Department for Transport

Tackling Potholes with Technology

May 2024

OFFICIAL

Tackling Potholes with Technology

There are many traditional and new technologies on the market in the UK and overseas to identify, prevent and fix potholes. There are different levels of confidence regarding each technology and it is not a one size fits all. Different technologies will be appropriate for different scenarios.

Identify

Resurfacing / Overlays

Crack Sealing

Pavement Rejuvenation - Bitumen Sprays

Prevent

Bitumen fillers

Pouring Mixes

Surface patching

Fix

Hot Rolled Asphalt (typically around 40mm)

Stone Mastic Asphalt

Thin Surfacing (Typically around

There is no process to assure and benchmark the different technologies or benchmark them against each other to see which ones work the best for different scenarios on UK roads.

The following steps could be taken to address this:

- Design and implement process for assurance and benchmarking of new technology / materials including a specification
- Implement annual audit process for each supplier/technology to ensure the technologies continue to perform to the required specification

Executive Summary (1)

- Potholes are a growing problem and will take millions to fix but can more be done to prevent them happening in the first place?
- Government has increased its national pothole repair fund to £700 million for 2023/24
- A pothole is *"a local deterioration of the pavement surface in which the material breaks down in a relatively short time and is lost causing a steep depression"*
- Potholes can form due to surface cracking, traffic loading, freeze/thaw, poor quality reinstatements from the "top down" or "bottom up" in the pavement
- There are four stages of deployment of a solution
    1. New Construction
    2. Preventative maintenance
    3. Interventions / Repairs
    4. Renewals
- Material / Technology selection requires consideration of a number of criteria as follows:
    - Strength, Performance, Durability, Scalability, Compatibility, Carbon, Ease of deployment, Impact to road user, Costs, Maintainability, Recyclable impact

Executive Summary (2)

- There are many traditional and new technologies on the market to prevent, fix and remove potholes
- They can be categorised as follows and more details of the products and technologies can be found throughout the presentation
  - Asset management
  - New / Renewal Construction
  - Preventative Maintenance
  - Pothole Repair Materials
  - Pothole Repair Plant
- Next steps
  - Prioritise immediate pothole repairs that are rapid and cost-effective
  - Continue implementation of PAS2161
  - Design and implement process for benchmarking of each new technology
  - Consider use / implementation of accelerated pavement testing to identify and test new materials and solutions
  - Implementation of new technology for identification and repair of potholes

1.0 Introduction

Why are potholes a problem?

Hitting a pothole with force can result in damage to a road user's vehicle.

Potholes are a safety issue. Potholes can be a catalyst to accidents and crashes through hitting or swerving to avoid them.

Two-wheel vehicles are particularly high risk.

Potholes are a growing problem and will take millions to fix but can more be done to prevent them happening in the first place.

Government has increased its national pothole repair fund to £700 million for 2023/24.

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> "The poor state of England's pothole-riddled road system is costing £14.4bn a year in economic damage"

> "Research has shown that average repair bill for pothole damage is £141.95"

https://www.localgov.co.uk/Potholes-cost-economy-over-14bn-a-year-/60278#:~:text=The%20poor%20state%20of%20England's,accidents%2C%20reduced%20speeds%20and%20emissions

https://thbuk.co.uk/everything-you-need-to-know-about-the-uks-pothole-problem-2/

2.0 Pavement construction in England

Motorways & all-purpose trunk roads

- Designed based on predicted traffic loading
- 40-year design life specified for National Highways
- Materials and thicknesses selected to provide required structural strength
- Surface materials selected to deliver desirable properties, e.g. friction, texture, low noise

Local Authority roads

- Some roads will have been designed; many others will have “evolved” without formal design
- Materials used in structural lower layers will be similar to those on motorways & all-purpose trunk roads
- Thicknesses may not be adequate for today’s traffic loads and volumes
- Materials likely to be aged
- Wider range of surfacing materials utilized, particularly on lower speed and lower trafficked roads
- Drainage systems and kerbing may not be adequate

3.0 What is a pothole?

- Many different definitions, but can generally be summarized as

  "a local deterioration of the pavement surface in which the material breaks down in a relatively short time and is lost causing a steep depression"

Notes:

- Generally, potholes require rapid remedial action to maintain the safety of road users
- Potholes will also need to be reinstated to maintain the functional requirements and comfort, but the time-constraints on rectification for these requirements will not be as immediate
- Potholes will typically have a depth of at least 30 mm and an area equivalent to a diameter between 100 mm and 1 m with the values for a specific situation depending on several factors including the traffic speed and intensity, the type of vehicle (particularly the presence of bicycles and pedestrians) and the climate
- Potholes can grow once they have emerged, but generally stop growing after a certain time. However, other potholes can appear close to an existing one
- Potholes can occur due to several mechanisms (such as fracture, attrition and seasonal)
- **Overview of Research Programmes Operations (cedr.eu)**

3.1 How do potholes form?

Generally caused by one or more of the following:

Primary factors

- Surface cracking – allows water to infiltrate the pavement
- Traffic loading – can induce shear stresses including hydrostatic pressures that exceed the strength of the material
- Freeze/thaw - moisture trapped between the surface and lower lays and the addition of freeze-thaw action and subsequent heave of the surface material leads to voids forming beneath the surface. Repeated traffic loading causes failure of the unsupported surface
- Poor quality reinstatements – can result in settlement of materials and also allow water ingress (e.g. unsealed joints)
- Surface deterioration (fretting) – localized loss of aggregate from the surfacing

Secondary factors

- Mechanical damage – impact from poor profiles and alignment
- Chemical damage, e.g. diesel spills

3.2 How do potholes form?

- Mechanisms for pothole formation can be
  - “top down” – starting at the top of the surfacing, or
  - “bottom up” – starting at the bottom of the surfacing or in the lower layers

- In future, pothole occurrence could be influenced by
  - Climate change – higher intensity rainfall, increased temperatures, reduced freeze/thaw
  - Traffic loading – increase in traffic volumes and/or vehicle weights
  - Ageing infrastructure and maintenance that does not address underlying causes

4.0 Road material selection and deployment

Key Criteria for whole life deployment

Question: What are the key criteria that need to be considered, when choosing road materials, both for the surface and subsurface not only for its immediate use, but its suitability over the life of the material.

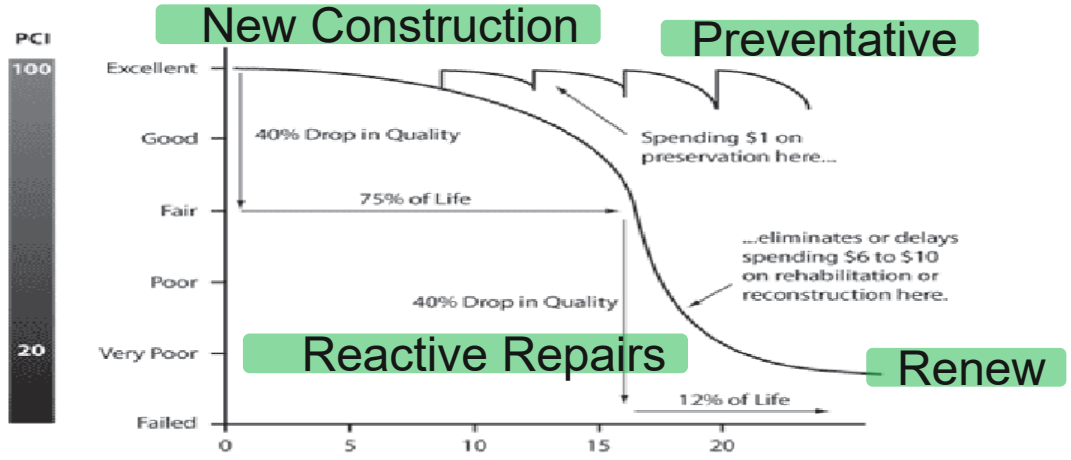
Consideration: There are, for this report, 4 key stages when certain criteria are more influential for deployment. The 4 stages of deployment of a solution are:

1. New Construction
2. Preventative maintenance
3. Interventions / Repairs
4. Renewals

> “…the Government and local authorities can do a lot more to bring the network up to standard so that when we do have a freeze the roads aren’t full of cracks waiting to turn into dangerous potholes that can cause collisions.”
>
> Road Haulage Association chief executive Richard Burnett

4.1 Road material selection – Deployment phases

The 4 stages for surfacing deployments are shown below. It is noted that for interventions/repairs, “interventions” involve works such as utility works which can occur at any time (if the road is not protected after major works). The key focus as set out by the HMEP documentation is preventative work, but it is acknowledged that currently roads are in a state that reactive repairs are also key for this report.



> Preventative maintenance is a planned strategy of cost-effective treatments to an existing highway in order to preserve it, prevent ingress of water, reduce the rate of future deterioration and increase service life, without increasing its structural capacity. Preventative maintenance is typically applied to highways with some remaining service life and comprises road surface treatments that include crack sealing, surface dressing, slurry or micro-surfacing and thin and hot-mix asphalt inlay and overlay.
>
> HMEP Review 2012

4.2 Road material selection - Criteria

Material selection, whether considering traditional or new technology requires consideration of criteria not only related to that material, but also consideration of the whole life operation and maintenance of the road in question. The table to right indicates the details of the criteria to consider.

Example; the deployment of specialist asphalt to minimise potholes is only effective it any future interventions such as utility work is able/complied to deliver the same product to standard. It is noted that UK asset management systems and New Roads and Street Works Act (NRSWA) do help record these specialist installations; but knowing and acting upon are different.

The following slide indicates typical materials used in deployment.

Criteria for whole life installation for a material deployment	
Strength	Core aim when delivering new surfacing; but once locked in, hard to improve without major renewal work.
Performance	Service levels of road including skid and noise
Durability	Life span for deployment
Scalability	Ability to deliver at scale required for deployment
Compatibility	Ability to repair/maintain after deployment
Carbon	Whole life carbon in production, deployment and removal
Ease of deployment	Ability of teams to obtain and delivery to quality
Impact to road user	Ability to manage road works around users
Costs	Deployment costs including TM, materials, plant, operatives.
Maintainability	Ability to maintain/repair/manage interventions
Recyclable impact	Ability to remove, recycle and reuse at end of life

4.3 Road materials – Typical materials used

New Construction

Stone Mastic Asphalt

Hot Rolled Asphalt

Warm Mix Asphalt

Geotextile reinforcements

Hybrid materials with additions

Preventative Maintenance

Resurfacing / Overlays

Crack Sealing

Pavement Rejuvenation - Bitumen Sprays

Surface Dressing

Microasphalt

Preservatives

Interventions / Repairs

Bitumen fillers

Pouring Mixes

Surface patching

Resurfacing

Hot Rolled Asphalt (typically around 40mm)

Stone Mastic Asphalt

Thin Surfacing (Typically around 20mm)

4.4 Road material selection - Criteria

With the 4 deployment phases identified, typical materials used and the key criteria defined; it is possible to build a picture or the most suitable material criteria to use depending on when and where a deployment is planned.

The table to right indicates when each criteria will feature the most.

The following slide indicates where potential barriers in certain material use and to be considered during this criteria selection process.

Criteria	Most appropriate time to consider
Strength	New construction
Performance	New / Preventative / Renewal
Durability	New / Preventative/ Intervention/Renewal
Scalability	New / Preventative/ Intervention/Renewal
Compatibility	New / Preventative/ Intervention/Renewal
Carbon	New / Preventative/ Intervention/Renewal
Ease of deployment	New / Preventative/ Intervention/Renewal
Impact to road user	New / Preventative/ Intervention/Renewal
Costs	New / Preventative/ Intervention/Renewal
Maintainability	New / Preventative/ Intervention/Renewal
Recyclable impact	New / Preventative/ Intervention/Renewal

4.5 Road material selection – Potential criteria barriers

New Construction

Hot mixes - Generating enough scale to achieve high quality product

Hybrid mixes – requiring knowledge for specialist rollouts

Alternative Materials (PFA/rubber) – deployment knowledge and ability to managed post deployment for repairs/renewals

Preventative Maintenance

Ability to scale up for large scale deployment.

Ability to have intervention such as surface dressing properly installed and an ability to patch/maintain post deployment

Interventions / Repairs

Interface with ironwork and level differences

Interface with aged material

Machine laying around tight urban areas with ironwork

Road space booking

Resurfacing

Interface with ironwork and level differences

Lack of profile to enable smooth longitudinal and transverse profiles

Ironwork interfaces

4.6 Road material selection – Tools

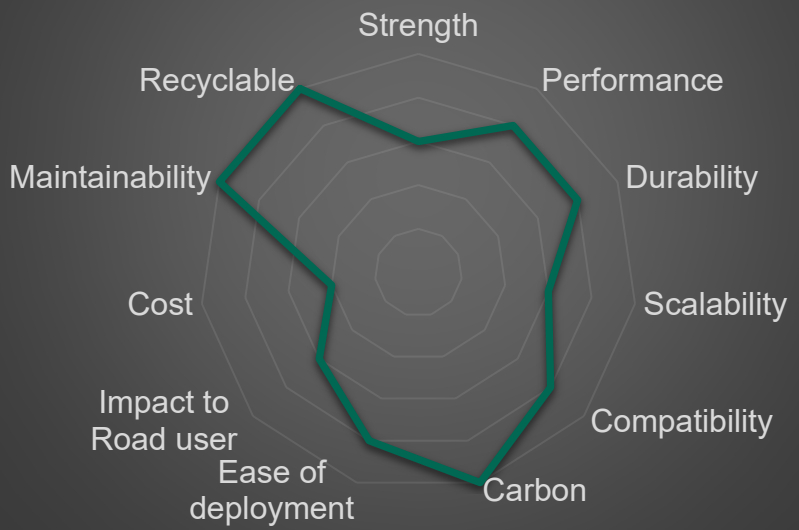
Tools to choose when and which materials are selected to be deployed

Core is understanding that early identification for the need for a deployment; and as such **ASSET MANAGEMENT TOOLS** drive decision making before the more detailed decisions are made on materials.

The following slides indicate both **TRADITIONAL** and **NEW TECHNOLOGIES** in asset management, materials and in some cases plant that can used for deployments that have arisen in the market.

When considering the material deployment options, the criteria for the selected option can be displayed in the form of a ‘radar’ diagram (see opposite). Variants of this are used by manufacturers for initial deployments but use of these diagrams or similar on any product/plant could benefit road maintenance engineers and planners.

Sample criteria ‘radar’ diagram when considering Warm mix deployment



5.0 Material and Plant Solutions related to Potholes

Prevent, Fix and Remove Solutions:

The following slides contain details on technologies and solutions that could assist with road construction and maintenance to prevent potholes, repair potholes in the short term and permanent repairs to remove and reduce the potential for a pothole to re-materialise.

The following slides cover traditional and new technologies related to:

5.1	**Asset management**
5.2 & 5.3	**New / Renewal Construction**
5.4 & 5.5	**Preventative Maintenance**
5.6 & 5.7	**Pothole Repair Materials**
5.8 & 5.9	**Pothole Repair Plant**

5.1
Asset Management

5.1 Asset Management

Current approach to pothole identification

- Safety inspections
  - Highway inspectors identify defects generally from driven surveys of the network
  - Can be assisted by video/image capture
- Public reporting
  - Public can report potholes via hotlines/dedicated online tools

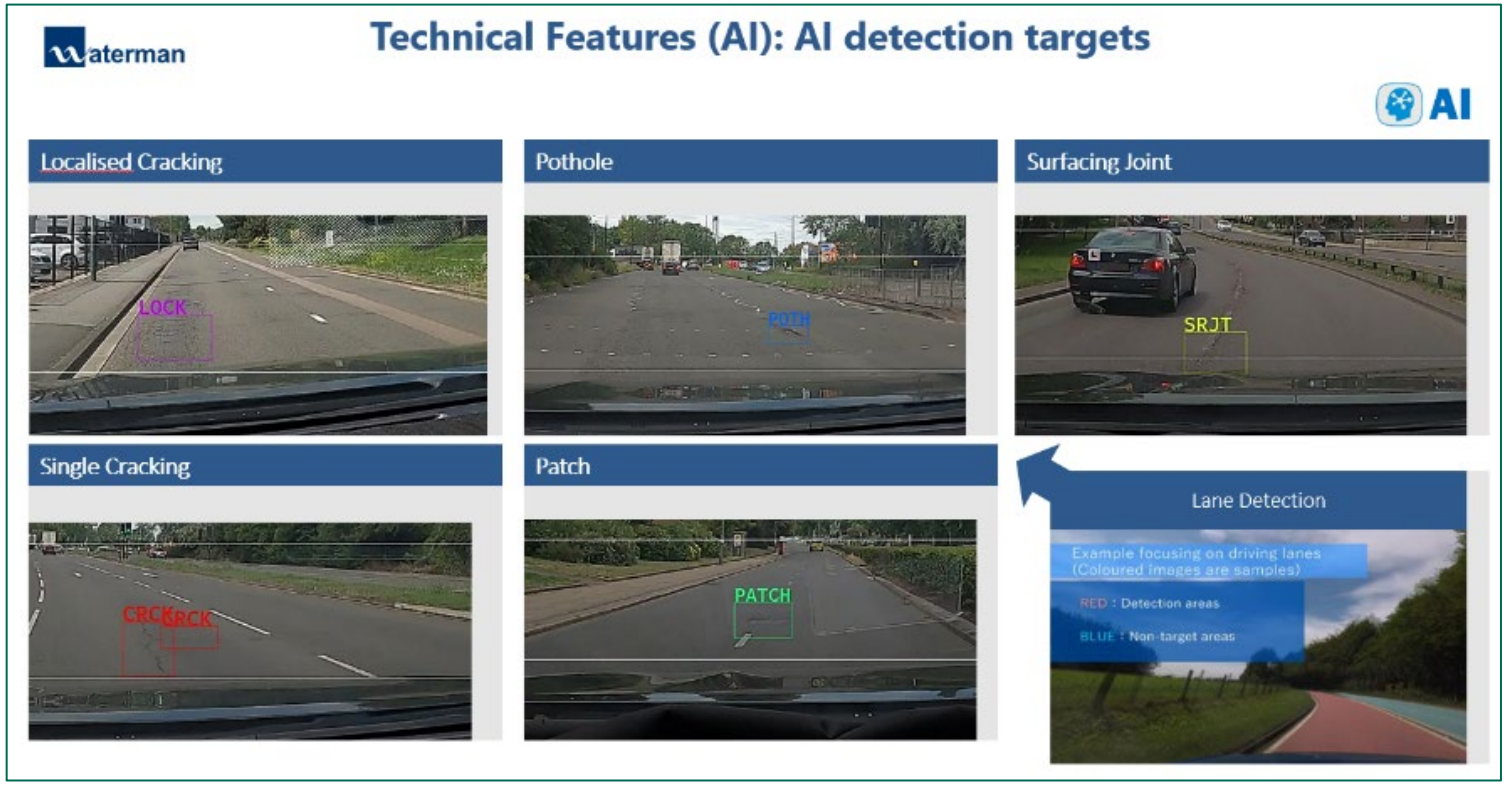
Current approach to Road Condition Monitoring (RCM)

- Traffic speed surveys (SCANNER for LA roads, TRACS for NH roads)
  - Uses laser-based technologies to assess pavement surface condition
  - RCM data used for network level reporting/monitoring, identifying lengths for maintenance investigation, and deciding treatments required
  - Potholes not reported as a specific parameter
  - Potholes could be identified and numbers reported on an annual basis, but annual survey could not identify potholes as they develop

5.1 Asset Management

Next steps for RCM

- Significant progress in the development of new and alternative technologies for the collection of condition data since SCANNER introduced in 2009
  - Dedicated survey vehicles
  - Dedicated mobile technologies
  - Application based mobile technologies
  - Mobile phone apps with AI
  - Vehicle telematics
  - Engineers' inspections



Tackling Potholes with Technology

5.1 Asset Management

Next steps for RCM

- Development and forthcoming introduction of PAS2161: Road Condition Monitoring For English Local Authorities
  - Developed for DfT by TRL (TRL PPR2042 - Introduction of new PAS)
  - Network study of 11 technologies undertaken and recently reported
  - Will enable a wider choice of technologies for the collection of RCM data
  - Will ensure consistent reporting of condition categories across technologies and between highway authorities
  - Requirement for Condition Category for each length of network to be reported (Category 1 to 5)
  - LA's advised to request additional data
    - Potholes are a specific recorded parameter

- Many of the new technologies are capable of identifying potholes. PAS2161 specifies data collection annually but tools permitted mean LAs have the ability to deliver more frequently and quickly.
  - Specific pothole identification could be undertaken more frequently
  - Vehicle telematics/crowd sourcing data could provide near real-time identification

5.1 Asset Management

Future developments

- Current approaches only identify potholes once they have formed
- Analysis and modelling of RCM data could potentially predict where potholes may occur
  - Data sets could include:
    - Trends in road profile linked to pavement construction/strength
    - Changes in use from traffic profile
    - Changes in climate
    - Changes in budgets, material criteria (eg carbon costs/ recycling costs)
    - Rapid breaking data
    - Road condition from in-vehicle sensors
- TRL has undertaken work to use spectroscopic analysis to identify the ageing (oxidation) of asphalt (SARTS)
  - Could be linked to the potential for potholes to form
- TRL have proposed development of benchmarking process for new technologies

5.2
New Construction Materials - Traditional

STONE MASTIC ASPHALT (SMA)

A dense-graded asphalt mixture containing a high proportion of coarse aggregate, polymer-modified binder, and mineral filler.

Deployment method

- Preparation of the subgrade
- Placement of base course
- Mixing and paving
- Compaction
- Finishing

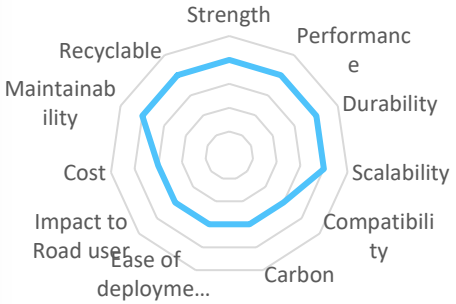
Criteria assessment

- Highly robust
- Long-term cost savings
- SMA production emits greenhouse gases
- Widely used in the UK
- Excellent longevity
- Effectively reduces road noise
- Reduces spray and splash
- Easy to repair and maintain

Image

www.machinio.com

Spider Diagram



Key Features

- Dense-graded asphalt mixture
- High proportion of coarse aggregate
- Polymer-modified binder
- Stone-on-stone contact

Advantages

- Exceptional durability
- Excellent rut resistance
- Good skid resistance
- Long service life (circa 16 years for TS2010)

Disadvantages

- Complex Mix Design
- Higher Initial Cost
- Limited Availability of Aggregates
- Installation Challenges

Depa

https://saferroadsconference.com/wp-content/uploads/2016/05/Wednesday-am-MA-6-Millar_Dougie_160_V1_2014415-TS-2010-a-surface-course-designed-for-safety.pdf

HOT ROLLED ASPHALT (HRA)

A dense-graded asphalt mixture composed of a combination of aggregates bound together by bitumen.

Deployment method

- Preparation of the subgrade
- Mixing and heating
- Transport and paving
- Compaction
- Finishing

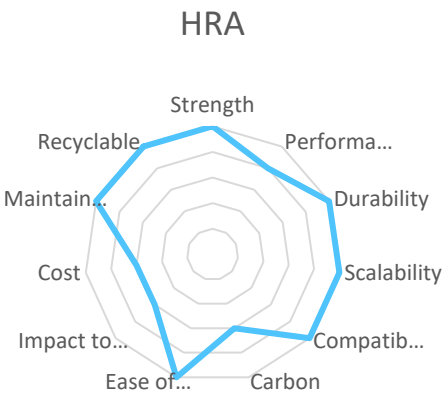
Criteria assessment

- Highly robust
- Long-term cost savings
- HRA production emits greenhouse gases
- Widely used in the UK
- Excellent longevity
- Easy to handle and install
- Reduces spray and splash
- Easy to repair and maintain

Image

www.tii.ie/tii-library

Spider Diagram



Key Features

- Dense-graded asphalt mixture
- Bitumen binder
- High resistance to deformation
- Smooth Surface Finish

Advantages

- Versatile
- Excellent durability
- Good skid resistance
- Rapid Construction

Disadvantages

- Higher Production Temperatures
- Limited Sustainability
- Limited Rut Resistance
- Cooling Time

WARM MIX ASPHALT (WMA)

An asphalt mixture produced and placed at temperatures typically ranging from 20°C to 50°C lower than those used for Hot Mix Asphalt.

Deployment method

- Preparation of the subgrade
- Mixing and heating
- Transport and paving
- Compaction
- Finishing

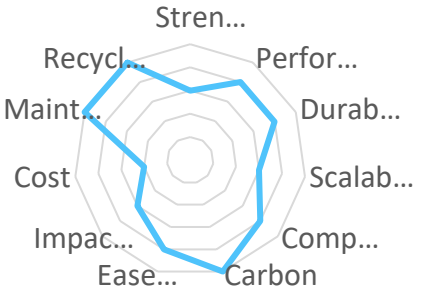
Criteria assessment

- Highly robust
- Long-term cost savings
- emits fewer greenhouse gases compared to HMA
- Increasingly adopted in the UK
- Excellent longevity
- Easy to handle and install
- Reduces spray and splash
- Easy to repair and maintain

Image

https://graynson.com

Spider Diagram



Key Features

- Lower production and paving temperatures
- Reduced energy consumption and greenhouse gas emissions
- Improved workability and compaction properties
- Suitable for various applications

Advantages

- Environmental Benefits
- Energy Savings
- Improved Workability
- Extended Paving Season

Disadvantages

- Mix Design Complexity
- Limited Availability of Additives
- Performance Variability
- Higher material costs

GEOTEXTILES:

Synthetic or natural fabrics used in civil engineering applications for soil stabilization, erosion control, drainage, filtration, and separation.

Deployment method

- Installed by placing directly onto the soil surface or within soil layers during construction. They can be laid flat, draped, or wrapped around structures depending on the application.

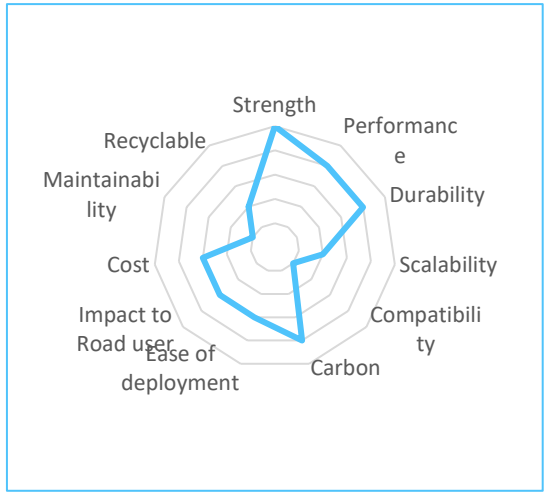
Criteria assessment

- Improve pavement robustness
- Cost-effective
- Low carbon footprint compared to other soil stabilization methods
- Widely used in the UK
- Enhanced pavement longevity
- Easy to install
- Enhances pavement durability
- Stabilizes soil and prevents erosion
- Improves road safety

Image

Geosynthetics magazine

Spider Diagram



Key Features

- High tensile strength
- Permeability
- Durability
- Resistance to biological and chemical degradation

Advantages

- Increased stability
- Improves drainage
- Extended service life
- Reinforces soil

Disadvantages

- Dependence on Soil Conditions
- Potential Installation Challenges
- Clogging with fines/debris over time
- Material Compatibility

HYBRID MATERIALS PLASTIC/RUBBER/LOW CARBON ADDITIVES/FIBRE REINFORCED:

A type of asphalt concrete mix that incorporates fibre/plastic/recycled tire rubber as a partial replacement for traditional bitumen binder or aggregates.

Deployment method

- Produced using hot mix asphalt (HMA) technology.
- Added to the asphalt mix during the blending process.
- Laid using standard paving equipment on site.

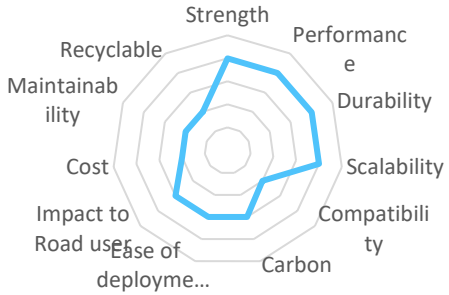
Criteria assessment

- Enhances robustness
- Higher initial cost
- Reduces the carbon footprint
- Increasingly adopted in the UK
- Extends the service life of pavements
- Easy to produce and install
- Enhanced durability and resistance to wear and tear
- Easy to repair and maintain

Image

Fibre reinforced asphalt pavement - Rock to Road

Spider Diagram



Key Features

- Modified bitumen binder
- Enhanced flexibility
- Improved resistance to cracking and deformation,
- Reduced susceptibility to moisture damage

Advantages

- Enhances pavement durability
- Improves asphalt performance
- Reduces maintenance needs
- Utilizes plastic waste/recycled tire rubber

Disadvantages

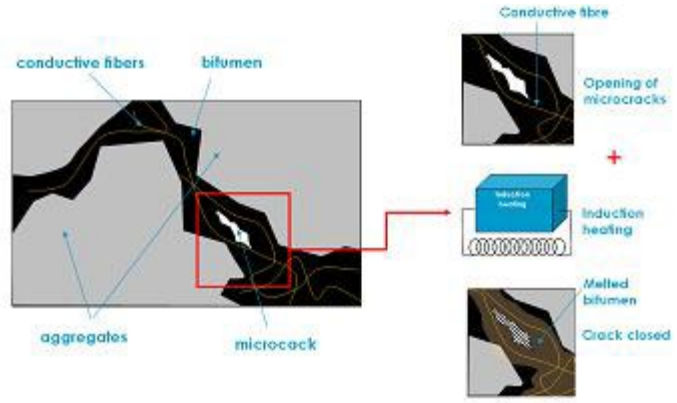
- Mix Design Complexity
- Limited Availability
- Quality Control Challenges
- Environmental Concerns

5.3
New Construction materials - Technology

5.3 New Construction materials - Technology

- **Self-healing asphalt**
  - Repairs micro-cracks as they appear
  - Extends pavement life and reduces likelihood of pothole formation
  - Various approaches - enclosed rejuvenator capsules, nanoparticles, inductive heating of conductive fibres (e.g. graphite, steel, polymer)
  - Self-healing roads could see the end of potholes | CIHT
  - Self Healing Technology for Asphalt Pavements (tudelft.nl)

- **Longer life binders/asphalt**
  - Slows the ageing process of bitumen caused by oxidation
  - Extends life compared to conventional asphalt
  - Innovative longer life asphalt mix used for Northamptonshire resurfacing scheme | New Civil Engineer



2. Sunlight

Oxidation breaks down and dries out the once flexible liquid asphalt that holds the aggregate together. This causes raveling and shrinking cracks which allow water to penetrate beneath the surface.

5.3 New Construction materials - Technology

- **Graphene reinforced asphalt**
  - Increases asphalt strength and resistance to stress/strain
  - Less susceptible to cracking and pothole formation
  - Highways Magazine - Graphene-enhanced asphalt 165% more durable, Oxfordshire finds

- **Ground source heating/cooling**
  - Regulate the temperature of the pavement during extreme temperatures
  - Prevent freeze/thaw during winter – reduces pothole formation
  - Reduce ice formation and need for gritting – safety
  - Cool pavement during high temperatures to reduce asphalt softening/deformation
  - https://www.icax.co.uk/report_on_iht_by_trl.html

5.4 Preventative materials - Traditional

RESURFACING/OVERLAYS:

The application of a new layer of pavement material over the existing road surface.

Deployment method

- Preparation of the substrate
- Mixing and heating
- Transport and paving
- Compaction
- Finishing

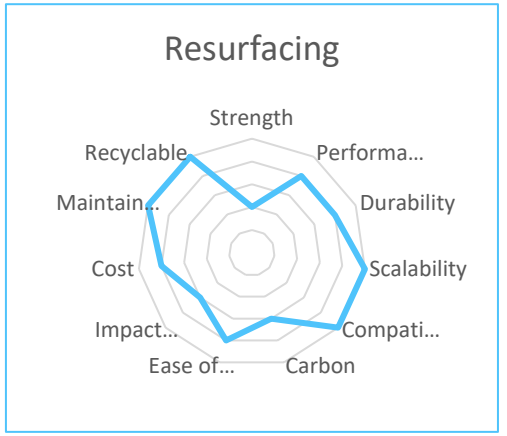
Criteria assessment

- Improve pavement robustness
- Cost-effective compared to full reconstruction
- Environmental impacts vary depending on production methods
- Widely used in the UK
- Extends pavement life
- Easy to install and maintain
- Enhances pavement durability
- Improves road safety

Image

Black Hawk Paving & Construction

Spider Diagram



Key Features

- Structural Reinforcement
- Quick Installation
- Improved Surface Characteristics
- Surface Rehabilitation

Advantages

- Cost-Effectiveness
- Extended Pavement Life
- Improved Workability
- Minimal Disruption

Disadvantages

- Limited Structural Improvement
- Compatibility Issues
- Surface Reflectivity
- Environmental Impact

CRACK SEALING:

A technique used to seal cracks in the pavement surface. The methods involve Overbanding or Resin injection.

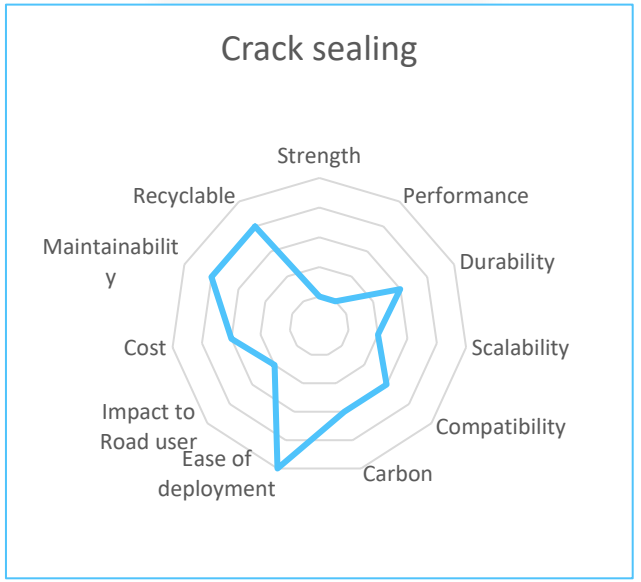
Overband

- A specific method of crack sealing that involves applying an overband seal over the crack after filling it with sealant.

Resin Injection

- A technique that involves injecting a specialized resin material into cracks to fill voids and cracks, restore pavement integrity, and prevent further deterioration.

Spider Diagram



Key Features

- Enhanced Crack Sealing
- Improved Durability
- High Bond Strength
- Quick Curing

Advantages

- Enhanced Performance
- Reduced Maintenance
- Cost-Effectiveness
- Effective Crack Repair

Disadvantages

- Visual Impact
- Limited Effectiveness in Wide Cracks
- Potential for Premature Failure
- Environmental Impact

SURFACE DRESSING:

A technique that involves applying a thin layer of bituminous binder followed by the placement of aggregate chips on the pavement surface.

Deployment method

- Application of a bituminous binder
- Placement of aggregate chips
- Compaction
- Finishing

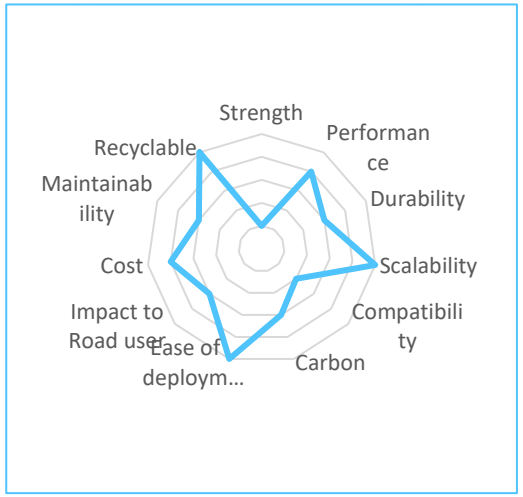
Criteria assessment

- Enhances pavement robustness and durability.
- Cost-effective
- Low carbon footprint
- Widely used in the UK
- Short to medium-term pavement protection
- Easy to handle and install
- Enhance road safety
- Easy to repair and maintain

Image

Surface Dressing - Colas Ireland

Spider Diagram



Key Features

- Enhanced Skid Resistance
- Surface Protection
- Cost-Effectiveness
- Quick Application

Advantages

- Improved Pavement Performance
- Cost-Effectiveness
- Minimal Disruption
- Improved skid resistance

Disadvantages

- Increased noise
- Limited Longevity

PRESERVATIVES / REJUVENATORS:

Additives or treatments applied to aged or oxidized asphalt pavements to restore flexibility, durability, and functionality.

Deployment method

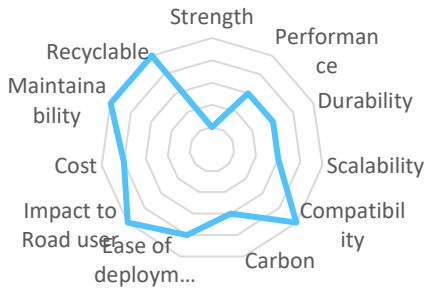
- Cleaning the surface
- Applying the preservative evenly using spray equipment or rollers
- Allowing it to penetrate the asphalt binder and cure

Criteria assessment

- Enhance pavement robustness
- Cost savings by reducing the need for frequent maintenance
- carbon footprint depends on material composition and application method
- Widely used in the UK
- Extends pavement life
- Easy to install and maintain
- Enhances pavement durability
- Improves road safety

Image

Spider Diagram



Key Features

- Protection/restoration of pavements
- Durability / preservation life of surface
- Ease of Application / cost effective maintenance
- Surface characteristics managed

Advantages

- Reduced Maintenance
- Enhanced service lifespan
- Restored flexibility & functionality
- Minimal Disruption

Disadvantages

- Limited Structural Improvement
- Compatibility Issues
- Varied effectiveness
- Environmental Impact

5.5 Preventative maintenance - Technology

INFRARED/REHEAT/MICROWAVE HEATING:

A pavement rejuvenation method that involves heating the pavement surface using infrared heaters or other heating equipment to soften the aged binder and rejuvenate the asphalt pavement.

Deployment method

- Preparation of the subgrade
- Mixing and heating
- Transport and paving
- Compaction
- Finishing

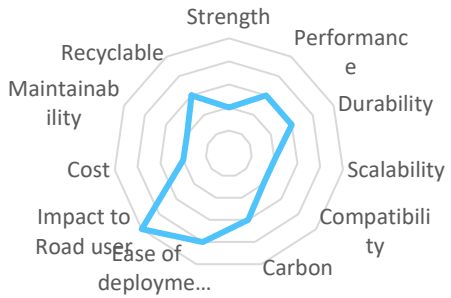
Criteria assessment

- Improve pavement robustness
- Cost-effective compared to full reconstruction
- Environmental impacts vary depending on production methods
- Widely used in the UK
- Extends pavement life
- Easy to install and maintain
- Enhances pavement durability
- Improves road safety

Image

Infrared Patching Erickson Asphalt

Spider Diagram



Key Features

- Surface Restoration
- Pavement Softening
- Localized Treatment

Advantages

- Effective Pavement Rejuvenation
- Localized Repair
- Improved Ride Quality

Disadvantages

- Equipment Requirements
- Environmental Concerns
- Less effective in severely aged or heavily distressed pavements

5.6 Repair materials - Traditional

BITUMEN FILLERS:

Asphalt-based materials used for filling cracks and voids in flexible pavements to prevent water ingress and further pavement deterioration.

Deployment method

- Deployed using pouring, spraying, or troweling.
- Application of material directly into cracks and voids in the pavement
- Compaction

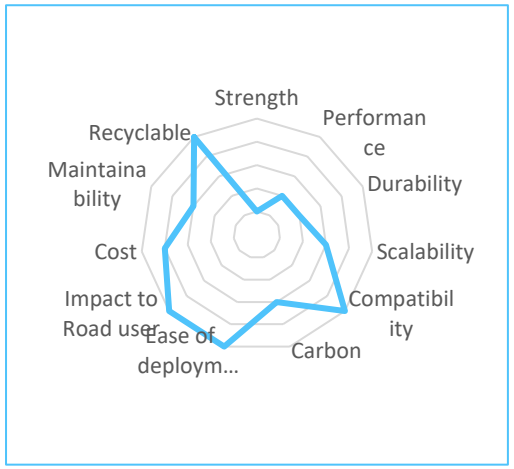
Criteria assessment

- Improve pavement robustness
- Cost-effective solution for crack sealing and pavement maintenance
- Environmental impacts vary depending on production methods
- Effective short to medium-term crack sealing
- Improves road safety
- Improves surface friction and skid resistance
- Widely used in the UK

Image

https://atdmco.com/coat/bitumen-mastic/what-is-2/

Spider Diagram



Key Features

- Waterproofing
- Flexibility
- Quick Installation
- Versatile

Advantages

- Improved Pavement Integrity
- Reduced Maintenance Needs
- Pavement Protection
- Cost Savings

Disadvantages

- Limited Longevity
- Potential for Tracking
- Limited Structural Support
- Limited Application Range

SURFACE PATCHING:

A method used to repair localized pavement defects such as potholes, cracks, and surface delamination.

Deployment method

- Removing loose debris and cleaning the surface
- Applying a tack coat if necessary
- Placement of patching materials into defects
- Compaction

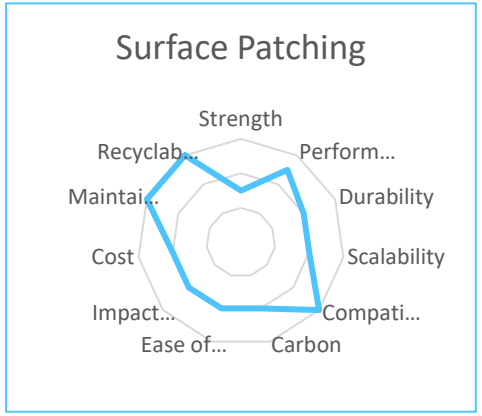
Criteria assessment

- Improve pavement robustness
- Cost-effective compared to extensive pavement rehabilitation methods
- Environmental impacts vary depending on production methods
- Widely used in the UK
- Extends pavement life
- May be temporary and require periodic reapplication
- Enhances pavement durability
- Improves road safety

Image

www.arnoldasphalt.com

Spider Diagram



Key Features

- Immediate Solution
- Durable Repairs
- Ease of Application
- Versatile

Advantages

- Immediate Repairs
- Extended Pavement Life
- Improved Workability
- Minimal Disruption

Disadvantages

- Potential for Premature Failure
- Temporary Repair
- Risk of Future Damage
- Limited Effectiveness

5.7
Repair materials - Technology

COLD MIX BAGGED/TUB PREMIX POUR-IN:

A method used to repair localized pavement defects such as potholes, cracks, and surface delamination.

Deployment method

- Removing loose debris and cleaning the surface
- Pouring the material into the pavement defect
- Compaction

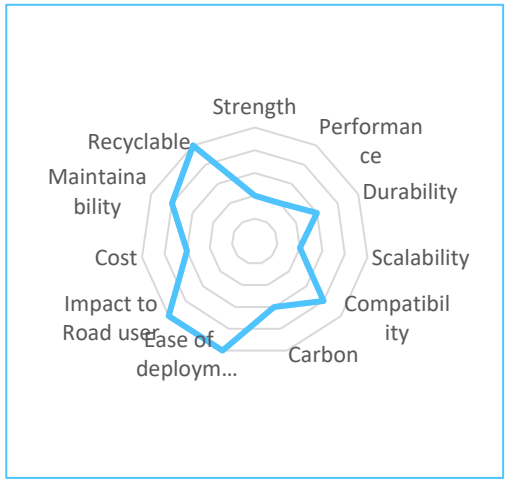
Criteria assessment

- Improve pavement robustness
- Cost-effective compared to extensive pavement rehabilitation methods
- Environmental impacts vary depending on production methods
- May be temporary and require periodic reapplication
- Improves road safety
- Widely used in the UK

Image

www.bitumer.com/coldmixasphalt

Spider Diagram



Key Features

- Convenience
- Long Shelf Life
- Ease of Application
- Versatile

Advantages

- Immediate Repairs
- Cost Savings
- Immediate Traffic Access
- Cold Weather Application

Disadvantages

- Lower Durability
- Temporary Repair
- Risk of Future Damage
- Limited Effectiveness

5.8
Repair plant - Traditional

5.8 Repair plant - Traditional

- **Jet patcher**
- All dust, debris and moisture from the affected area
- The defect is sealed using cold-applied bitumen emulsion
- The defect is filled and leveled using an aggregate/cold bitumen emulsion mix, all from the single delivery hose.
- The Jetpatcher is manually operated from the self-contained vehicle and carries all equipment and materials required to undertake the operation
- Jetpatcher.com.

5.9 Repair materials - Technology

5.9 Repair plant - Technology

- **Automated repairs, examples include**
  - JCB Pothole Pro
    - Interchangeable parts for plant vehicle to remove exiting material, cut edges & clean area ready for asphalt patch
    - Pothole repair in 8mins
    - JCB Pothole Pro
  - Velocity
    - Spray injection patching
    - High speed air cleans area of pothole
    - Area coated in cold bitumen to enable good bond/seal with existing pavement
    - Repair material (cold-mix asphalt) injected at high speed
    - Reduces repair time, lower carbon c.f. hot mix patch, immediate trafficking
    - Spray Injection Patching - Velocity (velocityroads.co.uk)

5.9 Repair plant - Technology

- **Next stage Technology - Autonomy**
  - Robitiz3d
    - Zenzic Scale-up Cohort 4
    - ARRES Eye - laser-based crack and pothole detection equipment
    - ARRES Prevent - robot arm to fill cracks & potholes detected by ARRES EYE
    - Equipment mounted on semi-autonomous vehicle
    - Robotiz3d: Road Maintenance, Reinvented

6.0 Next Steps

Short term

Prioritise and harmonise approach to pothole repairs to ensure they are rapid and cost-effective

Identify best short term solutions to reduce annual repair bill

Continue implementation of PAS2161

Medium term

Design and implement process for benchmarking of new technology and materials

Consider use of accelerated pavement testing to identify appropriate materials and solutions

Improve whole life value asset management and upskilling to embed for LA staff

Long term

Support research aimed at identifying sites at risk of pothole formation so preventative techniques can be targeted.

Implement new technology for identification and repair of potholes

Annual audit process for each supplier/technology (e.g. develop Technology Readiness Levels)

Implementation of accelerated pavement testing