Black Bear
CARBON BLACK

Co-funded by the Eco-innovation Initiative of the European Union

OP-Zuid

CERTIFIED cradle to cradle BRONZE

eit Climate-KIC

Black Bear RAMSpec Presentation

October 3-4 2018

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End of Life Tires are an Environmental Danger

- Non Biodegradable, Life expectancy 80-100 yrs

- Fire hazard, difficult to control and causes severe pollution (air, water and soil)

- Mosquito breeding place, outbreak of (tropical) diseases, 750.000 deaths every year

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BBC partners with tire collectors to solve the waste tire pollution problem

Pretreatment line

Black Bear upcycles the tire shreds in four technologically established steps

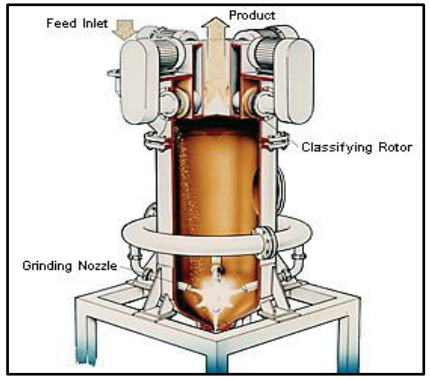
Black Bear line

1

Carbonisation

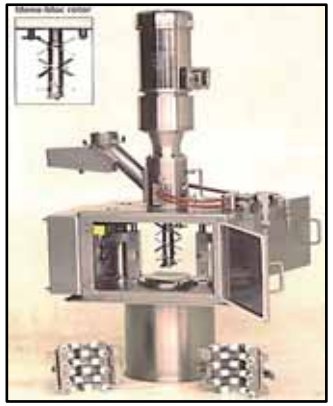
2

Milling



3

Pelletising



4

Drying

Black Bear's technology extracts carbon black, oil and gas from tires, ….

Indicative

Black Bear is 'upcycling' carbon black, oil and gas from waste tires…

=

Carbon Black

Oil

Gas

… at high quality for many applications

Coatings

Inks

Plastics & Rubbers

Tires

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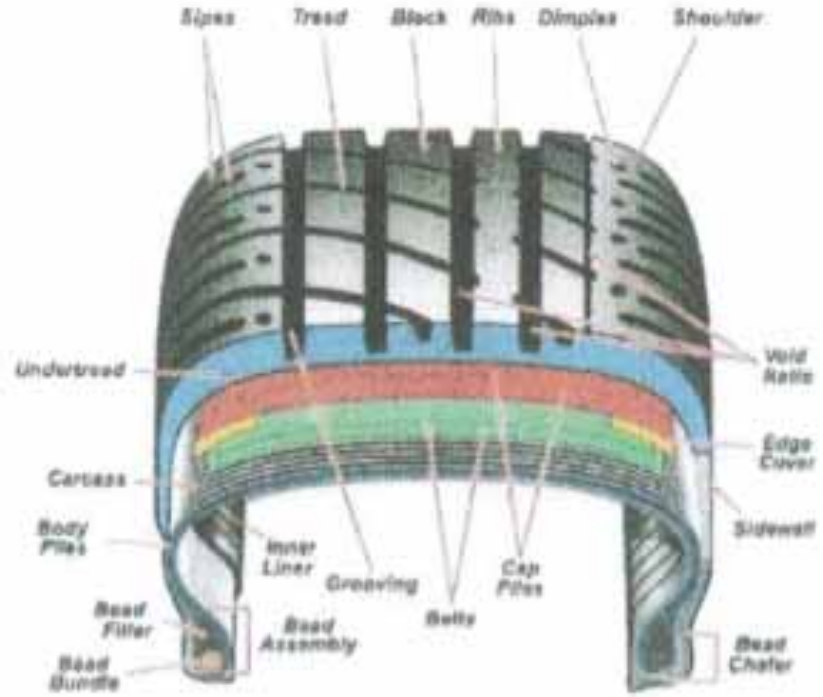
Typical Tyre Make-up



modified by J-P Bouysset –ETRA

Component	Black serie	Carbon black grade	Properties required
Tread	N100-300	N110 N234 N326 N330 N347 N375	Low Abrasion, High Modulus
Sidewall	N500-600	N539 N550 N650 N660 N774	Good fatigue, cut resistance
Belts	N300	N330 N375 N339	Adhesion, high modulus, good fatigue
Plies	N300-N600	N330 N339	Adhesion, good fatigue
Liner	N600	N660 N772 N774	Good air retention, fatigue
Chafer	N300	N330 N347 N339	High hardness, stiffness, good abrasion
Apex	N300	N330 N347	High hardness, stiffness
Tread Base	N500/600	N550 N650	Low hysteresis, high modulus

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Upcycled Carbon Black

- You can select from different feed stock; passenger car high and low silica tires, truck tires, agricultural tires, racing tires, solid tires, off the road etc.
- All these tires have a specific (but consistent) carbon black composition
- Pyrolyzing complete tires: these extracts are always a blend of more than one type of carbon black
- Hence 1:1 exchanges are theoretically difficult/impossible but by careful selection of tire we can get very close

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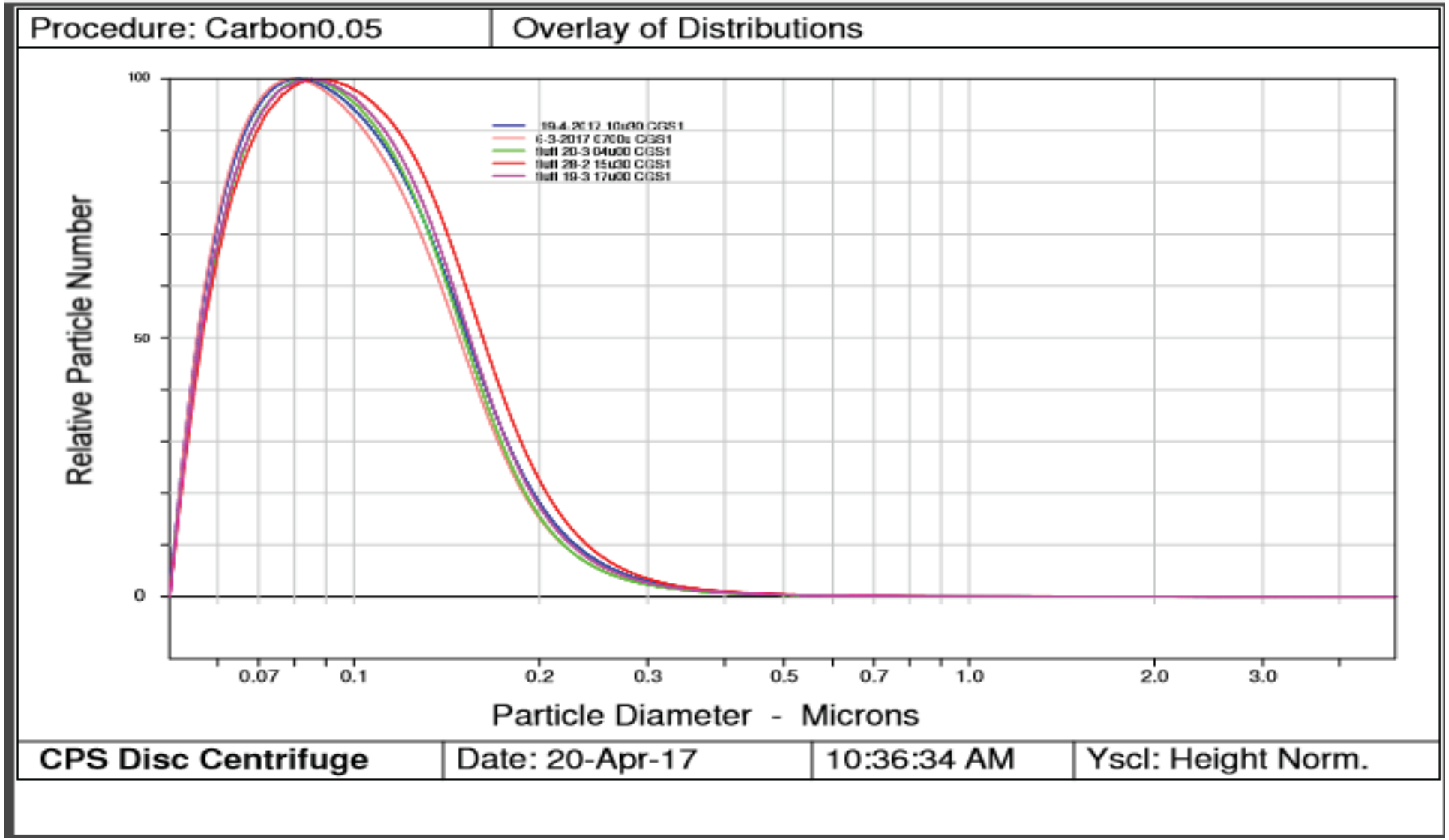
Very consistent Aggregate Size Distribution with BBC Carbon Black



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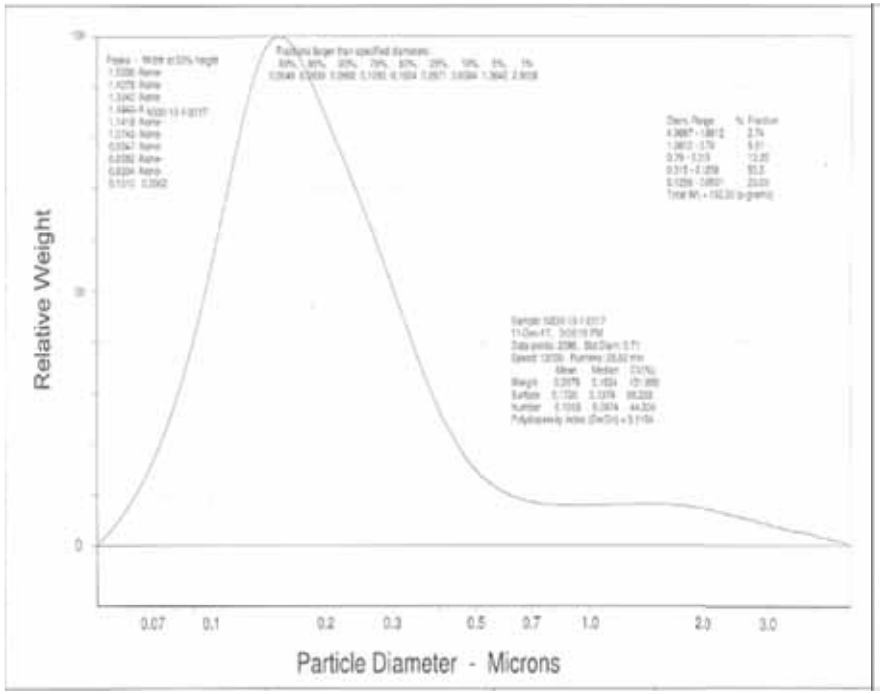
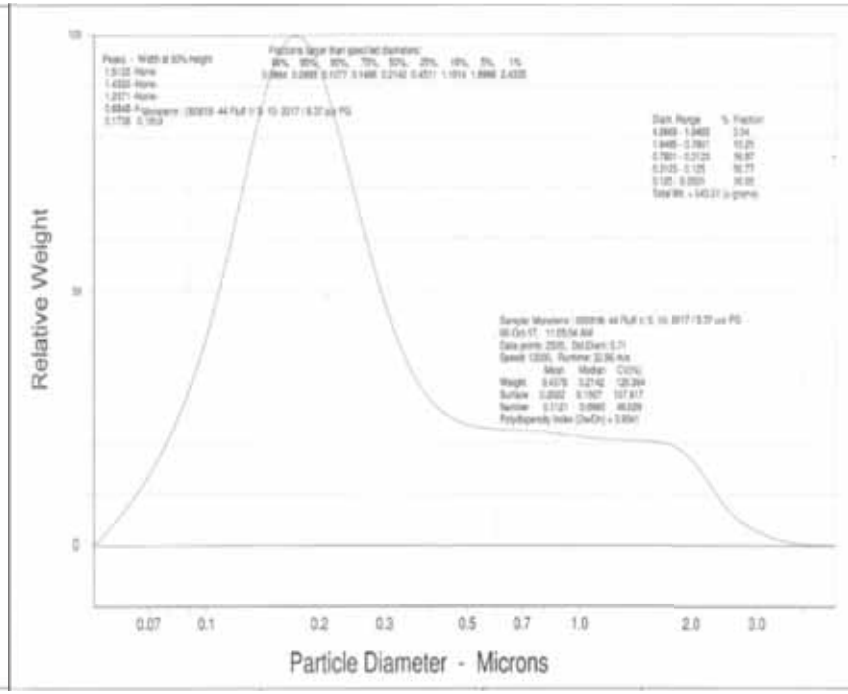
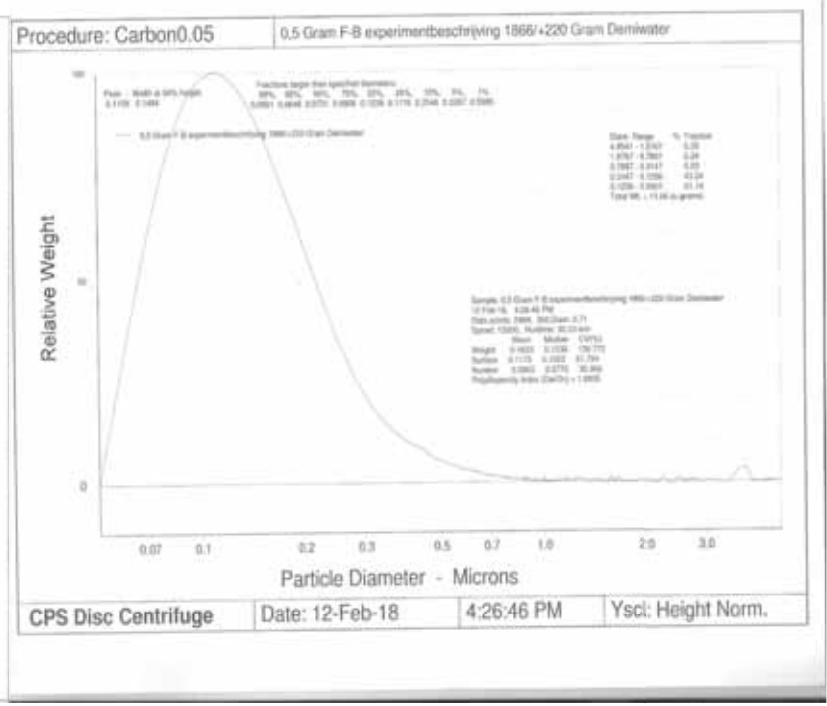
Aggregate size distribution of N 330, NEPtune 70 (TT) before and after Bead Milling







N 330 **BBC NEPtune 70** **After Bead Mill**

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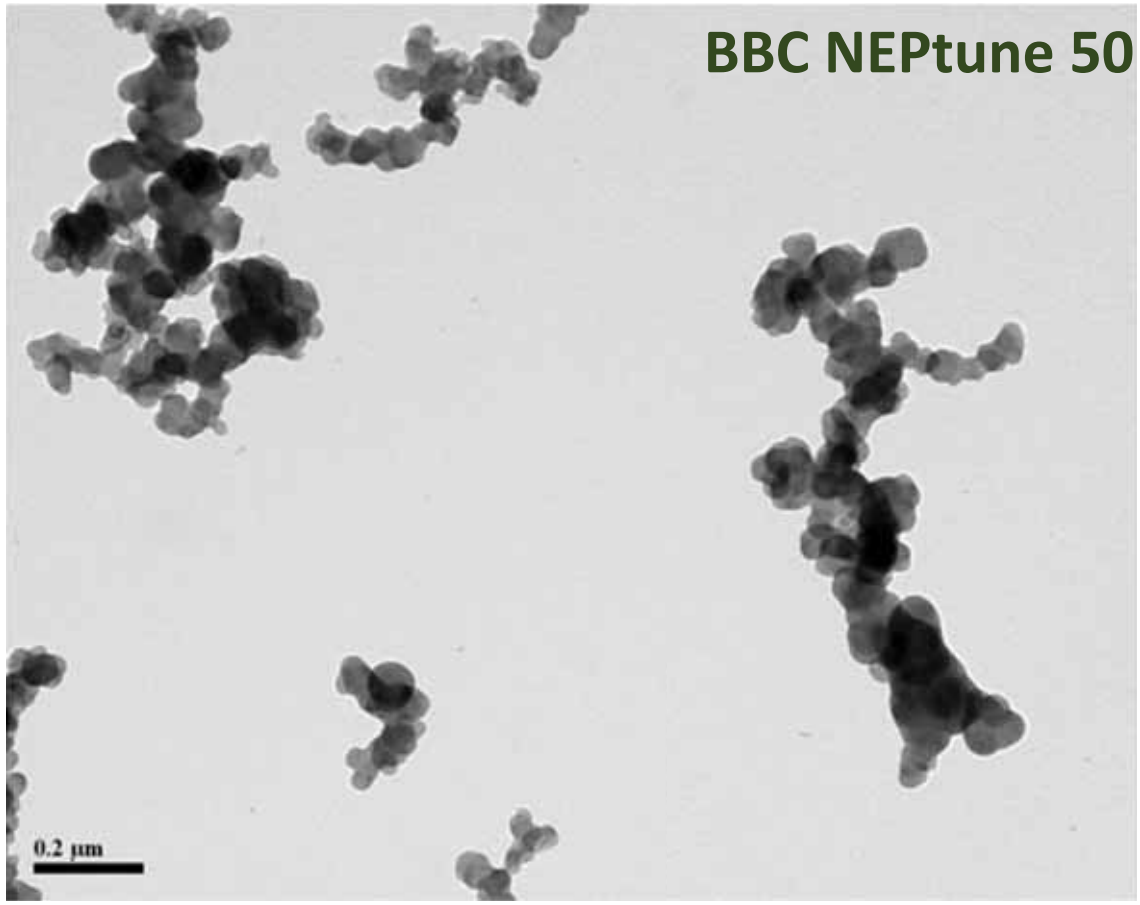
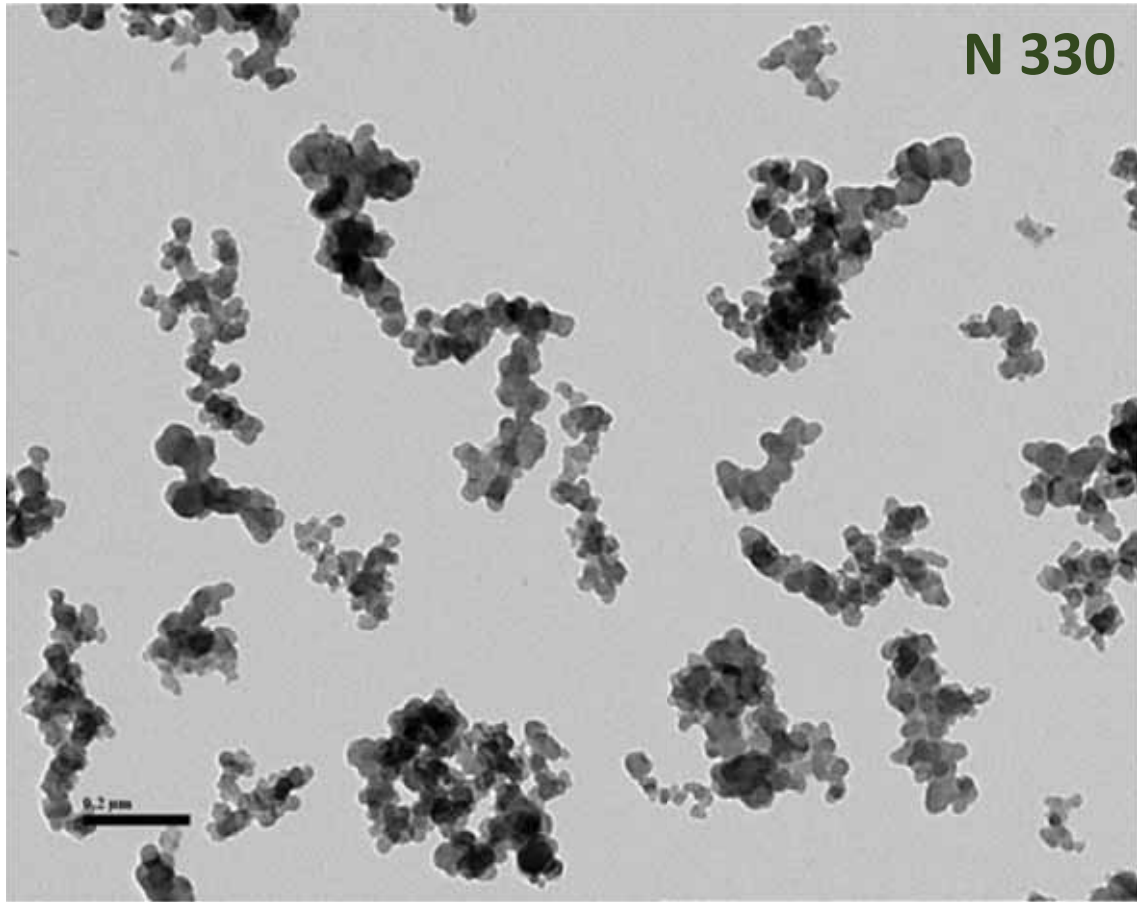
TEM Photo's; Left BBC NEPtune 50, right N 330



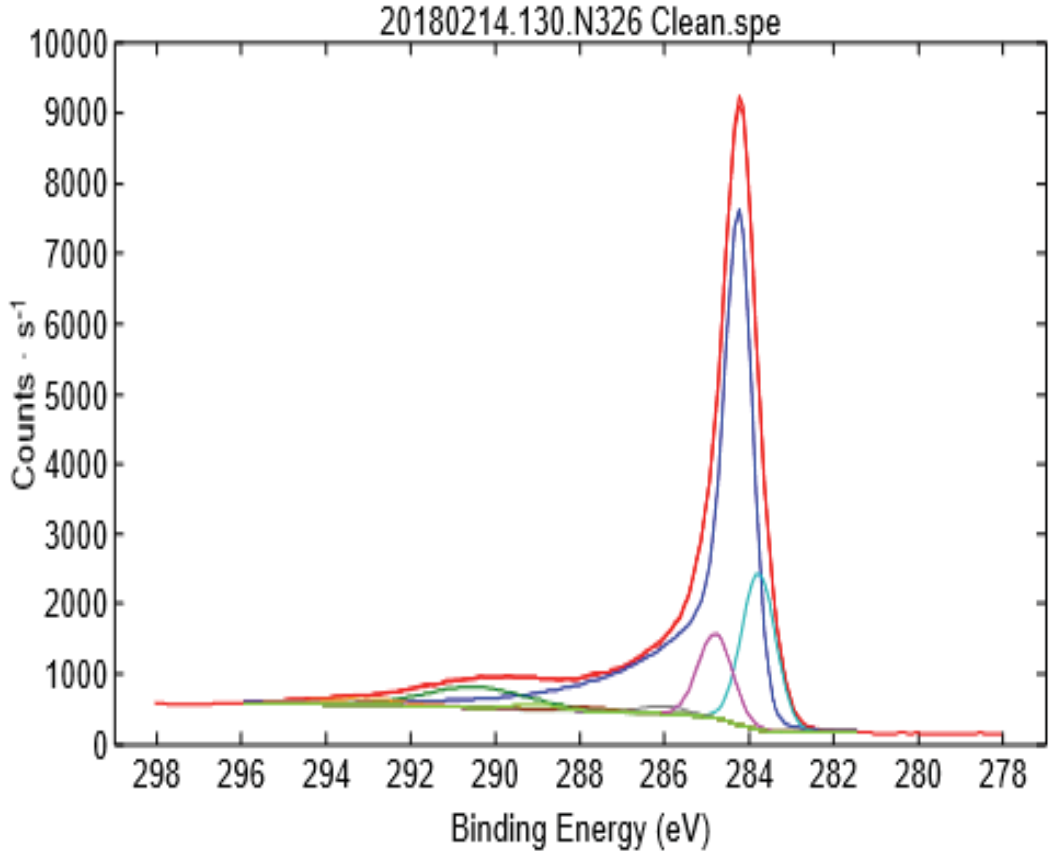


Surface chemistry changes slightly

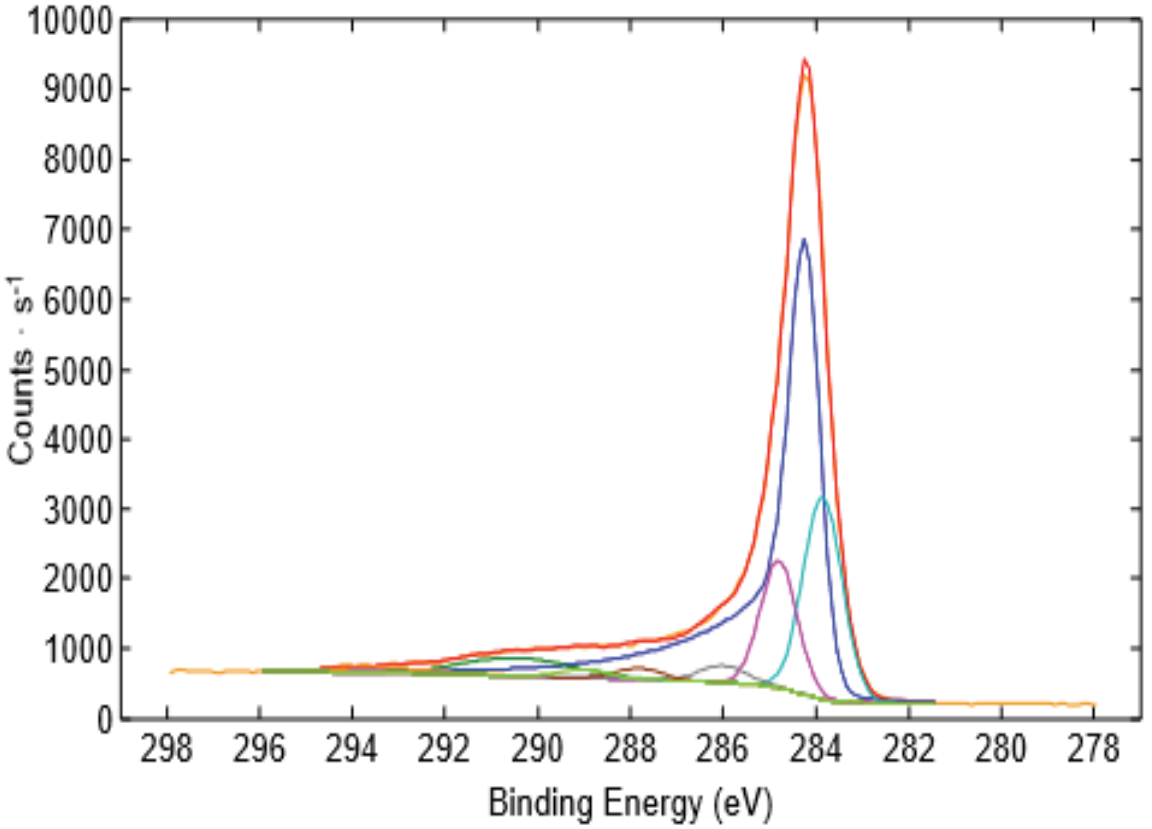
- 2 main reasons:
  - During pyrolysis PAH's are formed and the polymerize to carbonaceous deposits. The higher the temperature and the lower the pressure, the lower amount carbonaceous residue. These PAH's however are driven off of the carbon black surface so rCB is extremely low in PAH's.
  - High kiln temperatures also drive off oxygen groups and thus making the carbon black surface less polar => lower Hansen Solubility Parameter (HSP)

    This is confirmed by the big difference between the BET SA en the I_2 SA

XPS Analysis; divers carbon curves



N 326 clean



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XPS Analysis; carbonaceous residues

Binding energy (eV)	Chemical State	N 326 Ref	N 326 clean	BBC 11/10/17
283.5	Carbides	6	6	6
284.2	Graphite	81	80	76
285.0	C-C, C-H	3	3	10
287.8	C=O, C-S, C-N	<1	0	1_2
288.8	C-O, C=O	1	1	1_2
290.4	π --> π*	7	7	6
293.4	π --> π*	2	2	2

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BET, STSA, I_2 Surface Area and Sieve residue

Test	Units	N326	NEPtune	NEPtune	NEPtune
			30	**50**	**70**
NSA	**m2/g**	76.7	84	86.9	89.3
STSA	**m2/g**	76.7	65.5	67.7	72.3
Iodine Number	**mg/g**	82.5	121	133	124
Tint Strength	**% ITRB**	114	50.3	56.9	62
OAN	**cm3/100g**	70.4	-	84.4	86.9
Transmission	**%**	98.7	99.8	99.5	98.9
Ash (D1506)	**%**	0.3	22.8	15.4	16.7
Sieve Residue					
35 Mesh (500 µm)	**ppm**	3	0	0	0
325 Mesh (45 µm)	**ppm**	188	14	8	4

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Heavy Metals; typical values CONEG/BfR Recommendation IX (multiple measurements)

Test	Units	N326	N660	BBC	BBC	BBC
				HS PCT	LS PCT	TT
Ash Content (LS1-203)	%	0.28	0.25	24.2	16.3	17.4
Food Contact Metals						
Cd	ppm	<0.1	<0.1	1.1	1.5	0.7
Cr	ppm	0.2	0.3	2.3	2.4	1.5
Hg	ppm	<0.1	<0.1	<0.1	<0.1	<0.1
Pb	ppm	1	0.2	34.4	38.8	26.8

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PAH typical values according EU 10/2011 (MAS)

Sample matrix		carbon black dust		
mas sample		18 1356 001		
PAH compound	**Unit**	**Concentration**	**Limit of quantification**	**Test method[d]**
Benzo(a)anthracene	mg/kg	**0,180**	0,01	MAS_PA017
Chrysene	mg/kg	**0,240**	0,01	MAS_PA017
Benzo(b)fluoranthene	mg/kg	**0,0511**	0,01	MAS_PA017
Benzo(j)fluoranthene	mg/kg	**0,0263**	0,01	MAS_PA017
Benzo(k)fluoranthene	mg/kg	**0,0206**	0,01	MAS_PA017
Benzo(e)pyrene	mg/kg	**0,0482**	0,01	MAS_PA017
Benzo(a)pyrene	mg/kg	**0,0351**	0,01	MAS_PA017
Dibenzo(a,h/a,c)anthracene[a]	mg/kg	**nd**	0,01	MAS_PA017
Total of 8 EU-PAHs excl. LOQ[b]	mg/kg	**0,601**		MAS_PA017
Total of 8 EU-PAHs incl. LOQ[c]	mg/kg	**0,611**	0,08	MAS_PA017

nd	PAH compound not detected at levels above the limit of quantification (LOQ) indicated
a	co-eluting PAHs; concentrations and LOQs refer to the total of the co-eluting compounds
b	not detected EU-PAHs were not included in the calculation of the total
c	not detected EU-PAHs were included with their full LOQ in the calculation of the total
d	MAS_PA017:2016-09 accredited according to ISO/IEC 17025:2005

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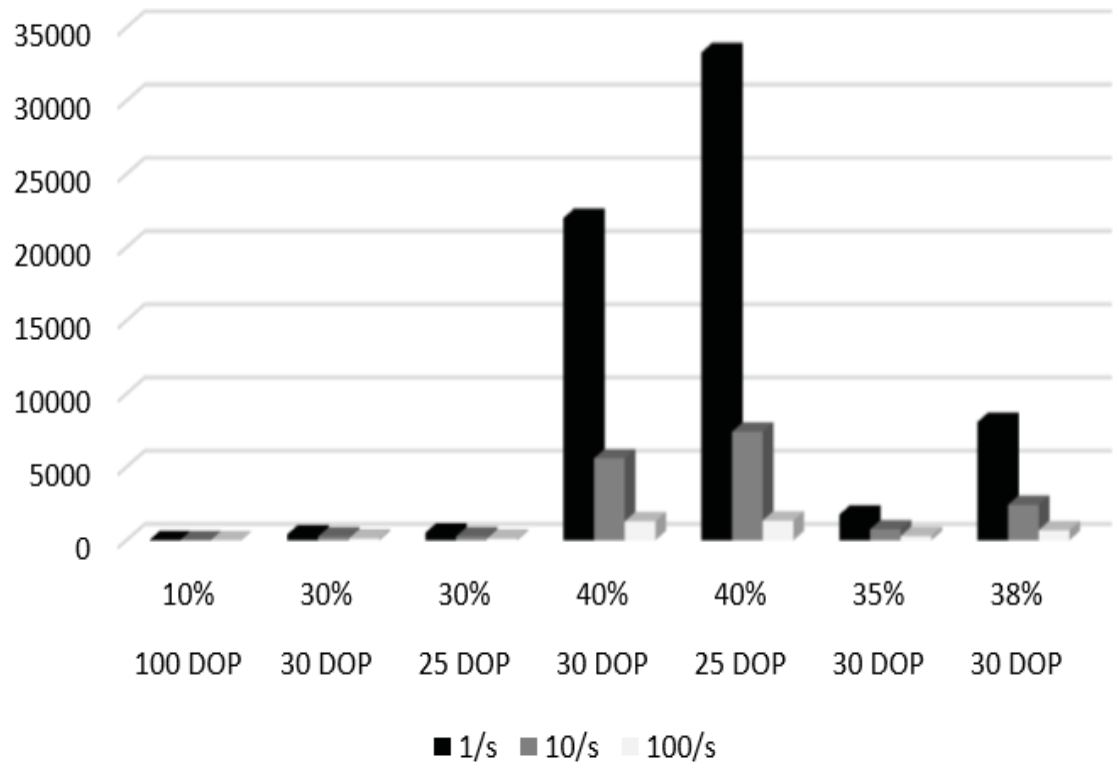
Pigment paste preparations (Borchers)

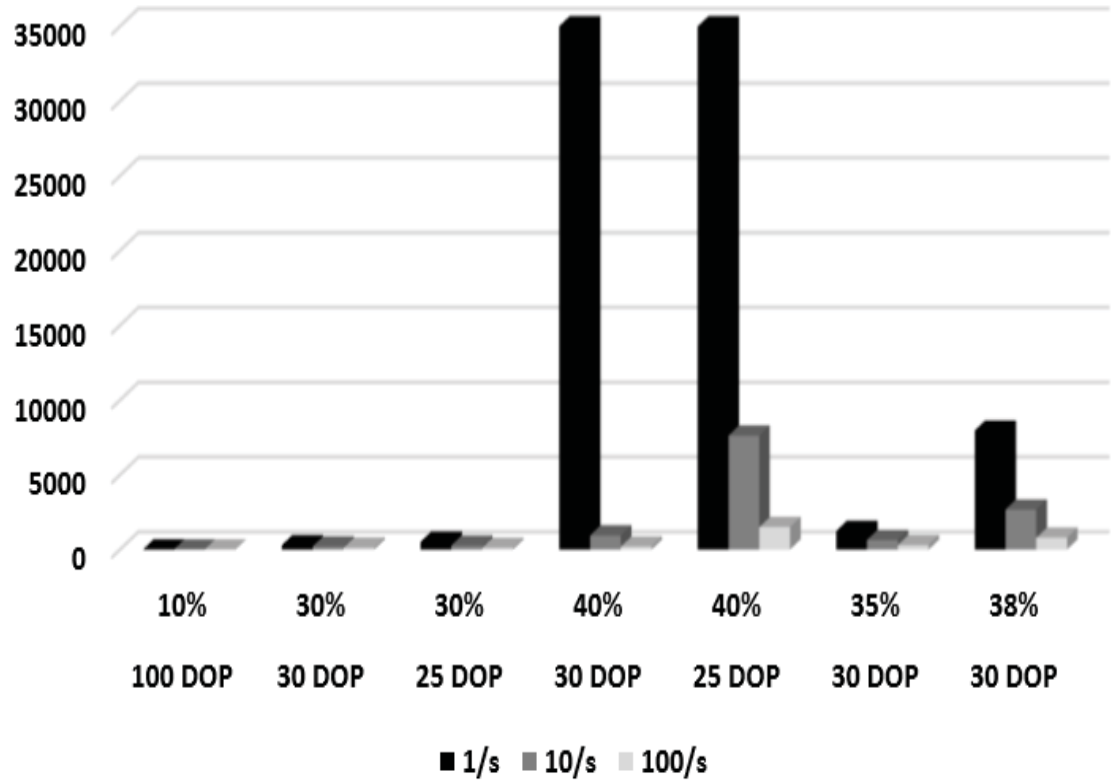
BBC NEPtune 50 & 70

BG 0851 (50%)	20.00	18.00	15.00	24.00	20.00	21.00	22.80
Water	68.75	50.75	53.75	34.75	38.75	42.75	37.95
BG AF 1171	0.25	0.25	0.25	0.25	0.25	0.25	0.25
AMP-95	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Pigment	10.00	30.00	30.00	40.00	40.00	35.00	38.00
	100.00	100.00	100.00	100.00	100.00	100.00	100.00
DOP	***100%***	***30%***	***25%***	***30%***	***25%***	***30%***	***30%***
% pigment	**10%**	**30%**	**30%**	**40%**	**40%**	**35%**	**38%**

Pigment paste Viscosity (Borchers)



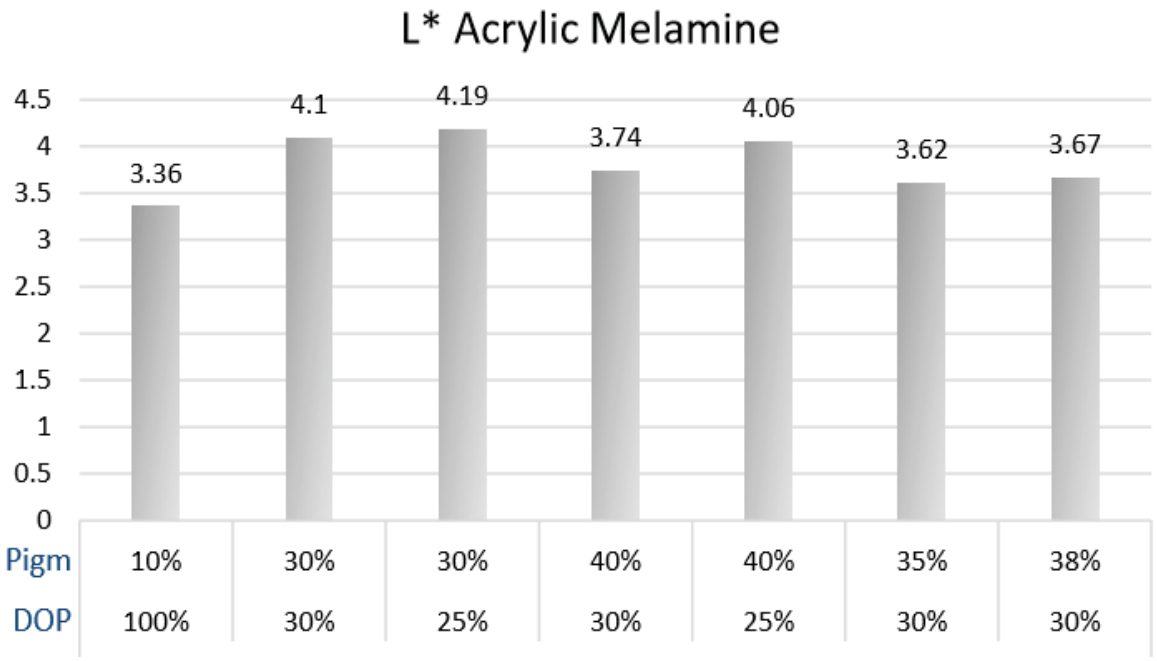
BBC NEPtune 50



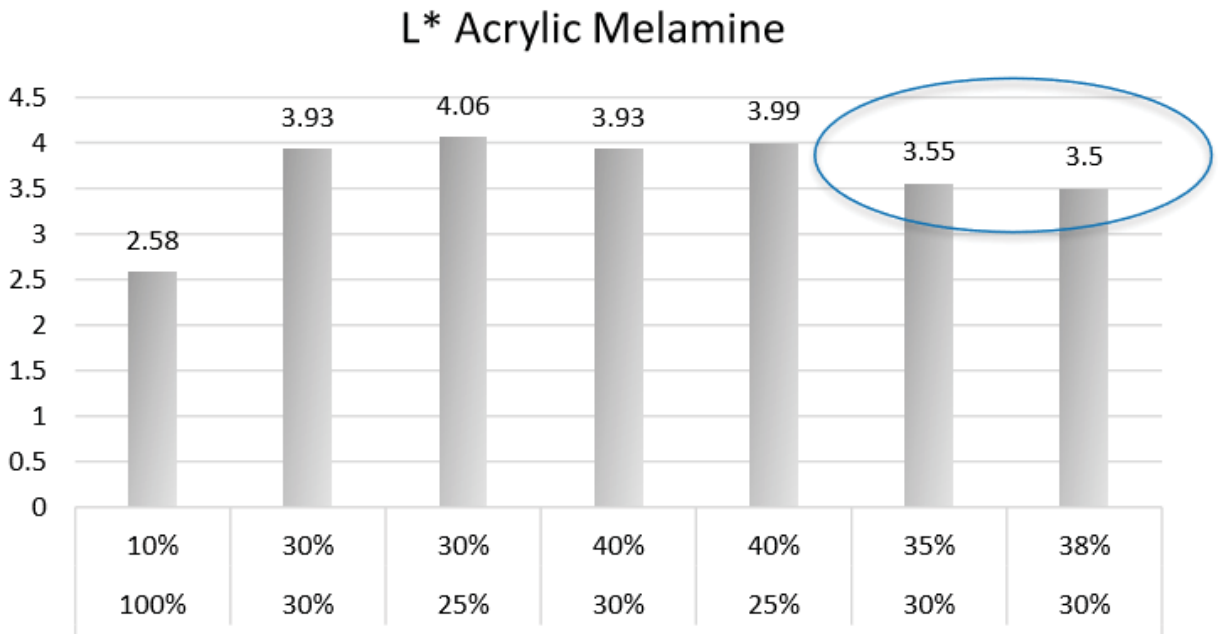
BBC NEPtune 70

L* Values in a WB Acrylic Melamine OEM

(Borchers)



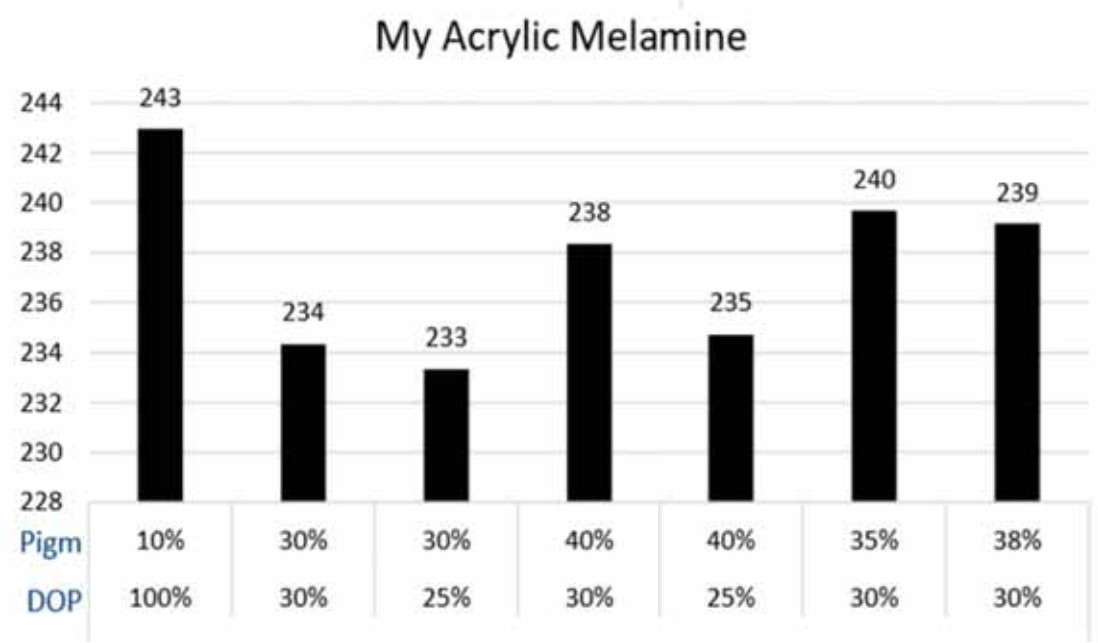
BBC NEPtune 50



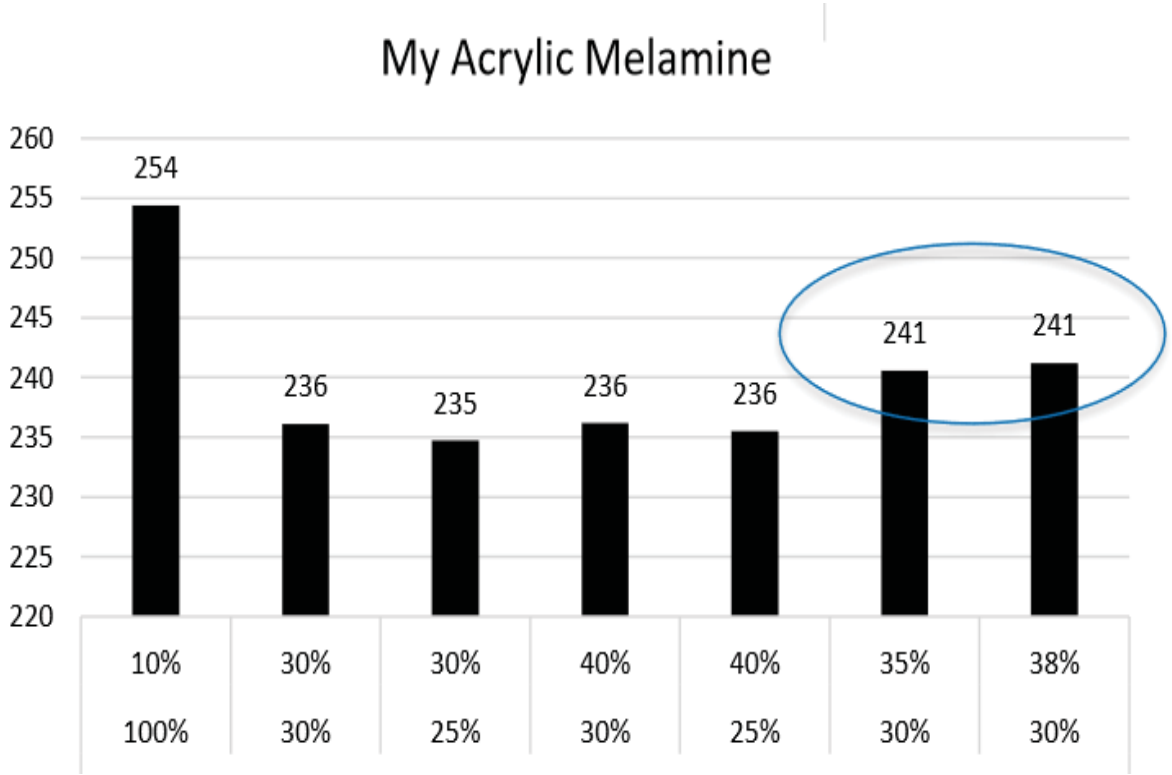
BBC NEPtune 70

My Values in a WB Acrylic Melamine OEM

(Borchers)



BBC NEPtune 50

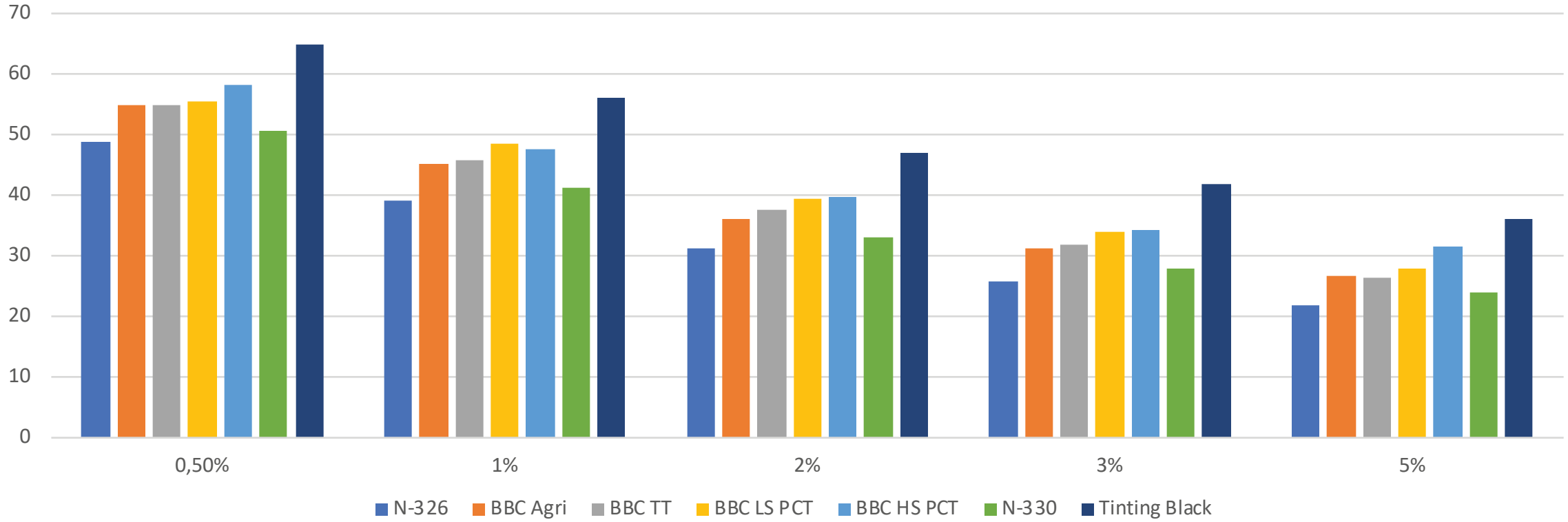


BBC NEPtune 70

Tint Strength in a White WB Acrylic Let Down

(AKZO)

Comparative L values in 1 : 1 replacement
No compensation for non-CB content nor aggregate size distribution



	N-326	BBC Agri	BBC TT	BBC LS PCT	BBC HS PCT	N-330	Tinting Black
BET	114	77	93	86	85	78	29
STSA	106	66	77	69	75	76	28_29
OAN	114	100	83	75	65	72	140
Ash	<1	<7	<17	<17	<35	<1	<1

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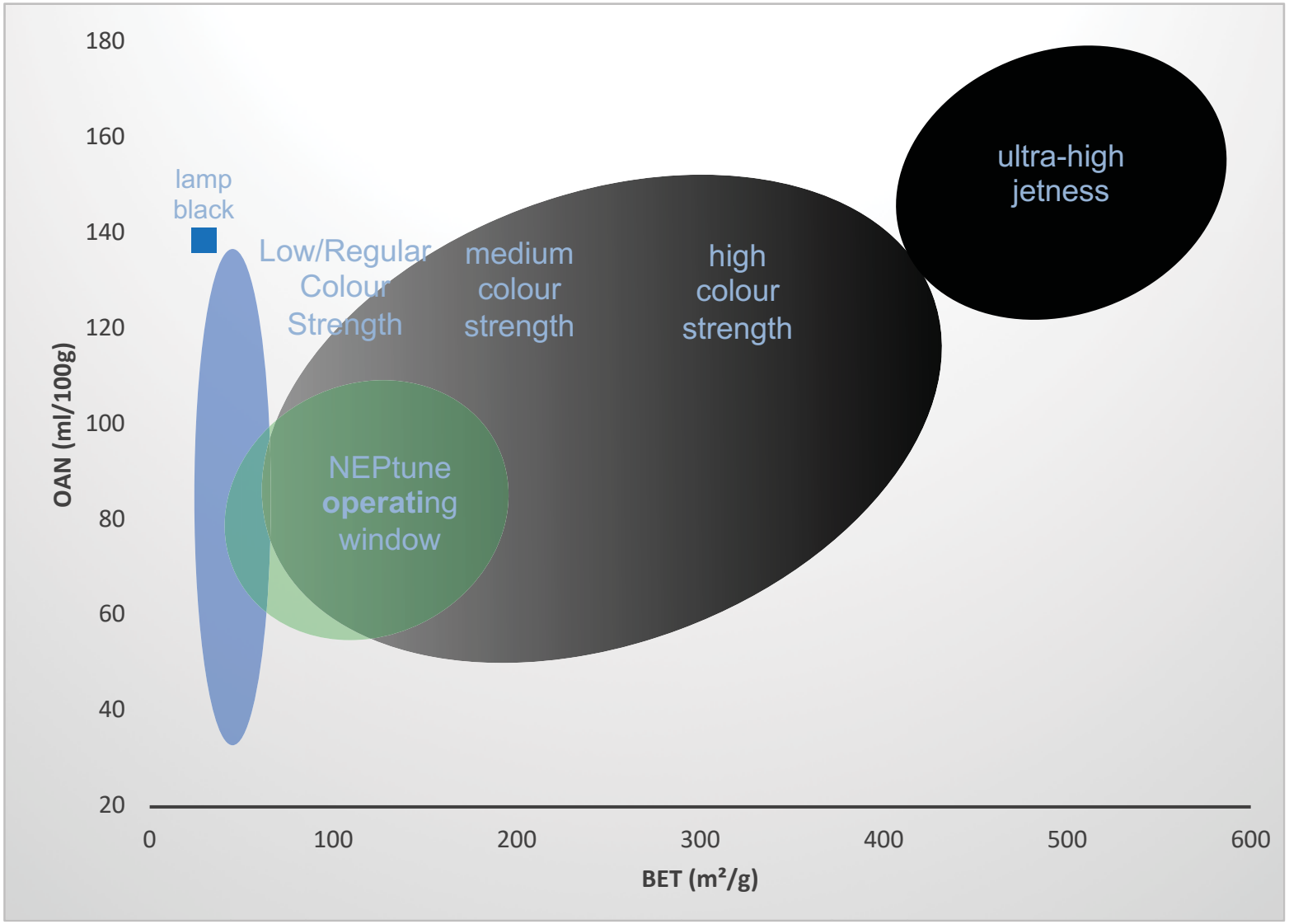
Technical positioning of low PAH/Grit NEPtune grades wrt BET and OAN



Disadvantages of BBC Carbon Black?

- No 1 to 1 exchanges/drop ins; we have a blend of carbon black thus colour and tint strength are different; relatively high ash
- Surface activity is different; need for optimization of the grind varnish
- Wider aggregate size distribution because of the blend: lower tint strength, especially in very low concentrations and/or thin films. Full tone no big issue performs like regular/medium CFB
- As we mill the silica down to (significant) smaller sizes no effects on gloss nor too much on viscosity
- Our carbon blacks are NOT conductive because of High Ash (ZnS sticks to the surface) & Carbonaceous Deposits
- Ongoing research & developments to change/modify surface activity and make them free (or low) in inorganics
- Especially the Agricultural tires would be easy to make low ash as main component, ZnS, can be washed out with a (mild) acid

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Why you should buy BBC Carbon Black?

1. It is a green technology: it reduces your CO2 output significantly, gets ride of stockpiles of old tires and converts them into valuable carbon black, oil and gas.
2. It is a clean product: our process gets ride of the original grit present in Rubber Blacks and is low in PAH's. Compliant with EU 10/2011 regulations, CONEG and REACh (exempted)
3. It is a consistent process: delivers very consistent products that allows you to reduce (QC) cost and improve your through put
4. We do not have to be more expensive compared to the original carbon blacks you are currently using
5. Special preparation techniques; no crystalline silica!

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