Surface Dressing
An Effective But Inexpensive Maintenance Technique
(Sharing the experience)

Roads and Buildings Deptt.
Govt. of Gujarat
Introduction

• A Surface Dressing is a process of spraying a road surface with bituminous binder and then covering the binder with clean, crushed aggregate or natural gravel.

• These layers are then rolled in order to press the aggregate into the binder film.

• Traffic movement commences the process of chipping movement which will produce eventually an interlocking matrix.
Economy in use of Surface Dressings

Indian Roads congress/MOST has recommended following types of bituminous wearing courses for road surface.

- Bituminous concrete
- Semi dense Bituminous concrete
- Premix carpet with seal coat
- Mix seal surfacing
- Surface dressing

Cont.
Surface Dressing Two coats

- Provides good sealing of the road surface, therefore no ingress of water in the lower layers resulting into a durable pavement.
- Provides high resistance to skidding hence accident hazards reduces.
- Bitumen content in two coats is 17-18 kg/10 sqm, which, means less expensive.
- The reflection cracking are retarded considerably due to its flexible behavior.
- Delay in oxidation of bitumen in binder course because stone chippings, provides protection from sunrays, resulting into a durable pavement.
- It is a simple and inexpensive treatment.
- Improvement of the light reflection characteristics
- Heating of chippings is not involved and HMP is not required, hence an environmental friendly treatment.
Surface Dressing Wearing Course

It provides a waterproof seal to a road surface

Provides Waterproofing of Pavement
Surface Dressing Wearing Course

Provides skid resistance to the pavement
Surface Dressing Wearing Course

Stone chipping reduces the oxidation of bottom bituminous layer
## Cost comparison
(Based on current prices of chippings & binder prevailing in Gujarat)

<table>
<thead>
<tr>
<th>Mix Seal Surfacing type A with tack coat (Rs/Sqm)</th>
<th>20mm Premix carpet with tack coat &amp; liquid seal coat (Rs/Sqm)</th>
<th>30 mm thick SDBC (Rs/Sqm)</th>
<th>30mm thick BC (Rs/Sqm)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Rs. 76.00</td>
<td>Rs. 90.00</td>
<td>Rs. 105.00 (@ Rs. 3500/cum)</td>
<td>Rs. 125.00 (@ Rs 4167/cum)</td>
</tr>
<tr>
<td>Cost per KM</td>
<td>Cost per KM</td>
<td>Cost per KM</td>
<td>Cost per KM</td>
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<tr>
<td>Rs. 5.32 Lacs</td>
<td>Rs. 6.30 Lacs</td>
<td>Rs. 7.22 Lacs</td>
<td>Rs. 8.61 Lacs</td>
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<td>Cost per KM</td>
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<tr>
<td>Rs. 4.69 Lacs</td>
<td>Rs. 6.70 Lacs</td>
<td>Rs. 7.60 Lacs</td>
<td>Rs. 8.61 Lacs</td>
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</table>

- **Savings in cost per Kilometer for a two – lane carriageway (Compared with MSS)**: Rs. 0.63 lacs.
- **Savings in cost per Kilometer for a two – lane carriageway (Compared with PMC)**: Rs. 1.61 lacs.
- **There is NO comparison with BC/SDBC because such layers provide strength to the pavement.**
The main objective of adopting surface dressing as a wearing coat over bituminous macadam is to achieve waterproofed, anti-skid but comparatively less expensive wearing coat which can last for more duration as compare to other wearing surfaces.
Surface dressing on Renewal Maintenance Component of Gujarat State Highway Project (RMC GSHP) corridors

- So far 625.57 km of roads have been treated with two coat surface dressing under RMC GSHP
- 1st year RMC : 5 corridors – 154 km (1999 - 2001)
- 3rd year RMC: 4 corridors - 98.20 km (2003 - 2005)
- 4th year RMC: 4 corridors – 179.97 km (2005 - 2006)
- Moreover 784 km of roads treated with 2 coats surface dressing under Earthquake Emergency Restoration Program for Kutchh & Saurashtra regions of Gujarat.
- Mr. L.S. Hitch an asphalt specialist from TRRL, UK performed the trial and demonstration of surface dressing in Gujarat.
- Selected corridor ranges from high rainfall (>250 cm annual rainfall) to moderate rainfall (>80 cm) region of Gujarat.
1st Year – 154 km
2nd Year – 193.4 km
3rd Year – 98.2 km
4th Year – 174 km
Maintenance Technique for Gujarat State Highway Project’s Renewal Maintenance Component (GSHP-RMC)

Pavement Preparatory works

Prior to laying of Bituminous Overlay, Extensive Pavement preparatory works have been carried out. These are:

- Sealing of Cracks by Fog/ slurry seals.
- Filling of potholes
- Reconstruction of distressed/ damaged pavement sections
- Providing Profile corrective Course with BM to bring back the cross profile of road to Standard camber.
- Strengthening course / Overlay
- Mixed Seal Surfacing or Surface Dressing two coats as a Wearing course
The chippings should meet the requirements of specifications in respect of:

<table>
<thead>
<tr>
<th>Properties</th>
<th>Tests</th>
<th>Requirements</th>
</tr>
</thead>
<tbody>
<tr>
<td>Single sized</td>
<td>Test on grading of chippings</td>
<td>Nominal size of chippings; 6, 9.5, 13.5 &amp; 19.5 mm</td>
</tr>
<tr>
<td>Cubicle in shape</td>
<td>Tests of Flakiness/Elongation index &amp; Average least dimensions.</td>
<td>Flakiness and Elongation Index&lt; 30 ALD not less than 0.5 of the nominal size.</td>
</tr>
<tr>
<td>Strong</td>
<td>Aggregate crushing Value (ACV) or Impact Value (AIV) and water absorption. Aggregate Abrasion Value (AAV)</td>
<td>ACV/ AIV &lt; 30 Water absorption &lt; 1 % Maximum –40%</td>
</tr>
<tr>
<td>Durable</td>
<td>Soundness Sodium Sulphate Magnesium Sulphate</td>
<td>Maximum – 12% Maximum – 18%</td>
</tr>
<tr>
<td>Not susceptible to polishing</td>
<td>Stone polishing Value (PSV)</td>
<td>Minimum- 60</td>
</tr>
<tr>
<td>Cleanliness(dust)</td>
<td>Grain size analysis</td>
<td>Max. 5% passing 0.075 mm sieve</td>
</tr>
<tr>
<td>Stripping</td>
<td>Coating &amp; stripping of bitumen aggregate mixtures</td>
<td>Min. retained coating 95%</td>
</tr>
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</table>
TRRL recommends the use of binder of various viscosities in tropical countries as under:

Proprietary additives known as adhesive agents (anti striping agents) can be added to binders to help better adhesion in wet weather or typical nature of stones.
Design Of Surface Dressing

For Double Coat Surface dressing select the nominal size of chippings as:

- First layer on the basis of hardness of the existing surface and traffic
- Second layer the size of chipping should be about half the nominal size of the first layer to provide good inter locking between the layers.
TRRL has suggested Jackson Design Method, which has been adopted depends on:

1. Average Least dimensions of chippings (ALD)
2. Traffic
3. Existing Surface
4. Climatic conditions
5. Type of chippings.
For other considerations overall weighting factors have been assigned for each parameter:

- Traffic
- Existing surface
- Climatic conditions
- Type of chipping

On the basis these factors and with the help of charts provided by TRRL the rate of spread of binder and Chippings are determined.
Chipping Application Rate

Fig. 7 Surface dressing design chart

1. For slow traffic or climbing grades steeper than 3 per cent, reduce the rate of spread of binder by 10 per cent.
2. For fast traffic or down grades steeper than 3 per cent increase the rate of spread of binder by 10 to 20 per cent.
Basic Equipment necessary for Surface dressing treatment is

- Binder Distribution
- Chip Spreaders
- Pneumatic Tyred Roller
- Compressors/ mechanical brooms
- Binder Heaters
- Front end loaders
- Tippers
Equipments Used In Gujarat

Bitumen distributor – 4000 litre capacity

Chipping spreader mounted on an 8 cum tipper
Equipments Used In Gujarat

Chipping spreader mounted on an 8 cum tipper in action
Equipments Used In Gujarat

Pneumatic Tyred Roller
Equipments Used In Gujarat

Synchronized Mechanized Equipment

Cont.
The results of surface dressing using Synchronized Mechanized equipment are much superior compared to conventional methods.
Equipments Used In Gujarat

Tractor Mounted Air Compressor

Various hand tools, scoops, depot trays etc.
The operations of surface dressing comprises of the sequences:

1. Provide traffic control equipment such as warning signs, control barriers, traffic cones etc.

2. To ensure that spray runs are parallel with the road pavement, the road centerline or edge line is marked at every 25 m and a chalk line is marked. The distributor driver can follow using his guide bar.

3. The binder distributor is checked and necessary adjustment in binder temperature is made using the burners. Check the jets for correct operations circulating the binder through spray bar.
The operations of surface dressing comprises of the sequences:

4. The distributor crew is instructed about the spray rate required, the corresponding road speed and pump output.

5. The road surface should be dry.

6. The loaded chipping tippers are ready to follow the bitumen distributor at the specified location.

7. Sweep of the road surface completely.
Surface Dressing Operations

The operations of surface dressing comprises of the sequences:

8. Extinguish the burners on the bitumen distributor & check the reading on contents gauge (Machine standing on level ground)
9. Adjust the height of spray bar, adjust the guide chain
10. Commence the spray of binder
11. No traffic is allowed whilst the binder is being spread.
12. The chip spreader & tippers follow the distributor and rollers closely behind them.
Surface Dressing Operations

The operations of surface dressing comprises of the sequences:

13. A strip of binder 150 mm wide is left unchipped at the edge of the lane to allow for the overlap of the adjacent run of the distributor.

14. Spread chipping by hand shovels on any places where there is deficiency of chippings.

15. Repeat the operation on the adjacent pass and allow the traffic slowly over the new dressing.

16. Check the level of binder contents in the tank at a level ground.

17. Roll the chippings using PTR with 5 to 6 passes.
Some of the finished Road Surfaces with two coat surface dressing

After 2 months

After 1 monsoon
Our Experiences (Problem Faced / Solved)

Difficulty in procurement of required quality and quantity of Chips from Quarries / Crushers.

- Persuasion with crushing plant owners
- Avoiding production of 40mm metal from crushers during the production of Surface Dressing chips
- Offering higher rates for surface dressing chips compared to prevailing rates of aggregate
- Changing the screens for production of 19mm / 9.5mm size chips
- Cone Crushers preferred with respect to Jaw Crusher
- Dust control is done by JCB machines / washing of aggregates and by dry run of hot-mix plant to blow away the dust from the chips.
Our Experiences (Problem Faced / Solved)

Frequent break-down of Synchronized Mechanized Equipment, difficulty in obtaining its spares and chocking of nozzles of Bitumen Distributor.

- Services from skilled foremen
- Advanced procurement of key spares was made
- Training of operators, cleaners, helpers for maintaining the equipments before and after Surface Dressing operations.
- Cleaning of nozzles of Bitumen Distributor twice a day and after halt to Surface Dressing work.
- One set of cleaned nozzles kept ready as standby.
- Chip spreader also kept standby.
Our Experiences (Problem Faced / Solved)

Early setting of Binder or delay in setting of Binder due to Seasonal / Climatic conditions, there was a restriction of working hours

• In winter, startup was delayed by 9 to 9:30am and stopped by 5:30pm
• Lunch time for workers was staggered
• In summer, the work started early by 7:30am to 12:00 noon and from 4:00 to 7:30pm, thus working the hours adjusted.

Road user unrest against rough road surface and complaints for breaking windshields of vehicles, accidents etc.

• Local awareness campaign about Surface Dressing treatment and its advantages
Our Experiences (Problem Faced / Solved)

In village area, sticking of cow dung on first coat of Surface Dressing and its cleaning

• Discussion with villagers in helping to change the path of cattle’s for the temporary period
• By using water, wet cloths, brushes and compressors, this problem was overcome

Traffic management in road section passing through urban area

• Such small road section are provided with B.C. / M.S.S instead of Surface Dressing
Our Experiences (Problem Faced / Solved)

- Touching of tree branches, electrical overhead lines while lifting the chip spreader of Synchronized Mechanized Equipment, road sections having green tunnel, electrical poles
- Restricting the lift of chip spreader
- Sometimes, Surface Dressing done manually in relatively small areas
- Over toppling of chip spreader on road sections having rising steep gradient, hilly regions, sharp bends, curves etc.
- Reversing the direction of chip spreader
- Manual chip spreading
Repairing of streaked portion of Surface Dressing layer

- The spray rate of Binder is reduced by half
- One or two nozzles of spray bar are opened
- Chip spreading is done by manual means or chip spreader
- Rolling through P.T.R.

Spreading out of road marking paint on Surface Dressing resulting in higher consumption of road marking paint

- Road marking is done after working up period of surface
- Preferably after one or two months depending upon the traffic
Our Experiences (Problem Faced / Solved)

- By using chip spreader, we can do single coat surface dressing in 1.5 to 2.0km road length per day
- By using Synchronized Mechanized Equipment, we can do single coat surface dressing in 2.5 to 3.0km per day
- The quality of surface dressing using chip spreader is almost same as compared to Synchronized Mechanized Equipment
Conclusion

• The local contractors are capable of carrying out surface dressing work producing good quality work.
• Initially difficulty was felt in mobilization of equipments, but subsequently the contractors managed to procure the same.
• Quite a good effort was necessary in training the contractor’s personnel in processing Surface dressings.
• Adequate adhesion, perfect mosaic formation and interlocking of chippings have been achieved.
• Streaking and fretting were observed where just after completion of laying process of surface dressing the rains have set in, requiring reprocessing.
Conclusion

- The margin of error in surface dressing is much less hence proper care & controls in design; planning, mobilization of proper equipment and application are essentials.

- Even after four monsoon seasons no defects have been observed on road pavement. Where as after completion of design period that is of Five years, marginal distress ranging from 2% to 5% in the form of potholes, patches etc. have been observed, thus the objective of surface dressing as a wearing coat on state highways is achieved.

- Post construction performance surveys viz. Roughness Survey, Traffic Census, Accident Analysis, Road User Satisfaction Survey has been carried out and the results are satisfactory and encouraging.
Suggestions

• The surface dressing should be adopted on low priority roads for renewal as well on new pavements in India.
• To achieve economy provide renewal coat on National Highways / State Highways with surface dressing in order to postpone the expensive treatment of BC/SDBC.
• On smooth and polished road surfaces a single coat surface dressing would provide skid resistance.
• Government should liberalize the rules for import of modern equipment for Surface dressing
Suggestions

• Government should accord high priority for transfer of technology from developed countries to India on Surface Dressing, by exchange of Experts, workshops, training & Demonstrations

• Public generally do not prefer surface dressing because it course texture therefore it is essential to create public awareness on this aspect.

• The agencies who have technical know how and equipment for surface dressings should be registered separately by Central / State Govt for carrying out the surface dressing works.
Thank You