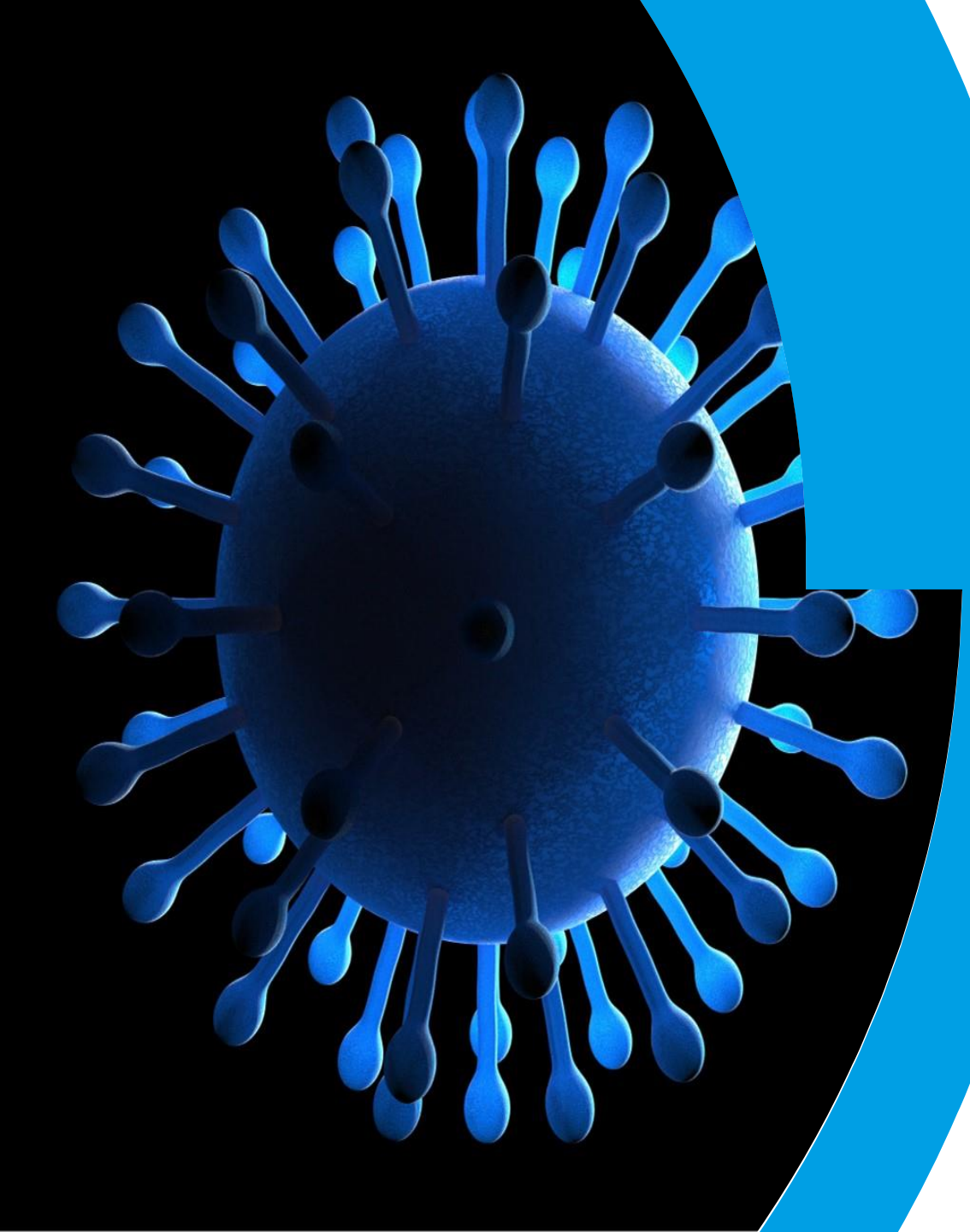
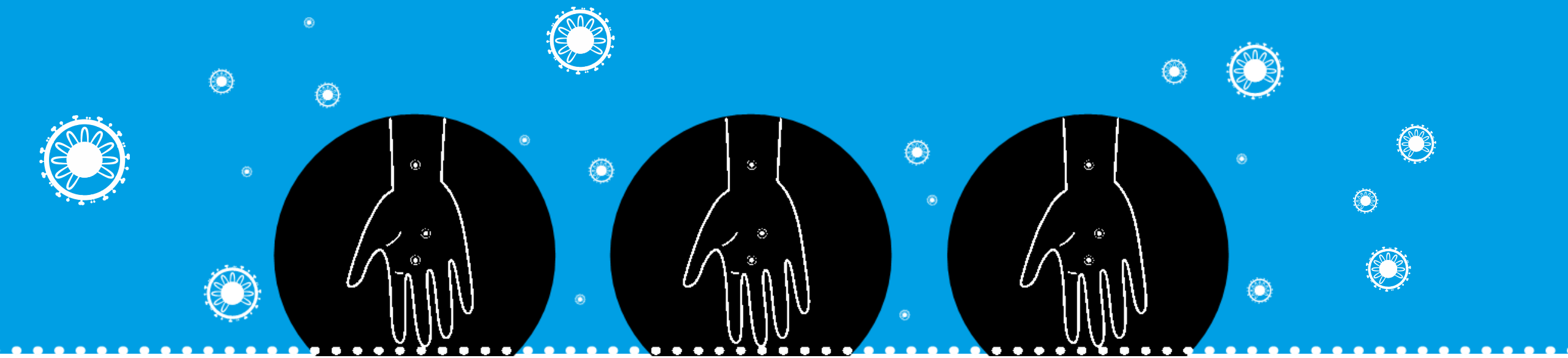


Covestro’s Safe Surface Technology resins enable anti viral coatings

07/2021

How a virus spreads



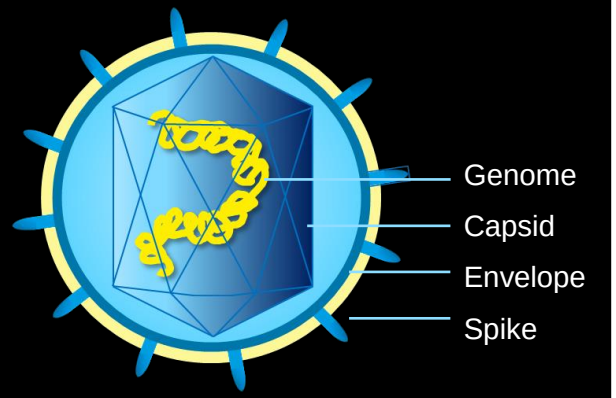
Viruses predominantly spread by air but contaminated surfaces also contribute to virus spread

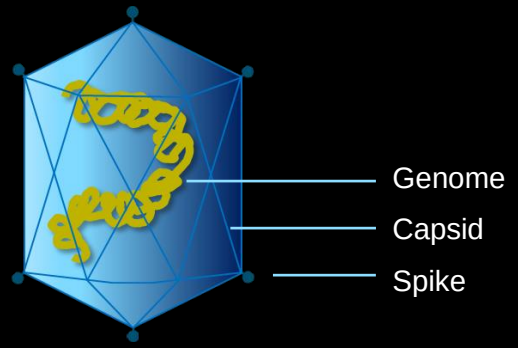
Spreading via surfaces

Wash your hands often:

What are viruses?

Viruses are simple structures, but yet complex





Examples of (non-) enveloped viruses

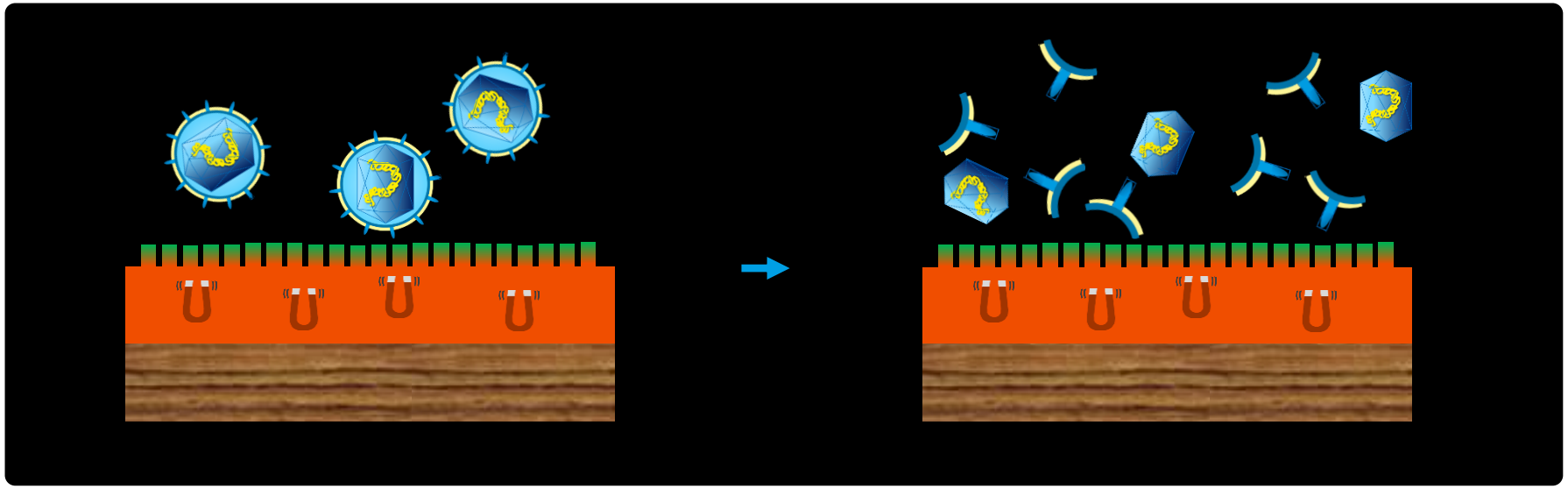
Influenza
HIV
SARS-COV-2

Norovirus
TMV

The envelope:

- Consists of lipid components, forming the bilayer, and proteins
- Protects the virus
- (Using the proteins) binds the virus to a host cell
- (Using the proteins) fuses the virus with host cells

Antiviral effect – “Grab and Kill” - mechanism



- The coating first pulls the virus close to the surface.
- At the surface, the virus bilayer is destabilized by the coating.
- This causes lysis of the virus resulting in its deactivation.
- After destabilization the virus is no longer able to adhere and fuse with a host cell

Biocidal products regulation (BPR)

According to article 3(1)(a) of the BPR, a biocidal product is:

Any substance or mixture, in the form in which it is supplied to the user, consisting of, containing or generating one or more active substances, with the intention of destroying, deterring, rendering harmless, preventing the action of, or otherwise exerting a controlling effect on, any harmful organism by any means other than mere physical or mechanical action.

The mode of action in our coatings is, however, to disturb the membrane physically.

Safe surface technology is out of scope of the BPR

Federal Insecticide, Fungicide, and Rodenticide Act (FIFRA)

According to EPA,
A pesticidal device [under FIFRA] is an instrument or contrivance (other than a firearm or chemical substance) that is used to destroy, repel, trap or mitigate any pest such as insects, weeds, rodents, animals, birds, mold/mildew, bacteria, and viruses. While devices are regulated by EPA and subject to certain regulatory requirements, they do not require registration as pesticide products.…

Coated articles are a device, full EPA registration will not be required

Surfaces that contribute to spreading viruses

Test Protocol ISO21702:2019

- Tests were done at a UK tests institute using bacteriophages (phi6), that have a similar envelope as covid-19 or influenza viruses (BSL-2 instead of BSL-3)
- 300.000 viruses were applied on a 3*3 cm coated substrate. After a contact time of 6 hours viruses were transferred to host cells (Ps. Syringae) for survival count.
- Efficacy was reported as log reduction.
- **Relevancy of results:**

log	rating
< 2	insufficient
2-3	significant
> 3	good
> 4	excellent

- Tests were done in triplicate

UV Curable Formulation Anti Viral Results

Coating	% reduction	Log
Polystyrene coating reference	82,3	0,75
Urethane acrylate UV coating reference	98,89	1,96
Urethane acrylate UV 1 with AV	>99,99	>4,88
Urethane acrylate UV 2 with AV	>99,99	4,36

UV Curable Formulation Cleaning and AV

Effect of cleaning	Urethane acrylate UV 1 with AV	
	Anti viral results of coatings cured under inert conditions	Anti viral results of coatings cured under inert conditions after washing with Ammonia[1]
% Reduction	>99,99	>99,99
Log	>4,88	4,78

[1] Ammonia concentration – 12,5%
10 double rubs horizontal
10 double rubs vertical
10 double rubs with water to rinse and finally dry cloth

UV Curable formulations

Staining performance of new AV UV formulations

	Description	Cure condition	Appearance	20 gloss	60 gloss	85 gloss
Coating 2A	UV formulation reference	atmospheric	High gloss	85	91	94
Coating 2B	**UV formulation with AV**	atmospheric	High gloss	81	93	98
Coating 2C	UV formulation reference	nitrogen	High gloss	84	93	98
Coating 2D	**UV formulation with AV**	nitrogen	High gloss	83	92	99
Coating 2E	Excimer formulation reference	Excimer cure	Matt	0	2	4
Coating 2F	**Excimer formulation with AV**	Excimer cure	Matt	0	1	3

Staining test results formula 2A and 2B

Formulation

2A standard

2B with AV

1 Water (24h)

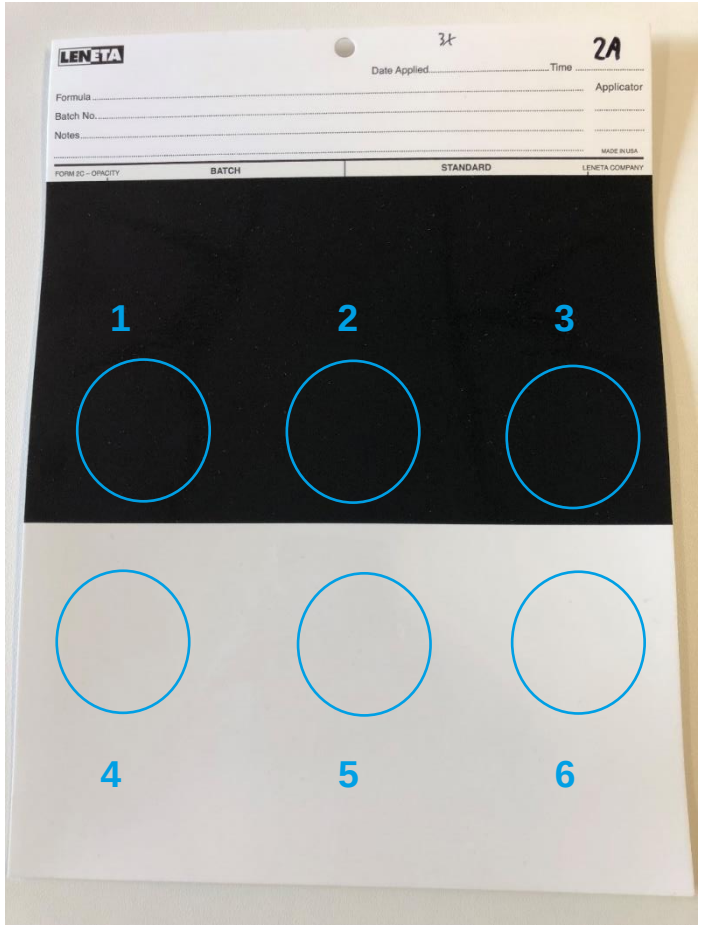
2 Alcohol 48% (6h)

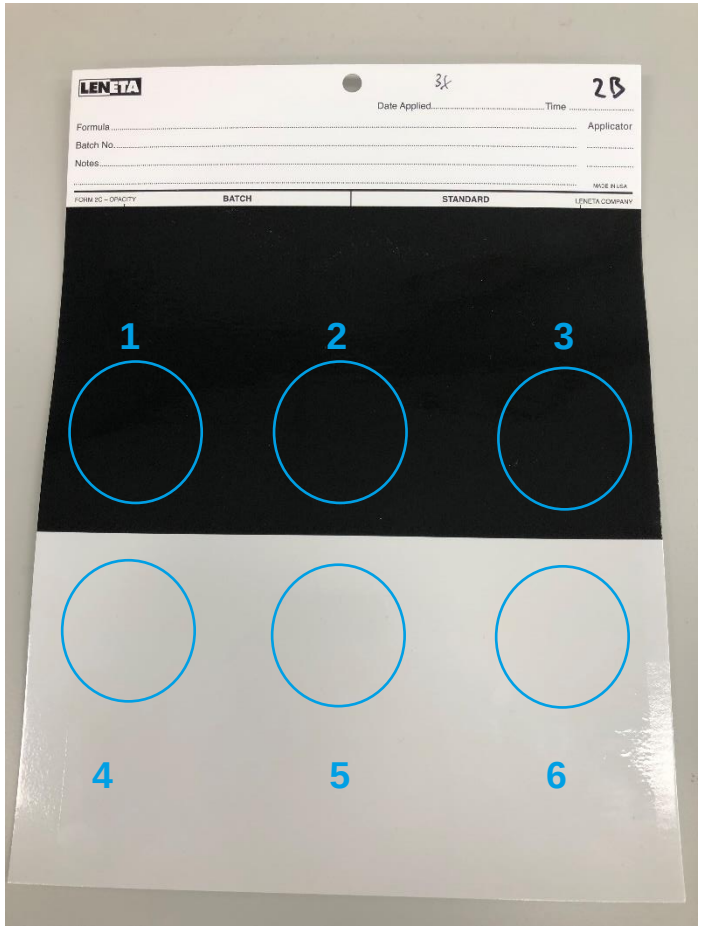
3 Paraffine (24h)

4 Coffee (6h)

5 Red Wine (6h)

6 Mustard (6h)





Staining test results formula 2C and 2D

Formulation

2C standard

2D with AV

1 Water (24h)

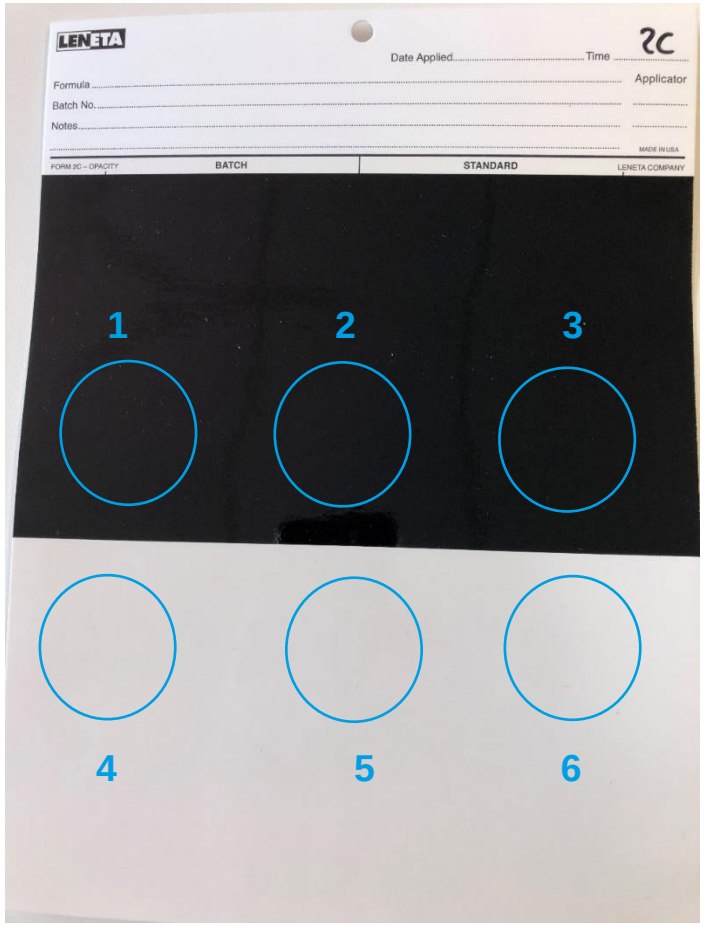
2 Alcohol 48% (6h)

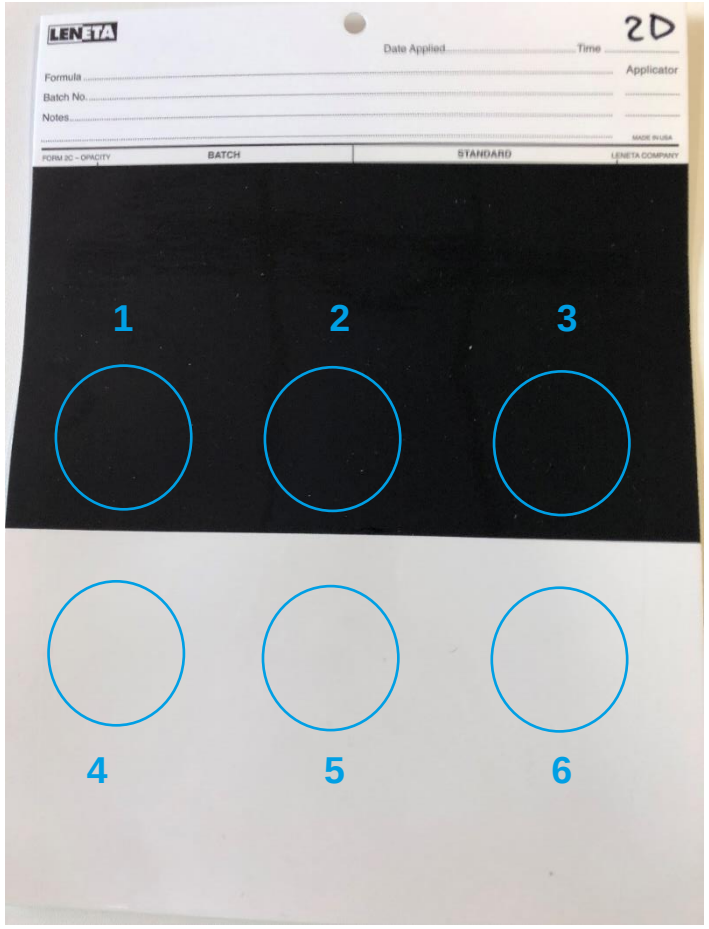
3 Paraffine (24h)

4 Coffee (6h)

5 Red Wine (6h)

6 Mustard (6h)





Staining test for use in hospitals

1 Crystal Violet sol.

2 $KMnO_4$

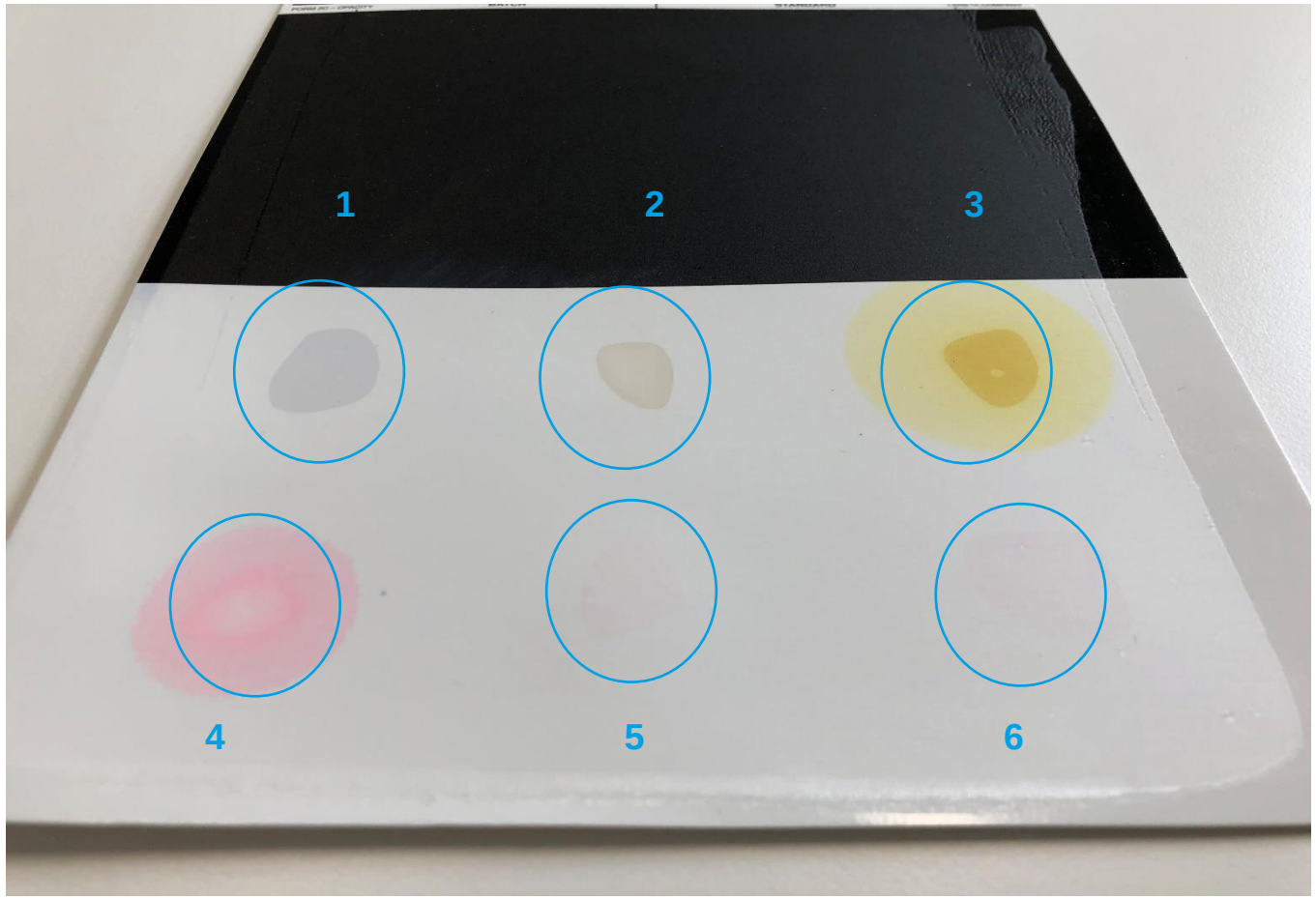
3 Iodine sol.

4 Eosine 1% in ethanol

5 Eosine 2% in water

6 Safranine

All 2h spot tests



Staining test results formula 2C and 2D

Formulation

1 Crystal Violet sol.

2 $KMnO_4$

3 Iodine sol.

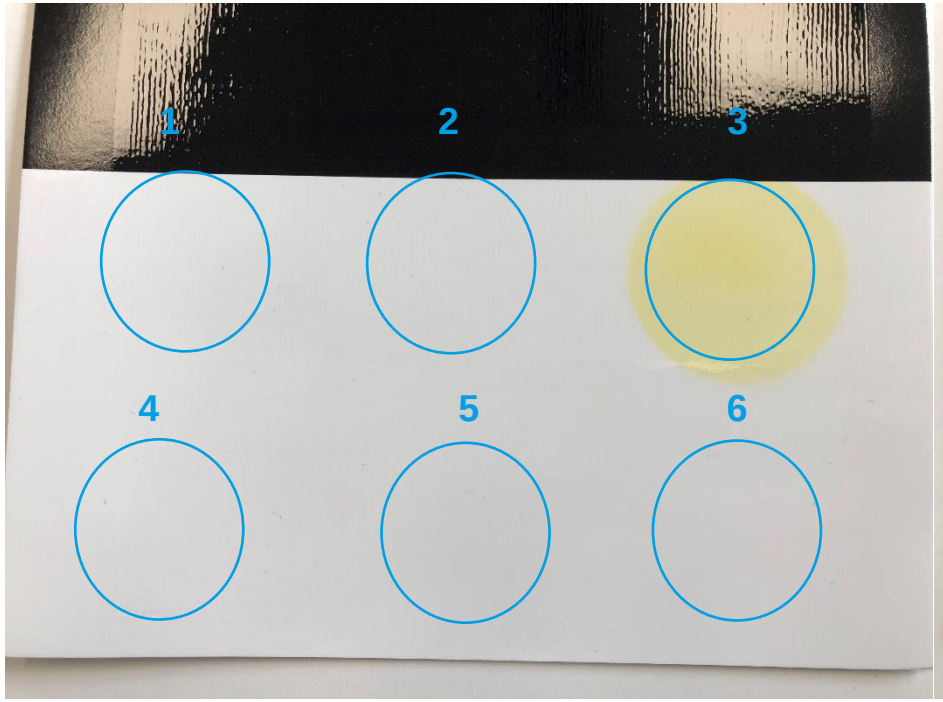
4 Eosine 1% in ethanol

5 Eosine 2% in water

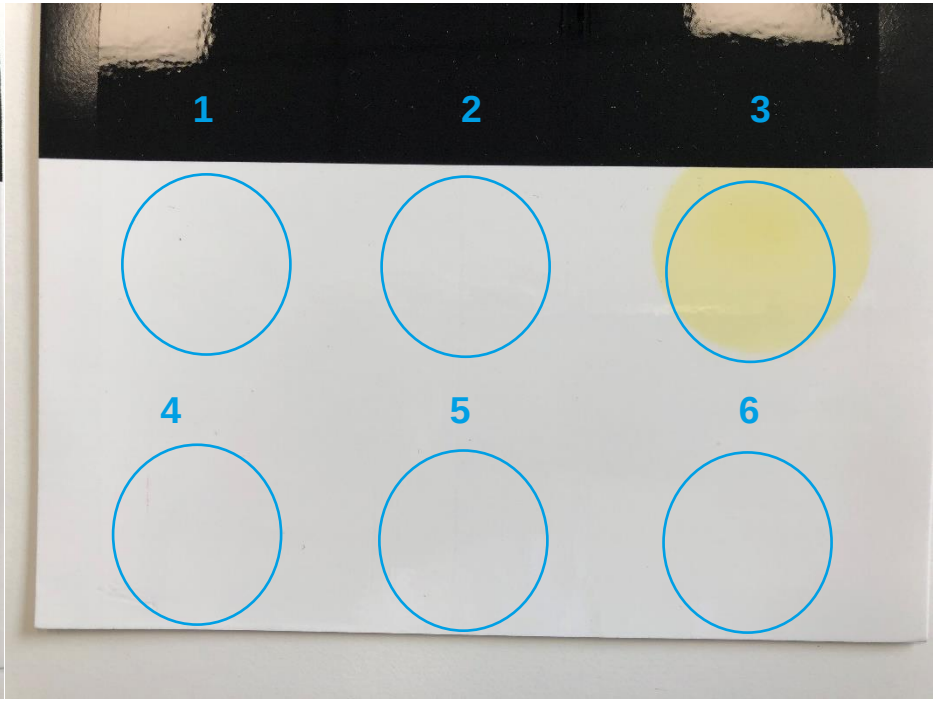
6 Safranine

Staining test for use in hospitals

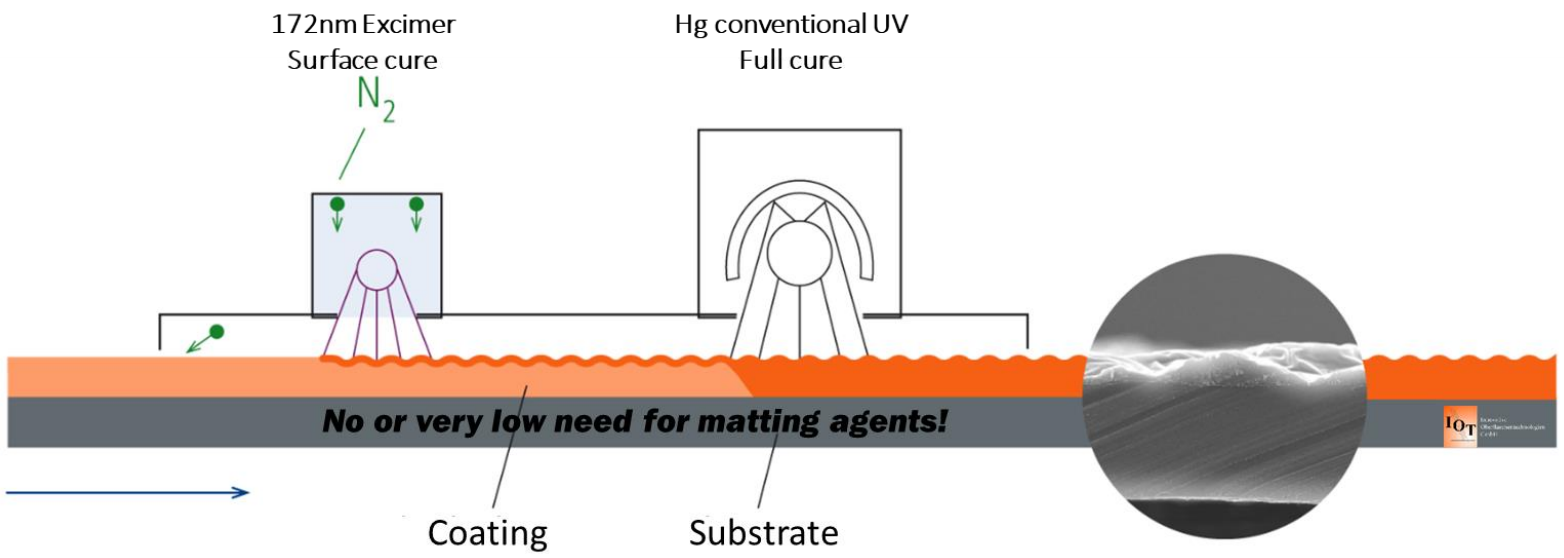
2C standard

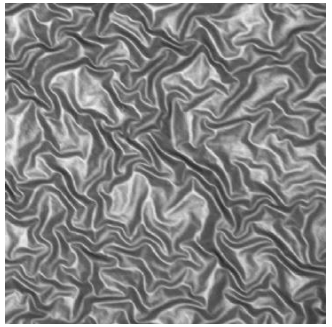


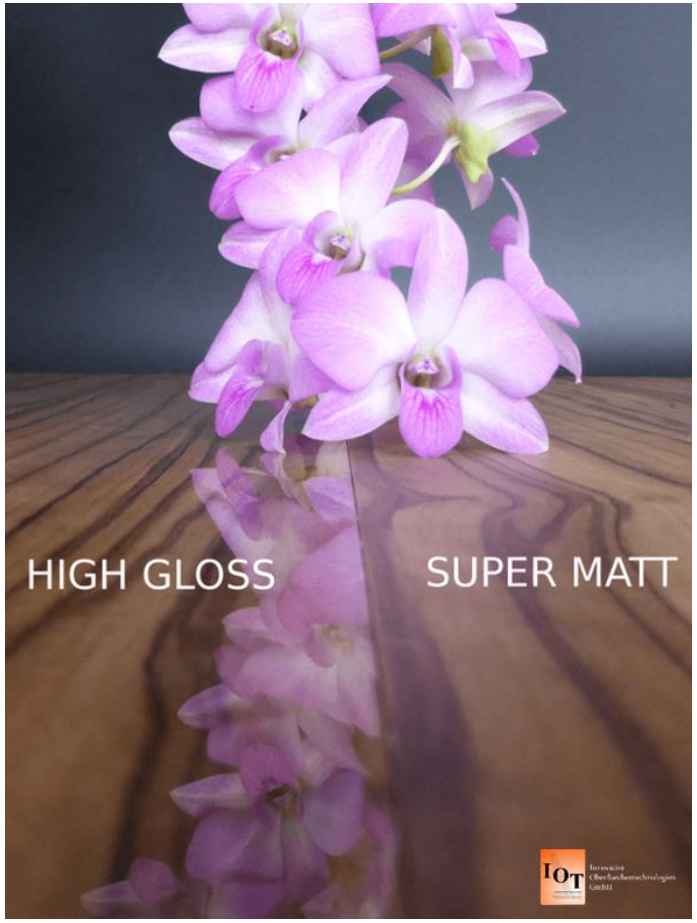
2D with AV



Excimer Cure for low gloss UV







Staining test results formula 2E and 2F

Formulation

1 Water (24h)

2 Alcohol 48% (6h)

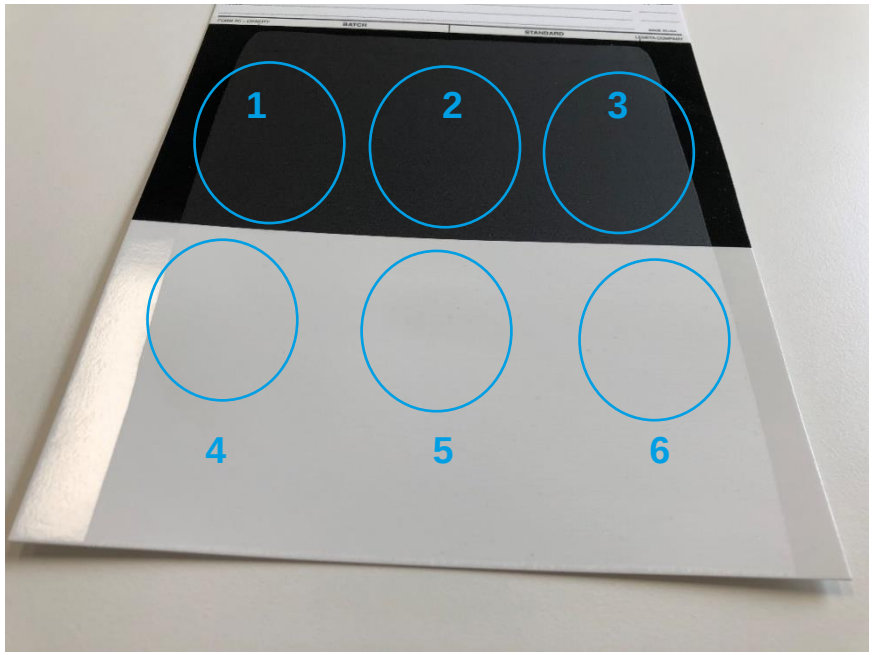
3 Paraffine (24h)

4 Coffee (6h)

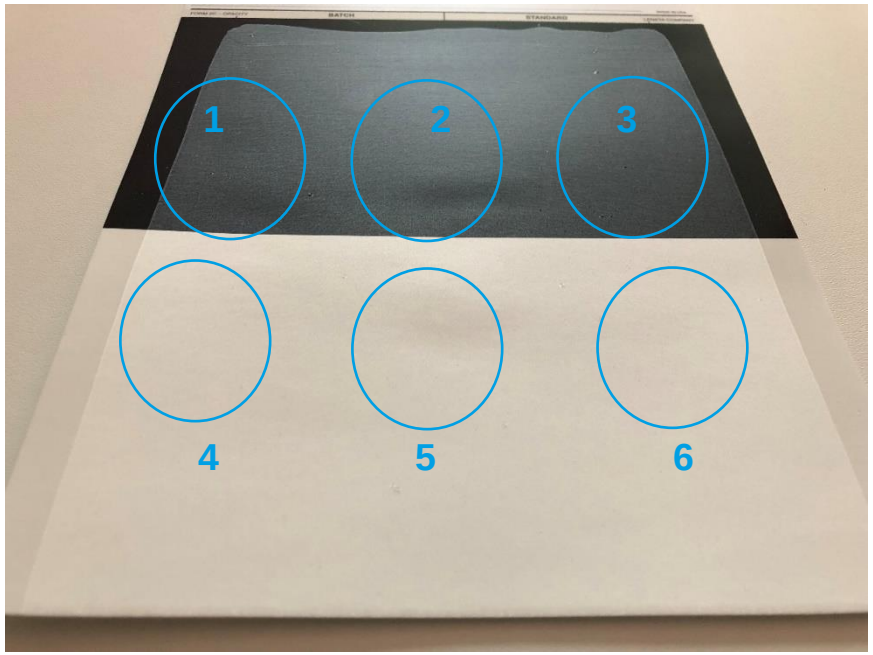
5 Red Wine (6h)

6 Mustard (6h)

2E standard



2F with AV



Staining test results formula 2E and 2F

Formulation

1 Crystal Violet sol.

2 $KMnO_4$

3 Iodine sol.

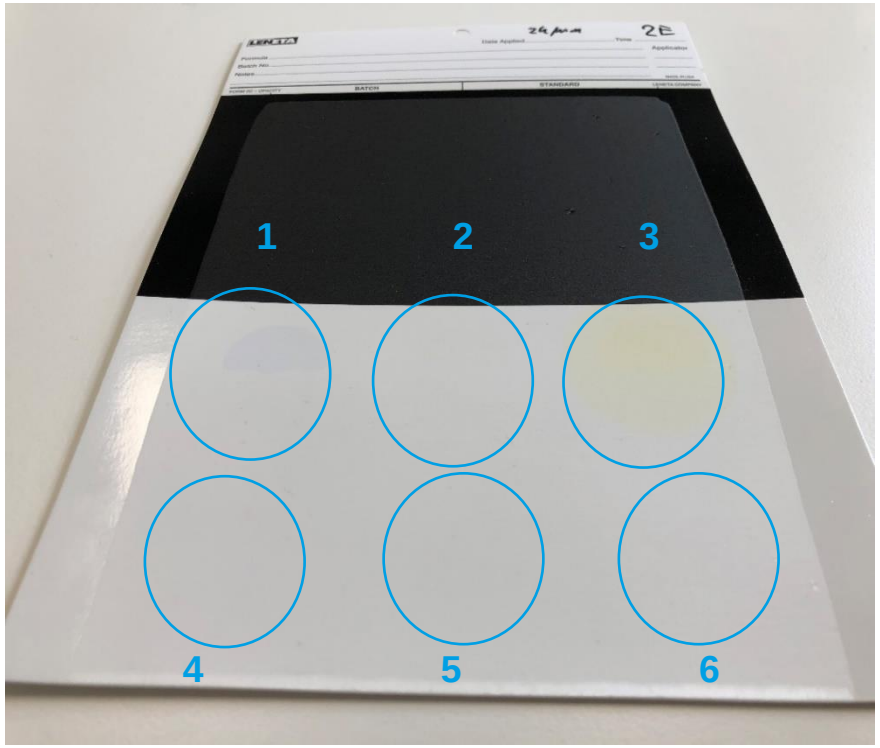
4 Eosine 1% in ethanol

5 Eosine 2% in water

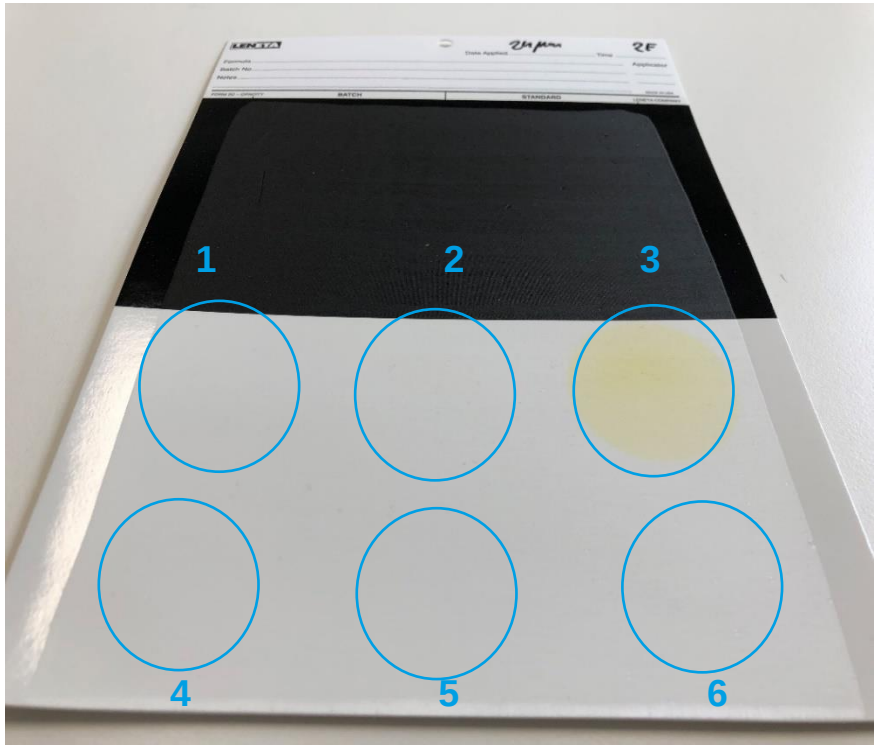
6 Safranine

Hospital use staining test

2E standard



2F with AV



UV & Excimer Curable Formulation Results

		2A	2B	2C	2D	2E	2F
		Atmospheric		Inert		Excimer	
Coffee	6h	5	5	5	5	5	5
Ethanol 48%	6h	5	5	5	5	5	5
Red wine (non-IKEA)	6h	5	5	5	5	5	5
Mustard (non-IKEA)	6h	5	5	5	5	5	5
Water	24h	5	5	5	5	5	5
Paraffin	24h	5	5	5	5	5	5
Crystal violet solution (Grams)	2h	-	-	4	4	3	4
Potassium permanganate solution (Myco)	2h	-	-	5	5	4	4
Iodine solution (Grams)	2h	-	-	0	0	1	0
Eosin solution (1% in EthOH)	2h	-	-	5	5	5	5
Cooper (2% eosin)	2h	-	-	5	5	5	5
Safranin (Schaeffer)	2h	-	-	5	5	4	4

Rating:
5= coating is not damaged/no stains visible
4= coating has minimal damage/very light stains visible
3= coating has some damage/stains are visible
2= coating has significant damage/stains are clearly visible
1= coatings has severe damage/heavy staining visible
0= coating is completely destroyed/very heavy staining visible

Conclusions

- **We have successfully made coatings with excellent anti viral properties**
  - The anti viral effect comes at minimum or no impact on the chemical resistances of the coating
  - Anti Viral effect is maintained after cleaning
  - Can be used for traditional high gloss UV, atmospheric and inert cure
  - Can be used with excimer cure for ultra low gloss coatings

- **The Anti Viral effect is by physical destruction of the envelope of the virus**
  - No Registration required for BPR in Europe
  - Easy registration envisaged for FIFRA in USA

Interested? Please contact us;

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QUESTIONS?

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