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MODERN ROAD SOLUTIONS FOR GREENER INFRASTRUCTURE

Clever use of data and efficient reuse of materials are vital if we are to reduce carbon emissions and waste when building and managing road networks, says AECOM's **Daru Widyatmoko**.

Given they account for 70 per cent of global greenhouse gas emissions, infrastructure construction and operations have an important role to play in helping the international community mitigate the risks from climate change.[1]

Sustainability advisory body the UK Green Building Council makes it clear in its *Delivering Low Carbon Infrastructure* report that: "There is a need for the infrastructure sector to reduce carbon emissions from the operation, maintenance and decommissioning of infrastructure assets, as well as from the construction of new assets or modification of existing asset systems[2]."

To respond, the roads sector needs to examine new ways of working to reduce reliance on virgin materials, adopt new methods and improve recycling rates. It should also look at new methods of managing asset deterioration caused by increased temperatures and higher rain intensities.

Estimates suggest that the selection and sourcing of materials as well as design can affect up to 85 per cent of a project's overall greenhouse gas emissions, and up to 60 per cent of the cost[3].

Asphalt — here to stay?

Recycling already plays a key role in minimising waste. A 2016 survey of the Dutch construction sector found that while it generated the highest volume of waste, it also used half of all recycled materials[4].

> "MANY MATERIALS EMPLOYED IN THE PROCESS OF BUILDING ROADS CAN BE RECYLCED."

Many materials employed in the process of building roads can be recycled. Reclaimed asphalt materials, including their residual binders, can be reused through a variety of techniques developed over the last decade. In addition, aggregate from other reclaimed materials can relatively easily be added to recycled asphalt.

Yet, the reality remains that we will likely still be building asphalt surfaced roads for decades to come. However, as the world weans itself off fuel, there will be fewer ways of producing asphalt binder — itself a by-product of crude oil refinement — and engineers will have to become more creative in sourcing the materials that are so essential for road construction.

There are some innovations in the works with the potential to reduce reliance on asphalt. For example, synthetic asphalt mixtures made with vegetable-based colourless binders have been trialled on road sites in Europe and UK.

These products were composed entirely of renewable raw materials from the agriculture sector. Unfortunately, there has been no further adoption due the absence of standard specification and the poor performance of the mixtures after four to seven years in service[5]. This however has not stopped research engineers and scientists exploring other renewable sources.

Further promising innovations include the use of nano-materials such as graphene in conjunction with other recycled materials in asphalt. Most of the road trials conducted to date have taken place in Italy and they report improvements against conventional materials[6]. Nonetheless, the recycled and virgin materials used in these trials were specific for the project sites so further field trials and in-service performance monitoring will be required to develop a sound database of track records.

The use of nano-materials in this context is relatively new to the UK where limited trial sections were only conducted last year[7]. However, a collaborative research program has been set up recently to examine wider applications in infrastructure projects in England[8].

Making recycling easier for future engineers

As recently as a decade ago, it was rare to record construction details such as materials, layer composition and methods of construction beyond the project's handover. Lost in local archives, there was little or no information to guide what could be recycled after demolition. In such cases, recycling experts are forced to play detective. Cross-contamination, increased costs, more waste to landfill and reduced recycling rates are often the result.

Adopting digital twin technology — where a live digital twin of a physical asset responds and behaves like its real-world counterpart — right at the start future-proofs a project against these inefficiencies. A digital twin provides asset owners with clear and specific digital data and modelling, making it much easier to determine how structures are to be disassembled and the materials recycled when the time comes.

For this to work, it is essential that project managers are extremely diligent in keeping track of all the data involved in construction, both in terms of what is being used on site, and where. Digital twins facilitate this process.

However, adoption of digital processes has been slow in the road sector. This needs to change if recycling is to become easier for future engineers.

Smart sensors provide a wealth of information

Increasingly, engineers have been employing sensors to monitor the condition of assets, such as bridges and roads, in real-time. According to a report by Deloitte, the global smart sensor market is growing at an annual rate of 19 per cent and is expected to reach $60 billion by 2022.

These sensors can either be embedded under the surface of the road or can be vehicle-mounted. They take measurements as well as detecting distresses and faults. Sensors are indispensable in providing information about what is happening below the surface, and how the structure is ageing.

60bn

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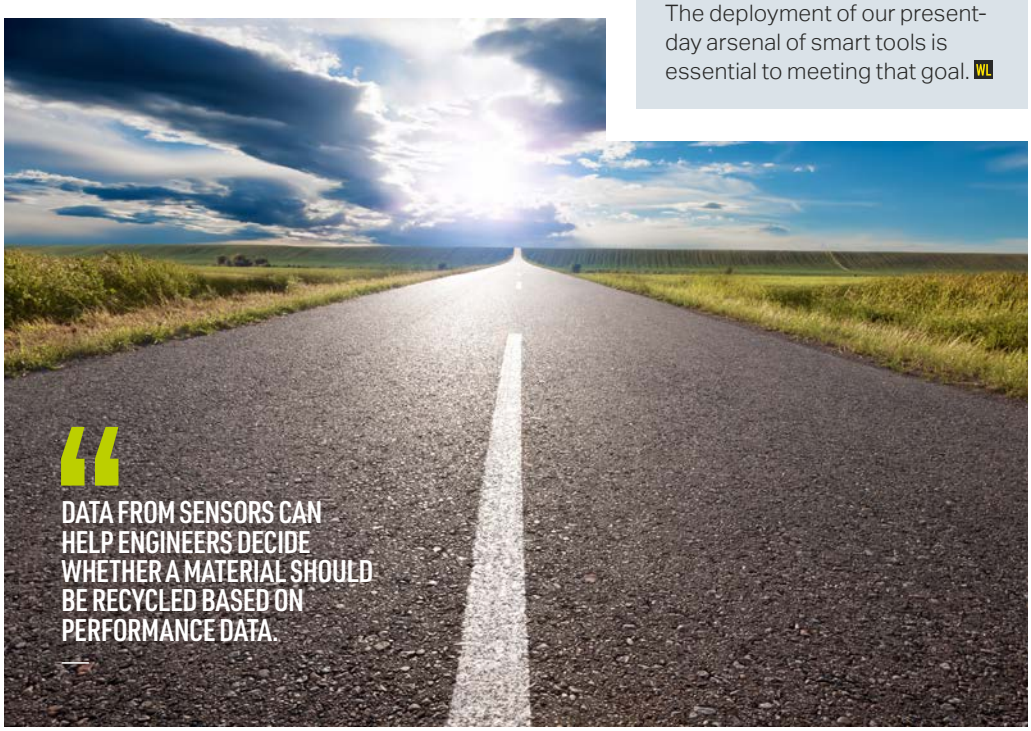
When used together with data captured from construction, they can also inform engineers on how individual assets are behaving so that they can assess their longevity. Why, for example, are two seemingly similar structures built only months apart, behaving so differently?

Data from sensors can also help engineers decide whether a material should be recycled based on performance data. Despite evidence to the contrary, engineers are often loath to recycle because of the risks of failure in the future if it has not performed well in its first application.

Time to accelerate change

Not much has changed in the last few decades regards materials in the field of road engineering. However, the drive to develop and adopt new technologies and materials to reduce the sector's carbon footprint needs to pick up speed.

The industry has a golden opportunity to increase efficiencies and meet ambitious emissions targets. The deployment of our present-day arsenal of smart tools is essential to meeting that goal. WL



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