

Recycling & Secondary Aggregates

The development of construction products using alternative aggregates

It is now widely acknowledged that the use of secondary and recycled aggregates in construction products contributes to more sustainable construction. By replacing part of the natural aggregate, the need for both quarrying and waste disposal is reduced with the associated benefits of reduced environmental and social impacts.

However, it is not enough to consider technical performance in isolation. For the use of alternative aggregates to be sustainable, there must be an economic supply of sufficient quantity, methods of quality assurance and specification, and a market for the products of a value appropriate to the costs of the processed material.

All of these factors were taken into account during recent work by TRL as part of a consortium led by Tarmac and funded by the Waste Resources Action Programme (WRAP) and the Department of Trade and Industry (DTI). The work looked at the potential use of recycled rubber crumb from used tyres and waste plastic as aggregates in asphalt and concrete and included product development trails.

In the UK, around 500,000 tonnes of tyre rubber and 200,000 tonnes of plastic are recycled each year; small quantities when compared to the volume of aggregates used in asphalt and concrete. Currently the infrastructure required to collect and process large quantities of suitable plastic and rubber waste is not in place.

The costs associated with processed recyclates are also an issue. Natural aggregates are supplied in vast quantities for a few pounds per tonne. Clearly it is uneconomic to use these materials as alternative aggregates unless waste streams with lower value can be sourced. Alternatively, the recycled rubber and plastic must add sufficient value to the asphalt and concrete so that their cost can be justified.

Waste plastic arisings exist that are difficult to separate and process and these are potential sources of plastic 'aggregates', including mixed plastics and shredder wastes. Unlike rubber crumb where specifications exist that could be adopted to partly specify this material as an aggregate, no form of specification for recycled plastic exists that would be suitable to specify its use as an aggregate. However, the general protocol developed in the Building Research Establishment report BRE 392 and adopted in the Specification for Highway Works, would be suitable for specifying both plastic and rubber.



Alternative aggregates: waste plastic

The new European Standard specifications for aggregates explicitly include manufactured and recycled materials. Similarly, when those asphalt are implemented, they will allow greater opportunities for the use of rubber and plastic. In the case of lightweight aggregates in concrete, the Standard does not discriminate between natural, secondary or recycled aggregates.

Preliminary trial mixtures of asphalt incorporating rubber were found to be suitable for school playgrounds, where a good level of safety – measured as head impact criterion – was achieved. Tests combining concrete with rubber indicated that this may be restricted to applications with an upper strength limit, such as foamed concrete for use in trench reinstatement.

Plastic aggregate could be incorporated in an asphalt binder course material if an adequate and economic supply of the material can be established, as test showed sufficient fatigue and deformation resistance for use in roads. However, because of a degree of moisture sensitivity, its use would probably not include surface layers.

In concrete blocks, up to 50% of course aggregates can be replaced with plastic achieving adequate strength and lightweight properties, while normal strength concrete can be produced using 15% replacement plastic aggregate.

These product development trials have been encouraged and indicate that, taking into account supply, specification, cost and market applications, some of these products will be commercially viable within the medium term. A full report of the work can be downloaded from the TRL website:

www.trl.co.uk/800/mainpage.asp?page=368

For further information, contact Tony Parry at TRL on tel: (01344) 770154; or email: enquiries@trl.co.uk

Leasing Scheme Extended

Business recycling aggregates can now take advantage of a leasing scheme set up by WRAP. Initially the eEquip scheme was available to companies operating in the glass, plastics and organics sectors, but it has now been extended to include paper, wood and aggregate recycling.

The scheme allows businesses to lease vital machinery and recycling equipment by guaranteeing its future residual value.

Tara Clair, WRAP's investment manager, explained: 'It has been very difficult to lease equipment in the recycling sector as banks and other lenders are often reluctant to look at technologies they are not familiar with. The eEquip scheme makes it a lot easier.

'Under the scheme, WRAP has set up a panel of lessors. When WRAP introduces applicants to them, we agree with them a residual value for the asset in question so that they can calculate competitive repayments, safe in the knowledge that, if the worst happens and the machinery depreciates more than expected, we'll make good any shortfall'.

First launched in February 2004, the scheme has already attracted applications for recycling plant and machinery worth £6 million. For further information call WRAP on tel: (01295) 819900 or visit the website: www.wrap.org.uk

The ecological and economic consequences of global asphalt production

The annual production of asphalt represents a large proportion of national wealth (see table 1). It is therefore in everyone's interest to maintain connecting infrastructure and preserve its value. Preservation is usually achieved by repairing or replacing damaged areas with new asphalt, while the used asphalt gained as a result of these repairs is often disposed of or used as a supporting layer in road building. Both cases result in a loss of value and loss of resources.

Table 1. Annual asphalt production and its value worldwide

	Production, Million tonnes/year	Value, US\$ billion
World	1.200	50
USA	600	25
Europe	300	13
UK	30	1.3
Rest of the World	270	7.0

Why Recycle?

Every 10 to 20 years asphalt road surfaces need partial or full replacement as a result of ageing, damage or increased traffic loads. The aggregate and bitumen constitutes, however, are often still in good condition and can be recovered and reused if suitable technology is accurately applied.

Table 2. Asphalt recycling figures for some of the main European countries

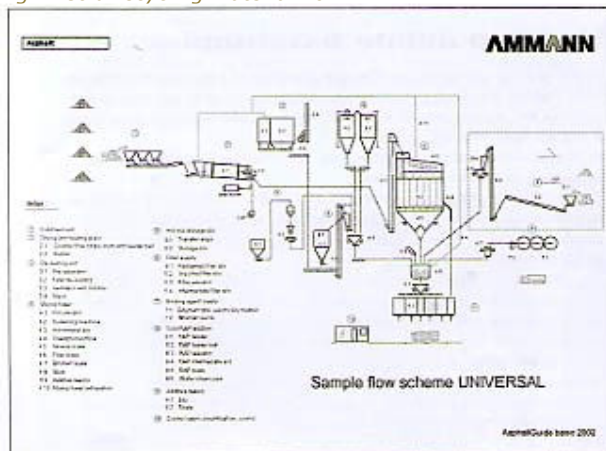
Country	Annual asphalt production, million tonnes	Annual amount of recycling available, million tonnes	Recycling/annual production, %	New production containing recycling, %
UK	30	1 (est.)	3	1 (est.)
France	40	5	13	15
Germany	60	15	25	20
Italy	40	13	33	5
Netherlands	8	4	50	65
Switzerland	5	2	40	20

There are three main arguments for recycling: first, it preserves the precious resources of processed aggregate and bitumen; secondly, it minimizes transportation and its associated costs, environmental impact and traffic; and thirdly, it avoids the environmental load caused by waster material, ie space requirement.

Recycling in Europe

Table 2 shows the actual situation in some European countries. The Netherlands can be considered with the country with the most recycling expertise; this can be explained by the fact that The Netherlands does not possess its own aggregates and therefore has to import them. France is about to start up recycling production and Germany and Switzerland have already installed a significant number of asphalt plants with good recycling facilities and the amount of recycling in these countries has increased over the last few years. By comparison, as a strong aggregate supplier, the UK has not had the same incentive to recycle but in future the amount of recycling will certainly increase, accelerated by rising oil prices.

Fig 1. Cold recycling material flow



Methods of recycling

There are four main ways of dealing with recuperated asphalt:

1. Recovered materials are thrown away resulting in loss of aggregates and bitumen.
2. Materials are crushed and reused as a gravel substitute, which results in loss of bitumen.
3. On site recycling is possible under restricted circumstances; however this needs special machinery and can be problematic in practice.
4. Recovered materials can be crushed and reused as aggregate in asphalt plants

The latter solution has gained worldwide acceptance and is the most widely used technique

The process of recycling in asphalt plants is well proven and a number of alternatives are available related to the desired amount of recycled material in the mix. The quality of a mix that incorporates recycled materials has been proven to be as good as 100% new mix and meets the same standards.

Recycling in asphalt plants

With experience based on more than 800 recycled asphalt installations worldwide, Ammann can supply well proven recycling solutions to equip new plants or extend existing ones.

Asphalt production with the addition of cold recycled materials:

This solution can be considered as a start up system, requiring low investment costs. It restricts the maximum amount of recycled material to approximately 25% of the new mix.

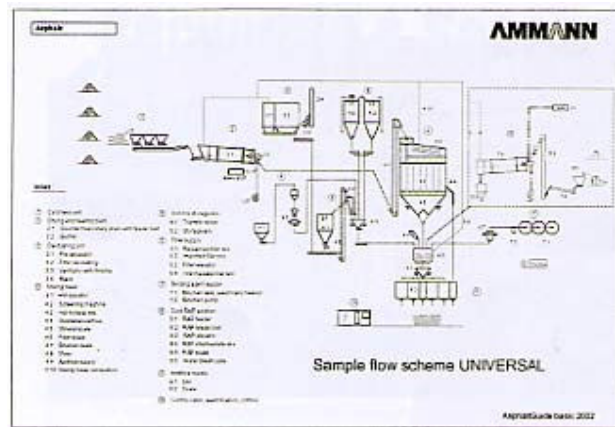


Fig 2. Warm recycling material flow

The main components of such a system consists of a cold feeder, a weighing device and a steam evacuation system (fig 1).

Asphalt production with the addition of warm recycled materials:

This solution involves higher investment costs but allows the reuse of approximately 50% recycled materials in the mix.

The main components of this type of system consist of a cold feeder, a recycling drum (parallel drum), a weighing device and an exhaust gas system (fig 2)

Conclusions

The UK market is not yet an asphalt recycling market, but the first steps have been taken and the amount of recycling will increase in the future. Oil prices will also have an effect on recycling. The asphalt producing industry and the authorities must find solutions and incentives for using recycling techniques and establish better acceptance of mixes that include recycled materials.

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FM Conway invest in recycling

Civil engineering and surfacing contractors FM Conway have invested £3.76 million in new equipment that makes them virtually self-sufficient in their use of aggregates, concrete and asphalt by using recovered materials excavated from their own road contracts.

Their new mobile concrete mixer lorries and a high pressure aggregate washing plant allow the company to mix a variety of different concretes on site using their own recycled aggregates, thereby reducing the need to purchase virgin materials and minimizing waste by mixing the exact amount required for each job.

'We are heavily committed to using our own recycled materials as much as possible and have so far spent over £2 million on special equipment for processing, recycling and reusing highway arisings, which will provide cash flow for the group,' said managing director Michael Conway.

The new equipment complements the existing plant the company already have in place at their Dartford facility, which allows them to produce 95% recycled FoamMix for use in road resurfacing. The company's aggregate washing facility is used to produce clean, high quality aggregate for concrete production, while a drainage treatment plant allows 95% of the drainage waste to be recycled.

Although producing design strength concretes with recycled aggregates is possible, convincing clients that the concrete conforms to standards remains a high priority. FM Conway are well aware of the potential difficulties of getting clients to accept their Conway Remix concretes and are extending an existing independent quality assurance and technical testing scheme with Babbie Group. The company are also working with London Remade to raise awareness of the benefits of recycled products through the Mayor's Green Procurement Code.



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Roadstone lead the way in Ireland

Roadstone Dublin Ltd (a subsidiary of CRH plc) are currently leading the way in the development and implementation of construction and demolition waste recycling facilities in the Greater Dublin area.



A Nordberg LT1415 Lokotrak forms part of Roadstone Dublin's recycling plant

At present Roadstone have obtained planning permission and waste permits (under the Waste Management (Permit) Regulations, 1988) for facilities at three of their existing operations at Belgard Quarry in Tallaught; Huntstown Quarry in Finglas; and Fassaroe in Bray. The three facilities provide a recycling capacity of 150,000 to 200,000 tonnes/year.

John Barnett & Associates Ltd, chartered mineral surveyors and environmental and geotechnical consultants, have provided planning and environmental advice to Roadstone's recycling manager Shane O'Reilly, have put in place a dedicated management system to control the types and volumes of construction and demolition (C&D) waste entering the recycling facilities. Under the conditions of waste permit only concrete, tiles, bricks and asphalt are allowed to be recycled. Segregation of the materials is carried out at source, with prior inspection carried out by company representatives as part of the material verification process.

Each facility comprises designated storage areas for incoming C&D materials and for the recycled aggregates. Processing, comprising crushing and screening, is carried out on a campaign basis over a period of weeks, depending on the volume of incoming materials. The plant consists of a Nordberg LTI415 Lokotrak crusher that is fed by a Volvo 460 tracked excavator. A Cat 972 wheel loader is used to stockpile the crushed recycled concrete.

The recycled concrete is used primarily for sites where a granular fill is required for site development. The use of this material has been prohibited in road pavement construction until recently. The revised 800 series of the NRA Specifications for Road Works permits the use of recycled crushed concrete aggregates, as defined in Annex A of IS EN 13285, and Roadstone Dublin's recycled concrete product conforms to this specification.

Shane O'Reilly comments: 'The recycling facilities thus far have provided an outlet for our internal material and improved our environment performance in keeping with our ISO 14001 environmental accreditation. The recycling facilities have also provided a valuable service to the construction industry and our customers.'

Roadstone Dublin are launching a new service for customers whereby segregated C&D waste is collected directly from construction sites, reducing the need for customers to deliver C&D materials to Roadstone's recycling facilities. The company are also leading the way with their recycled asphalt programme (RAP) that utilises up to 15% recycled asphalt in their road and base course materials. They are also developing the use of alternative aggregates sources such as rubber crumb and glass in various trials around the country, thereby reducing the volumes of primary aggregates needed for road construction.

Roadstone Dublin, along with other construction sector organisations, have been involved with the Irish National Construction and Demolition Waste Council (NCDWC). The Council was given the objective of achieving the recycling targets for the industry of 50% and 85% by the years 2003 and 2013, respectively. The Council has made great inroads into this target and will be publishing its second annual report in the coming weeks.

With the increasing costs of disposing C&D materials at landfills (Euro 100-150/tonne), the Roadstone recycling facilities provide the construction industry with the opportunity to significantly reduce haulage and disposal costs, and will contribute to more sustainable construction practices.

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A waste concrete stockpile



Recycled concrete

