Tire Applications of Thermax®

May 1st, 2020

AGENDA

- Overview of Thermax® N990
- Thermax in Inner Liners
- Thermax in Bead Insulation
- Thermax in Curing Bladders

WHAT IS THERMAX®?

- Medium thermal carbon black, ASTM grade N990
- Produced by thermal decomposition of methane molecule (CH_4)
- The largest particle size (280 nm average diameter) carbon black
- The lowest structure carbon black

THERMAX® VS FURNACE BLACK GRADES

Particle size diameter

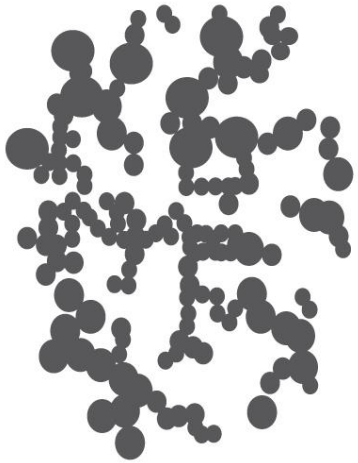
N110
(15 nm)

N762
(80 nm)

N990
(280 nm)

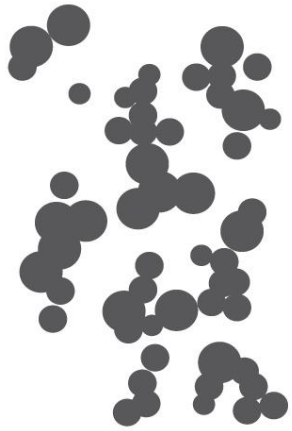
THERMAX® VS FURNACE BLACK GRADES

High Structure



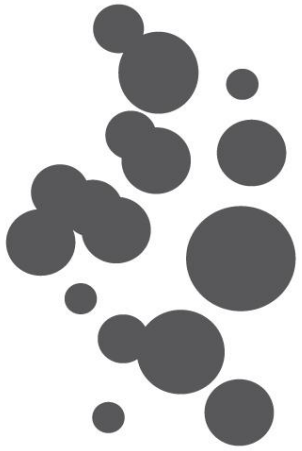
N550

Moderate Structure



N762

Low Structure



N990

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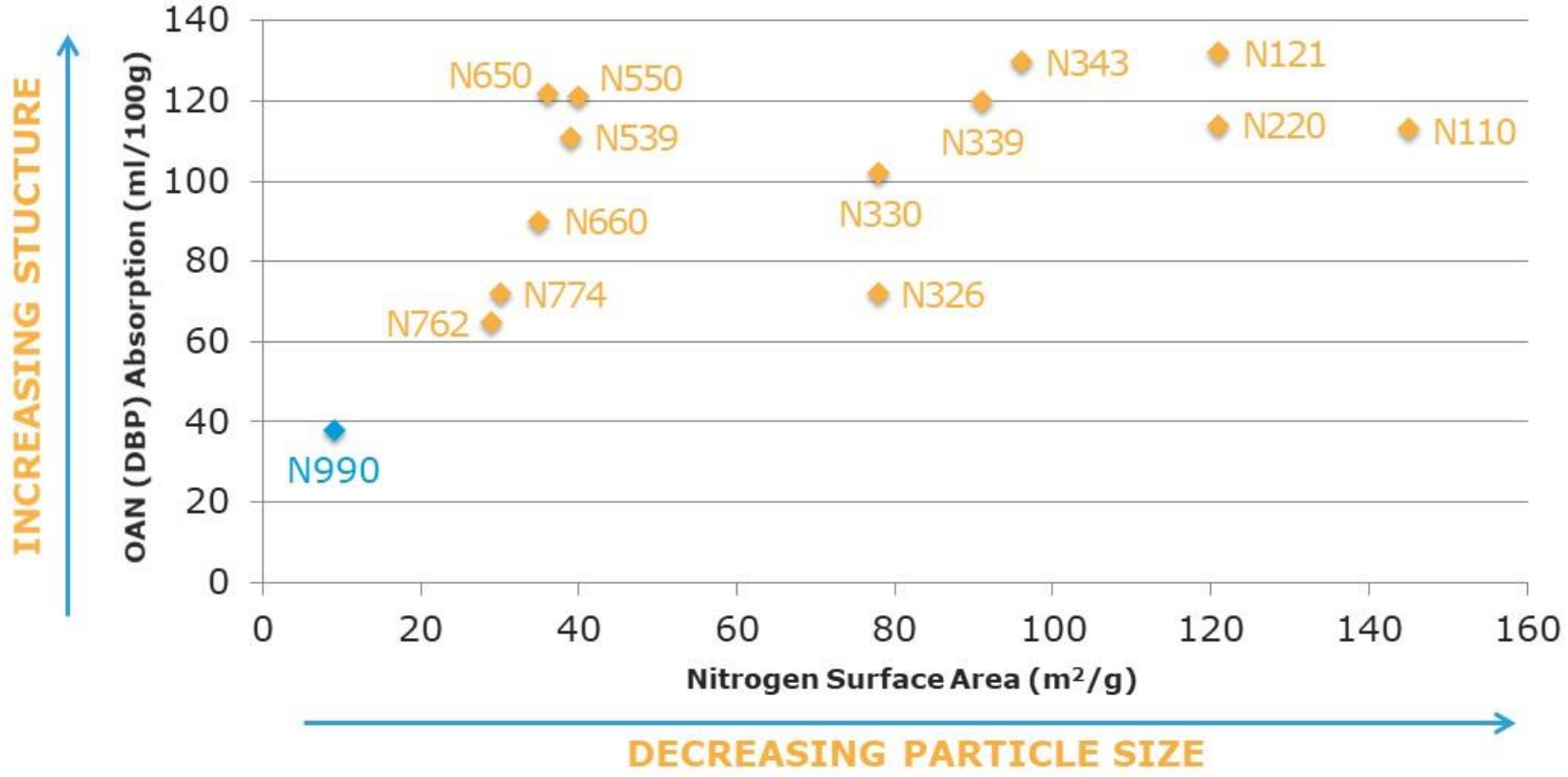
THE CARBON BLACK SPECTRUM



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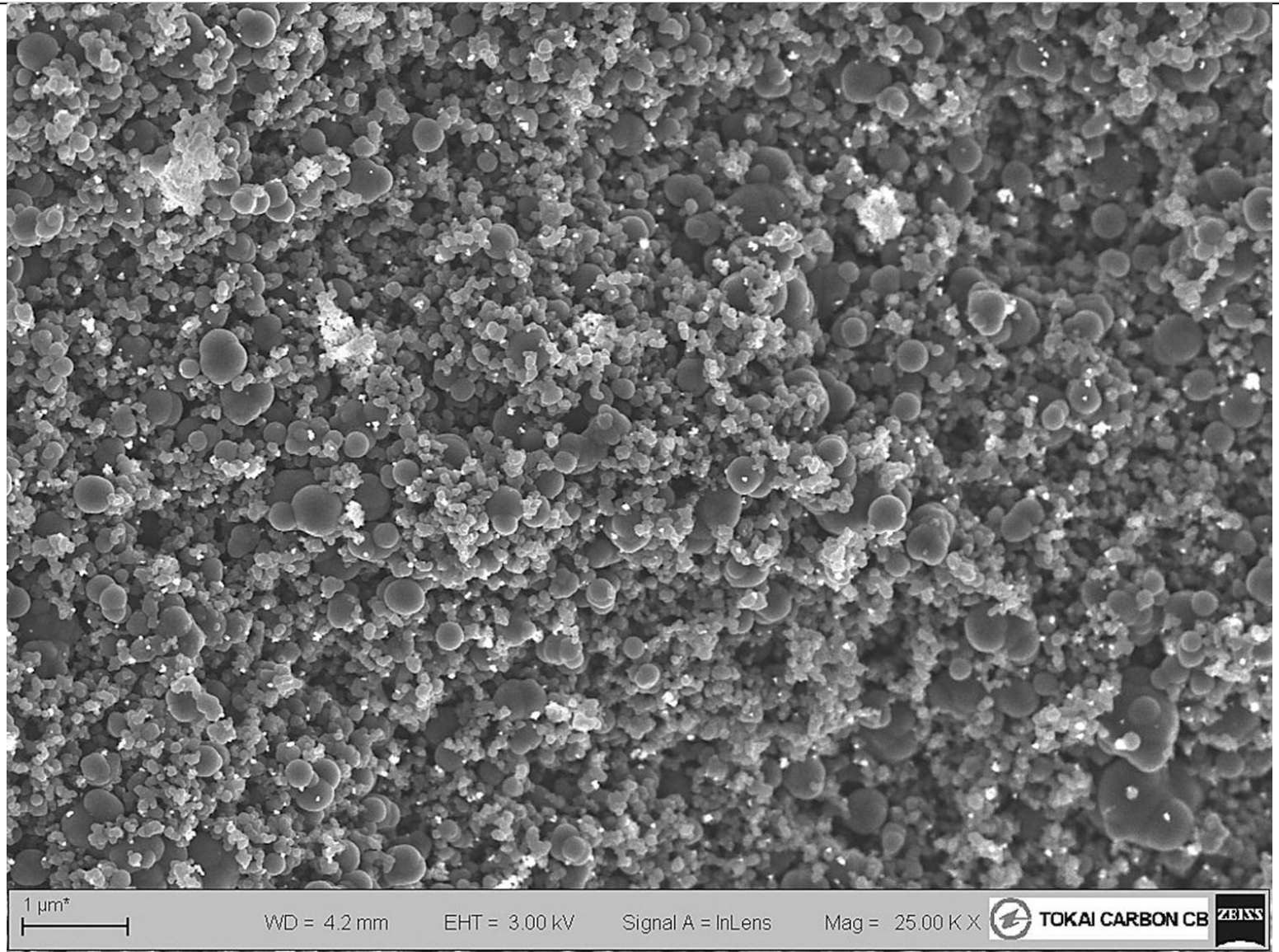
SEM N660/N990



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THERMAX® IN TIRE PRODUCTION

Inner Liner

Valve Stem and Valve Stem Pad

Bead Wire

Curing Bladder

THERMAX® IN TIRE INNER LINERS

Thermax can be blended with furnace carbon black to improve halobutyl (BIIR, CIIR) tire inner liners

High loading ability in halobutyl inner liners, compared to using only furnace grades:

- Reduces permeability
- Lowers compound cost

Additional benefits include:

- Possibility to reduce the inner liner gauge for both cost and weight savings
- Improved adhesion to the carcass

THERMAX® IN TIRE INNER LINERS

Thermax is impermeable to gases

- Load at the highest level possible to reduce the volume of the more permeable halobutyl polymer
- Improved impermeability can allow for a thinner inner liner, lowering the tire weight

Thermax is less expensive than halobutyl polymer

- Noticeable cost savings can be achieved by replacing the costly halobutyl polymer with the relatively inexpensive Thermax

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THERMAX® INNER LINER COST SAVINGS

	Traditional Formulation		Thermax® Formulation		
Inner Liner Recipe	**Parts by Weight**	**Parts by Volume**	**Parts by Weight**	**Parts by Volume**	**Specific Gravity**
Bromobutyl 2222	60	64.5	60	64.5	0.93
Natural Rubber (TSR20)	40	44.0	40	44.0	0.91
N660 Carbon Black	60	33.3	30	16.7	1.80
Thermax® N990	0.0	0.0	57	31.7	1.80
Naphthenic Oil	8.0	8.6	8.0	8.6	0.93
Escorez 5600	3.0	3.1	3.0	3.1	0.97
SP1068 Tackifying Resin	4.0	3.9	4.0	3.9	1.02
Stearic Acid	1.0	1.2	1.0	1.2	0.84
MBTS	1.3	0.86	1.3	0.86	1.51
Zinc Oxide	3.0	0.54	3.0	0.54	5.60
Sulfur	0.5	0.24	0.5	0.24	2.07
Totals	**180.8**	**160.25**	**207.8**	**175.25**	
Specific Gravity (calculated)	**1.13**		**1.19**		
Compound Cost					**Cost Savings**
USD/kg	**2.24**		**2.13**		**0.11**
USD/lb	**1.02**		**0.97**		**0.05**

THERMAX® INNER LINER COST SAVINGS

14” Passenger Tire	Traditional Formulation	Thermax® Formulation
Inner Liner Gauge (mils)	45	38
Inner Liner Weight (kg)	0.76	0.67
Inner Liner Cost (USD)	1.70	1.44
Savings per Tire (USD)	0.26	

Heavy Truck Tire	Traditional Formulation	Thermax® Formulation
Inner Liner Gauge (mils)	80	67
Inner Liner Weight (kg)	2.02	1.78
Inner Liner Cost (USD)	4.53	3.80
Savings per Tire (USD)	0.73	

INGREDIENT COST ASSUMPTIONS

	USD/kg	USD/lb
Bromobutyl 2222	$3.85	$1.75
SMR 20 Natural Rubber	$1.65	$0.75
N660 Black	$1.00	$0.45
Thermax® N990	$1.20	$0.54
Naphthenic Oil	$1.75	$0.79
Escorez 5600	$3.50	$1.59
SP1068 Tackifying Resin	$3.17	$1.44
Stearic Acid	$1.10	$0.50
MBTS	$3.09	$1.40
Zinc Oxide	$1.75	$0.79
Sulfur	$0.85	$0.39

THERMAX® IN BEAD WIRE COMPOUND

- Improvement in dispersion and decrease in total mixing energy
- Reduction in compound viscosity
- Decrease in dynamic heat build up and compression set
- Improvement in adhesion to bead wire

THERMAX® IN TIRE CURE BLADDERS

Cure bladder compounds must:

- Process easily and mold well
- Have good physical properties and ageing resistance
- Exhibit high flex and tear resistance
- Have low tension set
- Show excellent steam ageing properties
- Have good thermal conductivity

THERMAX® IN TIRE CURE BLADDERS

- Can reduce compound cost through high loading levels
- Reduction in compound viscosity
- High loading provides enhanced thermal conductivity via higher carbon content, for faster tire curing
- Improved heat and steam ageing properties provide for longer lasting bladders

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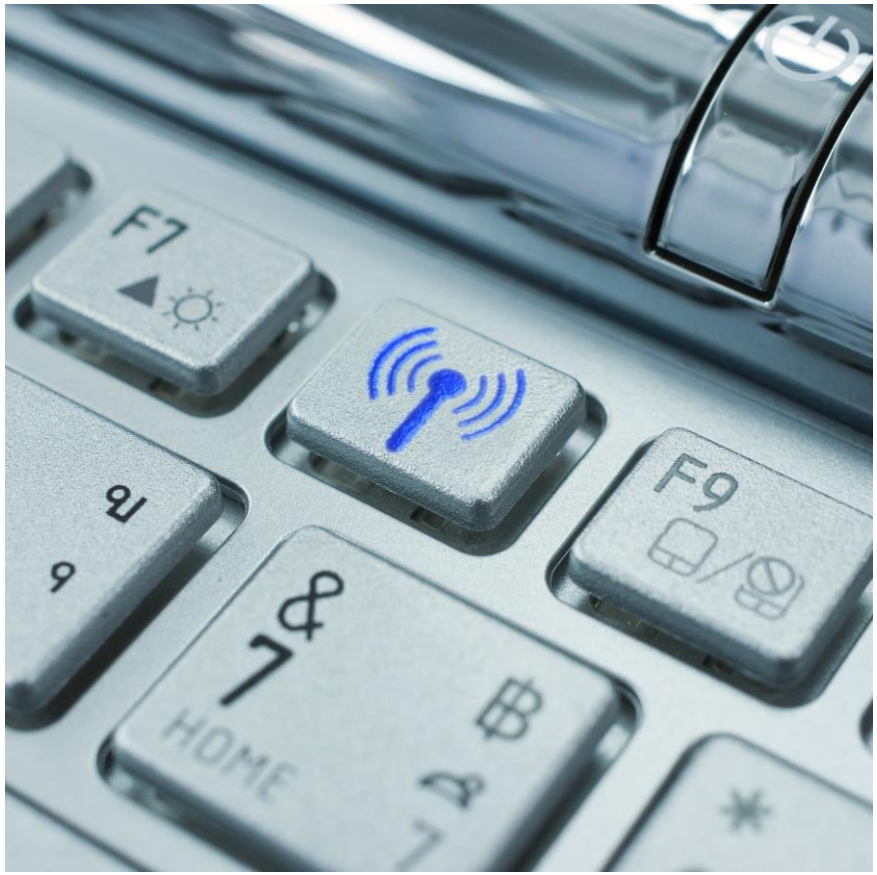

For further information on the Thermax® advantage in Tire Applications please visit:

www.cancarb.com