

## **APPENDIX A**

### **Programmed and Preventative Maintenance of Carriageways**

#### **1. Programmed Resurfacing**

##### **1.1 Techniques to Resolve the Issues**

###### **1.1.1 Resolving Surface Condition**

The decision on technique, will relate to the location of the site, whether it is urban or rural and the likely volume of traffic.

For urban situations, the preferred choice would be to plane & inlay a new surface course. As an alternative, where traffic volumes are low or in residential housing areas, surfacing such as slurry seal, surface dressing and proprietary micro asphalts would be considered.

In rural situations, the solution would probably be a surface dressing or proprietary micro asphalt. In the case of surface dressing, it will eventually get to the stage where multi layers of dressing have built up over the years, bitumen will start to bleed through in hot weather, and at that stage the dressings will have to be removed and replaced with a surface course inlay.

###### **1.1.2 Resolving Structural Condition**

Structural failure is a very expensive problem to solve. It will involve the total removal of the bituminous layers (200 – 220mm) and the replacement of the granular sub base (250mm), followed by the renewal of the bituminous layers.

An alternative to reconstruction is full depth insitu recycling. This involves the rotovation of ~300mm of the road surface, injecting either bitumen or cement and rolling to provide a new foundation. Costs are high, but cheaper than full reconstruction and the method is not suitable for heavily trafficked roads. It needs a conventional surface layer to protect the material as it cures, but by its nature, has considerable environmental benefits.

## 1.2 Options for Surfacing Materials

### 1.2.1 Surface Course

Surface Course refers to the top layer of a blacktop road construction which provides the running surface for the traffic. It will contain a hardstone aggregate rather than a softer limestone aggregate to resist wear from the traffic.

(a) Thin Surface Course Systems (TSCS) / Stone Mastic Asphalt (SMA)

These materials were developed in Europe in the 1960's, with its first use within Halton being the mid 1990's. They are rut resistant, and on major roads can be laid without the need for a road closure due to the lack of need for a separate chipping machine. In urban areas, however, due to limited widths and health & safety requirements, road closures still tend to be the method of traffic management used.

The finish is smooth, quieter than a HRA with chippings and can consequently provide significant aural environmental benefits in urban residential areas. The surfacing can be thinner than HRA, ranging from 30mm to 40mm, with an aggregate size of 10mm or 14mm. As such, they are cheaper to purchase and lay.

However, Tarmac has introduced a 20mm size aggregate which can be laid at thickness up to 75mm, which is still classed as a thin surfacing system. This provides the benefit of removing the existing surface course and part of the binder course and replacing it with one layer whilst still retaining the structural properties. This can provide benefits for us both in time and money and is a useful method for improving structurally unsound unclassified urban roads which are carrying modern heavy vehicles.

Thin surfacing however, has its own problems. These range from a reduced life span of between 8 – 15 years, to a difficulty in laying by hand in small areas. The material is also prone to early life skidding issues until the surface bitumen has worn away. Guidance notes advise the installation of warning signs for the first six months of the surfacing life. There are also environmental issues as TSCS use approximately 3 times the amount of premium hardstone than a HRA with chippings surface would. This is a problem due to the premium quality hardstone being a finite and diminishing resource.

(b) Hot Rolled Asphalt (HRA) with precoated chippings

This was once the surfacing material of choice for all major roads and motorways. However, in the last 15 or so years, it has been replaced by Thin Surfacing / SMA's on the Trunk Road network and for a time on the Local Authority network.

HRA is a high grade asphalt product with a wide range of applications and is the most common type of carriageway surfacing in the UK for major roads. In terms of both durability and surface friction, there has been nothing better than HRA. However, because of the need to apply coated chippings to the surface as a separate but concurrent operation during laying, the process necessarily takes up more room across the width of the road leading to greater traffic congestion and so, higher road user costs and where specified, high chipping spread rates applied to achieve high texture depth can lead to subsequent loss of chippings after the road is opened to traffic.

In addition, technical advances in HRA have not kept pace with the increases in traffic flows, vehicle loads and increases in summer temperatures globally. The latter of these causes the asphalt to rut under load.

There is a school of thought that the forecast climate change of + 3 degrees summer temperature by 2020, will see the end of HRA as a heavy duty surface course.

Consequently, we limit the use of HRA with chippings to roads where rutting is less likely to occur due to the type and volume of traffic and the geometry of the road.

(c) High stone content HRA

This type of HRA does not require a separate process for rolling in chippings into the surface as the asphalt mixture includes small sized stone in the mix to give a surface texture. As such the Traffic Management requirements are the same as Thin surfacing /SMA. However, the macro texture is inferior to a HRA with chippings leading to its use on lower speed roads rather than high speed roads. It is a very useful material which due to its relatively high bitumen content and being sand based makes it virtually impermeable to water.

(d) Dense Bitumen Macadam (DBM)

Due to the low life span of between 5 – 8 years, and the need to surface dress the surface after a short period of time, this material is no longer used as a maintenance option for surface course within Halton.

### **1.3 Other Processes**

#### **(a) Retread**

This is a variation on full depth recycling, but only deals with the top 100mm of surfacing and so it is used as an alternative to a surface course / binder course inlay. It is ideal for rural locations, or urban housing areas with little heavy traffic to provide a reasonable running surface. It involves rotavating the existing top 75mm minimum of blacktop, spraying with new bitumen and then rotavating again. The surface then has a surface dressing laid over the top. Consequently this gives the finished surface the same life span as surface dressing, but at increased cost. However, there are the obvious environmental benefits from recycling the in-situ materials in the reduction of vehicle movements and reductions in land fill. Unfortunately, it is rarely used in Halton as although it is ideal for rejuvenating unclassified urban roads, it requires 75mm thick minimum of existing blacktop to recycle which we simply do not have on our roads.

#### **(b) Full Depth In-situ Recycling**

In the case of reconstruction it is possible to rotovate the whole of the top 300mm of the road surface, inject bitumen and/or cement and roll to provide a new foundation. Costs are high but cheaper than full reconstruction and also quicker which can be a benefit to residents. As the material is processed in-situ it reduces the disruption to residents as they can drive over the material as the process continues unlike a full depth reconstruction which creates a huge hole in the road. Unfortunately, the method is not suitable for heavily trafficked roads and can have problems in urban areas due to buried services. It needs a conventional surface layer to be laid over the top to provide a durable layer that can be trafficked long term.

Other materials and processes are continuously being introduced but costs for these vary greatly, and care must be taken on site selection and cost benefit compared to conventional surfacing.

### **1.4 Deteriorating Safety**

- 1.4.1 There are a number of ways to improve the Macro and/or Micro texture of a road surface. The most expensive method is to replace the existing top layer of blacktop with new material. This could be either with a new blacktop surface layer as described earlier, a proprietary High Friction Surfacing which are used in high risk areas or for lesser cost, where appropriate, a surface dressing. The alternative to replacement is to retexture the existing surface. This is available if the existing blacktop material is still durable and in acceptable condition other than the texture issues.

There are three processes which aim to achieve this from different approaches.

- Water Jetting
- Shot Blasting
- Bush Hammering

Water jetting is used to increase the Macro texture of a surface and can be used to remove excessive bitumen from a surface. It will not improve the Micro texture of the stone in the blacktop. It is relatively cheap and quick but can be detrimental to the long term durability of a surfacing as it removes more bitumen and binder from the surfacing than the other techniques. Usually the equipment is lorry mounted which makes it unsuitable for roundabouts and tight geometries.

Shot blasting can be used to improve both the macro and micro texture of a road surface as the individual shot chips and roughens the stone in the surfacing as well as removes bitumen and binder from around the stone improving the macro texture. It is a relatively new process in the UK with similar costs to water jetting. There are currently quality issues as the degree of retexturing is governed by the forward speed of the vehicle, the velocity of the shot and the size of the shot. Whilst companies and operatives become accustomed to the process, the results can be different from one pass to the next which can generate safety issues rather than solve them. It cannot be carried out in the rain which isn't useful in our climate.

Bush Hammering will improve the Micro texture of a road and can also slightly improve the Macro texture. The process involves spring loaded hammers being mechanically struck onto the road surface which chips the stone in the road surface which improves the micro texture and also strikes the surrounding binder removing small elements to improve the Macro texture. This is usually the process that is used in Halton as it is quick, cost effective and can be completed in the rain. There is only one supplier for this process in the UK who, by coincidence, is located in Widnes which means that they can usually fit us in around their other work.

## **2. Preventative Maintenance**

## 2.1 Surface Dressing

Also known as “Tar Spray & Chip” as historically Tar was used, this process provides a new positive texture and waterproofs the underlying surface. The Polymer Modified Bitumen Binder glues and seals any surface cracking and prevents water ingress into the lower construction layers, whilst the chippings provide the new surface texture and provide a running surface for vehicles over the bitumen. It is similar to the analogy of repainting wooden windows that are structurally sound but whose paint has started to flake.

Again, there are problems associated with this process. A temporary 20mph speed limit needs to be maintained during the laying process and immediately after, to ensure the new chippings are sufficiently embedded. Due to the process having to “over chip” initially, there is the risk of claims from the public caused by loose chippings, although it is fair to say that the majority of these claims are due to the motorists exceeding the 20mph speed limit.

Due to the increased surface texture, it can also be a noisy surface, and for this reason, care is taken over the type of urban site it is used on, (usually slow speed urban residential), although there are no such limitations when it comes to rural sites. These issues can be reduced by the selection of a small chipping size if traffic volumes and types allow.

Another problem with Surface dressing when it is initially laid in an urban environment is that as residents reverse off their driveways, due to the narrow road widths they have to turn their steering wheels from lock to lock without moving the vehicle and rotating the tyres. This rolls the newly laid chippings under the tyres in the sticky bitumen which then leaves black circles of coated chippings which are unsightly and can be trafficked into properties on the soles of shoes etc. This is a phenomenon that has arisen over the last 5 years. Consequently, Surface Dressing is no longer carried out on narrow urban streets.

Life expectancy for surface dressing is in the region of 8 years, with whole life costs benefit being increased by repeating the process every 7-8 years. However, as mentioned earlier, roads that have had multiple applications of surface dressing are more likely to bleed in hot summer months and produce pools of bitumen on the surface. Remediation action in the form of high pressure water jetting can resolve this issue up to the point where the dressing needs to be removed and replaced with a new surface course. Consequently it is usual to only repeat the process 2 or 3 times.

## 2.2 Slurry Surfacing / Micro Asphalts

Slurry surfacing is a very similar process to surface dressing. The slurry is made up of water, bitumen, cement, stone and a binding agent. It waterproofs and holds together the fabric of the highway. It is fine graded and low in texture depth, and because of this, it is more suitable to low speed housing estates. Some heavy duty slurry surfacing with a larger aggregate size have the ability to regulate out minor undulations in the existing surface, up to say 6mm – 10mm. The life expectancy is similar to that of surface dressing, with a slightly increased cost. It is usually mixed and laid by hand leading to variable aesthetic quality and limiting the area that can be laid in a day.

Micro-asphalt Surfacing is a multi layer version of Slurry Seal and can restore a desirable profile, improving ride quality. It is typically undertaken on busy urban thoroughfares, housing estates and hard shoulders. The finished machine laid surface has low noise characteristics, and good riding qualities. It is an efficient process that allows us to reduce time spent on site and minimise disruption. It is, however, restricted by weather conditions, both rainfall and low temperatures.

### 2.3 Spray on processes.

Recently a family of new products have entered the UK marketplace and are still evolving. The first of these was sold as “moisturiser for roads” and contains a mixture of new bitumen and a mineral called Gilsonite which is only mined in Utah. This replaces the lost asphaltines and maltine fractions in the surface bitumen through the ageing process and effectively prolongs the life of the surface. It has been used in Halton as a trial on Thin Surfacing material located on roundabouts as there aren't any other preventative processes available for that geometry of road. It is sprayed on and requires the road to be closed for a number of hours whilst the process takes place and the solution is absorbed. It requires a dry period of at least 1 hour post spraying which can make it awkward to lay in our climate.

The next wave of products, which are just coming onto the market, aim to rejuvenate the bitumen in the surface and reverse the ageing process. These are very expensive at the moment and have not been trialled as yet in the borough but have the potential to dramatically alter how we maintain our road network in the future.