SURFACE ENRICHMENT SPRAYS AS A COST EFFECTIVE SOLUTION FOR PREVENTIVE MAINTENANCE

Back to Author's Index

G.D. van Zyl, T. Distin and K. Louw

PD Naidoo and Associates
PO Box 7786, Roggebaai, Cape Town, 8012.

ABSTRACT

More than 80% of all surfaced roads in southern Africa are surfaced and/or resurfaced with surfacing seals which include sand seals, single chip seals, double chip seals, slurry seals and combination seals e.g. Cape seals.

The application of enrichment sprays has been practiced for more than thirty years and has generally been accepted by major road authorities as a low risk and cheap solution to extend the life of existing surfacings. However, several concerns have been raised in recent years regarding the appropriateness of this preventive treatment and the effectiveness of the various products available.

Following several investigations into problems experienced and arguments related to enrichment sprays, the need was identified to obtain the opinions of practitioners and binder suppliers in an effort to record the current best practice in southern Africa.

1. INTRODUCTION

Diluted emulsion application as enrichment sprays has been practiced for more than thirty years and has generally been accepted as a low risk and cheap solution to extend the life of existing surfacings.

Following several investigations into problems experienced and arguments related to diluted emulsions, the need was identified to obtain the opinions of practitioners and binder suppliers in an effort to publish the current best practice in South Africa as part of the national guideline document TRH3: Design and Construction of Surfacing Seals for the Urban and Rural Environment (1).

The purpose of this paper is to:

- Discuss the purpose of enrichment and rejuvenation sprays.
- Provide some background to the intrinsic properties of bitumen emulsions and inverted cutback bitumen emulsions.
- Discuss the factors causing surface deterioration.
- Provide recommendations for the selection of the appropriate type of enrichment and rejuvenator sprays and emulsion composition
- Discuss the required binder application rates
- Discuss appropriate timing of application
- Provide guidelines for on-site application

- Discuss the cost effectiveness of enrichment and rejuvenator sprays
- Highlight typical problems and solutions

The paper is structured to consecutively address each of the abovementioned aspects.

The paper could be of value to road authorities, consultants and contractors tasked with decision making, design and application of diluted emulsions on surfacing seals

2. PURPOSE OF ENRICHMENT AND REJUVENATION SPRAYS

2.1 General

Bitumen emulsions can be diluted with water for the following purposes:

- As a cover spray for newly constructed single or double seals to prevent/ reduce aggregate loss
- Enrichment and rejuvenation of dry/porous surfacings, often as a pre-treatment before resurfacing operations
- As a prime coat on granular base courses
- As a tack coat for asphalt overlay
- Slushing of natural gravel base layer on low volume roads prior to surfacing

For the purpose of this paper only the first two applications are discussed in detail.

2.2 Prevent/Reduce Aggregate Loss on New Seals

Aggregate loss sometimes occurs soon after construction due to various reasons such as:

- Too low binder application rates
- Insufficient rolling
- Poor binder/aggregate adhesion
- Cold temperatures
- Open to traffic too soon and traffic speed limit not controlled

One of the most cost-effective ways to prevent premature ravelling could be to add binder to the newly constructed seal in the form of a diluted emulsion.

Due to the fairly coarse texture of the new seal and the need to create a bond between the aggregate as shown in Figure 1, a rapid setting grade emulsion is considered appropriate for this situation.

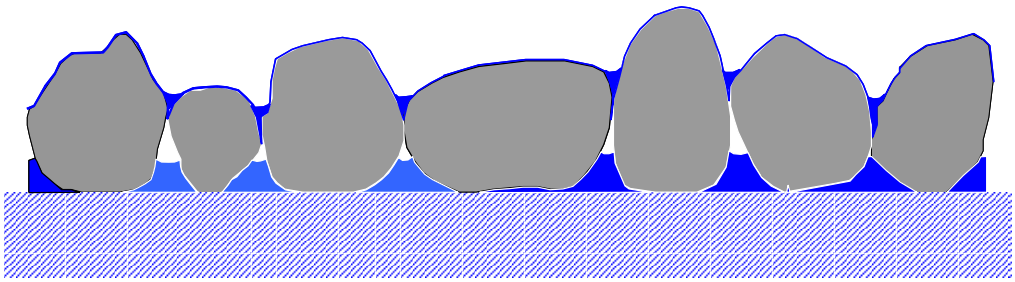

Figure 1. Dilute emulsion cover spray.

2.3 Enrichment and Rejuvenation of Dry/Porous Surfacings

2.3.1 Enrichment sprays

The main function of a diluted bitumen emulsion is to retard stone loss and partly enrich the binder in aged stone seals. Dilution of bitumen emulsion with water lowers the viscosity permitting easier penetration into the surface voids. Refer to Figure 2. The water evaporates leaving a residual deposit of bitumen to improve stone retention. Excess bitumen deposited on the stone is ridden off with traffic.

The most common feeling with enrichment sprays is to get as much as possible new binder as low as possible in the existing seal.

Experience (several case studies) indicate that diluted emulsion application:

- Partly enriches the existing binder
- Drastically reduces permeability of the existing surfacing
- Improves the performance of follow-up resurfacings (slurry seals and stone seals)

Dependent on the initial binder application, enrichment sprays could be applied up to three times during the life of a single 13,2mm seal, each time extending the effective life of the seal with up to three years.

With reference to the above, the appropriate type of binder would be a low viscosity stablemix grade bitumen emulsion that could flow around the existing particles, penetrate and fill up from the bottom. Refer to Figure 2.

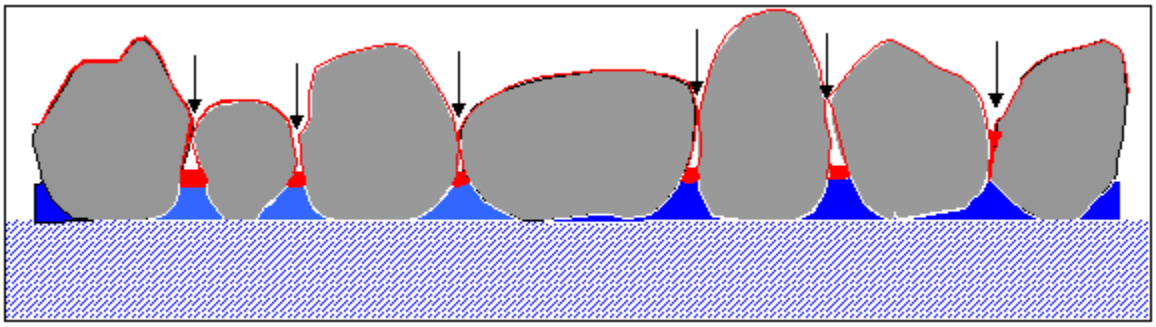

Figure 2. Dilute emulsion enrichment spray.

2.3.2 Rejuvenation sprays

Bituminous surfacings deteriorate with time due to various reasons. In the drier parts of southern Africa and especially on low volume roads, the effect of oxidation and hardening of the bituminous binder result in porous surfacings, surfacing cracks and/ or aggregate loss.

The purpose of rejuvenation is to improve the flexibility of the binder by the addition of aromatic oils and paraffinic cutters, which are lost with time. Standard grade bitumen emulsions do not have the solvency power to penetrate existing dry and brittle surfacings and therefore special inverted cutback emulsions are formulated for this purpose.

Whilst these special emulsions also add new bitumen to the surfacing, they have the added benefit of rejuvenating the aged bitumen. This is achieved via the cutter medium which also helps the rejuvenator penetrate the existing surface up to 10 mm, depending on the type of surface.

Other benefits of rejuvenator sprays are:

- Help close up hairline cracks under traffic
- Prevent stone loss
- Improve surface impermeability

3. INTRINSIC PROPERTIES OF BITUMEN EMULSIONS

3.1 General

The purpose of this section is to provide some background to practitioners regarding the development of different types of bitumen emulsions. A clearer understanding of the purpose of different products should minimize inappropriate specification.

The manufacturing of bitumen emulsions have developed in South Africa over the past 75 years with the aim to provide appropriate products for specific situations and applications.

3.2 Emulsification of Bitumen

Bitumen emulsion consists of three basic ingredients: bitumen, water and emulsifying agents. When bitumen and water containing an emulsifier are introduced into a colloid mill, which is a high-speed dispersing apparatus, the bitumen is broken down into microscopically sized spheres. The emulsifier molecules are adsorbed on the surface of the bitumen particles, lowering the interfacial surface tension between the bitumen and the water, and allow a stable dispersion of bitumen in water to be formed. If the emulsifier imparts a negative charge to the bitumen particles, the emulsion is classified as an anionic emulsion. Conversely, if the emulsifier imparts a positive charge to bitumen, the emulsion will be classified as cationic.

3.3 Emulsifiers

The purpose of the emulsifier is to suspend the bitumen particles in the water phase and to impart specific breaking characteristics to the bitumen emulsion.

Anionic emulsions are prepared with alkaline solutions of long chain fatty and rosin acids, whilst cationic emulsions are prepared with acidified solutions of long chain amines and its derivatives.

The type and quantity of emulsifier used will determine whether the emulsions will have rapid setting, medium setting or slow setting characteristics.

The use of anionic spray and premix grade emulsions have decreased considerably over the last twenty years, as the equivalent cationic grades are more rapid setting due to the chemical interaction with the aggregate. Anionic stable grade emulsions are still widely used.

3.4 Addition of Flux

Illuminating paraffin flux and other petroleum solvents are commonly added to cationic spray grade and cationic premix grade emulsions. The addition of solvent flux to spray grade emulsions enhances the breaking characteristics of the emulsion and chip retention during low temperature conditions. The quantity of flux is varied seasonally and could vary from 0% in summer to 5% by mass of the binder during winter. When solvent fluxes are added to premix grade emulsions, it enhances the coating of the aggregate by the binder and also extends the stockpile life of the cold mixes.

3.5 Product Ranges and Purpose of Development

3.5.1 Unmodified emulsions

Rapid setting emulsions were developed for chip and spray applications. These emulsions are reasonably unstable, and are formulated to have sufficient stability to allow for heating, pumping and application on the road, but after application, the emulsion rapidly breaks down on contact with the aggregate and during mechanical rolling. Surfaces can thus be opened to traffic shortly after application of the aggregate.

Medium setting emulsions have slightly higher stability than rapid setting emulsions. These emulsions are capable of mixing with clean, dust free aggregate and are commonly used for the preparation of cold mixes for patching.

Slow setting emulsions can mix with cement and very fine aggregate particles, allowing for the preparation of slurry mixes and dense graded cold mixes. They are also commonly used for soil stabilisation purposes.

3.5.2 Polymer modified emulsions

Anionic emulsions were first modified with natural and synthetic latex. The setting characteristics of these emulsions were, however, very slow. Cationic polymer modified emulsions are today widely used due to the enhanced breaking behaviour of these emulsions.

Two types of cationic polymer modified emulsions are commonly available in South Africa. These are: spray grade and Microsurfacing emulsions.

These emulsions are normally modified with SBR latex. Modified spray grade emulsions are used for resealing of cracked roads, whilst the Microsurfacing emulsions are used for preparation of rapid setting slurries. The residual SBR content of these emulsions varies from 3 to 5% by mass of binder.

3.5.3 Dilute emulsions

The following grades of bitumen emulsion can be diluted with water and used for enrichment sprays or fog sprays:

- Anionic or Cationic Stablemix 60%
- Unfluxed Cationic Spray 60, 65 or 70%
- Unfluxed Cationic Spray 65 or 70% modified with SBR latex
- Latex modified cationic microsurfacing emulsion

The decision on which type of diluted emulsion to use will depend largely on the purpose and most desirable flow characteristic of the emulsion.

3.5.4 Inverted cutback emulsions

An inverted emulsion is manufactured from a cutback bitumen with the addition of aromatic oil and a cutback medium. Inverted emulsion differs from that of a normal bitumen emulsion in that the water is dispersed in the binder which is the continuous phase. Once sprayed, it penetrates into dried and aged bituminous surfaces, and rejuvenates the binder, thus extending the time required before resurfacing.

When more binder is required in the surfacing it is recommended that bitumen emulsions be used, whilst inverted cutback emulsions are used when the oxidised binder needs to be rejuvenated.

4. SURFACING DETERIORATION

4.1 General

The typical deterioration of a bituminous surfacing is shown in Figure 3.

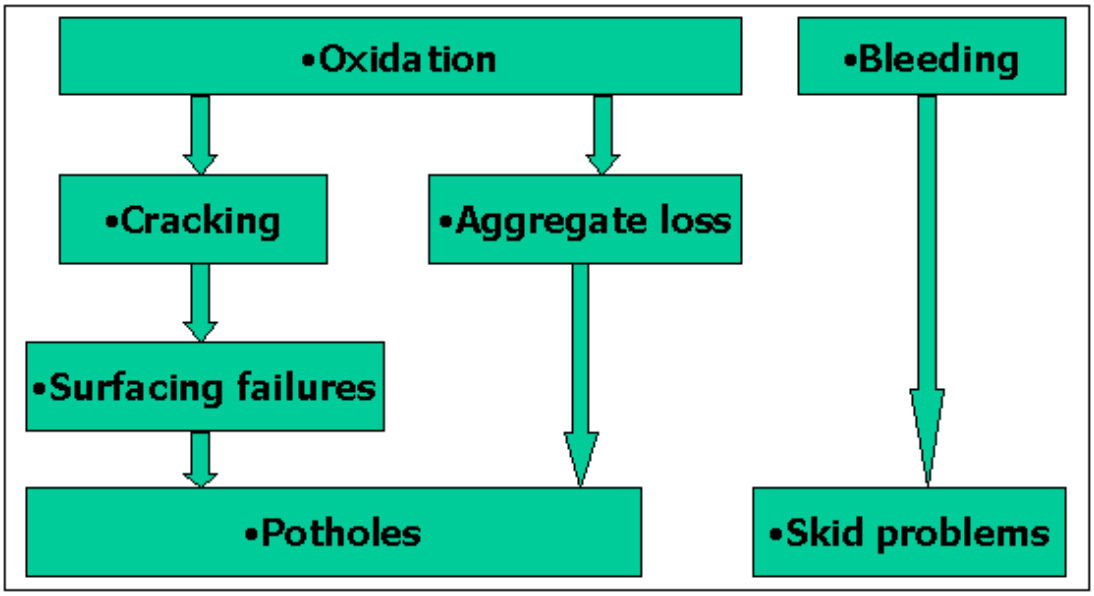

Figure 3. Surfacing deterioration.

4.2 Rate of Oxidation/ Hardening

No formal research results are available to quantify the rate of binder hardening in South Africa. However, based on and opinions of South African practitioners, the hardening of bituminous binders is a function of:

- Exposure
- Film thickness
- Humidity
- Binder quality
- Ultra violet radiation

The maximum air temperatures in all areas of southern Africa exceed 35ºC whilst the duration of sunshine varies from more than 80% of possible duration in the north-western parts to 70% over the remainder of the interior to less than 60% in the coastal areas. The high levels of ultra violet radiation coupled with the high summer temperatures are believed to correlate with the rapid aging of bituminous surfaces in the more arid north western parts of southern Africa. Figure 4 shows three different climatic regions based on the so-called Weinert N values (2) (Based on evaporation).

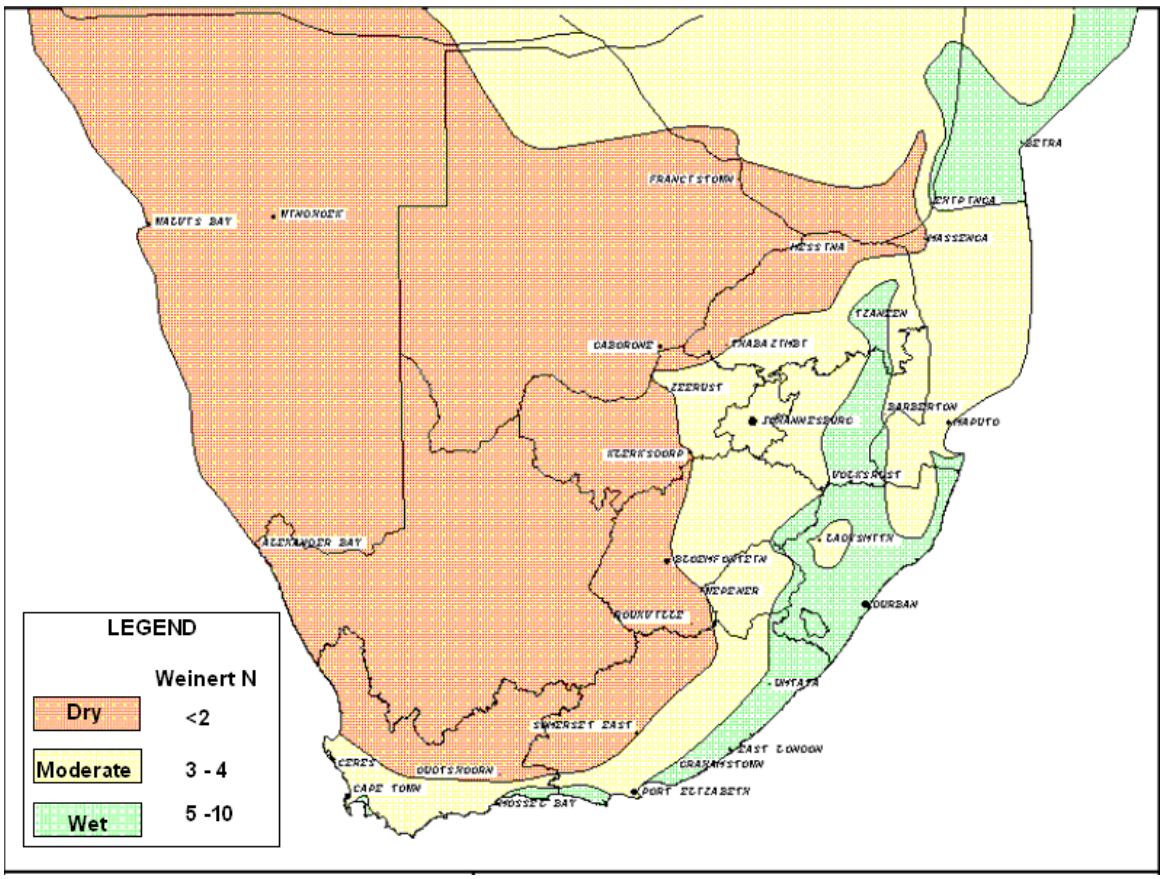

Figure 4. Climatic regions of Southern Africa.

5. SELECTION OF APPROPRIATE MEASURES

5.1 General

The purpose of this section is to assist practitioners in the identification of appropriate situations for the application of diluted emulsions for enrichment sprays.

Refer to TRH3 (1) for initial selection

5.2 Assessment

The purpose is to identify whether

- Additional binder is required to prevent stripping
- The product can and/or should penetrate into the existing surfacing

Constraints influencing the selection are:

- Sufficient voids and or texture exist to accommodate the additional binder
- Gradient of the terrain
- Whether traffic can be accommodated
- Climatic conditions at time of application

5.3 Selection Criteria for Emulsions

Table 1 provides guidelines for selection of suitable emulsions.

Table 1. Selection criteria for emulsions.

Condition	Type of emulsion			
	Stablemix	Spray grade	Latex modified	Inverted e.g.MSP 3
Coarse textured	1	2	2	1
Dense textured	1	2	0	0
Flat gradient < 3%	1	2	1	1
Steep gradient > 3%	0	1 see 6.1	2	0
Dirty surface	2	0	0	0
Cold temperature	2	1	2	0
Hot temperatures	2	2	0	1
Traffic accommodation	2	1	2	0

1 = primary recommendation 2 = secondary recommendation 0 = not suitable

5.4 Selection of Appropriate Composition and Application Rate

5.4.1 General

The purpose of this section is to give some guidance as to appropriate dilution ratios and application rates for different situations.

The factors mostly affecting the performance of emulsions as an enrichment spray are:

- Type and grade of emulsion
- Weather conditions
- Presence of cutters

5.4.2 Type of grade of emulsion

Cationic spray grades will tend to break quicker than anionic and cationic stablemix emulsions. Thus with spray grade emulsions the binder will tend to be deposited on top of the stone chips whereas stablemix emulsions will tend to flow into the voids more easily. Cationic emulsions will render improved binder/aggregate adhesion due to the chemical reaction which takes place between the positively charged bitumen droplets in the emulsion (and latex if used) and the free negatively charged ions of the aggregate.

5.4.3 Weather conditions

The prevailing weather conditions will affect the ‘breaking’ of a diluted emulsion. In the case of colder weather and in shaded areas, the lower temperature retards the breaking action of the emulsion. In the latter instances quicker breaking Cationic spray grades should be used.

During hot weather, latex modified emulsion will tend to form a skin which could create a false perception that the emulsion has broken. The emulsion must be checked by scratching with a knife to ensure that it is uniformly black under the skin.

In hot weather, the residual binder film tends to become tacky resulting in pick up on the tyres. When the expected road surface temperature is above 50 °C then a higher softening point binder such as 60/70 penetration base bitumen must be considered.

As a general guideline the following closure times should be observed after spraying, based on prevailing weather conditions:

- Hot, windy day: < 2 hours
- Overcast, cool day: < 4 hours

If the road is opened too early to traffic, the fog spray will pick up. If it becomes necessary to open to traffic, use coarse sand to blind areas which are not properly dry in order to reduce the tackiness.

There are some time and drying constraints to be considered when selecting candidate pavements for treatment with inverted emulsions e.g. MSP 3™, particularly in cool conditions or climates with high humidity. When applied on coarse surfaces such as chip seals, traffic can be allowed onto the surface within 4 hours, whilst the drying/penetration time on dense asphalt surfaces could be up to 36 hours.

5.4.4 Presence of cutter

The presence of cutter in emulsion is not desirable when used as an enrichment spray, as the residual binder tends to remain tacky after breaking. It must also be noted that all standard spray grades of emulsion are formulated with between 2% and a maximum of 5% cutter to improve the cohesion development of the residual binder when applied in stone seals. Therefore, when ordering spray grade emulsions for fog spraying purposes, it is important that the binder supplier be requested to omit the cutter in the emulsion formulation.

6. DESIGN

6.1 Binder Application Rates

The texture of the existing surfacing largely determines the application rate. A fine texture requires a light fog spray application whereas a coarse or open textured surface can take a heavier application. An indication of the maximum application rate that a surface can tolerate is definite signs of run off from the existing road surface. The maximum application rate could be up to 1.2 litres per square metre.

The lowest application rate is a function of:

- The minimum spray rate that the binder distributor can spray accurately, which is typically about 0.5 litres per square metre. This equates to a net residual binder of 0.15 litres per square metre for a 50:50 diluted 60% solids emulsion.
- Flow characteristics of the emulsion. Several practitioners recommend a minimum application rate of 0.8 litres per square metre on 13.2 mm seals to ensure that the aggregate is properly covered.
- Some guidelines appear in Table 2 below, but the application rate should be adjusted on-site to avoid problems with over application. In this regard the reader is also referred to the Gautrans manual (3).

Table 2. Application rates.

Existing surfacing	Diluted emulsion (30%) Litre/m²		Inverted emulsion Litre/m²	
	Diluted emulsion	Residual binder	Inverted emulsion	Residual binder
13 mm single seal	0.9 –1.2	0.27 - 0.36	0.6	0.27
13/6 mm double seal	0.8 – 1.0	0.24 – 0.30	0.5	0.23
Cape seal	0.5 – 0.7*	0.15 – 0.21	0.5*	0.23
Asphalt	0.5 – 0.6*	0.15 – 0.18	0.5*	0.23

*Only if surface is open textured

6.2 Binder Content

The bitumen emulsion is normally diluted in a 1:1 ratio with water. This ratio can be varied to overcome certain constraints e.g.:

- In the event of steep grades it is recommended that a spray grade be used with a lower dilution of 70:30 to prevent runoff.
- If the emulsion has to be transported long distances from the source then consideration must be given to using a higher binder content emulsion such as a cationic spray grade 70 or to rather dilute on-site to reduce the effective transport costs.

The lowest recommended binder content is 25% m/m of the diluted emulsion. Diluting the emulsion further will weaken the electrochemical charges thus rendering the end product unstable.

7. APPROPRIATE TIMING

The appropriate timing of diluted emulsion application as a preventive treatment is still considered by many practitioners as an art. The need is often based only on the amount of binder holding the stone and the risk of aggregate loss.

Parameters included in South African assessment methodology to identify the need for seal rejuvenation/ application of diluted emulsions are:

- Macro texture
- Voids to accommodate additional binder
- Dry/ brittleness of the binder
- Aggregate loss
- Low degree surfacing cracking due to hardening of the binder

The appropriate time during the year for application is dependent on the purpose and temperature constraints. Cognisance should be taken that:

- Fine surfacing cracking could close up during summer
- Surface temperatures could increase to above 60 degrees Celsius during summer
- Cold temperatures delay the breaking of emulsions

8. ON-SITE GUIDELINES

8.1 General

Some guidelines for surface preparation and application of dilute emulsions for enrichment or rejuvenating of existing surfaces have been obtained from practitioners and are hence provided.

8.2 Road Preparation

The road surface should be clean as dust will cause the fog spray to pick up on tyres. The area to be sprayed needs to be broomed to remove the loose stone chips and dirt prior to spraying. Patching and crack sealing is usually done after the application of enrichment or rejuvenating sprays as the emulsion will act as a prime for retaining the sealer.

8.3 Dilution Process

The water used for the dilution must be potable, free of soluble salts or suspended solids ie be suitable for human consumption. It is recommended that the candidate water be subjected to a dilution test to check its compatibility with the proposed grade of emulsion. This is best done adding half a litre of the water to the required amount of emulsion and leaving it to stand in a transparent container to observe if there is any separation with time. If separation problems occur the water can be stabilised by adding hydrochloric acid for use with cationic grades and caustic soda for anionic grades. It is best to dilute the emulsion on-site immediately prior to spraying particularly if cationic spray grades are used. Stablemix emulsion is chemically the most stable grade of emulsion for diluting with water. The water must always be added to the predetermined volume of emulsion in order to avoid the formation of lumps in the diluted emulsion. This is best done by sucking the water into the bottom of the sprayer and circulating until the required dilution level is achieved. The diluted emulsion should be heated to 60 °C to facilitate ease of spraying.

8.4 Application Procedure

Once the diluted emulsion is sprayed, it must be allowed to dry with no covering, before opening to traffic. The drying time is affected by a number of factors, as described above, and adequate traffic accommodation planning is needed. It is recommended that one square metre areas be painted at various application rates to determine the application rate and to monitor the drying time.

A full trial section will:

- Indicate whether overnight closure of the road will be required in the case of inverted emulsions
- Serves as a check on the appropriate application rate

Additional guidelines are as follows:

- Any pools which develop may be blinded with washed crusher dust or coarse sand prior to opening
- Spray only when the road temperature is at least 20^{o}C and rising.
- Do not spray if rain is expected
- Keep traffic off wet inverted emulsions and avoid using in residential areas
- Generally stop spraying by 14h00, unless the road is staying closed overnight
- In any areas of hand application, exercise care not to over-spray

- Place sand berms if steep cross-falls encountered
- No spraying should be undertaken in windy conditions

A period of 6-10 weeks should be allowed before a new bitumen stone seal is placed on a road treated with an inverted emulsion. This time could be reduced when using diluted emulsions without cutters.

9. COST-EFFECTIVENESS

The benefits of surfacing rejuvenation/ application of diluted emulsions have not yet been quantified to the extent that decisions could be based on the economic viability of these preventive measures.

The two approaches followed by some practitioners to assist in quantifying benefits could be summarised as follows:

- Area under the curve method using the standardised Visual Condition Index (VCI) as described in TRH22 (4).
  One of the problems using this method is that no benefit / improvement in the VCI can be calculated if no defects are eliminated. In the case of a diluted emulsion being added to a seal due to a too low binder content, no improvement in the VCI value is calculated.
  In addition:
  - The weight factors related to dryness of the binder and slight aggregate loss are too low to generate a sufficient increase in the area under the VCI performance curve
  - The longer term implications of rejuvenation in terms of VCI deterioration have not been quantified to define the shape of the performance curve

- Life cycle analysis using HDM4 (5)

  The opinion is held that the HDM4 models are not yet properly calibrated to analyse the true impact of surfacing seals and effects of rejuvenation in southern Africa.

  The HDM4 preventive treatments allow for two types of treatment: a fog seal and rejuvenation. The treatment is applied at the first signs of cracking or ravelling distress. The application is constrained by the user defined minimum and maximum allowable preventive treatment intervals.

  Preventive treatment is **not** applied if:

  $$ACRA_b \geq 5$$
  $$ARV_b \geq 5$$
  $$NPT_a > 0$$

  with

  $ACRA_b$ total area of cracking at the end of the year (% of total carriage way area)
  ARV_b area of ravelling at the end of the year (% of total carriage way area)
  NPT_a number of potholes at the start of the year

  The application of preventive treatments to the road surface delays cracking and ravelling initiation by changing the cracking and ravelling retardation factors (CRT and RRF). The procedure for the calculation of the change in the retardation factors is given. However, by definition of the two modes of application (scheduled and condition-responsive), the altering of the retardation factor should only be applied when the scheduled mode is selected.

  Thus, the cracking and ravelling retardation factors should not be altered when the condition-responsive mode is selected.

However, regardless of existing models not being able to properly quantify the benefits if rejuvenation, numerous road authorities in southern Africa consider these treatments as cost-effective to:

- Extend the life of existing seals. The general consensus is an additional three years with a diluted emulsion and even up to five years with an inverted emulsion
- Enhance the performance of reseals by pre-treatment of the old surfacing
- Prevent or reduce windscreen damage due to aggregate loss

10. TYPICAL PROBLEMS EXPERIENCED

10.1 General

The typical problems experienced by practitioners could be divided into the following:

- Poor penetration into the existing surfacing
- The emulsion breaks too slowly
- The binder stays tacky for a long time
- The emulsion develops a skin without breaking at the bottom
- Poor adhesion to aggregate
- General construction and environmental problems

Note: It is assumed for this discussion that the binder complies with the required specifications.

10.2 Poor Penetration into the Existing Surfacing

Possible causes are:

- Too dense surfacing – not sufficient voids in the surfacing for the binder
- Dirty surfacing prevents the binder from flowing into the surface voids
- Rapid breaking of emulsion thus not allowing sufficient time to flow into the voids
- Too low application rate - thus the binder is not able to ‘wet’ and flow into the surface voids

Note: Single seals with high texture depth are normally not too sensitive, even if the emulsion does not penetrate into the seal

Case studies:

- The road was identified for application of DE due to apparent dry and brittle binder showing oxidation/hardening cracking. Assessments were done during the dry winter months. At time of application during mid summer, no cracking was visible. Binder did not penetrate and picked up. Actions were postponed to the following winter with excellent results.
- Several situations where surfacings were dry and brittle but without sufficient voids.
- Several situations on double chip seals with sufficient voids between the larger and smaller aggregate but without access to these voids

Possible solutions

- Ensure that the surface is clean.
- Postpone action to dry season
- Prevent application during very hot temperatures if the existing binder appears to be tacky
- Lightly spray the existing surface with water to relieve surface tension
- Ensure the use of a stable grade emulsion preferably with a low viscosity
- Ensure sufficient application and dilution. Minimum of 0.8 l/m2 at a 50:50 dilution
- Ensure that sufficient voids exist to accommodate the additional binder

10.3 Emulsion Breaks Too Slowly

Possible causes:

- Recently tar-based pre-coated chips
- Very cold temperatures
- Too stable emulsion

10.4 Emulsion Breaks Too Fast

Possible causes:

- Use of rapid setting emulsion –unstable emulsion

10.5 Binder Stays Tacky for a Long Time

Possible causes:

- Too high road surface temperature > 50 °C
- Open road too early to traffic before the emulsion has broken.
- Over application resulting in high residual binder.
- Presence of flux (paraffin) in emulsion
- Fine textured surfaces are more sensitive
- Experienced often with the use of polymer modified emulsions

Possible solutions:

- Select emulsion without flux
- Select emulsion without polymer

Note: The “higher” effectiveness of a diluted polymer modified emulsion to fill surfacing cracks is still debated

- Select emulsion with higher bitumen softening point

Note: Emulsion can be manufactured with 60/70-pen bitumen

10.6 False Break

Emulsion develops a skin without breaking at the bottom.

Possible causes

- This problem has been observed with the use of polymer modified emulsions when applied in hot weather

Possible solutions:

- Select emulsion without polymer

10.7 Foaming

Foaming is a common problem when diluting emulsions. A small amount of Illuminating Paraffin (one litre) can be sprinkled on the surface of the diluted emulsion in the sprayer to reduce foaming. Also too low ratio emulsion /water

10.8 General Construction and Environmental Problems

Some of the most common problems relate to:

- Distributor and operation thereof
- On-site mixing – water quality and mix proportions (Refer Figure 6)
- Road geometry – gradients and camber causing run-off

Possible solutions:

- Check transverse distribution and leaks
- Check maximum application rates and ratio
  - Maximum 1.2 l/m2
  - Emulsion/ water ratio to 70/30 and reduce application rate to min 0.8l/m2
  - Use less stable emulsion – cationic spray70

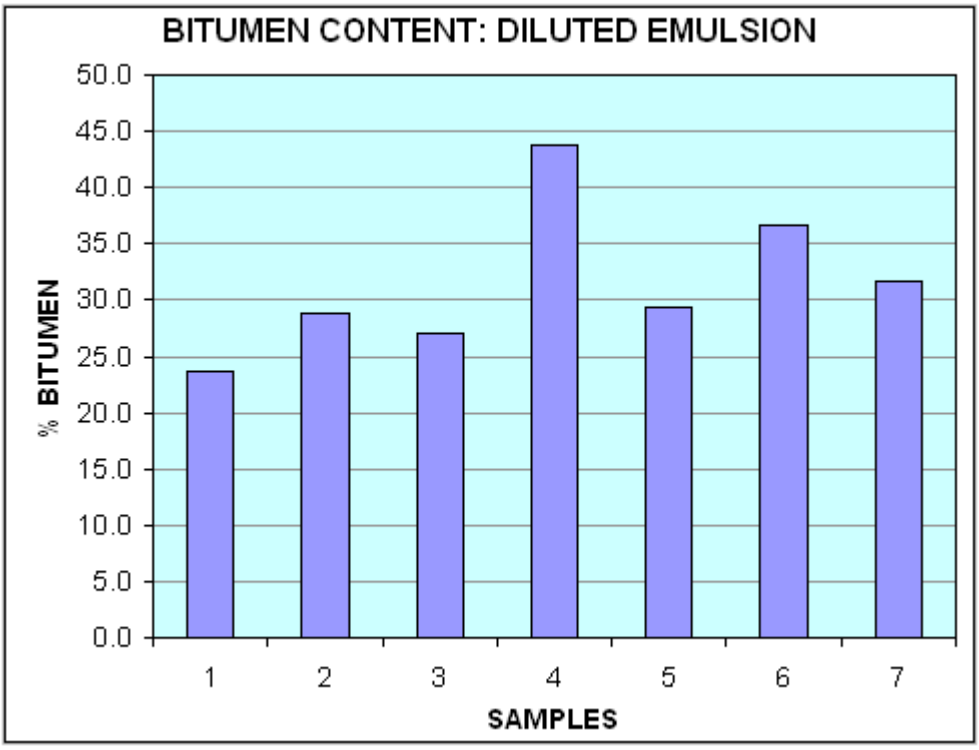

Figure 6. Variation in bitumen content.

Figure 6 shows the variation in bitumen content from samples taken on seven different projects.

Note: A 50/50 dilution of 65% emulsion was specified on all seven sites as displayed. (Target bitumen content 32.5%)

11. CONCLUSIONS

The application of diluted emulsions to extend the life of bituminous surfacings has been practiced in southern Africa for more than thirty years. Although existing performance models are considered inappropriate to quantify the benefits of these treatments, the majority of road authorities and experienced practitioners in South Africa are convinced that these measures are cost-effective and that the surfacing life could be extended by three to five years.

Different products are available on the market, each developed for a specific application. Knowledge of the purpose of development and characteristics of the different products could assist in selecting the appropriate product, mix proportion and application rate to suite different conditions.

12. ACKNOWLEDGEMENTS

The feedback and recommendations of numerous practitioners in South Africa and Namibia on this topic over the past three years is acknowledged.

13. REFERENCES

Committee of Land Transport Officials-South Africa, Technical Recommendations for Highways. **(Draft TRH3): Surfacing seals for rural and urban roads**. 1998, Pretoria, South Africa.

Weinert, H.H. **The natural road construction materials of South Africa.** 1980. Cape Town, South Africa.

Transvaal Provincial Administration. **Surface Treatment Manual**. 1994, Pretoria, South Africa.

Committee of State Road Authorities, Technical Recommendations for Highways. (**Draft TRH22): Pavement Management Systems.** 1994, Pretoria, South Africa. .

University of Birmingham. **Highway Development and Management model, Version 4. Part D – Road Works Effects.** 2001, United Kingdom.