
ROAD MATERIAL STABILISERS (Pty) Ltd



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INTRODUCTION

Any country's road network can be considered the backbone of its economy with private, public and commercial transport depending heavily on this infrastructure on a daily basis. The economy of the country is also therefore influenced and closely related to the well-being of the state of its road network. From general commerce, agriculture, mining, forestry and tourism almost every industry relies on an adequate network of all-weather roads for their economic activity and viability.



South Africa has a paved road network of approximately 158 000 kilometres and close to 590,000 kilometres of unpaved infrastructure (SANRAL 2016 estimates). Unpaved roads therefore form the major component of South Africa's road network and the design, construction and maintenance of this network should be approached with their economic importance in mind.

A gravel road, by definition, is a roadway that has been constructed with a suitable gravel material which meets the requirements to provide, once properly processed and compacted, a suitable surface for use by most traffic under all weather conditions.

The key requirements in achieving this outcome are;

- Correct selection of the wearing course material
- Correct geometric design – Drainage and alignment
- Correct construction procedures
- A dedicated and scheduled maintenance program



WEARING COURSE MATERIAL SELECTION

The most common problems encountered with unpaved gravel roads are caused by the poor performance of materials used in their construction. This can result in slipperiness and potholing when wet and high dust levels and raveling when dry. Corrugations will also form on roads with inadequate compaction or low plasticity soils.

Performance-related specifications for wearing course gravels have been developed in South Africa and follow guidelines that are based on sampling and testing of suitable materials and the monitoring of their performance over time.

Grading – Although there are a variety of gradings for natural gravels that perform well in practice when used to construct a gravel wearing course layer, no specific grading envelopes are currently prescribed however it is generally accepted that materials used for the formation of wearing course layers should be well graded.

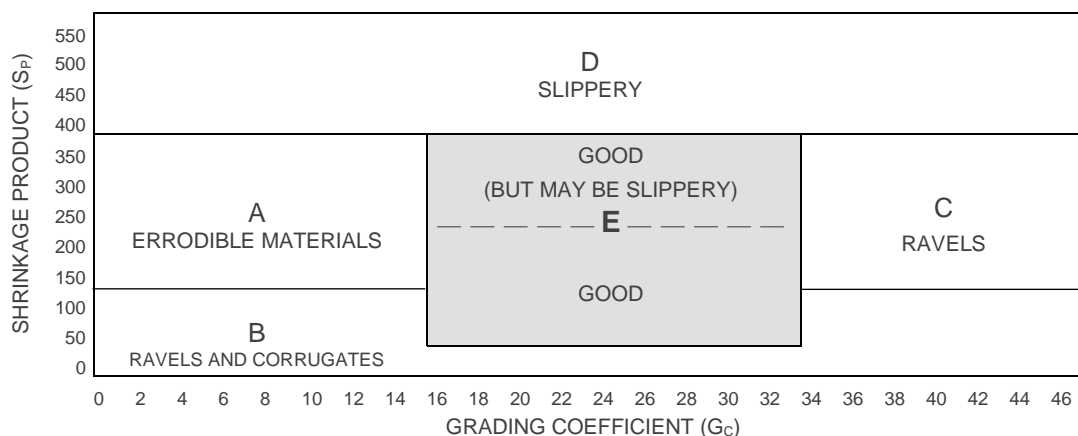
In the absence of experience, the following grading envelopes are suggested (DRAF TRH 4:1996);

Sieve size (mm)	<u>Percentage passing by mass</u>			
	<i>Maximum size of particle (mm)</i>			
	37.5	26.5	19.0	13.2
37.5	100	100	100	100
26.5	85 – 100	100	100	100
19	70 – 100	80 – 100	100	100
13.2	60 – 85	60 – 85	75 – 100	100
4.75	40 – 60	45 – 65	50 – 75	60 – 100
2.00	25 – 45	30 – 50	35 – 55	45 – 70
0.425	15 – 40	15 – 40	18 – 45	25 – 50
0.075	7 – 30	7 – 30	7 – 30	7 – 30

In addition to the suggested grading the recommendations based on the performance-related specifications for suitable materials for the construction of 'Rural unpaved' roads is as follows (Draft TRH 20:1990);

Maximum size	37.5mm
Oversize index	<5% (0 for Urban roads)
Shrinkage product (SP)	100 - 365 (max. of 240 preferable)
Grading coefficient (G _c)	16 - 34
CBR	>15% @95% MOD at OMC

The diagrammatic indication of the expected performance of materials;



GRAVEL ROAD DESIGN

The geometric design and basic alignment of an unpaved roadway should first and foremost take prevailing terrain conditions into account in order to determine with the final level, shape and finish also being considered as this will influence drainage of surface water and ride quality.

The final wearing course for an unpaved gravel road should be formed with a 100 – 150mm thick layer and either have a definite crown or cross-fall of 4% (not more than 5%). The final road surface being higher than the surrounding area to prevent water accumulating on the road surface during wet periods.

The importance of good drainage cannot be over stated, and suitable side drains and mitre drains being put in place along the road alignment, to control storm water run-off, and to collect and divert storm water away from the road surface at regular intervals.

For steeper gradients erosion protection in the drains may be required to protect the constructed wearing course layer.

CONSTRUCTION

The proper processing or construction of a gravel wearing course will provide;

- A correct and uniformly thick final layer to the required depth
- Adequate and consistent compaction
- A final surface layer to the correct levels, shape and finish

Subgrade – proper and adequate sub-grade strength is required to prevent deformation and permeability of this area influencing the constructed wearing course. Sub-grade densities should be prepared to a minimum of 90% Mod AASHTO with material of at least 5% CBR value.



GRAVEL WEARING COURSE CONSTRUCTION METHOD STATEMENT

STEP	DESCRIPTION
1.	Put all required signage, safety cones and flagmen in place.
2.	Ensure the road alignment is defined and that the sub-grade is of sufficient quality to support the final constructed wearing course layer.
3.	Ensure sufficient material is present to form the required cross fall or camber to the correct level above the surrounding area to facilitate proper drainage.
4.	The road surface should be ripped to the required depth (100 – 150mm).
5.	Large clods or agglomerations to be broken to maximum 50 mm.
6.	Add moisture to the layer with a water bowser in multiple applications thoroughly mixing the material with a motor grader between applications.
8.	Continue mixing with the motor grader until the moisture is properly distributed throughout the surface wearing course material and the moisture content is adequate for compaction (OMC).
9.	Shape to the required camber or cross fall
10	Compact with a vibratory roller to the required density
12.	Once the application is completed allow the road to dry slightly and remove the required signage, safety cones and spotters and open the road to traffic.

GRAVEL ROAD MAINTENANCE MANAGEMENT

The importance of routine maintenance on unpaved gravel roads cannot be over-emphasised. Once the condition of a gravel road deteriorates beyond a certain point, restoration of the road to an acceptable condition can seldom be achieved with routine maintenance and will require full reconstruction with considerable mechanical and labour input.

The maintenance of gravel roads can be broken down into 4 categories –

Roadside Maintenance

The main maintenance activity of roadside maintenance is bush clearing and grass cutting. This procedure not only adds to safety but also avoids fire hazards affecting drivers.

The repair and prevention of erosion affecting 'cut and fill' slopes and ditches should not be neglected and can be cost-effectively addressed through the establishment of suitable vegetation.

Roadside maintenance is ideally suited to labour intensive practices enabling the successful use of unskilled labour which can also include litter collection especially near built-up areas where local communities can get actively involved.



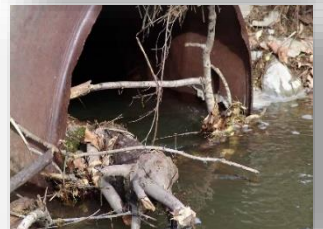
Drainage Maintenance

The three most important things to understand in maintaining gravel roads is drainage, drainage and drainage!!! When drainage is poor even the best efforts to maintain the roads will bring disappointing results. Allowing water to drain off road surfaces and out of roadbed layers will significantly reduce the effort required to maintain the road surface to acceptable standards.

Maintaining an effective drainage system on gravel roads in order to minimise the erosion of the constructed gravel wearing course is critical. Side drains that have eroded or silted up will impede the free flow of water from the road leading to damage and increased maintenance needed. Grass cover around culverts and drains can be used in order to reduce erosion.

Side and Mitre drains should be designed with widths and side-slopes (1:2 or 1:3) which would permit maintenance with a motor grader to be carried out during the routine pavement surface maintenance. The grader operators should ensure that all drains have an adequate fall with no low spots where water could accumulate and that no windrows are left during the blading procedure blocking the entrance to mitre drains.

Culverts are also critical drainage structures that carry the natural flow of water under the road so that the water can continue on its natural course and should be kept free of debris, silt and eroded soil. Cleaning of the outlet of culverts to ensure free-flow conditions on the downstream side should also not be neglected.



Surface Maintenance

The maintenance of the surface of gravel roads is the major cost factor in the maintenance program. Scheduled motor grader blading operations may be carried out from once a week to six monthly intervals depending on the climate, traffic type and volume, and required levels of surface quality required.



To maintain a gravel road properly, operators must understand the three important elements;

- The shape of the road surface (cross fall or camber)
- The shoulder area that slopes directly away from the edge of the riding surface
- The side drain

The basic shape or cross section must be correct or a gravel road will not perform well, even under low traffic. The road shoulder is required to allow runoff of water from the road surface and functioning drains will allow the water to be removed from the road reserve.

The standard procedure for surface maintenance is grader blading to remove potholes, corrugations, excessive loose material, ruts and erosion channels. Blading of the road surface should also not be done dry and moisture should be applied via a water bowser.

Re-gravelling

The process of re-gravelling is carried out when the constructed wearing course layer has been almost totally lost through traffic induced gravel loss through abrasion or erosion by rain and wind. Reg-gravelling should take place before the subgrade is exposed in order to avoid deformation which will necessitate reconstruction of this layer.



Spot re-gravelling can also be carried out to replace the gravel over localised areas where it has become excessively thin and for the filling of potholes, ruts and erosion channels. This is another function that can be effectively used to increase the labour component as part of the maintenance program.

The re-gravelling process will follow the same procedure for the construction of the wearing course layer once sufficient material is imported and placed to form the final 100 – 150mm with correct shape and level.

THE NEED FOR INNOVATIVE ALTERNATIVES



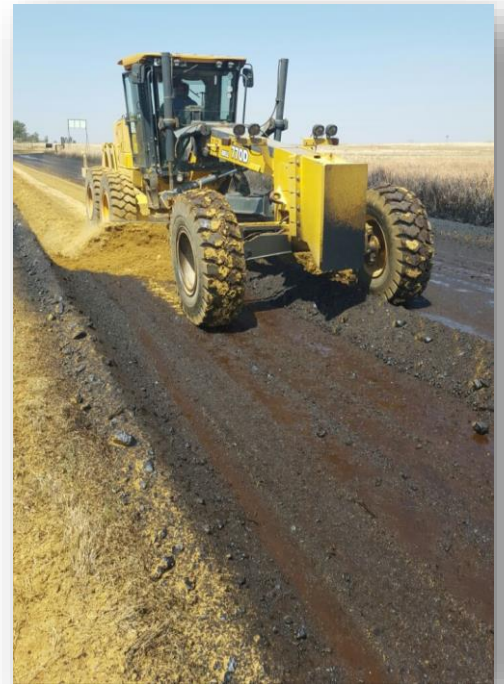
With limited available budgets and borrow pits becoming more and more scarce, the upkeep and maintenance of an unpaved road network is becoming increasingly difficult for many authorities. Innovative alternatives to improve the performance of this infrastructure whilst reducing the effort and cost required to maintain quality is required.

SOIL STABILISERS AND GRAVEL BINDERS

Conventional methods of stabilisation such as mechanical modification rely on the availability of local suitable materials and traditionally available products such as lime, cement and bitumen's are expensive, bulky and often unsuitable for the construction of gravel roads.

Alternative chemical soil stabilisers and gravel binders have been available for many years offering significant advantages and cost savings towards the improvement of gravel wearing course layers.

Product categories and options are available catering for various soil types and performance requirements.



KEY REQUIREMENTS OF ADDITIVES

- Reduce defects; gravel loss; corrugations; potholes; mud etc.
- Wet season - improved resistance to water erosion
- Dry season – reduction in dust levels
- Reduction in the required maintenance
- Gravel preservation
- Improved riding quality



Soil Stabilisers

Ionic Soil Stabilizers or a clay soil stabiliser generally require a cohesive soil with a clay-mineral content or indicated plasticity within the material to be effective. The addition of stabiliser improves compacted densities and bearing capacities and enables the layer to maintain these increased densities under wet conditions significantly improving wet weather performance of the layer. The improved densities and consistent year-round performance results in a reduction in material loss from the road surface retarding the formation of normal defects (potholes, etc) and reducing the overall required maintenance.

The use of type product requires no specialised machinery and is supplied in concentrated liquid form using standard water bowser with spray bar to apply diluted solutions. The application of a stabiliser requires the construction of the wearing course layer.

Normal or standard gravel road maintenance procedures are unaffected with the use of this type product and provided the surface is wet, it can be bladed.

Polymer Binder

Emulsified polymer products are generally formulated water-based emulsions of modified acrylic polymers suitable for the binding and stabilisation of layers for use in construction of all types of roads. Polymer binders provide a strong gluing and waterproofing action on soil particles and are suitable for application to a wide variety of soil types. The addition of product will also improve the wet weather performance of soils and gravel roads.

Polymer binders are best applied as a mix-in treatments during construction but are also suitable for application to the surface of already constructed roads requiring dust suppression or erosion protection. The application of polymer binder does not require any specialised equipment for application and a standard water bowser is suitable for product application.

Lignosulphonate Binder

lignosulphonate-based binders and gravel preservers are natural polymers and possess strong binding abilities making the product suitable for binding both fine and coarse particles. As a true dust palliative, lignosulphonates are suitable for spray-on applications or applications to the surface of areas requiring short or medium term dust suppression. Additionally, being water soluble, the application of a lignosulphonate does not require any specialised equipment and a standard water bowser or other available spray equipment can be used. The application of this type product to the surface of roads is generally not sensitive to over or under spraying for the purposes of suppressing dust.

For use as a dust palliative category of product, as with most all dust suppression options, will require periodic rejuvenations to maintain the required level of dust reduction. Rejuvenation periods are determined by prevailing site conditions, rainfall and customer requirements.

Lignosulphonate\Bitumen Emulsion

With lignosulphonates remaining soluble after drying their use is often considered better suited to drier climates due to its mobility in the layer under wet conditions. With the addition of a bitumen emulsion to a lignosulphonate treated layer the same strong binding properties of the lignosulphonate are enhanced with the addition of the bitumen emulsion. This enhancement adds a measure of water resistance allowing the treated layer to perform more consistently through wet and dry periods.



TECHNICAL DATA SHEET

Road Material Stabilisers

(Pty) Ltd

1986/004184/07

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Tel 27 (0)11 390 3499
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Website www.roadmaterial.co.za

ISS 2500 Ionic Soil Stabilizer

DATE: 02/005/2004

REVISED: 19/01/2005

DESCRIPTION:

ISS 2500 is an electrochemical clay soil stabiliser suitable for improving marginal or substandard soils for use in the construction of roads.

APPLICATION RATES:

% passing 0.075 <10%: 0.01-0.02 L/m²
10-15%: 0.02-0.03 L/m²
15+%: 0.03 L/m²
(refer to manufacturer before use)

BENEFITS:

- Economical construction method for use in gravel and surfaced roads
- Increase in compacted densities and bearing capacities
- Greater use of in-situ material
- No specialised equipment required
- Treatment is permanent
- Roads can be opened to traffic immediately

PREPARATION:

- Establish the suitability of the soil prior to construction
- Fill the water bowser and then add the required amount of ISS

APPLICATION:

- Scarify area to 150-200 mm depth
- Large clods or agglomerations to be broken to max 50 mm
- Add the required amount of ISS directly to the water bowser with the moisture needed to bring the material to optimum moisture content (OMC) for compaction. If the material is at OMC, a minimum amount of 1litre water/m² should be used
- Spray the ISS-water mixture over the entire area in multiple passes
- The area is to be thoroughly mixed until OMC is achieved
- Should more moisture be required after the application of the ISS to achieve OMC, use clean water
- At OMC, the area should be levelled and compacted to required density
- Any exposed ISS-treated areas should be lightly watered twice daily for three days or until covered

CHARACTERISTICS:

Appearance - oily, dark/red coloured, with characteristic odour
Specific gravity - 1.14 @ 25°C
pH - <2
Diluent - water

HAZARDS:

Fire - non-flammable
Explosion: - non-explosive

Skin - prolonged contact can cause minor burns
Ingestion - harmful
Eyes - may cause irritation or corneal burns

PRECAUTIONS:

-
-

Wear protective clothing for sensitive skins
Do not ingest
Avoid splashing

FIRST AID:

-
-

Rinse with water

Do not induce vomiting*
Flush with water for min 20 min*
* (Seek prompt medical advice)

STORAGE:

Store under cover and protect containers from direct sunlight
Storage temperature - -5-60°C
Transport temperature - -5-60°C

PACKAGING / LABELLING:

Packed: - 20/100/200 litre plastic drums
Label: - company details and contact numbers

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Website www.roadmaterial.co.za

SASBIND

DATE: 03/06/2004

REVISED: 19/01/2005

DESCRIPTION:

SASBIND is a uniquely formulated water based emulsion of modified acrylic polymers suitable for the binding and stabilisation of layers for use in the construction of all types of roads. SASBIND is also suitable for application to the surface of already constructed roads requiring dust palliation.

APPLICATION RATES:

Stabilisation: 0.4-0.1% MDD
Seal coat: 0.1 l/m²

(Application rates are offered as a guide, use as directed)

BENEFITS:

- Water-based (mixes in with compaction water)
- Suitable for application to a wide variety of soil types
- No specialised equipment required
- Minimal disruption to traffic
- Reduces erodibility and improves waterproofing of unsurfaced roads
- Increases CBR and UCS significantly

PREPARATION:

- Establish the suitability of the soil for use with SASBIND
- Add the required quantity of SASBIND directly to the water bowser with the compaction water

APPLICATION:

Mix-in

- Rip the layer to 100-150 mm and break large agglomerations to max 50 mm
- Calculate the approximate volume of water required to reach OMC
- Add the required quantity of SASBIND to required quantity of water
- Apply the solution onto prepared surface in 2-4 applications, mixing thoroughly between applications
- Shape to required camber and compact with pneumatic or vibratory roller to required density
- Apply the seal coat if required to the road surface while still damp and allow to dry (approx 1-2 hours)

Surface treatments (spray-on application)

- Road structure: well compacted base or wearing coarse layer; density >93%.
- Ensure the road surface is firm, free of excess loose material and with sufficient camber to ensure proper drainage
- Apply the product in multiple applications using the prescribed dilution ratio. Avoid run-off and pooling

CHARACTERISTICS:

Appearance	- milky black liquid
Specific gravity	- 1.04 @ 25°C
pH	- 7 ±1
Odour	- mild Acrylic
Solids %m/m	- 46-55
Diluent	- water

HAZARDS:

Fire	- non-flammable
Explosion:	- non-explosive
Skin	- slightly Irritating when undiluted
Ingestion	- irritant
Eyes	- slightly irritating

PRECAUTIONS:

-
-
Wear protective clothing for sensitive skins
Do not ingest
Avoid splashing

FIRST AID:

-
-
Rinse with water
Do not induce vomiting*
Flush with water for min 20 min*
*(Seek prompt medical advice)

STORAGE:

Maximum handling temperature	- 75°C
Storage temperature	- 5-60°C
Transport temperature	- 5-60°C

PACKAGING / LABELLING:

Packed:	- 200 kg mild steel drums
Label:	- including description, application, first aid and batch number

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DUSTEX

DATE: 02/005/2004
REVISED: 19/01/2005

DESCRIPTION: Dustex is a uniquely formulated lignosulphonate-based binder and gravel preserver suitable for binding both fine and coarse particles. Dustex is also suitable for spray-on applications to the surface of areas requiring short or medium term dust suppression		APPLICATION RATES: <table><tr><td rowspan="2">Mix-in</td><td>Liquid</td><td>1-2%</td></tr><tr><td>Powder</td><td>0.5-1%</td></tr><tr><td rowspan="2">Spray-on</td><td>Liquid</td><td>1.0-1.5 kg/m²</td></tr><tr><td>Powder</td><td>0.5-0.8 kg/m²</td></tr></table>		Mix-in	Liquid	1-2%	Powder	0.5-1%	Spray-on	Liquid	1.0-1.5 kg/m ²	Powder	0.5-0.8 kg/m ²					
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BENEFITS: <ul style="list-style-type: none">- Reduced gravel loss and dust levels and road maintenance- Suitable for use with a variety of materials with compositions and characteristics- Easy to apply, no specialised equipment required- Roads can be trafficked immediately- Environmentally friendly, non-toxic and non-hazardous																		
PREPARATION: <table><tr><td>Liquid</td><td>Dilute the required Dustex with the water in the water bowser</td></tr><tr><td>Powder</td><td>Fill the bowser with one-third water; then add the required Dustex. Circulate the water during this process if possible. Once mixed, fill the bowser with water</td></tr></table>				Liquid	Dilute the required Dustex with the water in the water bowser	Powder	Fill the bowser with one-third water; then add the required Dustex. Circulate the water during this process if possible. Once mixed, fill the bowser with water											
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APPLICATION: Mix-in <ul style="list-style-type: none">- Rip the road to 150 mm and break large clods to maximum 50 mm- Calculate the approximate volume of water required to reach OMC and add 85% of the required product application rate to this quantity of water- Apply the solution onto the prepared surface in 2 to 4 applications, mixing thoroughly between applications- Shape to required camber and compact with pneumatic or vibratory roller to required density- Apply remaining 15% product to the road surface while still damp Spray-on <ul style="list-style-type: none">- For spray-on applications, the road surface should be well compacted, density >93%, firm and free of excess loose material and with sufficient camber to allow for proper drainage- Apply the product in multiple applications using a 10-15% solution of product with water- Avoid run-off and pooling																		
CHARACTERISTICS: <table><tr><td>Product form</td><td>Liquid</td><td>Powder</td></tr><tr><td>Appearance</td><td>- Brown viscous liquid</td><td>Brown water-soluble powder</td></tr><tr><td>Specific gravity</td><td>- Liquid -1300kg/m³</td><td>Powder - 530kg/m³</td></tr><tr><td>pH (10% solution)</td><td>- 3.3 ±1</td><td>5.4 ±1</td></tr><tr><td>Solids % m/m</td><td>- 50 ±1</td><td>93% dry matter</td></tr></table>				Product form	Liquid	Powder	Appearance	- Brown viscous liquid	Brown water-soluble powder	Specific gravity	- Liquid -1300kg/m ³	Powder - 530kg/m ³	pH (10% solution)	- 3.3 ±1	5.4 ±1	Solids % m/m	- 50 ±1	93% dry matter
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		FIRST AID: <ul style="list-style-type: none">- Rinse with water- Drink water- Flush with water																
STORAGE: The product is stable for several years under dry cool storage conditions		PACKAGING: <table><tr><td>Liquid:</td><td>- bulk 34 ton loads</td></tr><tr><td>Powder:</td><td>- 25 kg and 600 kg bulk bags</td></tr></table>		Liquid:	- bulk 34 ton loads	Powder:	- 25 kg and 600 kg bulk bags											
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