

# GREEN ASPHALT

## LOW ENERGY COLD RECYCLED ASPHALT

### Introduction

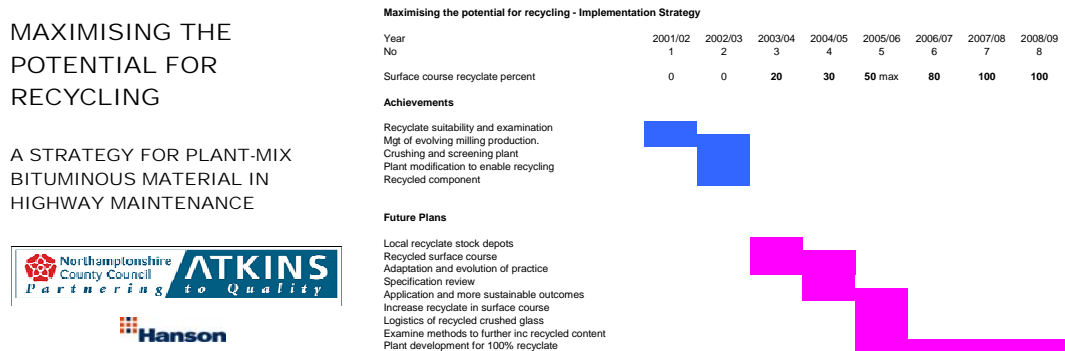
Hot-mix asphalt materials comprise mixtures of bitumen and aggregate and are core materials used in large quantities in the care, repair and refurbishment of highways. Within the integrated highways service partnership `Atkins Northamptonshire Highways` the principal parties, Northamptonshire County Council (NCC) and Atkins collaborated closely with key supply partners Nynas and Hanson to bring about cultural change through progressive development in the unglamorous field of asphalt materials.

The aims were to create a more sustainable way of undertaking highway works to:

- Maximise recycling
- Reduce carbon emissions
- Reduce energy consumption
- Create a safer work environment.

### Planning

The highways partnership developed a strategy `Maximising the Potential for Recycling in Highway Maintenance` which established a programme of progressive change and development of asphalt materials over a five year period.



Long term strategic planning to maximise reuse

A long term approach is essential for introducing change to established practices and progressive adjustment *meets the desires of citizens for more recycling and added value aspirations in a sustainable manner.* Central government policy `Securing the Future` and strategies in NCC`s Carbon Management Plan and Cabinet priorities for `recycle more – waste less` provide catalysts for change. Highway maintenance operations have the potential to make real and tangible contributions to sustainable development as the traditional asphalt materials consume considerable quantities of mineral resources and high levels of heat energy during manufacture.

The environment can be protected through local procurement of aggregate resource and sustainability improved by the adoption of newer cleaner technologies which deliver wide scale societal benefits to mitigate the impact of a changing climate.

## Implementation

The management and implementation of the project was undertaken in a jointly constituted focussed team all acting in the spirit of true integrated partnership and with clear goals and objectives.

Hot-mix asphalt manufacture is energy intensive as temperatures of the component parts are elevated to enable mixing. Energy is also expended in the quarrying and processing of minerals and transportation to the mixing plant and onward to the installation site on the highway.

Up to fifty thousand tonnes of life-expired asphalt material is removed each year by planing from the County highway network to enable new installation refurbishment works. There is therefore a continually recurring `black` aggregate milled material resource generated locally which, with improved management, can be reused in the highway network. This resource can, and often is, reused in limited proportions in hot-mix recycling for structural materials such as binder and base asphalt mixtures or as granular material in foundation applications. However, by far the principal type of asphalt material used highway maintenance is surface course.

To maximise the potential of this premium resource, reduce production emissions and drive reuse levels markedly upwards required a step change in asphalt technology. Movement from the traditional hot-mix asphalt process to a cold-mix alternative with the capability to enable full recycling in surface course material provided the means of reusing at the highest possible engineering value.

## Innovation

*The process of cold mixture design, formulation, manufacture and installation differs substantially from hot-mix asphalt.* Laboratory design of the cold asphalt mixture is critical to ensure that the required engineering performance parameters are achieved.



*Laboratory design for cold-mix characterisation*

Full scale `proof of concept` trials were initially undertaken by modifying an existing concrete production plant to manufacture cold asphalt. The asphalt mixture comprised processed `black` aggregate plantings blended with Nyrec, a bespoke emulsion binder, specifically designed for reuse applications and to `break` from the emulsion phase under pressure imparted by compaction. Nyrec emulsion binder is the result of many years of research and development. The concept trials illustrated the manufacturing potential and resulted in the successful installation of cold structural material in the highway network.



More extensive full scale network prototype trials followed over a two year period for both structural and surface course applications. For these works a low energy mobile manufacturing plant was used and a 100% recycled cold emulsion surface course was successfully manufactured and installed.

Different transport and installation practices were also developed for the cold asphalt. Manufactured material was loaded directly into delivery vehicles with minimal pre-placement handling and no need for specially insulated vehicles or release agents in the body of the vehicle. These changes all resulted in transport efficiency and additionally the mixed cold-mix material could be supplied from stock several days after manufacture. Pneumatic tyre rollers were used on the cold-mix asphalt to impart compaction through a kneading action which is critical to facilitate the emulsion `breaking` process and to resist surface cracking thereby allowing the road to be quickly opened to traffic. The mixing plant required only a fraction of the energy required by a hot-mix plant and delivered a high tonnage production output for efficiency in use.

In-service evaluation proved that the cold emulsion structural material provided a Structural Strength Index equivalent to traditional hot-mix and good integrity was demonstrated by intrusive investigation.

The successful manufacture and installation was undertaken with collaborative European expertise from Sweden, Lithuania and Denmark all focussed toward the Partnership goal of achieving a low energy fully recycled asphalt material.



*Cold emulsion asphalt manufacture with recycled aggregate*



*Cold emulsion structural asphalt installation and core specimen.*



*Cold emulsion 100% recycled asphalt surface course*

## Benefits to Society

The manufacturing process for cold emulsion asphalt is both innovative and practical in its application. It involved integrated partnership development, cooperation with practices tailored for application in Northamptonshire, and utilised the performance concepts of the SMART initiative to yield a low emission asphalt material for use in highway works.

The cold asphalt has been utilised in a number of different highways applications and installer feedback has been very positive including:

- Ease of installation.
- Swift installation with no need to wait for layers to cool before progressing.
- Storage potential and time flexibility prior to placement.

The cold emulsion asphalt process demonstrated sustainability benefits:

- Production carbon emissions reduced by more than 90% (compared with a hot-mix asphalt plant.)
- 100% recycled content and complete reuse of aggregate feedstock.
- Production fuel consumption reduced by 99% (at full capacity operation compared with a hot-mix asphalt plant.)
- Enhanced health and safety environment.
- Improved transport efficiency with environmental benefit.
- In-service engineering performance equivalence.

## Objectives met

The low energy plant manufactured cold-mix process represents a major step forward in highway maintenance sustainability as the first such 100% recycled asphalt surface course developed and installed in the UK.

This provides a practical and positive means to reduce Highway Service `carbon footprint` and contributes directly to NCC's objectives and strategy as a mitigation measure for `climate change` impact as it is virtually emission free.



The cold recycled emulsion asphalt process has the potential to change highway work practices and was developed as a long term partnership which brought together a team of highway engineers to develop and implement the entirely new low energy manufacturing process.

The catalyst for this demonstration process was conceived with client commitment from Northamptonshire County Council and delivered by Atkins Northamptonshire Highways Partnership through collaborative development with Hanson and Nynas as key supply partners.