BITUMINOUS SURFACING OPTIONS FOR LOW VOLUME ROADS CONSTRUCTED BY LABOUR-BASED METHODS

By Jon Hongve, Senior Technical Adviser, ILO, Limpopo Province, South Africa, October 2006

Background

Since labour-based road construction was introduced on a large scale with the Rural Roads Access Programme in the early 1970's, this and all similar programmes throughout Africa and elsewhere have concentrated on earth- and gravel road construction and improvement.

The Gundo Lashu programme in Limpopo Province, South Africa, which started in 2001 was designed along the same lines. However, it soon became apparent that continuing with gravel road construction would not be sustainable for various reasons (most gravel sources not meeting specifications for good wearing course gravel resulting in high maintenance costs due to corrugation and ravelling, depletion of and uneconomical use of existing gravel deposits, dust pollution particularly in built up areas etc.). A life cycle cost analysis conducted by CSIR (Council for Scientific and Industrial Research, South Africa) showed that constructing to a low volume sealed road standard in most cases would be more cost effective (Paige-Green, P and Cassiem, I. 2003. **Alternatives to Conventional Gravel Wearing Courses on Low Volume Rural Roads: Phase 1**. Pretoria: CSIR-Transportek. (Contract Report CR-2003/30)).

Ongoing contracts were revised to include construction of a proper base layer and bituminous surfacing and the contractors given additional training in the required construction techniques.

This posed new challenges in terms of workmanship, quality assurance and adherence to specifications and efforts are continuing to ensure quality of the works in line with the current specifications and public demand.

Purpose of this article

The purpose of this article is to share information with other labour-based practitioners who may want to go in the same direction as the Gundo Lashu programme.

The space is not sufficient to give a detailed description of all aspects of base construction or sealing operations, rather an outline is given of each procedure or product with emphasis on salient points that the designers, supervisory staff and project managers must bear in mind.

The aim is of course to strive for perfection and live up to the promise that labour-based techniques can produce works of similar quality as conventional machine based methods. It is indeed true that this can be achieved by skilled and conscientious contractors and some of our contractors are now producing high quality works without supervising engineers and technicians looking over their shoulders at all times. Others still require strict and continuous supervision and control. In a contracting relationship though the supervision costs have to be kept at a reasonable

level, otherwise the premium to be paid for a labour-based approach would be unjustifiable in most peoples eyes. Sometimes the designing and supervising engineers are part of the problem and not the solution in that they simply do not have the required knowledge and experience to guide the contractors.

Our efforts are hence concentrated on making life simpler for the contractors so that the quality standards can be achieved by removing as many of the potential pitfalls and logistical problems as possible by means of appropriate design and specifications as well as in the work methods.

The learning curve for everybody involved has been quite steep, but we can confidently say that the quality now being produced under the programme is close to our end goal. There is still room for improvements, some of which are alluded to below, but one can only take one step at a time. In the end there are problems of a managerial nature rather than technical that most often cause the demise of emerging contractors.

Pavement Design and Construction

The change to construction of sealed roads as mentioned above, came concurrently with the introduction of the SATCC (Southern Africa Transport and Communications Commission) Guideline for Low Volume Sealed Roads (LVSRs). For subsequent contracts consultants were thus given a thorough briefing on the LVSR design philosophy and principles based on regional best practice. However, old habits die hard and a thorough scrutiny and discussion of the proposed designs were necessary in order to ensure optimal use of project funds and feasibility for labour-based construction. This poses a huge challenge for clients with little in house design expertise and experience. Clients will undoubtedly be taken for a ride when no questions are asked and end up paying dearly for unwarranted pavement designs.

The construction techniques were revised to include use of a steel shutter system which, when used properly will ensure uniform thickness of the pavement layer, correct levels and camber/crossfall. The workmanship when constructing the payment layer(s) on sealed roads is of course of utmost importance. When correct procedures are followed it has been shown that compaction in excess of the required 98% (unstabilised) or 97% (stabilized) Mod AASHTO respectively can be achieved with commonly used pedestrian vibratory rollers. Compaction should in any case be done to refusal, i.e. when no further settlement is achieved.

However, from our experience so far a few potential areas for improvement have been identified:

- Layer works should preferably be designed in 100mm compacted thickness. This will make it easier for the contractors to achieve the specified compaction at all times with little chance of rejection of the works.
- If need be for added strength a 67 mm Emulsion Treated Base (ETB) layer can be added on top. Otherwise the full 100 mm base layer can be and ETB. This will add some costs, but will greatly increase the durability of the road, simplify maintenance and eliminate the need for a prime. The ETB can also be trafficked without damage before it is sealed and will make life simpler for the contractors in the scheduling of the works.

- If the above recommendations are followed, the shutter system should be modified to include only one steel section of 150mm x 100mm x 8mm with no loose bulking rail to be placed on top. Experience has shown that the bulking rails take a hard beating on site, get bent and become unusable through inappropriate care. The proposed steel shutter is also more versatile in that it can be used on both sides to produce different thicknesses of compacted layers as shown in Figure 1 below:

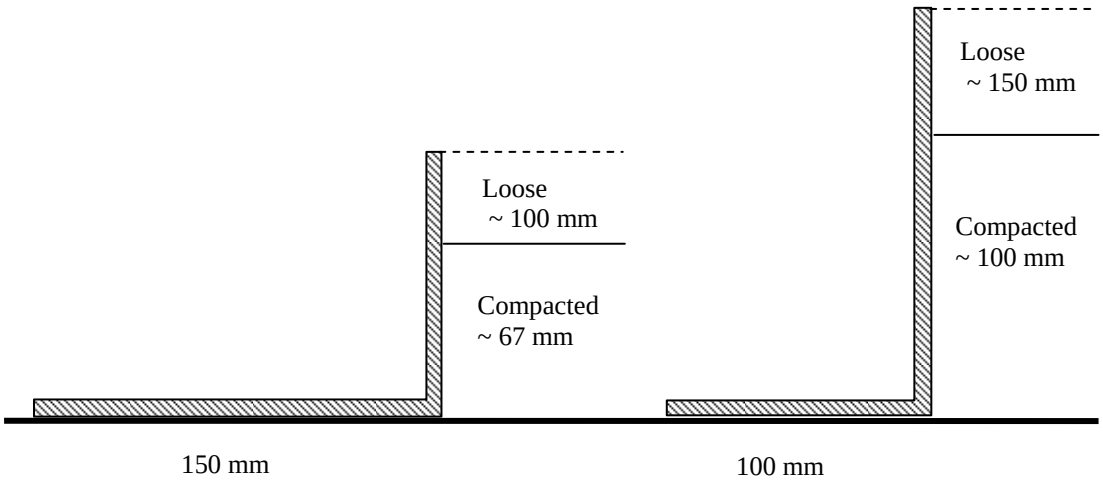


Figure 1: Use of steel shutters for layer works

Bituminous seals

General requirements for successful sealing operations

All bituminous seals require a sound base which must be swept clean of all dust, dirt, animal droppings etc. before the seal is applied. Except in the case of an Emulsion Treated Base, a prime is generally recommended although it may not be strictly required for technical reasons. The base must always be dampened with a light spray of water before the tack coat, or prime as the case may be, is applied in order to break the surface tension of the base material.

Failure to attend to these preparations before sealing will eventually result in premature failure of the seal caused by insufficient bonding between the base and the bituminous seal.

Hot bitumen applications

Otta Seal

Background

The Otta Seal originated in Norway as a gravel road maintenance seal using natural continuously graded gravel from river beds as aggregate. It has since been applied successfully *inter alia* in a number of Sub-Saharan countries on secondary roads. In Botswana alone Otta Seal has been used on more than 3000 km of roads and has proven to be a durable seal with potential cost benefits over conventional chip seals.

The main philosophy behind the Otta Seal is to use a graded aggregate and thus, whether the aggregate is natural gravel or taken from a crusher, use more of the available material with less processing (screening) involved in order to keep costs down. A completed Otta Seal has a dense matrix of graded aggregate held together by a relatively soft bitumen. It performs much like a premix asphalt and does not rely as much on the quality of the stone as do chip seals. This opens up for the use of a wide range of lower quality locally available materials (e.g. Ferricretes, Silcretes etc), which in remote areas may save considerable costs over the importation of crushed stone over long distances.

Grading

The acceptable grading envelope for Otta Seal aggregate is quite wide as shown in Figure 2 below:

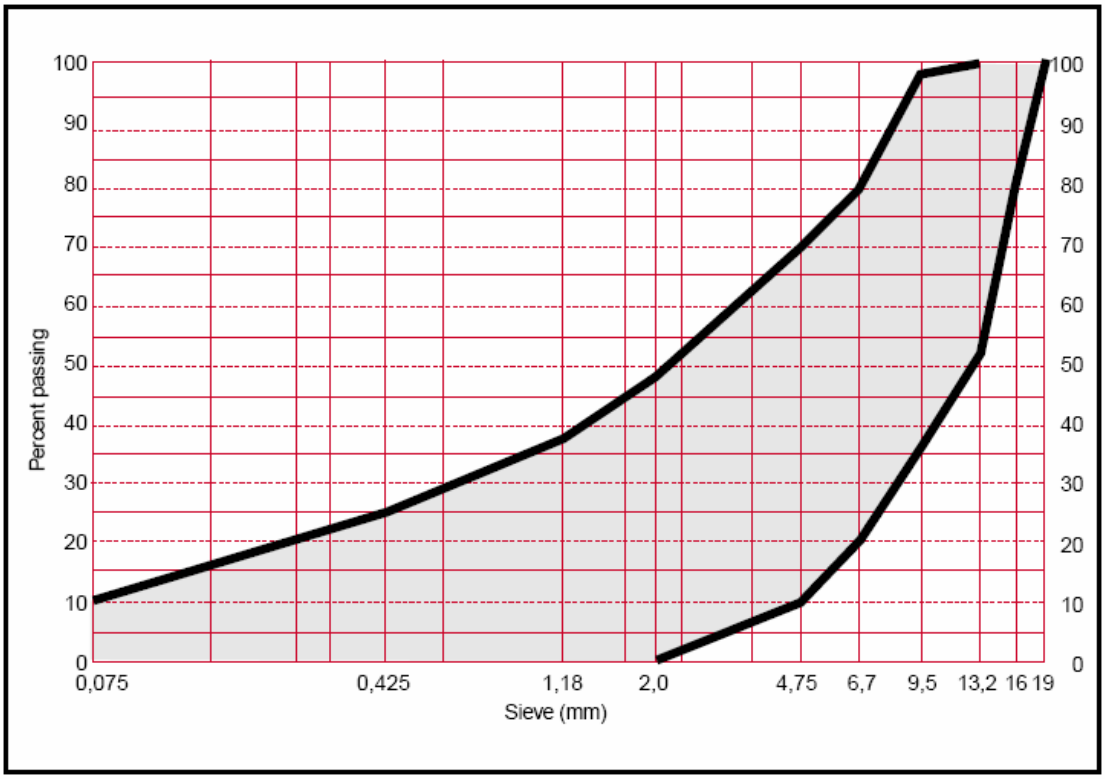


Figure 2: General grading envelope for Otta Seal

With this wide grading envelope, care must be taken not to stretch the outer limits any further, e.g. by having too much fines. The aggregate to be used should preferably have a grading curve more or less parallel to the curves in Figure 2.

The recommended bitumen spray rate will vary within the range of 1.7-2.0 l/m^2 according to the properties of the aggregate. Detailed information is given in reference 1.

Aggregate strength and flakiness

The Otta Seal has relaxed specifications for aggregate strength and flakiness as opposed to Chip Seals that rely on the strength and shape of the stones for good performance. For details, see reference 1.

Sand cover seal

A Single Otta Seal should as a minimum receive a fog spray and a Sand Cover seal for increased durability. This should however only be applied after approximately three months under traffic during which period dislodged aggregates must be swept back and patches of excessive bleeding blinded off with sand.

Material for a sand cover seal used with Otta Seals can be crusher dust, river sand or Kalahari sand or a combination of these materials. The material should be free from organic matter and lumps of clay and should be non plastic. All material should preferably pass the 6.7 mm sieve.

Binders

The correct choice of binder for Otta Seals is critical for its performance and a good result requires that both the binder type and application rate are tailored to the aggregate properties. Binders used for Otta Seals should:

1. be soft enough to initially coat the fines in the aggregate;
2. be soft enough to rapidly move up through the matrix of aggregate voids by the action of rolling and traffic;
3. remain soft long enough to continue moving up through the matrix of aggregate voids over a period of 4 to 8 weeks;
4. be able to be applied in a large enough quantity in one spray operation.

In addition to the above, the following binder properties are desirable in any bituminous seal. The binder must be:

- viscous enough to provide sufficient stability after the initial curing of the seal;
- durable enough to give the expected service life;
- able to be used with available equipment and skills;
- environmentally friendly to the greatest possible extent; and
- economical in use.

Types of binders

A general description of selected binder types and their potential use in Otta Seals is given below.

a. Penetration grade bitumen

80/100 penetration grade bitumen, which is normally used with conventional Chip Seals, does not meet the requirements for Otta Seals and should NEVER be used. The hardest type of bitumen that can be used for Otta Seals is the 150/200 penetration grade which has been successfully used, particularly during hot periods.

Botswana experience suggests that that 150/200 has generally performed well for crushed rock aggregate provided it is cut back with 5% power paraffin when used during the cold months of the year.

b. Cutback bitumen

Alternatively cutback bitumen in the MC 3000 and MC 800 viscosity can be used under certain conditions.

Grav Seal

Grav Seal is a proprietary product of Colas SA derived from the principles of and constructed similar to the Otta Seal. The main difference is that the binder used for Gravseal is a modified bitumen containing a polymer (latex) which makes it retain its elasticity over time. In all other respects the Grav Seal is similar to the Otta Seal although the aggregates are preferably sourced from commercial crushers.

Points for consideration

+ By using -19mm graded aggregate a relatively thick, dense seal (+/- 16mm) is obtained which has proven to be more durable than a single chip seal under similar circumstances;
+ The seal remains flexible over time and is not prone to cracking as are chip seals where harder bitumen binders are used;
+ A wide range of locally available materials can be used in Otta Seals with scope for cost reduction over use of single sized stones for traditional chip seals;
+ Natural gravel deposits can be screened by labour to obtain a grading within the grading envelope, thus increasing the labour content of the project;
+ The aggregate can be applied on the road by labour thus further increasing the labour content;
+ Due to the binders used for Otta Seals, no prime is strictly required. However priming may be necessary for protection of the base until sealing can be done.
− Due to the construction methods, the seal appears initially like a loose gravel layer. This has caused resistance among the uninformed public and communities who tend to think they are not getting a “black-top” road;
− Otta Seals require extensive after care for up to three months for sweeping back dislodged aggregates, blinding off patches of extensive bleeding. This has proven difficult to handle contractually and has caused contractors to “overprice” the Otta Seal;
− Loose stones can cause damage to windscreens during the first months before all loose aggregates are eventually securely lodged in the seal or are swept off;
− Contractors are reluctant to re-mobilise after three months for application of fog spray and Sand Cover seal;
− The Otta Seal requires spraying of hot bitumen by a motorized bitumen distributor. Dealing with hot bitumen in itself as well as cutting back bitumen on site poses a potentially severe health hazard, in particular so for inexperienced contractors;
− Faulty bitumen distributors often cause severe logistical problems, in particular for small, inexperienced contractors, and inferior end products due to striping, ravelling etc.;
− It is difficult to obtain a uniform spreading of the aggregates by labour and thus get a smooth riding surface. Use of a drag broom to even out the aggregates will improve the riding surface. Back-chipping must be done carefully where the aggregates have been under applied. Use of a mechanical chip spreader pushed by labourers will give a more uniform spread rate and greatly improve the appearance and riding quality of the finished surface;
− The seal requires extensive rolling preferably with a heavy pneumatic roller for at least three days after sealing in order to knead the bitumen up through the graded aggregate to ensure that all particles are coated and held together. Even in South

Africa pneutmatic rollers are scarce and cannot always be mobilized just when needed. As a replacement the rolling may be done with loaded trucks, but this requires careful monitoring to ensure that the entire surface receives the required compaction effort.

- For labour-based construction the base will be exposed for a long period before the sealing can be done. A stretch of at least 1 km is required in order to get a good price for the bitumen, which if supplied in small quantities becomes uneconomical.
- During the long exposure period severe damage to the base may occur unless the road can be completely closed to traffic, something which has proven difficult in many projects particularly in remote rural areas. Any damage to the base must of course be repaired at the contractors' cost before sealing can be done. This causes continuous headaches for the small emerging contractors who most often battle with cash flow even if the project is running normally;

Figure 3: Levelling of aggregate for Otta Seal using a drag broom

Suitability of hot bitumen applications for labour-based projects

The first sealing contracts were designed with either Otta or Grav Seal. The results were mixed, not because of the seal itself but rather with the quality of the base and problems with the bitumen distributors etc. as outlined above.

In South Africa with an abundance of crushers producing aggregates at a lower cost than contractors can provide suitable natural gravels, we have found that the Otta Seal does not have any significant cost advantage over other seals, if any at all. When constructed properly it has been shown to be an excellent seal that could provide an excellent alternative in other countries depending on the local circumstances if natural gravel sources can be economically exploited using labour.

Figure 4: Spraying hot bitumen for Otta- or Grav Seal. Aggregates are spotted along the road and labourers waiting to spread.

Figure 5: Hand spreading of aggregates for Otta- or Grav Seal

Emulsion based applications

In order to overcome some of the problems encountered with hot bitumen applications on labour-based projects as outlined above, trials with emulsion based seals have been conducted in conjunction with CSIR and private sector suppliers.

These emulsion based seal-as-you-go techniques has a number of advantages that remove or minimize the headaches of the contractors related to hot bitumen applications:

- All of the seals mentioned below can be laid in short sections shortly after the base has been completed on, say, a daily production of 60-100m full width. The base hence gets protected before any damage can occur either from inclement weather, traffic or livestock moving over the road. Contractors are thus spared the problems with and expenses for base repairs which can otherwise become quite extensive;
- For stabilized base layers the seal will also function as a curing membrane. Adequate curing of stabilized base layers has proven to be a huge logistical problem for the contractors with potential for rejection of the works. If the base is primed and/or sealed shortly after construction and approval, this problem is to a large extent solved;
- The sealing operations are easier to organize and manage and there are far less problems if something somehow goes wrong in the chain of events with less impact on the cash flow of the contractor;
- Heavy pneumatic rollers are not required. The pedestrian vibratory rollers that the contractors are already in possession of are perfectly adequate for compaction of the seals.

Modified Otta Seal

Aggregate

The seal retains the main idea of the original Otta Seal using graded aggregate, albeit with a narrower grading envelope mainly due to the way the bitumen is applied.

In the original Otta Seal the soft bitumen tack coat is kneaded up through the aggregate until slight bleeding occurs to ensure that all particles are coated and retained in the seal. The modified Otta Seal, however, is based on penetration of the bitumen emulsion from the top. In order to achieve proper penetration and coating of all particles, the aggregate cannot contain as much fines as for the original Otta Seal. With a high fines content the emulsion will be trapped in the fines and not penetrate the aggregate properly.

The rate of application of the aggregate is determined by using the “Pan and cylinder” apparatus, by placing material from a representative sample of the graded aggregate fractions in the pan to obtain the visually desired texture i.e. the thickness of the layer is determined by the largest fraction and the voids filled with the smaller fractions. This amount of aggregate is then poured into the cylinder and the application rate determined by reading the theoretical ALD of the aggregate off on the gauge and dividing this figure by 1000 to determine the application rate of the aggregate in m^3/m^2

The recommended grading envelope for the Modified Otta Seal is shown in Figure 6.

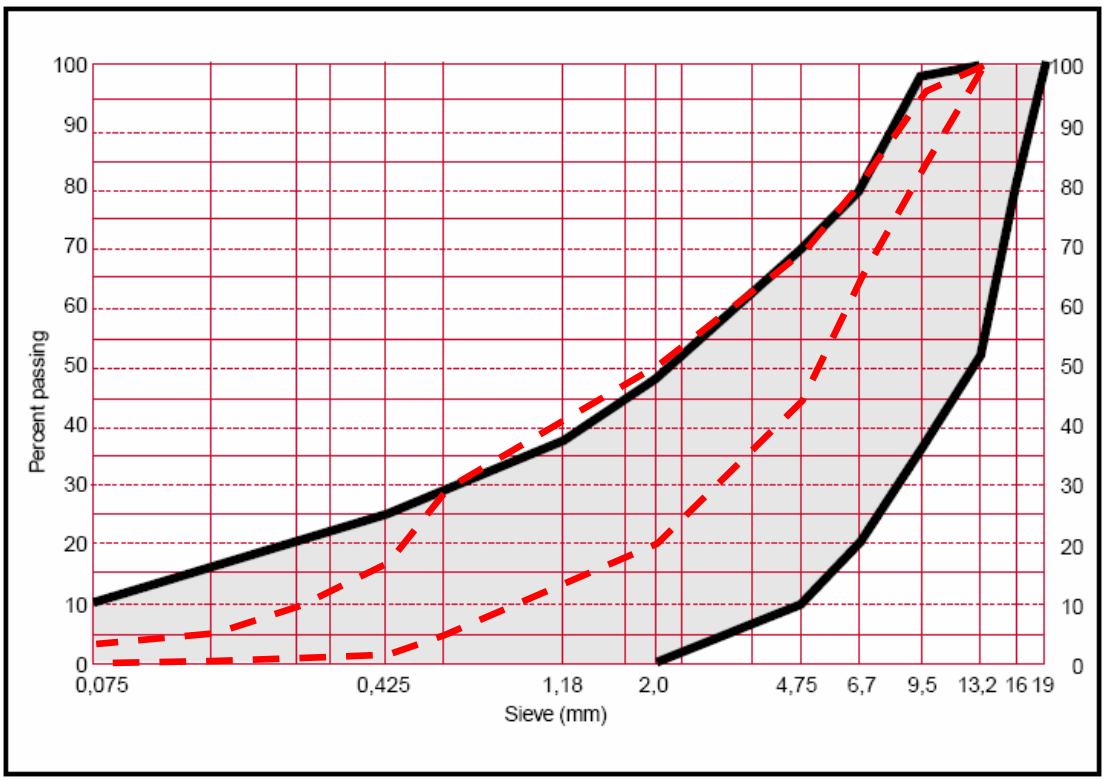


Figure 6: Recommended grading envelope for Modified Otta Seal (dashed line) superimposed on the grading envelope of the original Otta Seal

Spreading of aggregate

The aggregate can be spread manually or by means of a mechanical chip spreader or "chippie". Use of a chippie is highly recommended for an even application of the aggregates and a smooth riding surface.

For manual spreading the aggregate must be spotted in accurate quantities along the section to be sealed and care be taken that each heap is spread evenly on the predetermined area.

When using a chippie the tack coat should ideally only be sprayed on a length that can be covered by one run of a full chippie. This can easily be determined by a "dry run" of the chippie before the sealing operation starts. The width of the spray can be 2-3 times the width of the chippie (1.2m). If the total width to be sealed does not correspond to a multiple of 1.2m, it is recommended that the aggregate is spread from the outer edges of the road using the chippie leaving a strip in the middle that must be manually chipped.

Figure 7: Spotting of aggregates in accurate quantities for the area to be covered. The amount is measured in a half drum open on both ends placed on the plastic sheet and lifted off once the required quantity has been filled in the drum.

Figure 8: Manual spreading of aggregate requires a good technique and careful brooming and backchipping to ensure the entire area is covered uniformly

Figure 9: "Chippie"

Figure 9: The "chippie" greatly simplifies the uniform spreading of aggregates.

When the penetration spray is still fresh it may be advantageous to choke the surface with a fine layer of crusher dust before final rolling is done. This will fill in any surface pores in the seal and make it more water tight and further ensure that the coarse aggregate particles are held in place and thus enhance the durability of the seal.

Binder

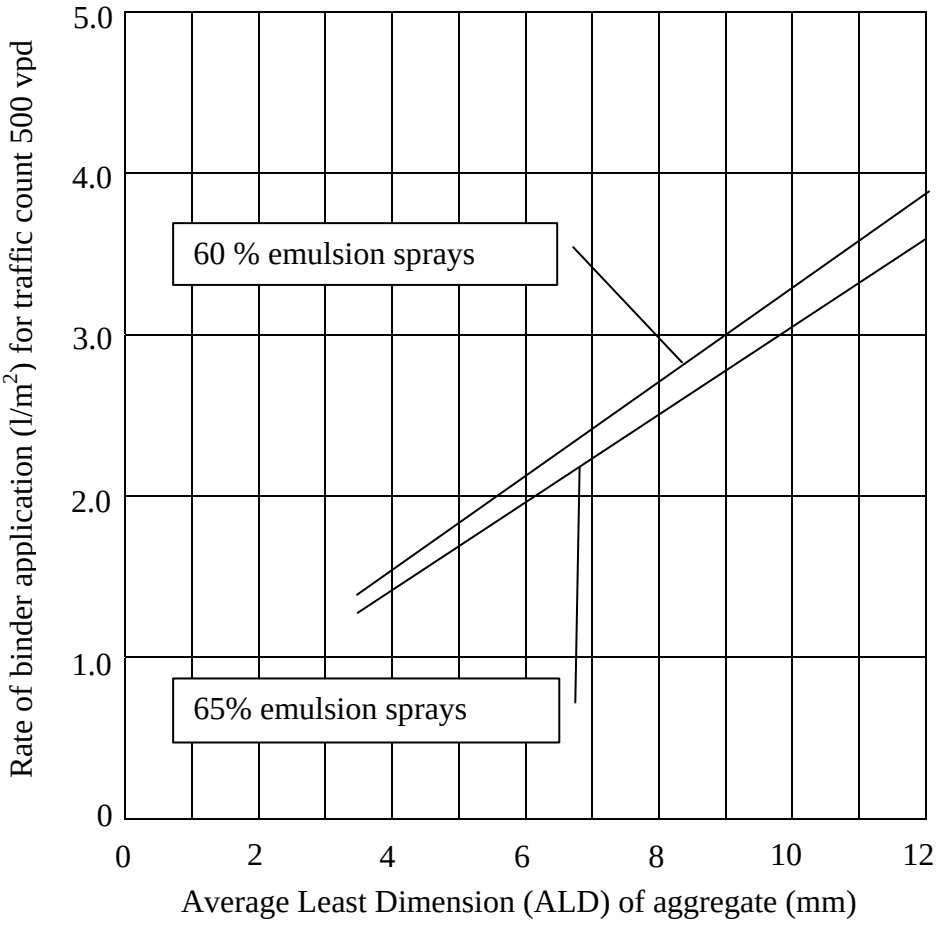
A 60% Stable Grade anionic emulsion (SS60) has proven to be most suitable for the Modified Otta Seal in that it allows sufficient time to penetrate the seal before breaking.

Once the Average Least Dimension (ALD) for the aggregate has been determined, the application rate for the binder can be read from the diagram in Figure 10.

For lower traffic volumes the binder application rate must be adjusted according to Table 1:

Traffic Count of vehicles per day	Adjustment of spray rate
500+ vehicles per day	No adjustment
200 – 250 vehicles per day	Add 7.5% to calculated binder
Less than 100 vehicles per day	Add 10% to calculated binder

Table 1: Adjustment of binder application rate



Spraying of the binder

Before spraying, the binder should ideally be heated to around 50^{o} C, which will ensure good flow of the emulsion through the sprayer and good penetration through the aggregate layer. Care must be taken not to overheat the binder.

The binder is applied in two operations. First 0.6-0.7 l/m2 is applied as a tack coat and allowed to break before the aggregates are spread and rolled. Due to the low viscosity of the emulsion, the binder will run off the road if more than the recommended rate above is applied.

The aggregate can be spread on the tack coat once this has broken after about 10 minutes. When the aggregate has been rolled sufficiently (first pass in non-vibratory mode, another two passes with intermediate vibration), the remainder of the binder is applied as a penetration spray and allowed time to penetrate the seal and break before final rolling takes place.

It is equally important that the hand sprayer is kept clean at all times. Once spraying stops, the suction pipe must be put into a drum of water and the sprayer cleaned out by spraying water back into the drum. By the end of the day the sprayer must be cleaned out with water and then with diesel or paraffin before being brought back to the site store.

Figure 11: Spraying of tack coat with a motorised hand sprayer

Sand Seal

The Sand Seal can be an economical solution for very lightly trafficked roads or as an intermediate seal until one of the other sealing options are applied. A Single Sand Seal is very thin and therefore not very durable, but it is easy to apply a second layer

and thereby increase the thickness and durability. Examples of large scale application of Sand Seals are found in the Kruger National Park where most of the surfaced roads have been surfaced with a Sand Seal using sand from the rivers in the park. A second and even third seal is applied as part of maintenance and thus the thickness and durability of the seal increased over time.

Aggregate

Sive size (mm)	Percentage passing
6.7	100
0.3	0-15
0.15	0-2

Table 2: Grading of sand for Sand Seal

The Sand Equivalent of the aggregate should be at least 35.

In many cases locally available sources (e.g. river sand, leached sand graded of the road) can be used successfully, but sand containing a high proportion of dust should be washed before use.

The aggregate spread rate should be +/- 0.007 m^3/m^2.

The aggregate must be spotted along the road as described for the Modified Otta Seal above and is spread with shovels once the emulsion has started to break (turning from brown to black in colour).

Figure12: Spreading of sand for a Sand Seal. A flipping of the shovel will make dust fly away with the wind. The sand should be broomed to an even layer before rolling.

Binder

A cationic spray grade emulsion, e.g. Cat 65, is used. At an application rate of 1.6 l/m^2 there will be approx. 1.0 l/m^2 residual bitumen in the seal once the water has evaporated.

The binder should be heated to around 50^oC before spraying with a motorized hand sprayer.

Cold Mix Asphalt (generic)

Aggregate

The same aggregate as for the Modified Otta Seal (see figure 2 above) can be used for on site production of a cold mix asphalt. This will however give a fairly porous asphalt. Trials have shown that 5-6% crusher dust can be added to the mix without causing problems to the mixing process and thus reduce the porosity of the asphalt.

It is, however, critical to limit the lower fraction material (0.075-0.15 mm) to not exceed the upper limit of the grading envelope as too high a percentage of fine material tends to absorb the binder resulting in a “dry” product.

Tack coat

Diluted 60% Anionic stable grade emulsion (SS60) (1:1 emulsion/water) at the rate of 0,4 – 0,5 litres/m^2 is used as a thin tack coat. It is applied with a watering can and broom between the 20mm guide rails.

Binder

A 65% Cationic mix grade bituminous emulsion (Tosas KMS 65 C or similar) has proved the most suitable for the construction of the asphalt surfacing.

A residual binder content in the asphalt of 5½% of the bulk dry density of the aggregate has been found suitable for the construction of low volume roads.

However, when working with a dense aggregate such as a Dolerite this will result in the over application of bitumen binder in the asphalt as the density of the dolerite is much higher than that of quartzitic aggregate.

As an indication an application of 124 litres of 65% Cationic mix grade emulsion per cubic meter of aggregate has been found adequate for the construction of low volume roads.

Mixing and laying

It is recommended a trial mix be prepared and a trial section constructed to determine the “placeability” of the mix.

It is essential that the process of batching, mixing, discharging, transporting, placing and screeding of the asphalt is properly controlled and efficiently executed to ensure that the process is completed before the emulsion breaks. Once the emulsion has broken it will be difficult to place and screed it. For this reason it is recommended that:

- Mixes should be limited to 100 liters.

- The width of a section to be screeded should not exceed 1 – 1,5 meters. (Try to arrange the guide rails so that they do not fall in the “wheel paths”).

Steps:

1. Measure the required amount of aggregate and load in the mixer.
2. Add water. About 1-2% water of the bulk dry density of the aggregate is normally sufficient. Mix thoroughly before emulsion is added. The amount of water can be increased in hot, dry weather and decreased if the aggregate is damp.
3. Pour the right amount of emulsion from the drum into a measuring bucket, then pour it slowly into the mixer while this is rotating. The mixing process is quick and after +/- 2 minutes the mix is ready to be placed on the road.
4. Pour the mix into wheel barrows (about half full) and transport to the section to be sealed.
5. Place the mix in small quantities at regular interval in front of the screed, then spread with shovels and squeegees to the approximate level and quickly screed off against the guide rails. If the heap in front of the screed is too big, the screeding will be difficult.

Guide rails of 20 mm height will give a finished asphalt thickness of +/- 14mm.

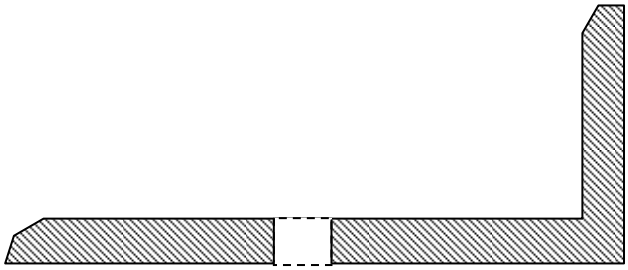


Figure 13: 20 mm x 50 mm x 4 mm angle iron is most suitable as guide rails

The guide rails must have holes for nailing them to the base so they don’t move during the screeding. 20 mm square tubing with welded on lugs may also be used but these tend to be a little too flexible and will follow any unevenness in the base when nailed down.

When laying the asphalt on the adjacent strip, a 6 mm flat bar is placed flat on the edge of the previously compacted asphalt to ensure tie-in when the new asphalt is compacted.

Compaction

When the emulsion has broken and set, the wet asphalt must be compacted with the pedestrian roller in vibratory mode. The reason for using vibration right from the start of compaction is to avoid any air to be “sealed in” and thus not obtaining maximum compaction of the asphalt.

LBS Asphalt

This is a proprietary cold mix product developed by Road Material Stabilisers (Pty) Ltd Johannesburg on request of the Gundo Lashu project team.

The LBS Asphalt has been designed specifically with labour-based methods in mind, i.e. to make it as labour-friendly as possible and to make use of labour for mixing instead of concrete mixers.

Typical mix proportions are:

LBS filler :	20%
Bitumen emulsion (60% nett) :	9%
Crusher sand (<6mm) :	50% (supplied form approved local source)
6,7mm roadstone :	21% (supplied from approved local source)

The filler is supplied in sealed 20-30 kg plastic bags and is added to the aggregates (crusher dust and road stone) and dry mixed by hand on site before emulsion is added.

The laying is done much the same way as described above. Guide rails of 25 mm height will give a resulting thickness of the compacted seal of +/- 20 mm. Once the layer has been screened off, water is added from the top using watering cans.

The LBS Asphalt is compacted with a vibratory roller immediately after laying. The drums should be watered to avoid asphalt sticking to the drums. Once the surface becomes saturated with brown liquid, sufficient water and compaction has been applied.

Due to the high proportion of fine material the LBS Asphalt becomes very dense and forms a fine textured, tightly knit surface. Light traffic can be allowed after a few hours at reduced speed. Full strength will only be achieved after all the water used has evaporated.

Figure 10: LBS Asphalt being mixed on site

Figure 11: Emulsion is added to the dry mix of filler and aggregates and mixed by hand

Figure 12: Compaction until surface is saturated with brown liquid

Points for consideration

+ All the emulsion based applications eliminate the hazards of working with hot bitumen;
+ They can be set up to progress at the same pace as the completion of the base and thus eliminate the danger of damages to the base before it is sealed;
+ They are much more labour-friendly than hot bitumen applications and will contribute to a higher labour content of the project;
+ The batching and laying of cold mix asphalts can be tightly controlled and thus ensure a uniform and high quality of the end product;
+ Cold mix asphalts give a superior riding surface. Minor irregularities in the base are compensated for with slight variations in the thickness of the asphalt;
+ The thickness of the asphalt can easily be varied by using different guide rails;
+ Potential damage to windscreens caused by loose aggregate whip-off, as can happen on a Otta Seal, is eliminated
– Modified Otta Seal require extensive training and control of the operator of the hand sprayer in order to obtain the specified spray rates. There are thus more things that can easily go wrong with this than with the cold mix asphalts;
– The riding surface of the Modified Otta Seal seal does not become as smooth as for a cold mix asphalt in that the surface of the seal tends to follow the surface of the base. Even when a chippie is used minor variations in the aggregate spread rate will result in a slightly uneven surface;

Suitability of emulsion-based applications for labour-based projects

From the above it should be clear that all of the emulsion-based applications mentioned here are eminently suitable for labour-based operations for a number of reasons.

Quality control is easier with the cold-mix asphalts and are thus preferred to the Modified Otta Seal. The asphalts also give a superior riding quality and will therefore contribute to create a positive perception of labour-based technology.

Of the two cold mix asphalt alternatives mentioned here, the LBS asphalt is the preferred option since it gives a much denser and watertight seal and does not require the use of a concrete mixer.

References

This article should by no means be used as a technical guideline for any of the mentioned alternative products. For successful project implementation further reading of the reference material below is required:

1) Guideline no 1: The Design, Construction and Maintenance of Otta Seals, Botswana Roads Department, June 1999.
2) Construction of trial sections of penetration seal and emulsion bound asphalt surfacing, Limpopo Province Department of Public Works, July 2006.
3) LBS Asphalt Booklet, Road Materials Stabilisers (PTY) Ltd, 2005