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WESTERN AUSTRALIAN ROAD RESEARCH
AND INNOVATION PROGRAM

Development of Crumb Rubber Modified Binder Asphalts in WA

AN INITIATIVE BY:



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Rosemary Pattison

Webinar Moderator



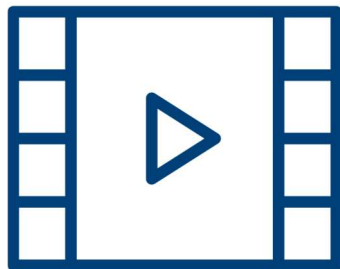
Professional

- Knowledge Hub - ARRB Group
- P: +61 3 9881 1590
- E: training@arrb.com.au

Housekeeping



- Webinar is **60 mins**
- inc. question time of **15 mins**



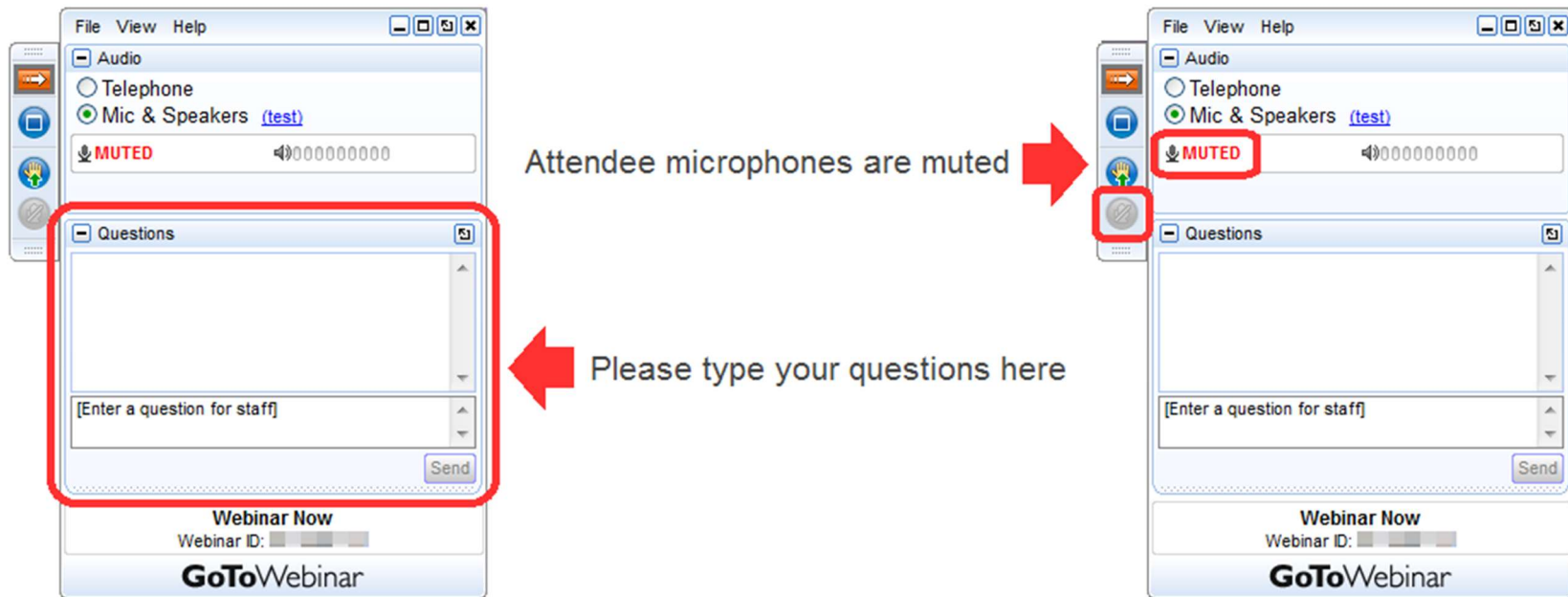
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Today's Presenters

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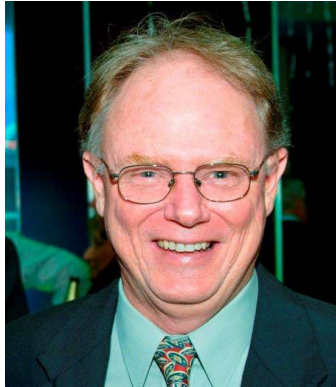


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Steve Halligan is the Bituminous Products Consultant and is based at the Main Roads Engineering Branch. Steve provides expertise in the surfacing discipline including bituminous material, spray seals, asphalt, road marking material and properties of road surfaces. He has over 40 years' experience in materials engineering and road construction.



Steven Middleton has been with ARRB for 6 months, is a qualified Civil Engineer and holds a Masters of Pavement Technology with 9 years' experience in the pavements engineering field.

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Identify innovative practices and guide implementation to deliver superior technology and cost savings in road infrastructure

A collaborative research agreement between Main Roads WA and ARRB





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Open Graded Asphalt (OGA)

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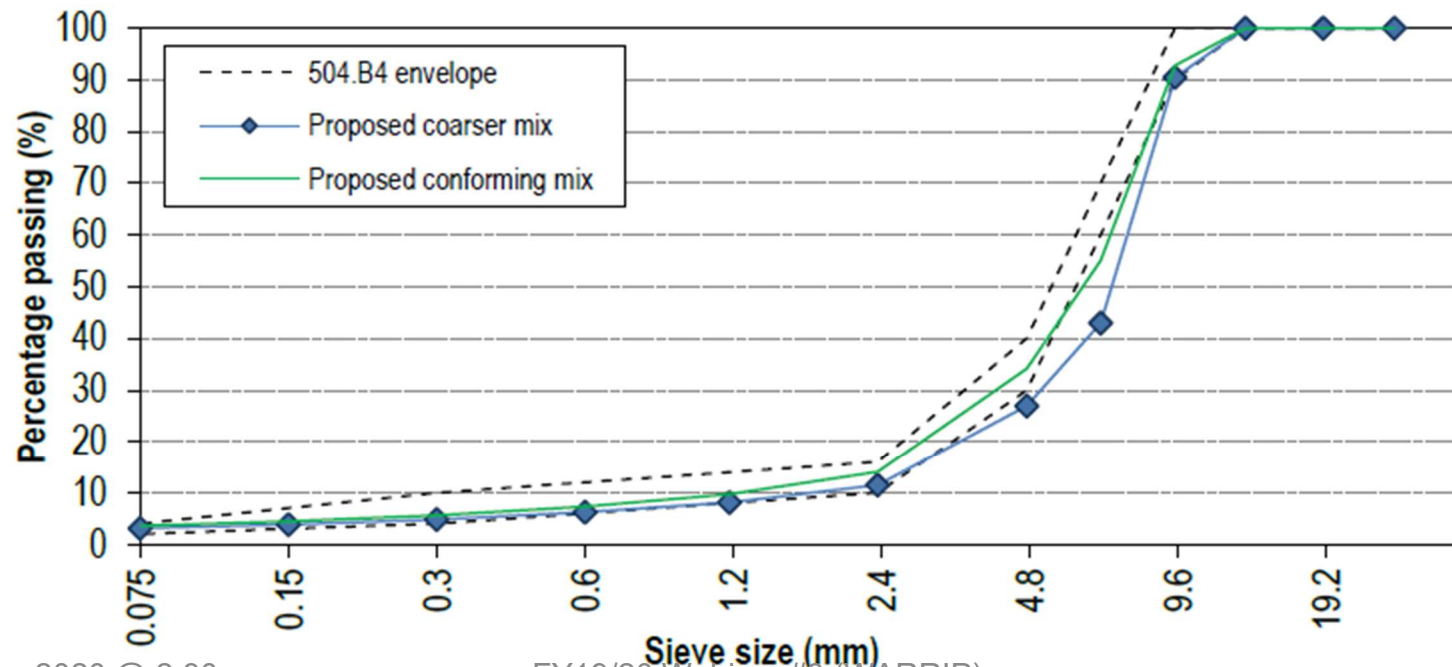


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Design of Open Graded Asphalt (OGA)

- Marshall design
- Coarser grading developed – Increase binder content



OGA Construction Trial

- 3 mixes trailed
 - Standard Grading 4.5% A20E
 - Standard grading 5.0 & 5.5% CRM binder
 - Coarser grading 5.0 & 5.5% CRM binder

SHLD	R2	R1	SLK	L1	L2	SHLD	SLK
				18/03/2019 BC 5.0%	17/03/2019 BC 5.5%		25.88
							25.46
			22.96				
	25/03/2019	24/03/2019					23.11
			22.96				
			22.70				
	20/03/2019 BC 5.0%	21/03/2019 BC 5.5%					22.54

Legend:

	Standard OGA + CRM
	Standard OGA + A20E
	Alternative PSD OGA + CRM

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OGA Benefits

- Increased binder content
- Next Steps



18 June 2020 @ 2:30pm

FY19/20 Webinar #3 (WARRIP)

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Gap Graded Asphalt (GGA)

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Crumb Rubber Modified (CRM) Gap Graded Asphalt (GGA)

- What is CRM GGA
- Benefits
- Aims of Project



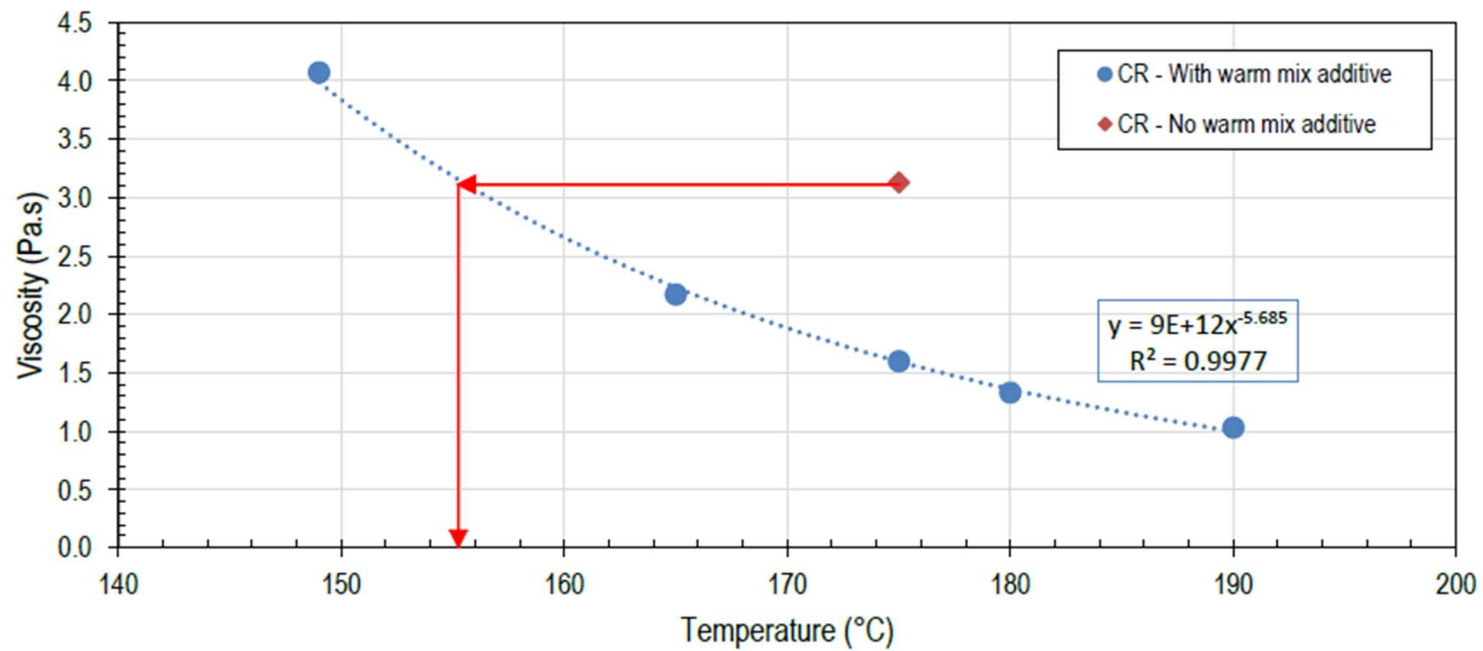
Design of CRM binder

Property	Test Method	Digestion Time				
		60min	120 min	240min	11 hrs	Maximum (Note 1)
Penetration at 4°C, 200g, 60s , pu (minimum)	AS 2341.12	15	-	15	15	15
Resilience at 25°C, % rebound (minimum)	ASTM D5329	20	-	20	20	20
Consistency 6% at 60°C	AGPT/T121	Report	-	Report	Report	
Torsional Recovery at 25°C, 30s , %	AGPT/T122	Report	-	Report	Report	Report
Softening Point, °C (minimum)	AGPT/T131	55	-	55	55	55
Viscosity at 175°C	ASTM D7411/D7741M (Note 2)	1.5 – 4.0				
	AGPT:T111 (Note 2)	Report				

Binder profile (18% CR)

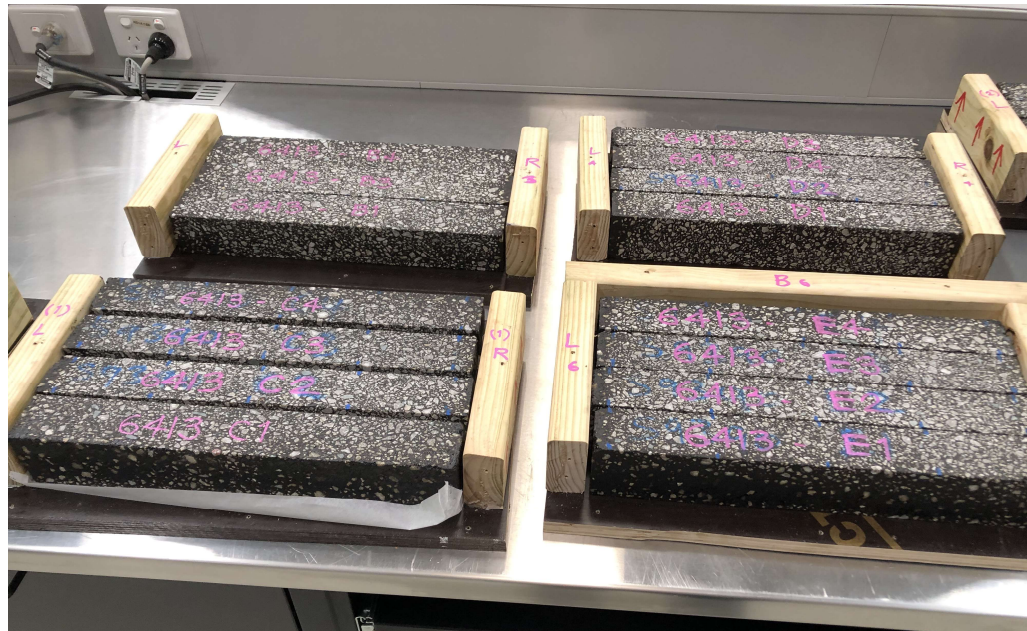
Property	Test Method	Digestion Time					Limits
		60min	120 min	240min	11 hrs	24 hours	
Penetration at 4°C, 200g, 60s , pu	AS 2341.12	24	-	24	23	22	Minimum 15
Penetration at 25 °C, 100 g, 5 s, pu	AS 2341.12	42	-	41	44	43	Not required
Resilience at 25°C, % rebound	ASTM D5329	31	-	39	Not tested	30	Minimum 20
Consistency 6% at 60°C (Pa.s)	AGPT/T121	2284	-	2162	1697	2162	Report
Torsional Recovery at 25°C, 30s , %	AGPT/T122	50	-	51.9	53.9	48.1	Report
Softening Point, °C	AGPT/T131	67	-	67	69	69	Minimum 55
Viscosity at 175°C	ASTM D7411/D7741M (Note 2)	1.6	1.7	2	1.9	1.9	1.5 – 4.0
	AGPT:T111 (Note 2)	2.83	2	1.63	1.99	2.95	Report

Use of warm mix additive



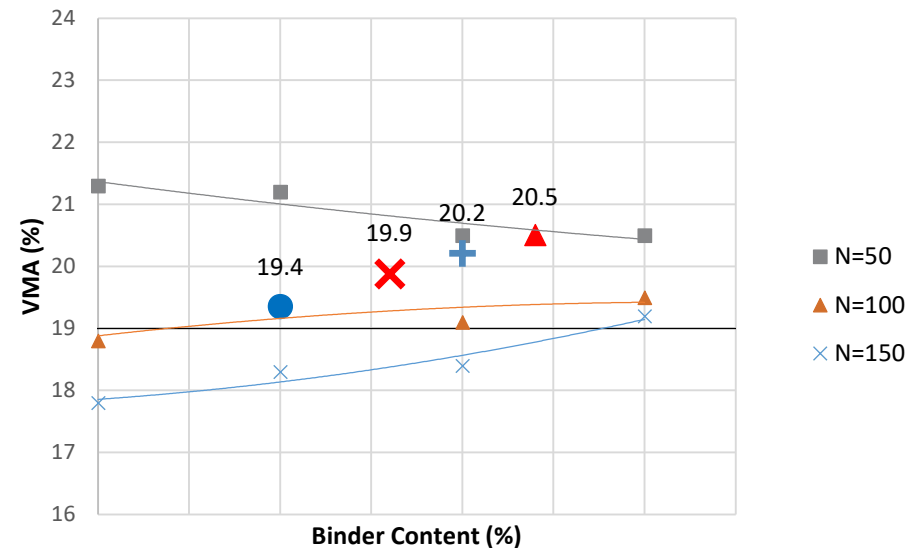
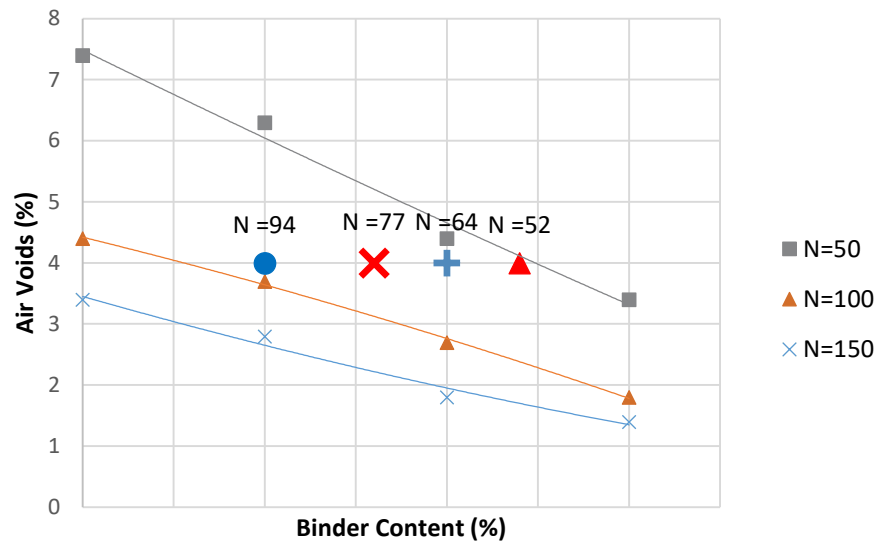
Design of Gap Graded Asphalt (GGA)

- Based on Superpave Mix Design method
 - Air voids at design gyrations (N) = 4.0%
 - VMA 18.0 – 23.0% for 14mm and 19.0 – 23.0% for 10mm
 - Binder content 7.5 – 8.5%.



Design of Gap Graded Asphalt (GGA)

- Volumetrics determined at:
 - 50, 100 & 150 gyrations
 - 4 Binder contents

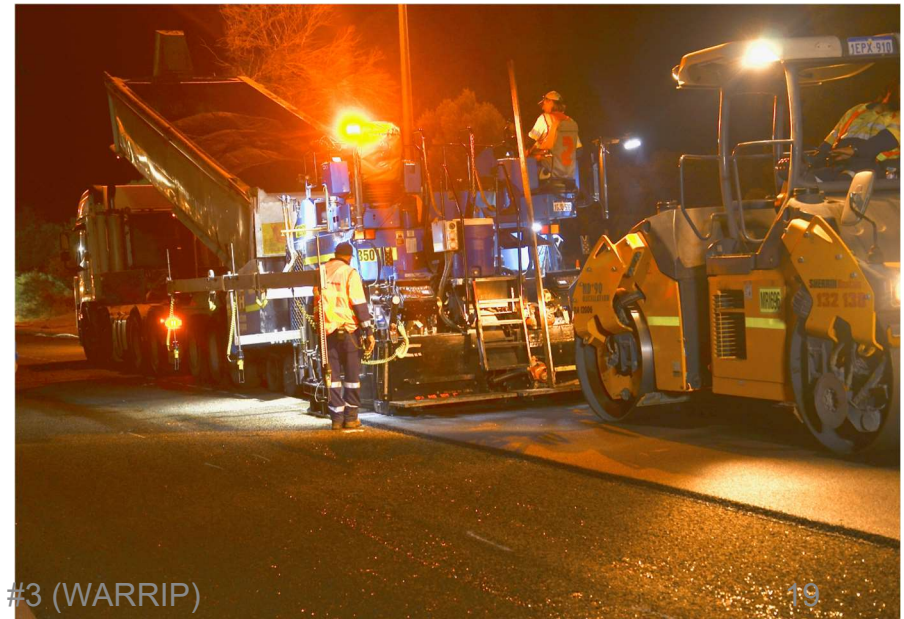


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Construction Trial

- Placement of 14 mm and 10 mm CRM GGA mixes on Marmion Avenue



Production Temperatures

	15 December 2019 (14 mm)		16 December 2019 (10 mm)		17 December 2019 (10 mm)		Requirement
	Temperature	Time	Temperature	Time	Temperature	Time	
Truck 1	155.8 °C	-	156.8 °C	12:21 am	Not Recorded	-	Maximum 165 °C
Truck 2	156.0 °C	-	159.0 °C	12:35 am	156.2 °C	12:20 am	
Truck 3	155.9 °C	-	156.6 °C	12:45 am	158.0 °C	12:35 am	
Truck 4	156.1 °C	-	157.0 °C	12:55 am	156.3 °C	12:45 am	
Truck 5	156.3 °C	-	159.8 °C	1:01 am	159.8 °C	1:00 am	
Truck 6	156.1 °C	-	160.2 °C	1:13 am	151.9 °C	1:10 am	
Truck 7	Not Recorded	-	155.0 °C	1:44 am	155.2 °C	2:15 am	
Truck 8	156.4 °C	-			155.4 °C	2:45 am	
Truck 9	158.4 °C	-					
Truck 10	161.4 °C	-					
Truck 11	146.1 °C	-					
Range 18 June 2020 @ 2:30pm	146.1 – 161.4 °C		155.0 - 160.2 °C		151.9 - 159.8 °C		20

Compaction

	15 December 2019 (14 mm)	16 December 2019 (10 mm)	17 December 2019 (10 mm)	Requirement
Mean Air Voids (%)	5.4	7.3	6.4	-
Standard deviation of Air Voids	1.8	1.5	1.9	-
Upper characteristic Air voids (%)	6.8	8.4	7.8	Less than 8%
Lower characteristic air voids (%)	4.1	6.2	5.0	Greater than 3%

Emissions Monitoring

- Examination of OGA, GGA, A15E and C320



Emissions personnel

	Inhalable dust ($\mu\text{g}/\text{m}^3$)			Reportable VOCs (m and p Xylenes) ² ($\mu\text{g}/\text{m}^3$)			Reportable PAHs (Naphthalene) ($\mu\text{g}/\text{m}^3$)		
	Paver Driver	Truck Controller	Screed hand	Paver Driver	Truck Controller	Screed hand	Paver Driver	Truck Controller	Screed hand
10 mm CRM OGA	280	240	350	104	167	93	1.9	1.3	1.3
10 mm CRM GGA	210	280	110	153	-	-	2.8	1.4	-
14 mm A14E	290	350	790	-	-	-	1.9	-	-
14 mm C320	320	450	380	-	-	-	2.1	1.3	1.7
Limit ¹	10 000			350 000			52 000		

1. TWA exposure standard for pure compound detailed in NOHSC:1003 (1995)

2. 1,2,4 Trimethylbenzene also detected for OGA see report for further details

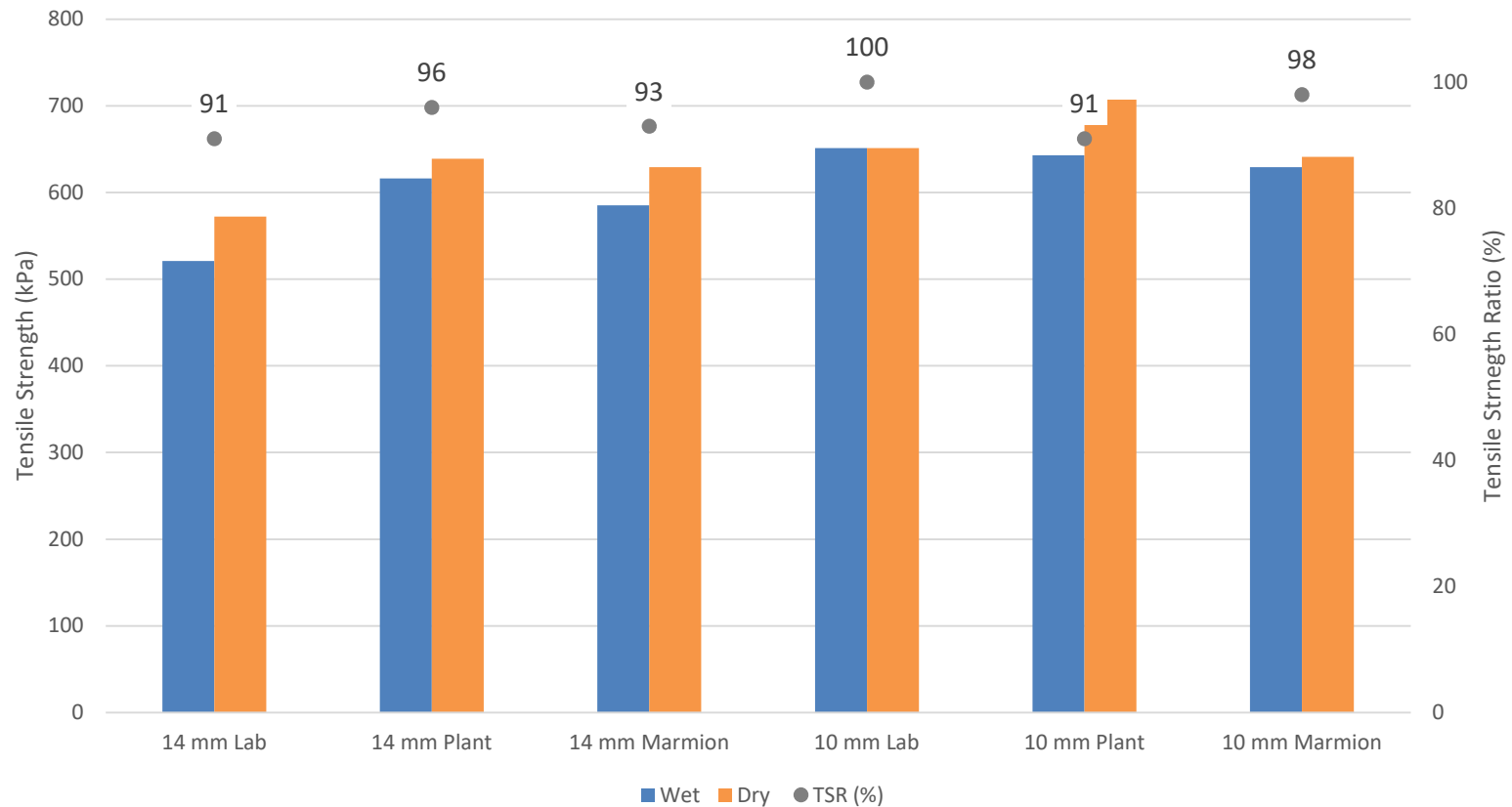
Emissions ambient monitor

Compound	TWA Exposure standard ⁽¹⁾ (µg/m ³)	10 mm CRM OGA	10 mm CRM GGA	14 mm A14E	14 mm C320
		measured concentration (µg/m ³)	measured concentration (µg/m ³)	measured concentration (µg/m ³)	measured concentration (µg/m ³)
Inhalable dust	10 000	90	720	110	360
Dichlorodifluoromethane	4 950 000	5.8		9	19
Acetone	1 185 000	5.8	9	2.6	76
Ethanol	1 880 000	3.2	4.9		
Heptane	1 640 000	7.8			7.9
Toluene	377 000	16			
Ethylbenzene	434 000	13			
m & p-Xylenes	350 000	66			
o-Xylene	350 000	27			
4-Ethyltoluene		8			
1,3,5-Trimethylbenzene		18			
1,2,4-Trimethylbenzene		43			
Carbon disulfide	31 000		3.5	2.2	4
2-Butanone (MEK)	445 000		1.7		220
2-Propanol	983 000				65
Ethyl Acetate	1 440 000				
TPH>C8-C10		150			
TPH>10-C12		55			
Naphthalene	52 000	1.9			

1. TWA exposure standard for pure compound detailed in NOHSC:1003 (1995)

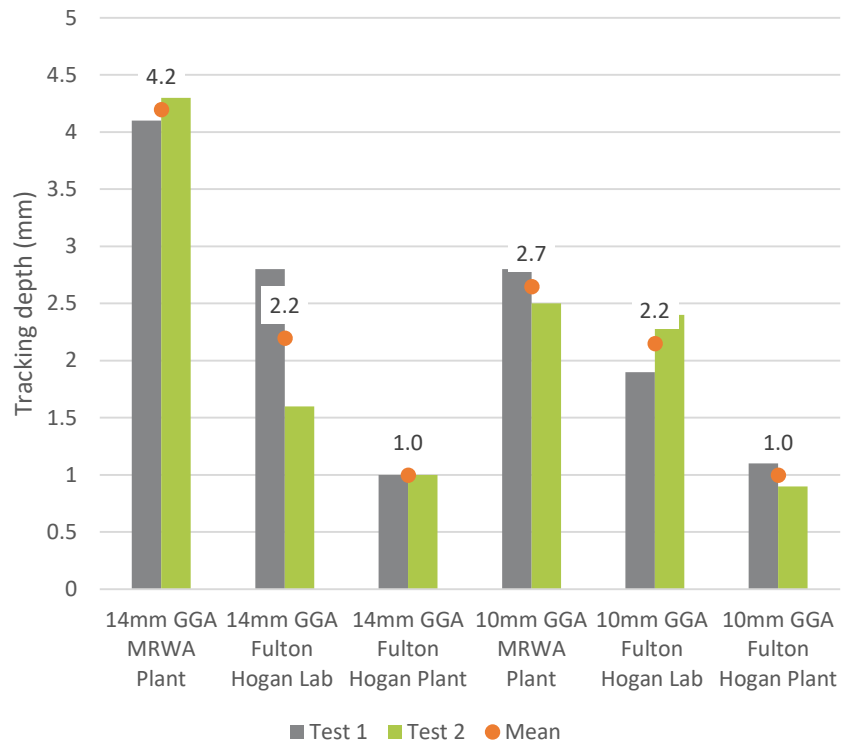
Tensile Strength Ratio

Minimum 80%

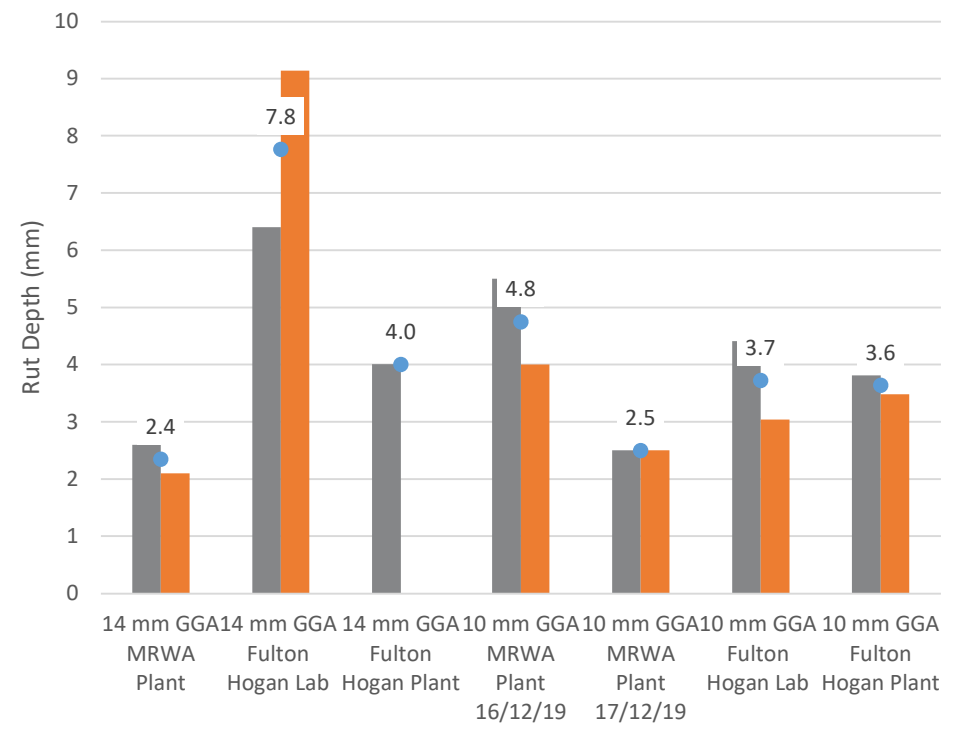


Wheel Tracking

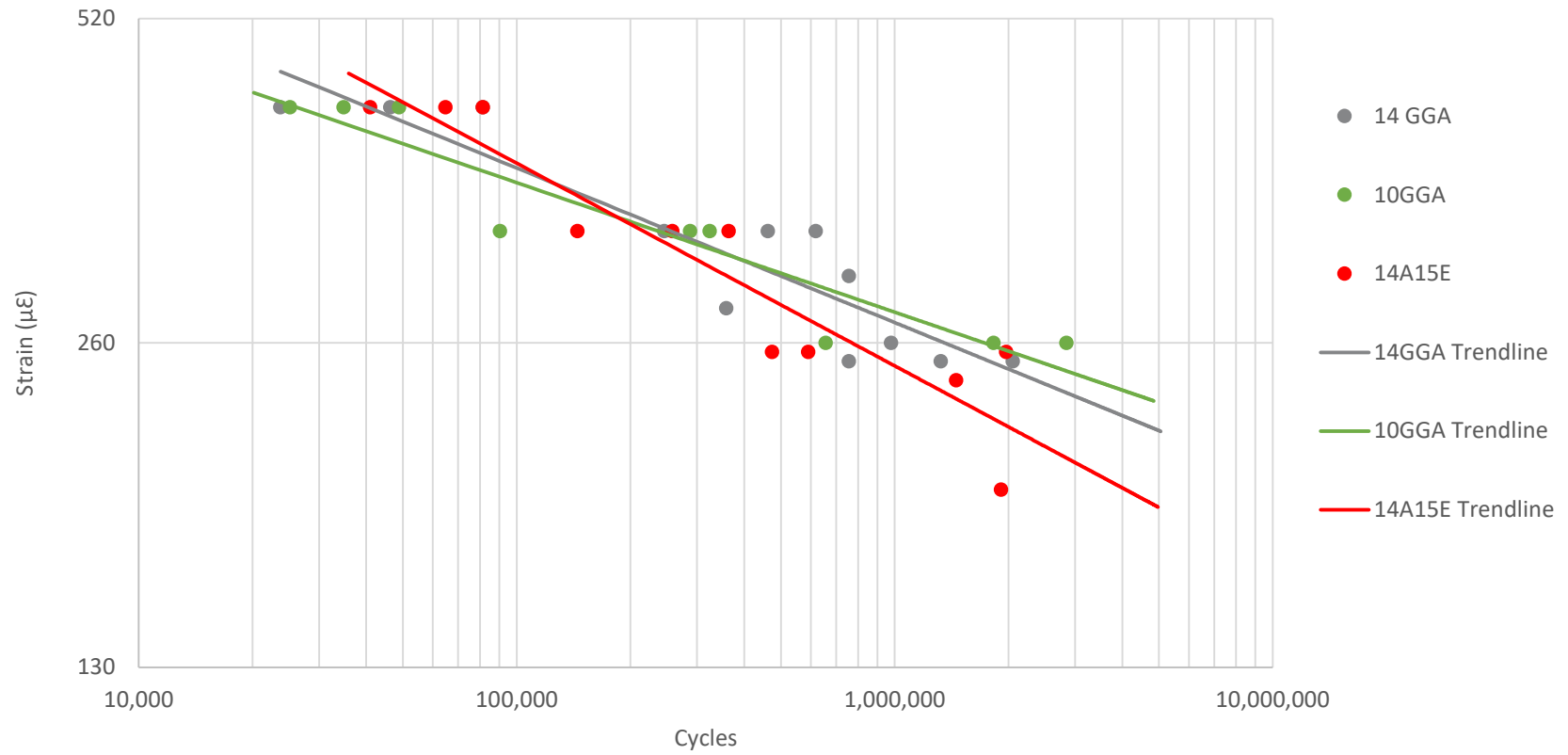
AG:PT/T231 - Report



Q325 (HWTD) - Maximum 12 mm



Fatigue



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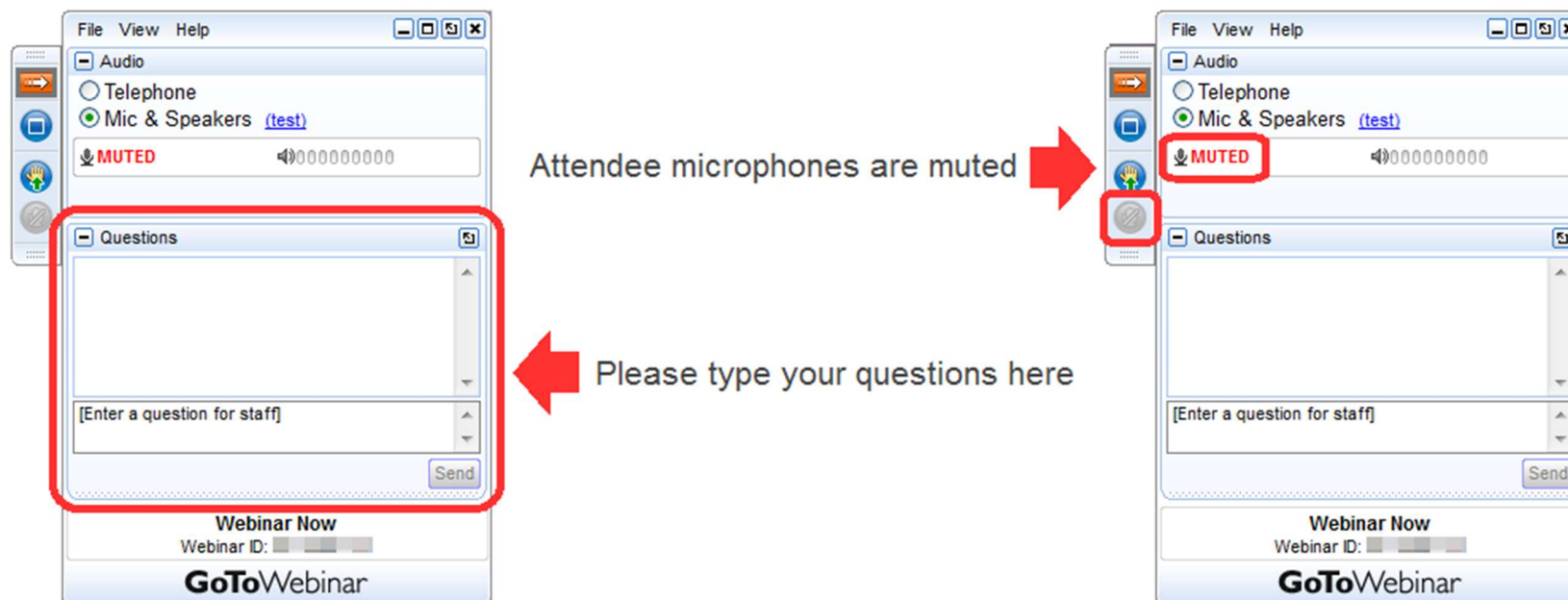
GGA Next Steps



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Please send your questions with slide number





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Q & A

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