

CCC Highways Technical report on the use of Plastic & Rubber in Asphalt

Background

1. Waste reduction and recycling are forming significant strands of the government policy and the war on plastic, images of our polluted oceans and the effect on wildlife are some of the ways this is being highlighted.
2. Internationally, there has been a lot of recent publicity about how plastic waste can be recycled into an asphalt mixture to produce roads that are kinder to the environment and (a manufacturer claims), longer lasting to make a “revolutionary new road surface”.
3. In recent years there have been initiatives aimed at including waste streams into asphalt, including plastic and car tyres. However, the claimed benefits and any impacts on the durability of the asphalt have not been proven by any robust national and international laboratory testing, normally required for all construction materials to meet legislative requirements. Such certification is also vital to give public bodies some protection from risks associated with performance of the material.
4. A recent example is the marketing of waste plastic pellets for inclusion in asphalt as a route to ‘recycle’ plastics. One company, MacRebur use local waste plastic for local roads and seek to divert waste from land fill sites into roads. They state that “In the UK alone 20 million tons of asphalt are produced annually – if MacRebur’s products were used in every ton, 60,000 tons of plastic would be saved from landfill each year”. The claimed benefits are:
 - a. Increase lifespan of roads;
 - b. Reduced maintenance costs;
 - c. Cheaper alternative to modified bitumens;
 - d. Reduction in landfill tax costs;
 - e. Reduced carbon emissions and adds to the circular economy;
 - f. Green alternative to bitumen in asphalt.

While this sounds like the perfect solution, there is little evidence that it has been proven technically through in-situ performance, nor for its impact on the future recyclability of the asphalt, nor the cost reduction claims, nor the environmental impact of manufacturing the pellets.

5. Some commonly recycled plastics do not generally form a homogeneous mixture when added to bitumen – creating a weak bond between the recycled plastic surface and the bitumen. So, it is understood that this new product only uses very selected types of plastic.

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6. The process for making plastic pellets from selected recyclable waste plastics involves sorting and transporting the plastic to a plant that then extrudes the pellets. The pellets are then melted into the asphalt mix as part of the binding agent. The plastic used makes up approximately 0.5% of the total surfacing mixture. There are three types of MacRebur pellets which can replace between 3kg and 10kg per 1000kg of surfacing material.
7. The “green” benefits clearly link to lowering the environmental impact of road maintenance. The company promoting this product highlight how the use of this type of local waste can be diverted from land fill sites into the asphalt that is produced and used on roads. However, it is uncertain if the wider environmental impact of making the pellets, their transportation for the manufacturing process and then transport to the asphalt plant etc have been factored-into this assertion.
8. Rubberised Asphalt consists of regular asphalt concrete mixed with crumb rubber made from recycled tyres. Asphalt rubber is the largest single market for ground rubber in the United States, consuming an estimated 100,000,000 kg, or approximately 12 million tires annually.

Use of rubberised asphalt as a pavement material was pioneered by the city of Phoenix, Arizona in the 1960s.

9. There are 40 million waste tyres produced every year in the UK. Tarmac estimates that it will be possible to recycle and reuse up to 750 waste tyres for every kilometre of highway surfaced with the new material, depending on the thickness of the road, which would help to reduce the 120,000 tonnes of rubber waste exported from the UK annually.
10. There is no extra cost for the addition of Tyre crumb addition, however, there is an uplift for the use of the MacRebur products, this varies from £4.35 to £9.40 depending on the type of pellet. An average resurfacing scheme uses around 300 tonnes of material; this could incur an uplift of around £2-3k.
11. There is an industry drive to use warm mix asphalt which gives around a 50°c reduction in mixing temperature, which equates to around a 30% saving in fuel. Rubber crumb asphalt can be added to a warm mix asphalt. However, the plastic pellets can't be used with a warm mix asphalt and require the asphalt to be heated to around 190°c, this in turn uses more energy and releases more carbon into the atmosphere.

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12. Highways England have laid rubber crumb asphalt on the M1 in June this year as a trial.

Trials in Coventry to date.

Following National news items and with senior member support Highways Officers looked into using recycled plastic pellets made from waste plastic products in road materials (asphalt mixes). MacRebur had developed this idea and began working with asphalt suppliers in Cumbria to use such waste materials in roads. We made enquires with Cumbria County Council, who were the first council in the country to use the product; they offered advice and support to the Council following their experience of delivering road resurfacing using plastic pellets.

Council engineers then engaged with local asphalt producers to see if they would partner with the Council to deliver a new sustainable solution for road resurfacing. Coventry's contractor, Tarmac had already carried out a small trial in Gloucestershire, which provided Council Engineers with confidence that Tarmac knew how to distribute the plastic within the asphalt mix. Tarmac were also keen to trial the use of shredded tyre rubber in a test section within a road trial site, which after further investigation officers agreed to trial.

Considerations.

1. A scientific paper from India in 2015 highlighted that plastics are virtually indestructible, and any attempts to destroy them give rise to new problems and new pollutants. Far from being a solution to plastic pollution, plastic road-making itself is a source of pollution. Plastics release toxic gases when heated. Putting plastics in roads does not make plastics disappear. They are merely hidden. Over time, as the road weathers, the plastic breaks down into micro particles of plastic and enters the environment. To convert them into daily-use products, chemical additives are added to give them various required properties. The toxicity of most of these chemicals is not known. Research in China in 2009, exploring plastic recycling techniques, indicated that heating most plastics releases moderate to highly toxic emissions. Workers engaged in road-laying could then be at risk from these emissions.
2. The use of plastic additives is still a new concept, so it is early days for understanding the long-term effects or consequences of using plastic in our roads. There are some concerns about a lack of evidence that the plastics are chemically inert; for example, could the degradation process of the plastics leach toxic substances or noxious gases further down the line and once the plastic / rubber road surfaces have reached the end of their life span, how will they be safely disposed of.
3. There is no specification or standard available. Suppliers are currently agreeing specifications with clients on the basis that it is at the client's risk.

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4. Currently, there would appear to be no evidence to support claims that this asphalt is more durable or even as durable as conventional asphalts.

5. It is possible that when the road surface wears, the plastic will be released back into the environment (with surface water runoff) in the form of microbeads.

6. It is uncertain if this asphalt can be recycled in the future, it could potentially become very costly to dispose of at its end of life.

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November 2019