In-service performance benefits from asphalt on roads

this is essential to ensure that technical standards and hence pavement quality are maintained and customer confidence ensured.

Many of the products listed above have traditionally been considered to be 'waste' or by-products and because of this are increasingly subject to legislation regarding waste management; including handling, processing, disposal and recovery. The point at which a useable element or product is recovered and is no longer defined as a waste has been extensively discussed and as a result a 'Quality Protocol'[2] has been developed by industry stakeholders. The purpose of the protocol is to provide a uniform control process for producers from which they can reasonably demonstrate that their product has been fully recovered and is no longer a waste. It also provides purchasers with a quality-managed product to common standards which can help increase confidence in performance. It also provides a clear audit trail for those responsible for ensuring compliance with Waste Management legislation.

Technologies continually improve for the inclusion of 'reclaimed' materials, increasing the types and percentages of materials that can be reused, thus making them more cost effective. Cost effectiveness is measured by maintaining or improving the design life and performance capability of the asphalt in which they are reused, so any major technical disadvantages must be avoided. Thorough research, development and quality control of such products will ensure good performance.

There are a number of environmental benefits from use of asphalt on roads and these are discussed in the following sections.

Noise

Noise can be defined simply as 'unwanted or unpleasant sound'. Road traffic noise arises from two main sources: the interaction between tyres and the road surface, and from vehicle engines and other mechanical parts of the vehicles.

Modern asphalts can influence the level of noise, by changing the nature of the tyre/road surface interface, particularly through the use of the new generation of thin surface course asphalts. These materials help to reduce generation of noise both by 'absorbing' tyre noise into the voids of the negatively textured surface and by providing a more even running surface than traditional positively textured (chipped) surfaces which reduces the tyre/aggregate impacts and resultant impact noise. Noise levels can be reduced by 3-6 decibels (dB(A)) compared to traditional road surfaces, which is equivalent to more than halving the traffic flow or doubling the distance of the listener from the source of the noise. In addition, by improving the smoothness of the road surface and reducing rolling resistance the vibrations in suspension systems and body panels, which can also create noise, are reduced. Improvements in pavement ride quality and smoothness have also been linked to improvements in fuel economy and reduced tyre wear.

Unnecessary noise is also generated by vehicles running on poorly maintained road surfaces e.g. rattling covers on inspection chambers and excessive ground-borne vibrations from running over pot holes and across joints in concrete slabs. Improved levels of maintenance using asphalt materials can help to reduce some of these noise sources. Also, as modern asphalt materials can be laid more quickly than traditional materials, delays and disruption and associated noise during resurfacing of roads are reduced.

Visual Intrusion

By proper design and engineering, the visual impact of a road can be kept to the minimum. Careful consideration of route, visual barriers, landscaping and sympathetic planting are highly important. From a material point of view, asphalt can contribute to this reduced visual intrusion as it has less 'glare' than some alternative materials.

As asphalt materials are available in a wide variety of textures, finishes and colours[4] they can also make a contribution to identifying the various functions of a road, for example delineation or segregation of cycleways and bus-lanes and the use of differential surfacings to indicate a change of amenity e.g. from a main road to a local or estate road with additional speed restrictions. They can also be used to enhance the visual acceptability of the built environment by providing paving materials sympathetic to a particular building or other structure.

Sustainability

Sustainability in terms of asphalt materials can be simply defined as their *ability to maintain their desired or designed characteristics in the most economical, socially acceptable and least environmentally damaging way*. This particular field has been one of extensive research, in order to determine how to demonstrate the sustainability of asphalt materials and highways[3]. This can be determined throughout the whole supply chain, from extraction of raw materials to energy consumption during manufacture and laying and recycleability for future reuse.

A combination of economic, environmental and resource (both natural and social) factors all go in to influencing the best sustainable solution for road construction and/or maintenance and are carefully considered when developing that solution. As has been stated previously, recycled or reclaimed asphalt materials from worn out roads are increasingly being used in higher quantities in the production of new durable asphalt and this trend is likely to continue. In addition secondary materials and by-products of other industries are also becoming incorporated into the asphalt supply chain. As long as these materials perform to the same standard or better than traditional materials, their use will contribute to sustainable use of resources.

Drainage

Roads can have a noticeable impact on the natural drainage of an area, altering the volumes and pattern of water run-off. By using a permeable pavement structure, it is possible for water to percolate through (or be temporarily 'stored') in the asphalt layers and into the sub-soil. This will attenuate run-off and, by filtering action, can improve the water quality prior to flow into a watercourse. This technology is still undergoing development and is restricted to use on roads with low traffic flows and car parks, but the technique is likely to gain wider acceptance as the technology advances.

Thin surfacing systems can also reduce the effects of rainfall and surface water by reducing the levels of spray generated from wheels of vehicles. The negative texture of such materials provides voids which help to temporarily retain the water away from the running surface. Careful design of surface and sub-surface drainage, cross-fall and profile are required to ensure that any necessary water flow within the structure of materials and pavements is effective.

Conclusions

In summary, it is evident that the use of asphalt in roads can provide many environmental benefits. In particular, asphalt:

- is 100% recyclable;
- makes good use of alternative resources to conserve virgin aggregates;
- reduces traffic noise;
- reduces surface spray in wet conditions;
- helps in minimising visual intrusion of traffic routes;
- assists clearer identification of route function;
- promotes and enables sustainable development;
- assists in maintaining natural drainage.

For 'Green' Roads, the choice is clearly Asphalt - and if you really want a green-coloured road, this can be produced with asphalt as well - as can red, blue or even speckled!

References

1 TRL Report 473, 'In-service performance of recycled asphalt roadbase', TRL, Wokingham
2 'The quality protocol for the production of aggregates from inert waste', WRAP, Banbury
3 TRL Report 638, 'A model set of asphalt sustainability indicators', TRL, Wokingham
4 'Decorative and coloured finishes for asphalt surfacings', Asphalt Applications, Sheet 4, Quarry Products Association, London

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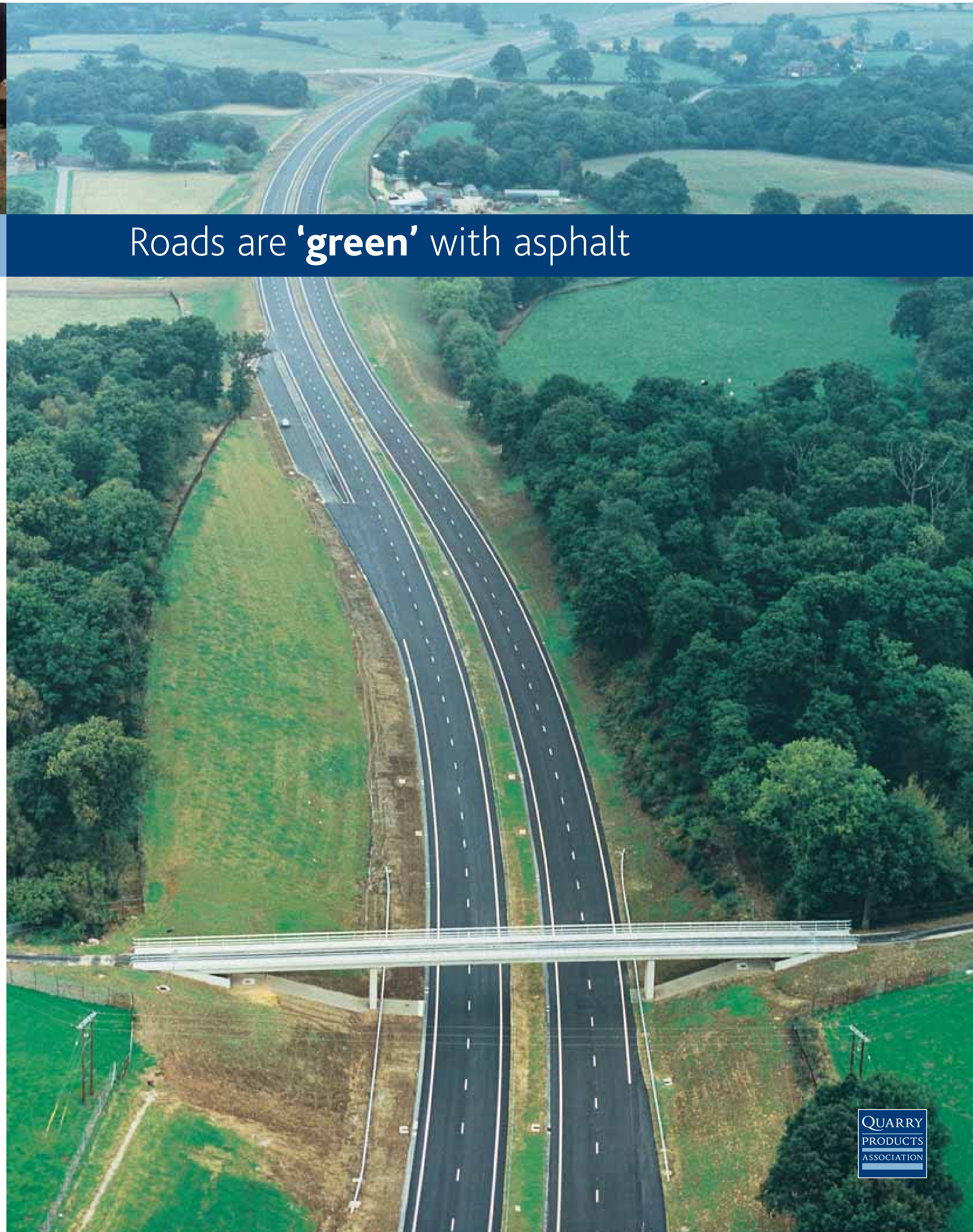
Roads are **'green'** with asphalt



QUARRY PRODUCTS ASSOCIATION



Recycling and the use of secondary materials in asphalt roads

Roads are a vital part of modern life which we take for granted and think little about. However, step out of your home and you will have to use roads to travel to work, shops or leisure facilities and to go on holiday. The goods and services that we require have to be transported by road for at least part, if not all, of their journeys. There are, of course, inevitable environmental impacts from roads, but using asphalt* in their construction and maintenance can help to limit the impact while improving the experience of roads for everyone.

Opportunities for this arise both in the construction and maintenance stages as well as from the in-service performance of the road. During construction and maintenance of roads and other paved areas there are opportunities for recycling of old asphalt and the use of secondary materials (which would otherwise be treated as waste) in the asphalt or elsewhere in the road structure. Additionally, asphalt in service can reduce noise pollution and visual intrusion and, through its high performance and durability, help to ensure sustainability of our natural resources. This information sheet explains these various benefits of using asphalt on our roads.

**The term 'asphalt' is used here in its generic sense to refer to the range of coated macadam and asphalt road materials available in the UK.*

The following extract from the Highways Agency's Design Manual for Roads and Bridges (Volume 7 Section 1 Part 2) outlines the importance of recycling and reclaiming of construction materials.

"It is Government policy to encourage conservation and facilitate the use of reclaimed and marginal materials wherever possible to obtain environmental benefits and reduce the pressure on sources of natural aggregates. Suitable materials may be those reclaimed from roads during reconstruction, from residues of industrial processes including mining and from the demolition of other construction projects. Such materials may provide good value for money particularly if their use involves less haulage. Where existing road foundations are in good condition, conservation of the pavement structure, strengthening with an overlay or inlay and widening where necessary, can also be an effective strategy for reducing the demand for natural aggregates."

The Specification for Highway Works, also issued by the Highways Agency, permits a wide range of reclaimed materials to be included in asphalt mixes. The range of sources of secondary aggregates is ever expanding and research within the industry continues in the search to find viable alternative or recovered materials for inclusion in asphalt.

It is often assumed that recycling or using 'waste' products will result in savings in end product cost. However, it should be recognised that additional processing may be necessary in order to make such materials suitable for further use. Thus recycling or use of secondary materials will not necessarily lead to reduced costs and environmental benefits will need to be weighed against costs in individual circumstances.

Recycling

Possibly the most important point to remember, when considering asphalt, is that it is ***100% recyclable or reusable in some way***. It can either be recycled back into asphalt or reused as a fill or sub-base material in constructing roads, footways, car parks and similar paved areas.

Methods

There are a number of methods for recycling of old asphalt removed from roads during maintenance (planings) back into asphalt. These are classified as:

- Off-site hot recycling - adding reclaimed materials into fresh hot-mixed asphalt (common practice)
- Off-site cold recycling - adding reclaimed materials into fresh cold-mixed asphalt (using bitumen emulsions e.g. Foamix)
- in situ hot recycling - reheating an existing surface, scarifying and, after some processing, re-laying the hot planings either as found or mixed with fresh asphalt (e.g. Remix and Repave)
- in situ cold recycling - as for hot in situ recycling, but using emulsion bitumen (e.g. Re-tread, in situ Foamix)

The choice from this list will depend on the site circumstances. For example, off-site recycling is generally considered to be more controllable than in situ recycling as there is more opportunity to assess and, where necessary, further process the recycled material, but in situ recycling reduces vehicle movements.

Road planings are permitted to be included in fresh asphalt mixes without consultation with clients at levels set out in the Specification for Highway Works, at the time of writing 10% for surface course and 50% for binder and base course materials.

It has been shown that the performance of asphalt roadbase containing recycled asphalt compares favourably to asphalt based purely on primary aggregates[1].

Use of Secondary Materials

A wide range of secondary aggregates has been recycled as a replacement for primary aggregates in asphalt. Some of the more frequently encountered materials are outlined below.

Slag: Both blastfurnace and steel slag, by-products of the manufacture of iron and steel respectively, have long been permitted by specifications for use in asphalt. They are widely used for this purpose and their utilisation in the new generation of thin surface course systems increases.

Glass: Crushed glass has been used as a replacement for asphalt sand. The glass is subjected to careful crushing and screening to ensure that the particle grading and shape is suitable to retain the engineering properties of the asphalt. It has also been used in combination with clear resin binder systems as a coarse aggregate to provide a highly decorative surface.

China Clay Sand: With careful mix design China Clay Sand has been found to perform well in roadbase asphalt. Large quantities of this material are available but these are located in Cornwall, which may make haulage costs to other parts of the country prohibitive.

Fibres: Cellulose fibres are widely used in the production of Stone Mastic Asphalt (SMA) and many proprietary surfacing systems. They are produced through recycling of paper and wood products. They act by inhibiting binder drainage from the open aggregate skeleton of SMA and similar products.



Foundry Sand: Used in moulds in foundries, certain fractions of foundry sand have similar properties to fine asphalt sand and can be used to produce asphalts suitable for many highway applications. Others are suitable as fillers, although some may not accept bitumen coating because of the presence of resins.

Incinerator Bottom Ash: This 'clinker' material drawn from the bottom of domestic waste incinerator plants has recently become more widely adopted for inclusion in asphalt, mainly for roadbase materials. Trials have been carried out at various locations although the technology may be subject to patent application. Aggregate must be well controlled in terms of quality.

Slate Waste: The quality of this product can vary significantly, but the portion of highest quality has been shown to give improvements in stiffness of asphalt roadbase compared with some more widely used aggregates. Laying material produced with slate waste therefore requires additional skills. Stockpiles of the source material tend to be remote from the major markets for asphalt e.g. Cornwall, Cumbria and North Wales, with cost implications for use in other areas.

Rubber: Crumb rubber from recycling of tyres has been successfully used in various applications such as impact-resisting play area surfacing. It has also been used on occasions in asphalt for roads.

The term 'Secondary' aggregates might be seen to imply lesser quality and sources of these materials must be shown to be as equally suitable for inclusion in asphalt as primary aggregates. This may require additional monitoring and testing of the products, but