clean4Yield	DuPont Teijin Films, Phillips, Horiba, Dr Shenk GmbH, IBS Precision Engineering, Teknek, Innophysics BV, Eight19 Ltd, Thermosensorik GmbH, Orbotech Ltd, Coatema Coating machinery GmbH TNO Netherlands, Riso Denmark, TU Delft Netherlands.
C	Cleaning in High Vacuum	The Holst Centre Netherlands, Teknek
D	Macromolecular and Particle Adsorption on Different Surfaces	University of Sheffield, Teknek
E	Advanced Organic Polymers	Aston University, Teknek

Peer Reviewed Outcomes

#	Paper Title	Conference	Organisation
1	Short Course Instructor on Barrier Coatings	Flexible and Printed Electronics	Flextech Alliance
2	Contact Cleaning for Barrier Coatings	18th New Industrial Chemistry workshop on Barrier Coatings	Council for Chemical Research
3	Contact Cleaning for Functional Coatings in Emerging Technologies	AIMCAL Fall USA	AIMCAL
5	Role of Surface Cleanliness in Yield Enhancement	European Electronics Assembly Reliability Summit	Organic Electronics Association
6	Reducing Waste in Plastic Electronics	LOPEC	TCM
7	Improving Yields in High Gloss Laminates	Decorative Surfaces	Ligna
8	Optimising Cleaning Techniques for increased Manufacturing Yields	Think Light	International Converting Association
9	Reducing Waste in Thin Film Manufacture	ICE	IMID Korea
10	Cleaning in a High Vacuum Environment	International Meeting for Information Display	AIMCAL
13	Clean Substrates give Yield Improvements in Printed and Flexible Electronics	ICFPE	European Commission
14	Continuous Innovation - From Research Idea to Production	Industrial Technologies	Japan
17	The Importance of Clean Surfaces	Automotive Surfaces	The Fraunhofer Institute
18	Successful Substrate Cleaning in a High Vacuum Environment	Proflex	
19	Advances in Particle Romoval Techniques	PE2013	Cemconex
20	Reliability - the Impact of Contamination in Electronic Production	European Electronics Assembly Reliability Summit	3M
21	The Science of Contact Cleaning		DSC-IC
22	Cleaning for Dye Solar Cell manufacture	International Conference on Industrialisation of DSC	CREO
23	The Impact of Contamination on Solar Cell Yields	Clean Rooms Europe	SVC

New Teknek Web Cleaner

Teknek Web Cleaner



“Teknek’s most versatile web cleaner”

Teknek Web Cleaner

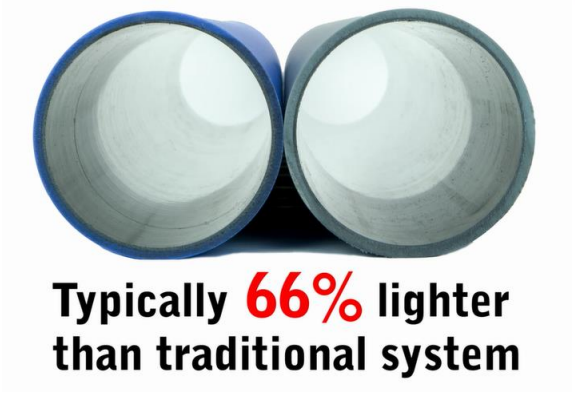
- **Versatile** – Cleans standard and thin films, no adjustments required
  - Modular design quick and easy to change to smaller line width.
  - Light weight sleeve technology for cleaning rollers and adhesive.
  - Low applied pressure - 60% less mass than traditional Teknek rollers

- **Best cleaning** – Produce consistent high quality products
  - Generation 2 Teknek composite rollers and adhesive rolls which have the best cleaning performance - independently tested.

- **Low running costs** – Low operator involvement, easy to use, simple to maintain cleaning solution.
  - Adhesive roll keeps the cleaning rollers free of contamination, no need to change over and wipe down rollers daily. No need to install and maintain vacuum or electrical systems.

Versatile – Thin film capable

- Innovative lightweight roller
  - Sleeve technology (Tube)
  - 66% less weight than traditional roller
  - Lightweight roller & adhesive easy to change



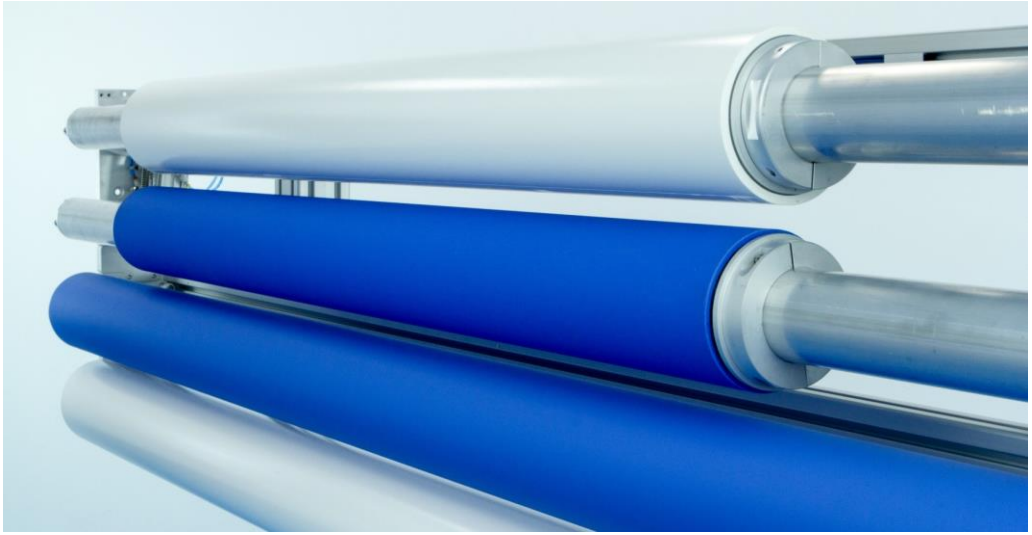
- Low Tack cleaning roller
  - Low rolling resistance

- Low pressure cleaning
  - No applied pressure to the web
  - No Regrinding required

- Low applied web tension 10 N/m

Versatile – Modular Design

- Smaller elastomer sleeves can be used on same shafts.
  - Simple locking chuck used
- Standard frame can be fitted with a smaller roller sleeve to process narrower webs.
  - Elastomer sleeves available in 9 sizes. (1000 to 1800mm -100mm increases)



Note – roller and web must be centralised on the machine

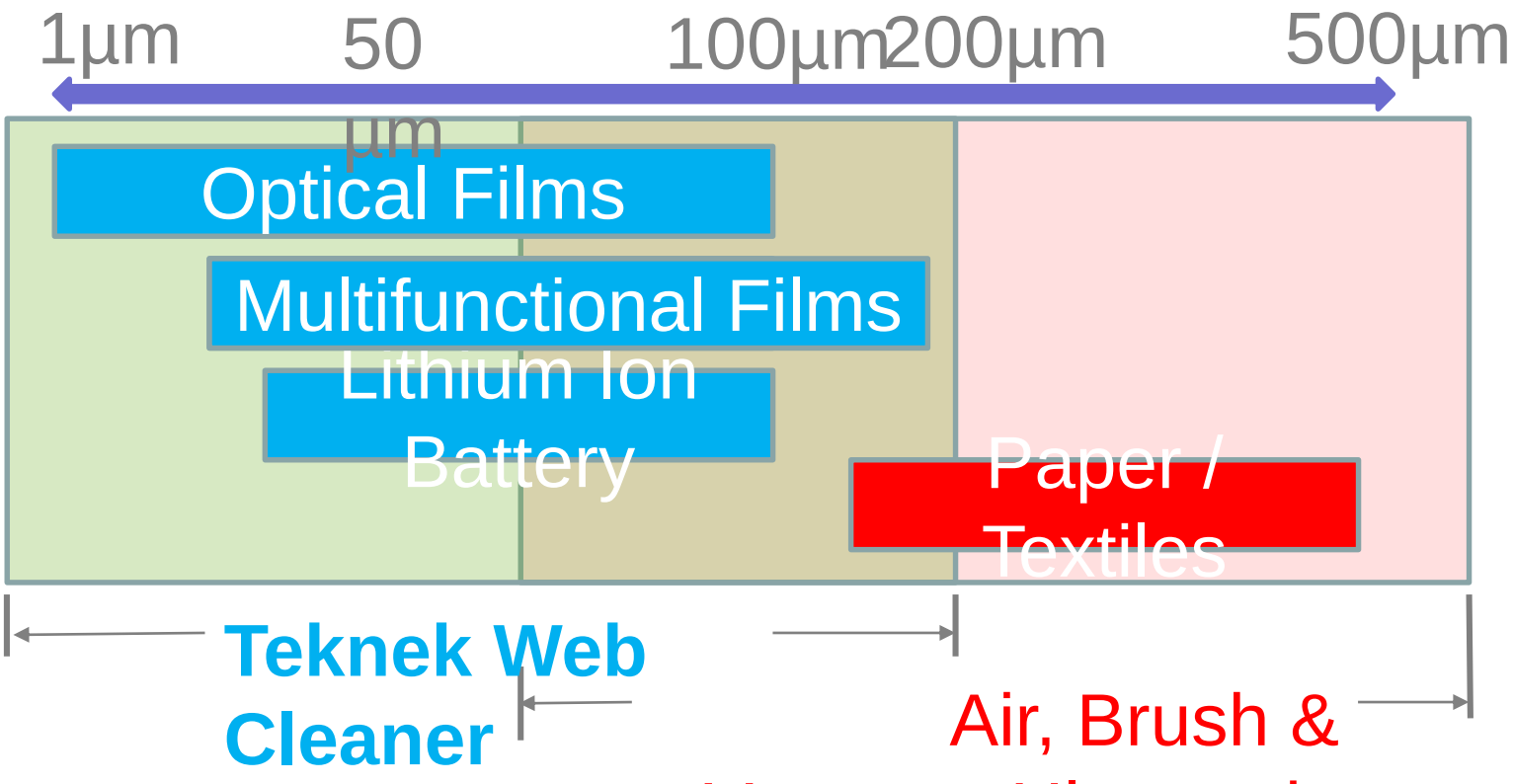
Versatile – Modular Design

- Use small roller assembly is same frame when processing narrow films
  - Lower running costs

Note – roller and web must be centralised on the machine

Best Cleaning

Range of particles required to be removed in target sectors



Target particles below 50µm cannot be removed using Air, Brush & Vacuum or Ultrasonic Systems commonly used in these sectors.

Best Cleaning

- Cleans what other leave behind
  - Testing show Teknek™ rollers clean better
- Leaves no trace – (Nanocleen™ option)
  - Silicone free cleaning system
  - Surface Energy Friendly
  - Static dissipative roller
- Cleans with Care
  - G2 roller design results in low web tension
  - Unique Teknek polymers
  - Manufactured to ISO 6123 class A standard

Low Running Costs

- Adhesive rolls keeps the cleaning rollers free of contamination
  - No need for operator to frequently wipe down rollers
- Teknek Web Cleaner only available as a 4” adhesive roll
  - 25% longer life than traditional 3” system

Example –

Cleaning Pet at 100m/min

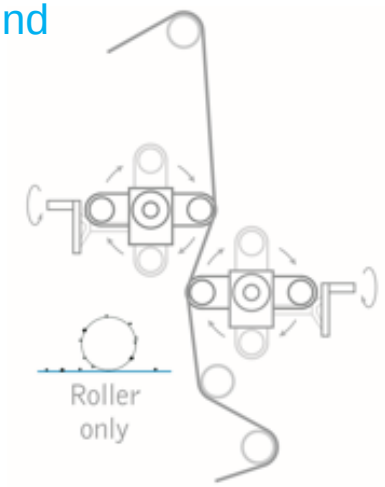
Old style 3 “ Adhesive roll - Change one layer – 8 hours

New style 4” Adhesive roll – Change one layer – 12 hours

Low Running Costs

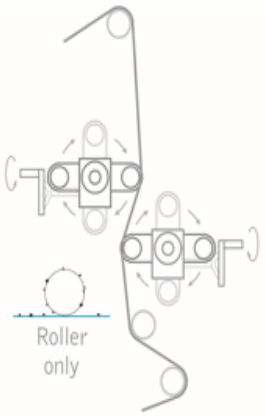
Teknek Web Cleaner is lower cost system to operate than roller only system

- Operator uses liquid to clean the rollers
  - slower than removing adhesive sheet, high cost in operator time
- Frequency of wiping is high
  - contamination is not transferred to an adhesive
- Roller only system uses a wrap angle
  - A wrap angle will wear the rollers and they will require to be re-ground
- Particles left on contact roller cause recontamination of web
  - Indent or embossing
- Roller only does not clean as well as contact cleaning
  - No transfer of contamination / potential to leach



Low Running Costs

Example 1500 double sided cleaner



- **Roller only turret system**
  - 4 rollers, regrind required 2 x each year - cost approx. $800/roller
  - Annual roller regrind cost - $6400
- Manual wiping of rollers –
  - 5 mins per roller, 2 times a day = 40 mins/day
  - Time to clean rollers/year = 200 operator hours

(Note:- special cleaning fluid must also be purchased)

- Teknek system
  - Teknek rollers have 12 month warranty - no regrinding
  - One layer of adhesive per day
  - Typically $3-5 a day (price varies by size)
  - Annual cost $9-1500 per year - 40-70% Less

- Time to remove a layer – 1 min
  - Time to change adhesive/year = 5 hours 95% less

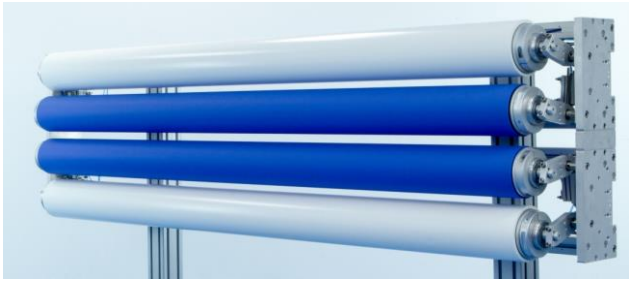
Hirano (assume 300 working days/year)

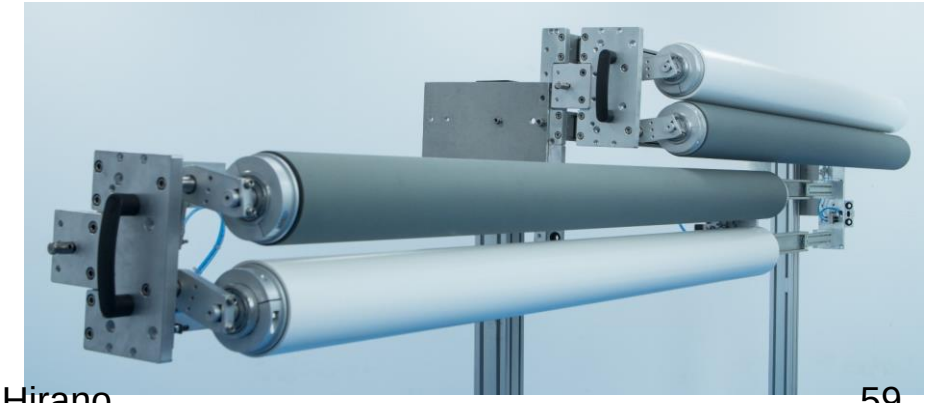
Product overview

- Standard machine covers most applications
  - Standard machine can be used for range of web widths. Easy to install and specify. Can clean up to 1800mm width at speeds up to 250m/min
- Thin film capable (below 100 microns)
  - 66% less weight than traditional roller, cleans without pressure. Low applied web tension 10 N/m
- New 4” diameter adhesive roll
  - 25% more adhesive than traditional 3” size adhesive
- Single or double sided frame
  - 1000 – 1800 wide web width (100mm increases)
  - UTF or Nanocleen 20.20 Rollers
- Available options
  - Slide out system
  - Anti Static system

No specials available

No overs available





Target Customers

Tier 1 manufacturers of:

- Multifunctional films e.g.– polarising, diffusing, electronic, etc.…
- Optical films
- Lithium Ion Batteries
- Primary film manufacturers

Technology is currently being used by by Major Global brands around the world

Typical Applications

Environment Wide web

		Calendaring	Sputtering	Printing	Coating	Lamination	Sealing	Primary slitting/rewind	Slitting new machines only	Embossing	Inspection	Roller cleaning
Film production	Cast											
	Cast/Stretched											
	Extrusion											
	co-extrusion											
	Blown											
Label stock production												
Siliconising Film	Film											
	Paper											
Window tinting film												
Packaging	Drink											
FPD Films	Diffuser/Polariser											
Battery production	Separator film											
	Cathode/anode											
Abrasives												
CCL												
Paper	Technical											
	co-extruded											
Medical	Pouch											
	Blister											
	Films/tape											
Holographic /security												
Photo Imagable film	Dry film											
Filter / screen mesh												
Flexible circuits FPCB												
Digital												
BIB/BIC												
Ceramics												
Glass												

Existing application	
Requested	Requested

Example Sectors

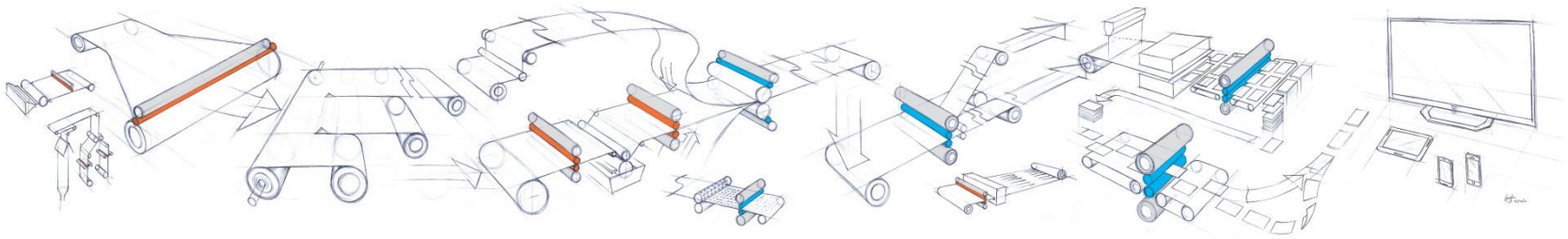
- PCB
  - Flex and Rigid
  - HDI
- PCBA
  - Medical
  - Auto
  - Display
  - Military
  - Consumer
- Glass
  - Automotive
  - Architectural
- Web
  - Optical Films
  - Security Films
  - FCCL
  - Plastic Electronics
  - Medical packaging
  - Ultra High Vacuum
- Display
  - BLU
  - TFT
  - TCO

Cleaning Applications

Primary Converting

Secondary Converting

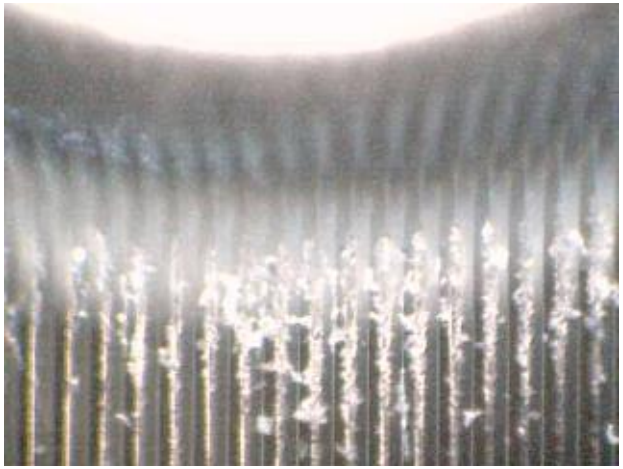
FPD and BLU Assembly



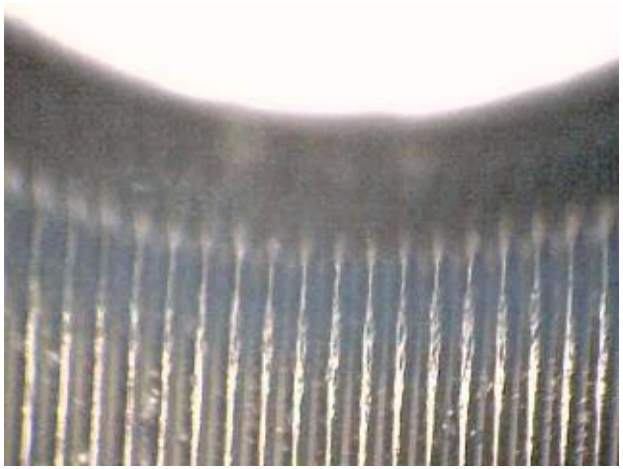
XCH

Prism Cleaning

Before Cleaning



After Cleaning



WGCM

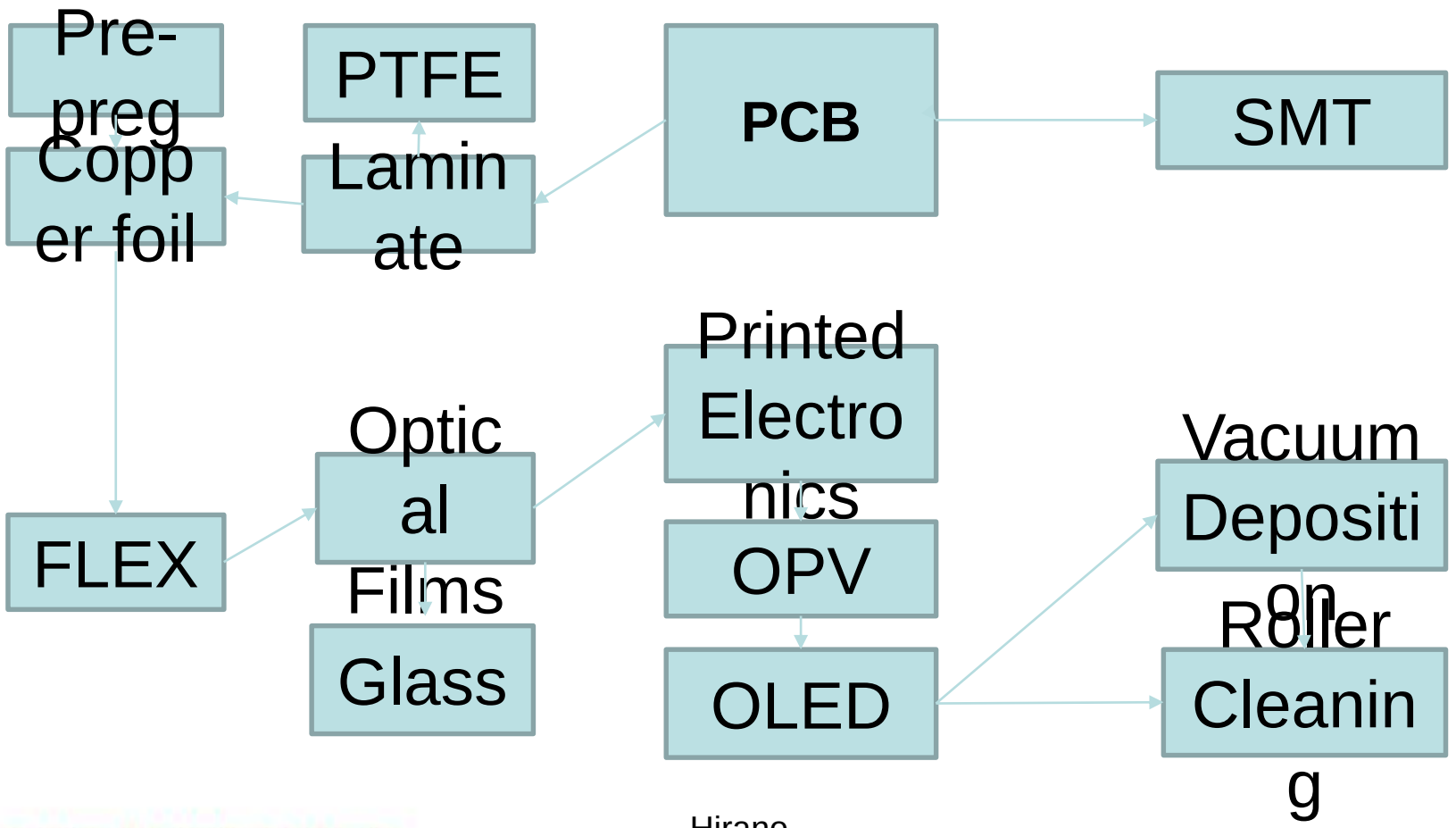
Adhesive Roll Pull Out on WGCM

Vacuum Compatible Cleaning Engine

- Vacuum Compatibility
  - Can be used in high vacuum environments
  - No outgassing from elastomer or adhesive
  - Silicone free system
  - No reduction in cleaning performance
  - No detriment to vacuum system

Teknek in Vacuum Chamber

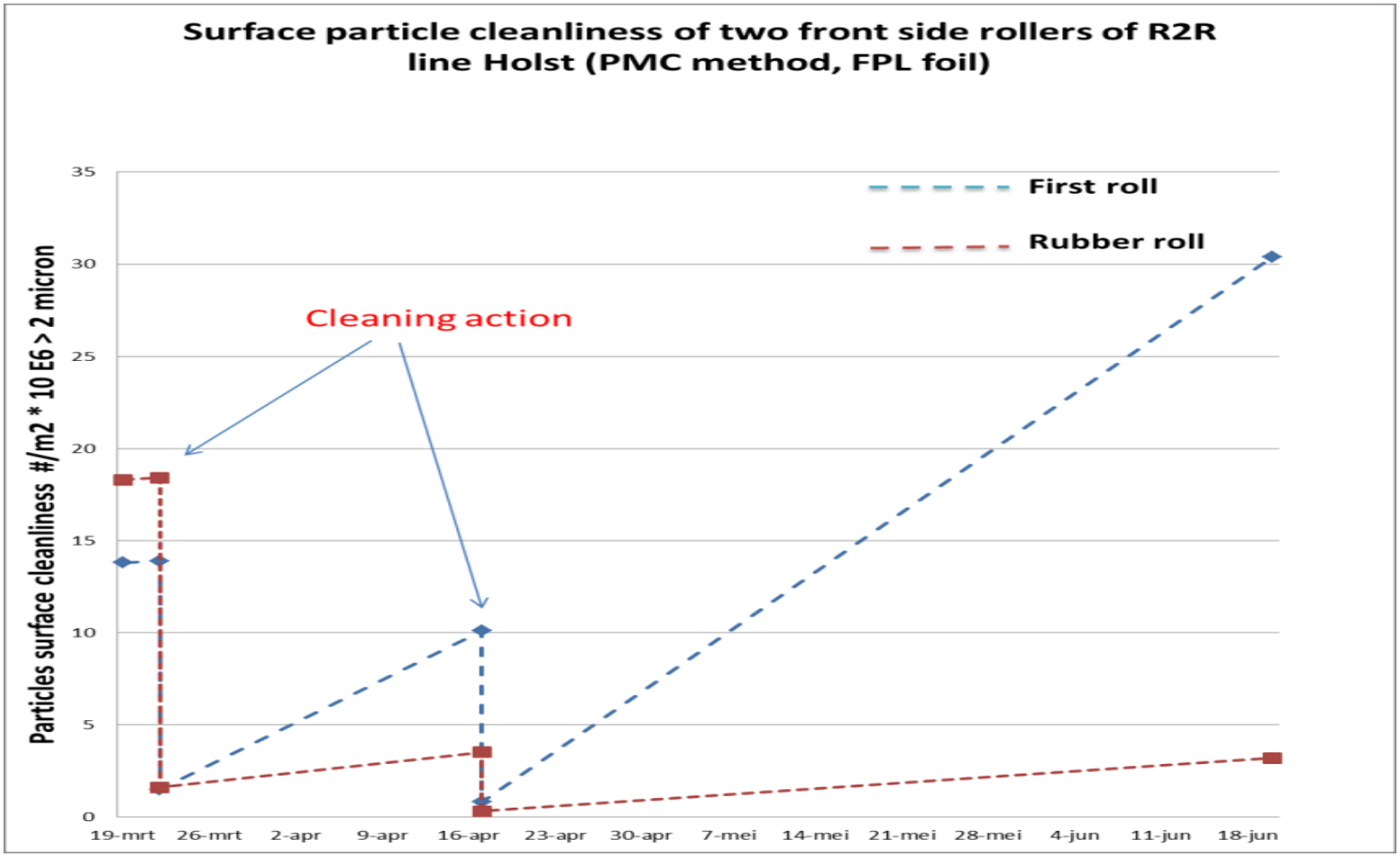
Electronic Materials



Roller Cleaning

- Rollers in coating lines hold many particles
- Particles generated by slip and abrasion
-
- Rollers transfer these particles to the film
- Clean rollers are essential to minimise coating defects

Roller Cleanliness

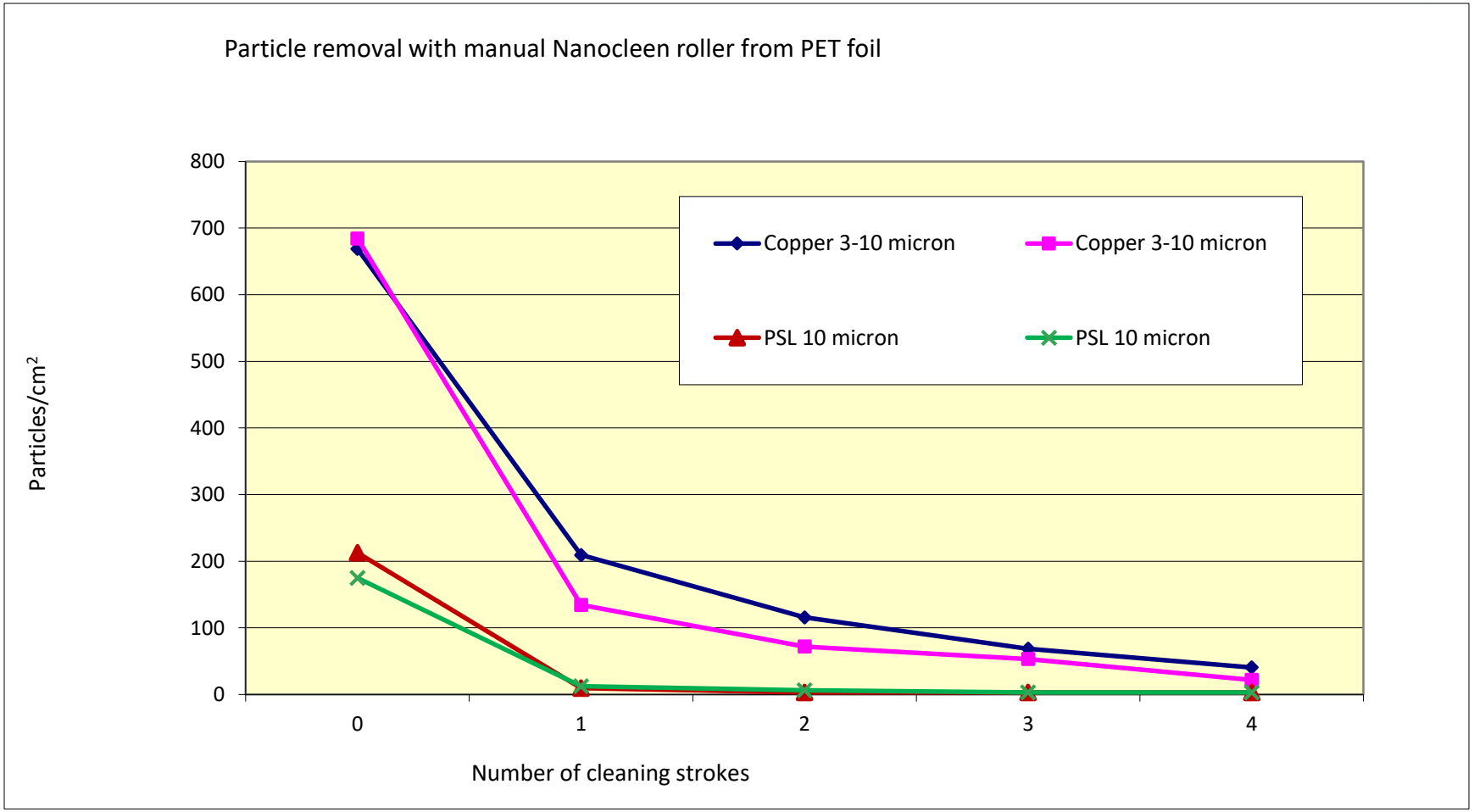


Advantages

Substrate Summary

SUBSTRATE	ELASTOMER	EFFECT	CLEANING	TESTED BY
PEDOT	Panel	None	Yes	Coatema
ITO	Panel	None	Yes	Nihama
ITO	Nanocleen	None	Yes	Nihama
ITO	UTF	None	Yes	Nihama
Ag nanowires	Ultracleen	None	Yes	TU Dresden
C nanotubes	Ultracleen	None	Yes	TU Dresden
Silver Ink	Panel	None	Yes	DZP
Silver Ink	Nanocleen	None	Yes	DZP
Silver Ink	UTF	None	Yes	DZP
Silicon ink	Panel	None	Yes	DZP
Silicon ink	Nanocleen	None	Yes	DZP
Silicon ink	UTF	None	Yes	DZP
Metal Oxide ink	Panel	None	Yes	DZP
Metal Oxide ink	Nanocleen	None	Yes	DZP
Metal Oxide ink	UTF	None	Yes	DZP
ETFE	Panel	None	Yes	DZP
ETFE	Nanocleen	None	Yes	DZP
ETFE	UTF	None	Yes	DZP

Cleaning Efficiency



Cleaning Efficiency

- Ave. concentration rollers before :10E6 p/m2
- Ave. concentration rollers after :<1 E6 p/m2
- Cleaning efficiency contact cleaning > 90 %

Silicone Free Cleaning Engine

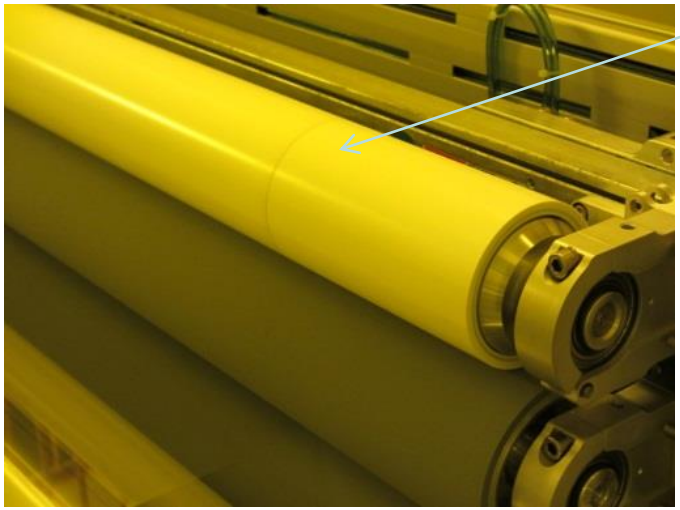
- Silicone free cleaning rollers
- Silicone free adhesive

- Silicone free confirmed by
  - FTIR,
  - Edx (Energy-dispersive X-ray spectroscopy)
  - RGA (residual gas analysis)

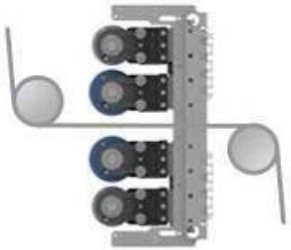
Static Dissipating Elastomer

- Nanocleen
  - Static dissipating NO conductive particles – clever polymers not cheap additives
  - Dyne Neutral, contact angle (Measurements on PET)
    - Uncleaned contact angle 71.57, SD +/- 1.49
    - Cleaned with Nanocleen 71.80, SD +/- I.46

顧客事例 1



コーティング前にポリエステル網の端をクリーニング

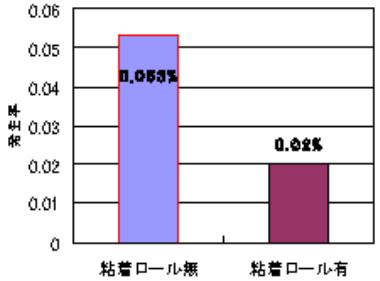


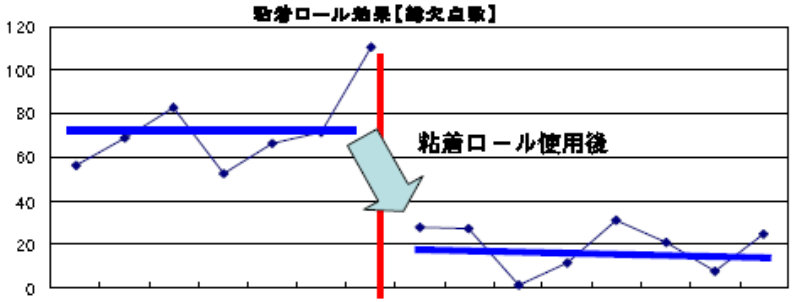
TEKNEK社製粘着ロール効果

1)エンボス抑制効果

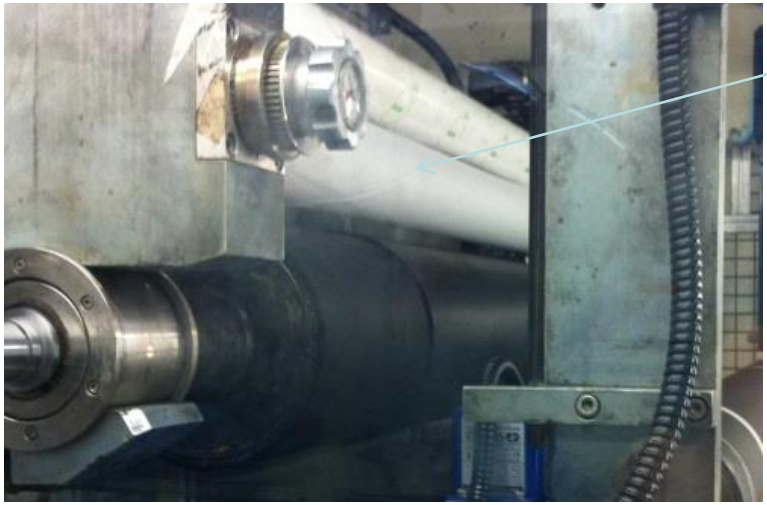
粘着ロールを使用する事で連続欠陥発生率が、1/3近く減少。
欠点総個数においても大きく改善。

→ 非常に効果がある。

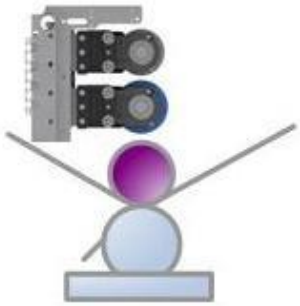


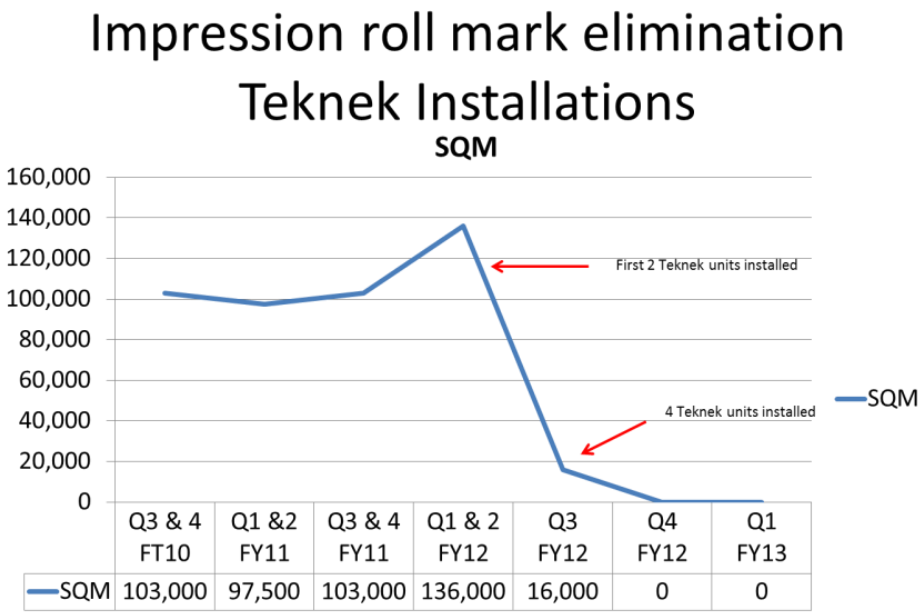


顧客事例 2



高熱ホイルコーティング内の印刷ロール(roll)ローラー (original – roller)をクリーニング

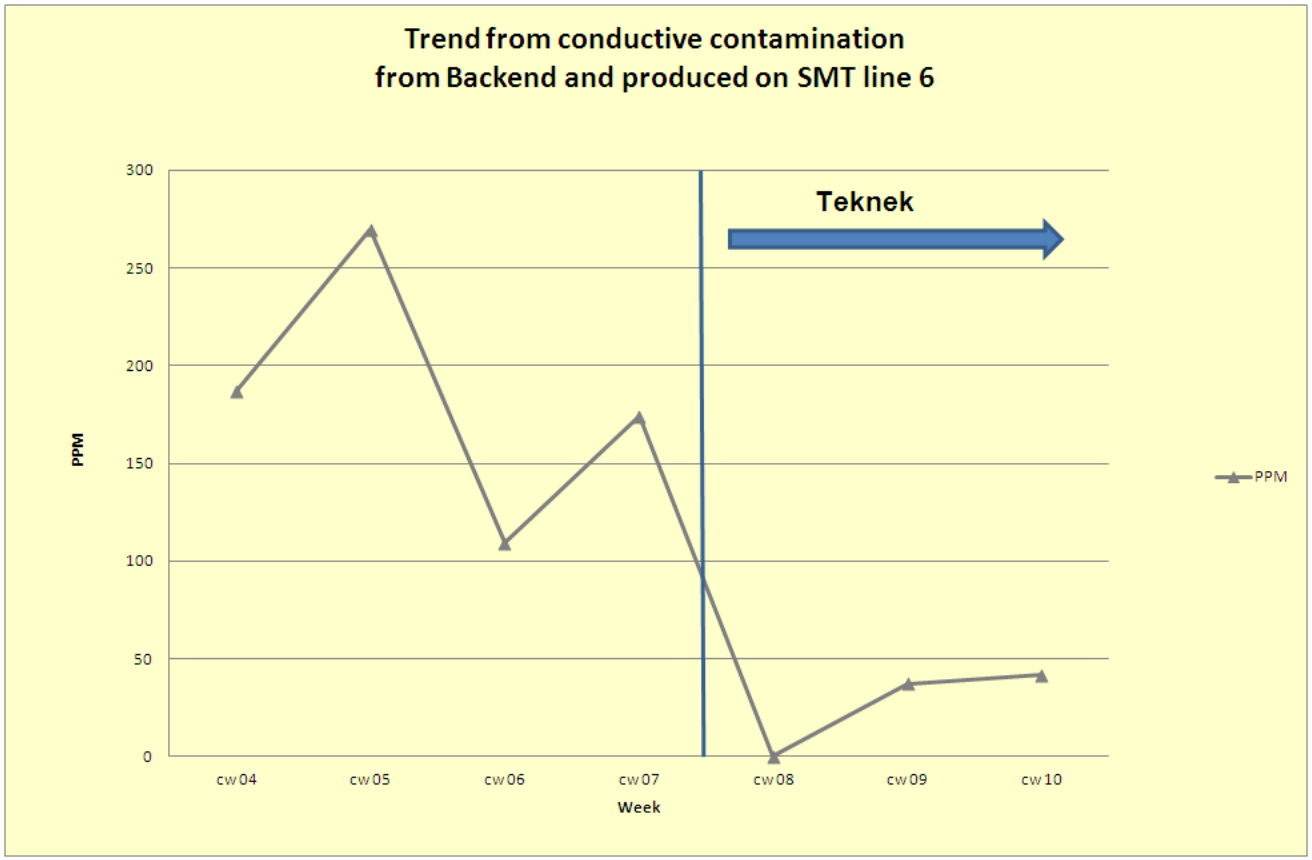




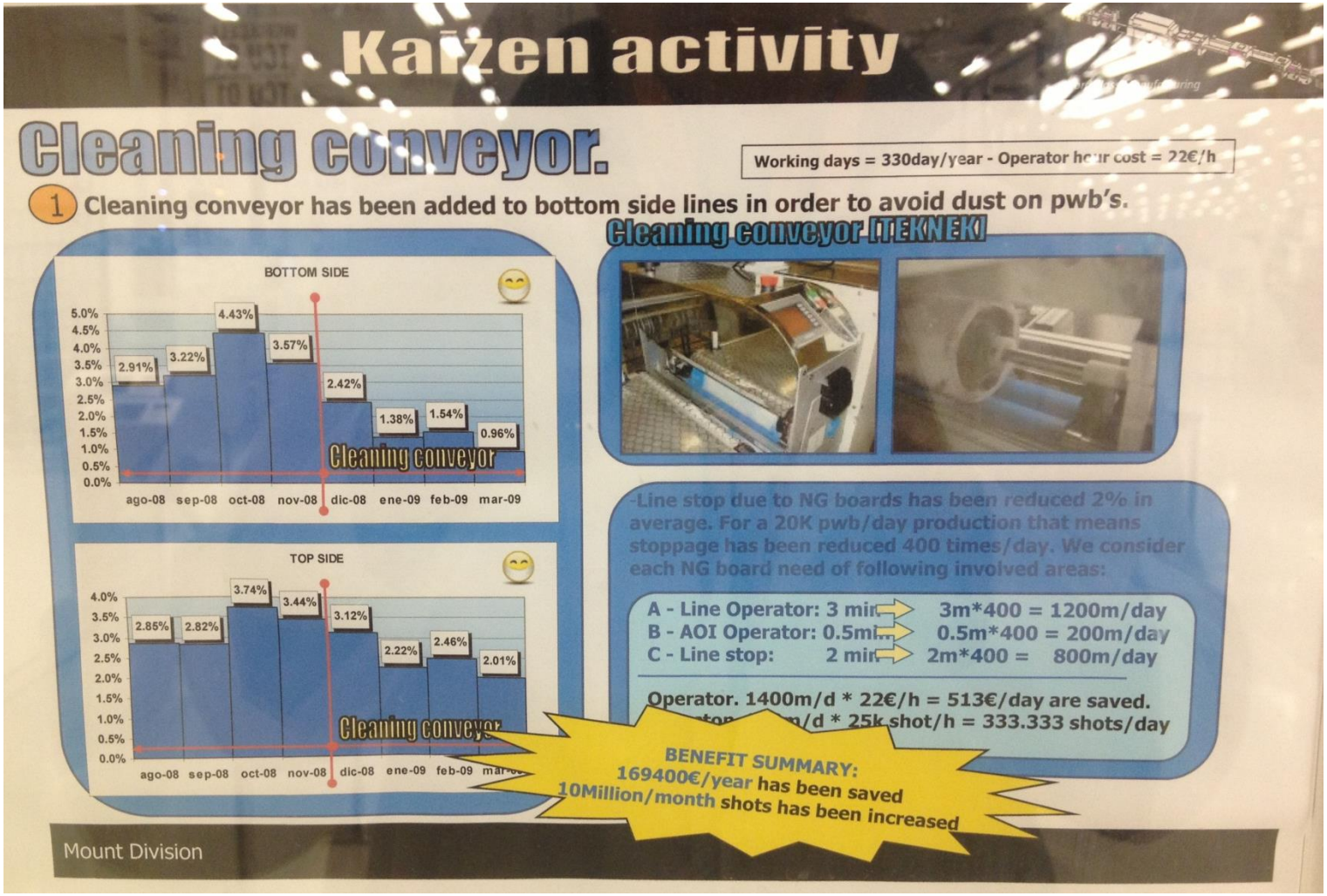
Case Study 2

- Major display manufacturer
- Very fine line circuits
- Polyester film substrate
- 50% defect reduction in flexible OLED matrix production

Case 2 – Automotive Hungary



Case 3 -PCBA


Kaizen activity
Cleaning conveyor.
Working days = 330day/year - Operator hour cost = 22€/h
1 Cleaning conveyor has been added to bottom side lines in order to avoid dust on pwb's.
BOTTOM SIDE
2.91%
3.22%
4.43%
3.57%
2.42%
1.38%
1.54%
0.96%
Cleaning conveyor
ago-08 sep-08 oct-08 nov-08 dic-08 ene-09 feb-09 mar-09
TOP SIDE
2.85%
2.82%
3.74%
3.44%
3.12%
2.22%
2.46%
2.01%
Cleaning conveyor
Cleaning conveyor [TEKNEK]
-Line stop due to NG boards has been reduced 2% in average. For a 20K pwb/day production that means stoppage has been reduced 400 times/day. We consider each NG board need of following involved areas:
A - Line Operator: 3 mi... 3m*400 = 1200m/day
B - AOI Operator: 0.5mi... 0.5m*400 = 200m/day
C - Line stop: 2 mi... 2m*400 = 800m/day
Operator. 1400m/d * 22€/h = 513€/day are saved.
...m/d * 25k shot/h = 333.333 shots/day
BENEFIT SUMMARY:
169400€/year has been saved
10Million/month shots has been increased
Mount Division

Best Cleaning

TEKNEK社製粘着ロール効果

Effectiveness of Teknek Transfer system against roller only system

1)エンボス抑制効果

粘着ロールを使用する事で連続欠陥発生率が、1/3近く減少。
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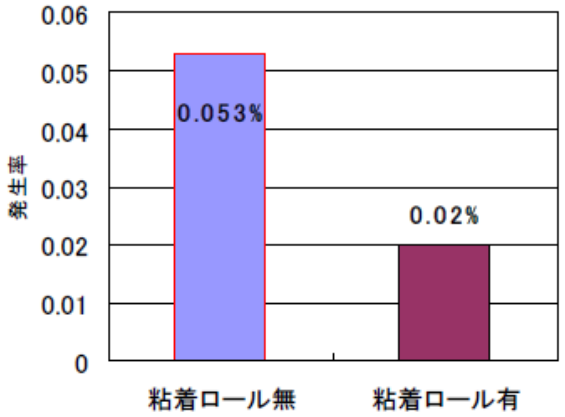
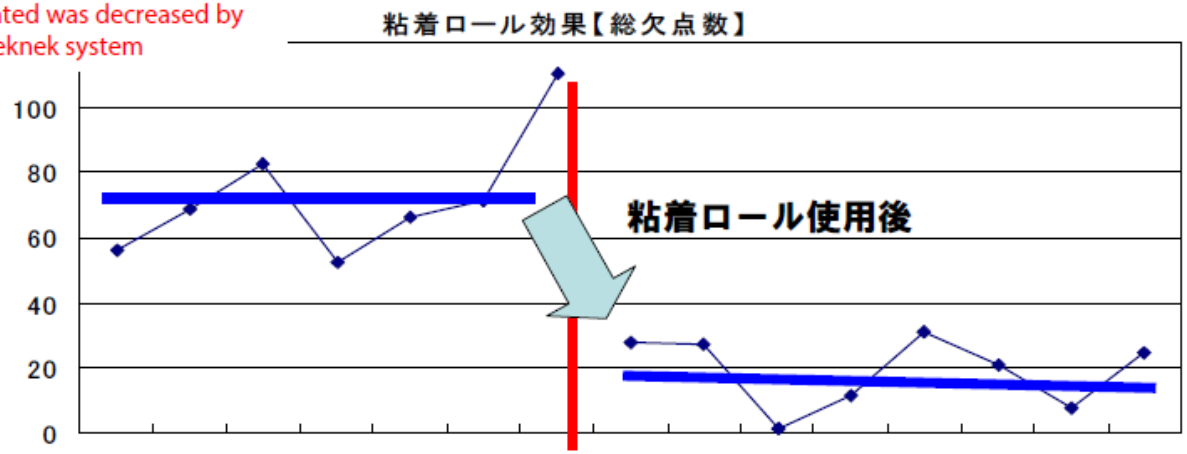
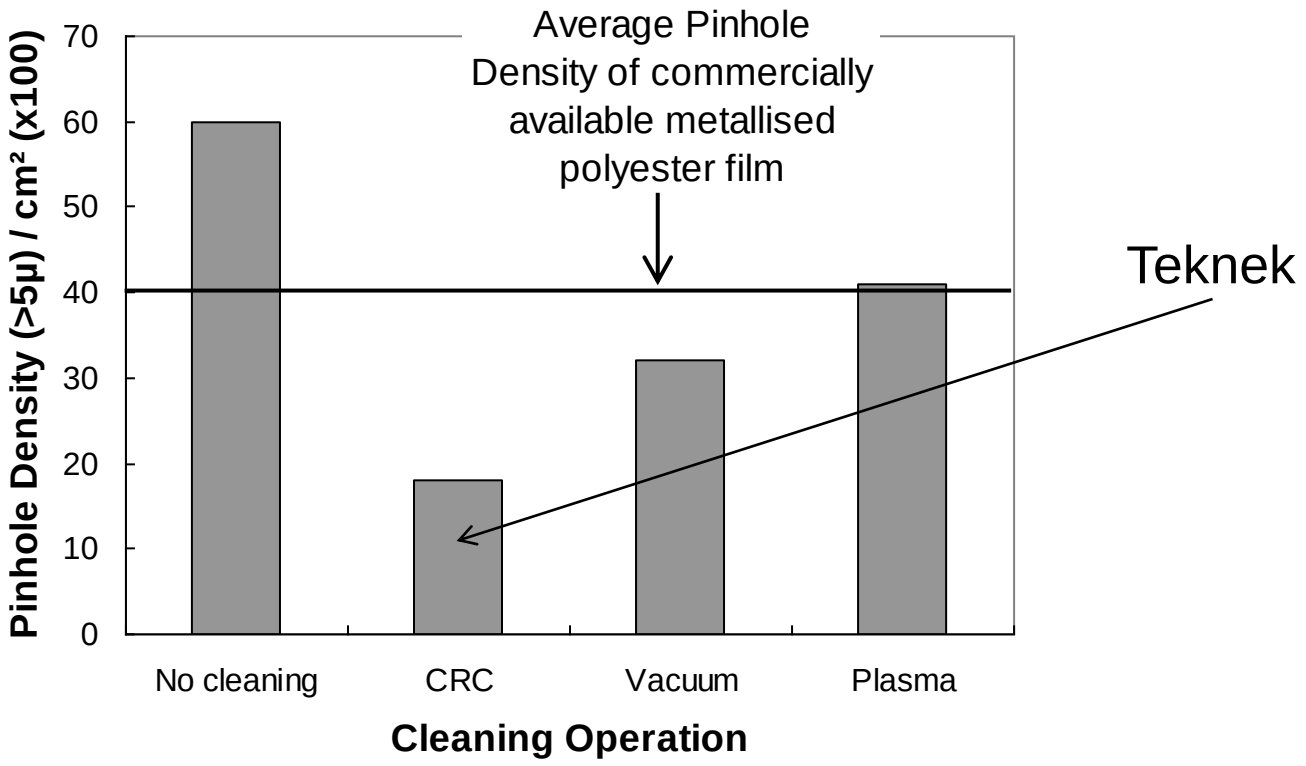


1) Recontamination effect using roller only system.
Number of flaws generated was decreased by one third when using Teknek system



Pinhole reduction in metallised film

Data courtesy of Dupont Teijin UK



Elastomer Properties

- Silicone free system
- High cleaning performance
- Remove particles less than 1 micron
- Minimise static electricity
- No effect on substrate surface properties

Summary

Conclusions

- Contact cleaning offers very effective cleaning
- It is a dry cleaning method without chemicals
- Independent testing shows it does not recontaminate the materials
- It works on a large variety of materials
- It can operate in a range of environments
- It can clean materials with very different dimensions and mechanical and chemical properties through tailored elastomers.

Capabilities

- Removes particles from 5mm to 20nm.
- Clean webs up to 4 metres, at speeds up to 600mtrs/min
- Clean sheets as small as 15mm x 10mm and big as 2mtrs x 4mtrs. Gen 10 in FPD.
- Clean substrates as thin as 9 micron.
- Operate in PCB, PCBA, FPD, OLED, OPV, FCCL, High Value Print

Questions