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Solutions

Paving low temperature Gap Graded Asphalt with crumb rubber

RUBBER FROM OLD TYRES IMPROVES ASPHALT PERFORMANCE

Rubber derived from end-of-life tyres can be used to improve the performance of asphalt. Rather than dispose of old tyres in landfill, the rubber can be recovered to modify bitumen for producing new asphalt.

The rubber contains polymers and carbon black which improves the performance properties of the bitumen. The rubber is ground into particles called crumbs which can either be preblended with bitumen or added directly into the pugmill when mixing the binder with the heated aggregates.

The practice of recycling crumb rubber from old tyres into asphalt is a well proven technology and offers the following benefits to society and road asset owners:

- **Helps keep old tyres out of landfills** and reduces the risk of landfill fires and spread of mosquito borne diseases.
- Recycling crumb rubber from old tyres **reduces the need to use imported polymers** to improve the performance of asphalt.
- Up to 20% crumb rubber can be used to modify the bitumen which **reduces the amount of virgin bitumen used** in asphalt.
- The polymers in the rubber will increase the:
  a. elastic properties of the bitumen which **makes the asphalt more flexible** and resistant to reflective cracking;
  b. viscosity of the binder which **makes the asphalt more rut resistant** under heavy traffic at high road surface temperatures.
- The carbon black in the rubber acts as an antioxidant making the binder more durable which **provides a longer lasting asphalt surface** with lower life cycle maintenance costs.

"Retread your old road with crumb rubber modified asphalt for a longer life"

MAKING ASPHALT MORE SUSTAINABLE

The COLAS group uses warm mix technologies to reduce the generation of fumes and odours when mixing and paving asphalt modified with crumb rubber. RAP and other secondary waste materials like recycled crushed glass, steel slag and fly ash can also be used to reduce the demand for virgin materials to produce crumb rubber modified dense graded asphalt without compromising the overall performance of the asphalt. Old asphalt containing crumb rubber can also be reused to produce new asphalt.

By using crumb rubber to increase the performance and durability of asphalt you will reduce the demand for non-renewable materials like bitumen and aggregates during the life cycle of the pavement.

The COLAS group uses the equivalent of 1 million passenger car tyres per year to produce crumb rubber modified binders for asphalting and spray sealing Australia's road network.

WHAT ASPHALT MIXES CAN BE MODIFIED WITH CRUMB RUBBER?

Dense graded (DGA), gap graded (GGA) and open graded (OGA) asphalt mixes are most suitable for modifying with crumb rubber. The % of rubber used and the binder content of the asphalt will vary depending on the mix type.

Mix type	Binder %	Binder Type	Rubber %	Rubber kg/t	Number tyres	Thickness mm	tyres/ lane/km
DGA10	5.5	S45R	13	7	1	30	335
GGA14	8.0	CR1	18	14	3	50	1,125
OGA10	6.5	CR1	18	12	2	50	548

Table 1: Comparison of rubber consumption by mix type

1. Dense Graded Asphalt

The bitumen in DGA can be substituted with preblended crumb rubber bitumen (CRB). The % of crumb rubber used is typically between 13 – 15% by mass of bitumen. The binder content of the mix needs to be increased slightly to accommodate for the increase in mix stiffness to achieve good field compaction. The substitution of C320 with CRB will improve the moisture susceptibility, rut resistance and flexibility of the asphalt. The results from the Mitcham Council demonstration trials (Table 2) showed that the laboratory performance properties of the AC14 were significantly enhanced when substituting the C320 bitumen with CRB in the mix.

Test Property	Test Method	Binder type	
		C320	CRB
Wheel tracking at 10,000 passes at 60°C, mm	AGTP/T231	8.1	3.2
Fatigue at 200 mircostrain at 20°C	AGPT/T274	90,000	332,000
Resilient modulus at 25°C, MPa	AS 2891.13.1	4,174	3,500
Tensile Strength Ratio, %	AGPT/T232	80	89

Table 2: Performance properties of AC14 modified with CRB versus C320

Test Property	Test Method	Mix type	
		DGA/CR	GGA/CR
Wheel tracking at 10,000 passes at 60°C, mm	AGTP/T231	3.2	
Fatigue at 200 mircostrain at 20°C	AGPT/T274	332,000	1,401,000
Resilient modulus at 25°C, MPa	AS 2891.13.1	3,500	
Tensile Strength Ratio, %	AGPT/T232	89	95

Table 3: Typical performance properties of crumb rubber modified DGA vs GGA

The use of crumb rubber modified DGA will provide a wearing or base course which will be less prone to cracking and rutting, more durable and require less maintenance during its service life.

2. Gap Graded Asphalt

By using a gap graded asphalt more binder can be incorporated into the stone skeletal structure of the mix. With the higher binder contents (> 7.5%) and higher % of rubber in the bitumen (>18%), GGA offers substantially more enhanced performance properties over DGA mixes. (Table 3)

GGA/CR are most suitable for placing over cracked pavements to stop reflective cracking. Experiences in California shows that the use of GGA/CR can lead to a reduction in the asphalt layer thicknesses of up to 50% compared with conventional asphalt mixes.

3. Open Graded Asphalt

The use of highly modified crumb rubber bitumen in OGA mixes can lead to much higher binder film thicknesses being achieved compared with polymer modified binder due to the increase viscosity of the binder. This will result in quieter, more durable and much longer lasting OGA wearing courses.

"At COLAS sustainability starts when the rubber hits the road"

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