USE OF HIGH FLOAT
EMULSION ASPHALT IN ALASKA

(Report to the Legislature)

By

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January 1985

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HIGH FLOAT EMULSION ASPHALT SURFACE TREATMENTS IN ALASKA

Introduction:

A resolution passed by the Thirteenth Alaska Legislature (SCR-27) requested the Department of Transportation and Public Facilities (DOT&PF) to investigate the merits of a high float emulsion asphalt surface treatment currently used in the Yukon Territory. To fulfill this request, three sections were constructed during the summer of 1984 at the following locations:

Persinger Drive/Keeling Road - Fairbanks, Alaska
Freeman Road - Fairbanks, Alaska
Mud Bay Road - Haines, Alaska

Since these test sections were only constructed this past summer, this report can offer little more than a preliminary report, a review of the Alaskan, Canadian and Norwegian experience, and a few general observations. However, these sections have been and will continue to be monitored to observe their performance. Further reports will be issued as necessary to relate performance with time.

In this report approximately 10 years of Canadian experience and 15 years of Norwegian experience will be discussed. The economic considerations for their use of this type of surface will be presented. However, it should be emphasized that the political and economic environment in these countries is significantly different than Alaska's, which may impact our choice of surface types.

Background:

The term "high float emulsion" refers to a specific type of asphalt cement dispersed in a water carrier, and not to the construction method, which is more accurately described as a surface treatment. An emulsion is a stable mixture of two or more fluids that under normal circumstances would not mix. Common examples are milk and latex paint. Asphalt emulsions consist of three basic ingredients: asphalt, water, and an emulsifying
agent, which is basically a form of soap. The purpose of an asphalt emulsion is to make a dispersion of asphalt cement in water which permits the coating rock particles with cold asphalts, after which the water phase evaporates away.

High float emulsion has the distinguishing characteristic of permitting a thicker asphalt film on the aggregate particle with a minimum probability of drainage. This allows the coating of dusty aggregate particles in seal coat applications.

This is the property that is desired for the Canadian surface treatment. Like conventional surface treatments the primary purpose is to provide an all weather and dust free surface that seals the pavement structure from moisture. Surface treatments do not add strength to the roadway. Therefore, no cost savings can be expected in construction of the embankment or in the preliminary preparation of the surface when surface treatments are used. An adequate non-frost-susceptible pavement structure must still be provided.

High float emulsions are not currently produced in Alaska or on the West coast of the U.S. The nearest source is Watson Lake, Yukon Territory Canada. The long highway hauling distances result in high delivered costs in Alaska. High float could easily be produced in Alaska, thereby reducing the shipment of the 30% water fraction, if there is sufficient demand. This would significantly reduce the cost.

The primary difference between the Canadian technique and the conventional surface treatment is the aggregate gradation, as shown in Table 1. High float emulsion asphalt can be used with both aggregate types. Canadian experience indicates that high float is critical to their technique because of its ability to coat dusty particles, its slow setting properties, and the wicking action it provides. Discussions with Canadian officials indicate they feel that their surface treatment is cost effective when compared to the alternative of maintaining gravel roads using calcium chloride for dust control when sufficient funding is not available to upgrade the surface beyond a surface treatment. The distances involved in Canada greatly increase mobilization costs for equipment required to mix and place hot asphalt pavements. Finally, the low traffic volumes in Canada do not warrant extensive hot asphalt paving.
<table>
<thead>
<tr>
<th>Sieve</th>
<th>&quot;C&quot; Chips</th>
<th>Canadian Cover Coat</th>
<th>Alaskan Cover Coat</th>
<th>Norwegian Cover Coat</th>
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<tr>
<td>1&quot;</td>
<td></td>
<td>100</td>
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<td>0-2</td>
<td>5-15</td>
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Norway has used a medium cure cutback asphalt for about 15 years for a similar surfacing they call "Otta-surfacing" (1). Some cationic asphalt emulsions (CMS-2) have been successfully used in the Otta-surfacing method. Norway finds it cost effective when compared to gravel roads but do not feel it is competitive with higher performance pavements when higher pavements are required for traffic levels above 500 vehicles per day.

Construction Experience in Alaska (1984)

Mud Bay Road

The first section to be constructed in Alaska was on Mud Bay Road in Haines. Some problems were encountered in the construction process. Most of
the problems were due to the lack of experienced personnel and inadequate equipment. Changes in specifications have since been made.

Both high float emulsion (HS350S) and CMS-2 emulsions were used on the project. D-1 aggregate was used which is similar to the Canadian specifications. The resident engineer felt the high float provided superior coating to the CMS-2, which is consistent with the Canadian experience.

Shortly after completion of this project, complaints of potholing and severe surface deterioration were received. The specifications had called for paint striping within 10 days of the placement of the surface. As expected, the excess gravel became loose and caused a surface which appeared similar to a gravel road. At the suggestion of Mr. Ray Magneson of Yukon Highways, the excess gravel was removed using a grader equipped with a rubber blade followed by power brooming. The brooming left a hard surface similar to conventional surface treatments.

Because of the construction technique, the high float surface treatment does not provide the smooth surface of a hot asphalt pavement. This fact caused public criticism on all projects constructed.

From experience gained on this project, the following generalizations can be made (2):

1) The experience of the construction crew with surface treatments is critical.
2) Only high volume asphalt distributors should be allowed.
3) In areas of high rainfall, the technique may be ill-advised because of high aggregate moisture content and the sensitivity to rain within 36 hrs after application.
4) Loose gravel should be removed prior to paint striping.
5) Use of this type of surface treatment should be avoided on grades steeper than 6 percent.
6) The ride quality and low noise level of hot asphalt pavement should not be expected.

Persinger Drive/Keeling Road:

A second test section was constructed near Fairbanks on Persinger Drive/Keeling Road. Again both HS350S and CMS-2 emulsions were used on
adjacent lanes. Placement of the surface went very smoothly except for a delay in the arrival of the high float emulsion from Watson Lake. Adjacent lanes were paved using CMS-2 and high float. Traffic caused potholing of the unsurfaced lane which was difficult to repair. Again the aggregate coating with the high float emulsion appeared superior.

The project engineer had the following comments (3):

1) Chip spreader equipment is designed for a single sized material and does not work well with a wider band of well graded material such as D-1. Also the chip spreader is not designed to spread at this higher application rate (70 Lbs/SY) required.

2) The High Float Asphalt (HS350S) appeared to wick into the cover coat material better than the CMS-2. However, high float asphalt produces an erratic pattern where it wicks through the cover coat material surface producing spots the size of a quarter or larger in erratic patterns. The rollers picked this up leaving "potholes" and deposited "pancakes" elsewhere on the mat.

3) Brooming the surplus cover coat material off after three days or longer requires a considerable effort before paint striping can be done.

4) The immediate appearance of this method of paving is not impressive, although the long term durability is yet to be known.

5) The contractor has stated that he will bid other projects much higher so it is safe to predict higher future costs. The costs on this project were equivalent to double chipping, and in the opinion of the resident engineer, not as good; so this method is not cost effective.
Freeman Road:

A third section was constructed near Fairbanks on Freeman Road. The results were similar to those on Persinger Drive. As previously stated, some problems with segregation were encountered.

Monitoring Program:

A monitoring Program has been established on each test section to determine the rate of pothole development. Grids have been laid out on the surface at several locations which will assist in the determination of how well the surface will perform. The results of this program will be published upon completion of the study.

Cost Comparison:

In order to compare the cost effectiveness of any process, its cost must be compared to some standard. Two types of surfacing are commonly used in Alaska; hot asphalt concrete and bituminous surface treatment (BST). Table 2 compares the costs of each surface type. The comparison assumes the following:

1) Only the cost of placing the surface is considered. It is assumed that grade preparation is the same for all surfacing.
2) The expected life is based on averages for low volume roads.
3) No maintenance costs are included.
4) A 10% interest rate is assumed.
5) Costs are based on Fairbanks area projects.
6) The structural strength of the embankment is adequate.

It should be realized that the comparison in Table 2 is valid only for the stated conditions. Any variation may alter the results.
TABLE 2
COST COMPARISON PER SQUARE YARD

<table>
<thead>
<tr>
<th>Surface</th>
<th>1st Cost</th>
<th>Expected Life</th>
<th>Equivalent Annual Cost</th>
<th>Expected Maintenance</th>
</tr>
</thead>
<tbody>
<tr>
<td>High Float</td>
<td>$2.68</td>
<td>3 years*</td>
<td>$0.68</td>
<td>High</td>
</tr>
<tr>
<td>BST</td>
<td>$2.85</td>
<td>5 years</td>
<td>$0.54</td>
<td>Moderate</td>
</tr>
<tr>
<td>1 1/2&quot; AC</td>
<td>$4.37</td>
<td>15 years</td>
<td>$0.53</td>
<td>Low</td>
</tr>
</tbody>
</table>

* Based on Canadian experience on the Alaska Highway.

Summary:

Three roadway test sections have been built in Alaska using a surfacing method commonly used in the Yukon Territory and Norway. The method consists of dropping a layer of well graded aggregate onto a single application of high float emulsion (HS3505). Placement is very similar to that used in conventional bituminous surface treatments.

It is still too early to determine how well this surface will work. However, a number of statements can be made from experience gained thus far.

1) Placement is little more difficult than conventional surface treatments. Since the chip spreader is designed to spread single sized chips, minor modifications must be made to the spreader to reduce segregation.

2) The high float emulsion appears to work better than CMS-2 because of the aggregate coating and ease of handling.

3) Considerable brooming is required before stripping.

4) A weak foundation will result in a rapid failure, as evidenced by the Yukon Territory experience on the Alaska Highway.
5) Canadian experience has shown the maintenance costs to be higher for high float surface treatments than for hot asphalt concrete pavement. Potholes must be repaired soon after they develop to prevent rapid deterioration.

6) On low volume roads constructed over stable terrain, high float surface treatments appear to be least desirable. On roadway sections built on ice-rich permafrost ground where the surface type has no influence on the life, this method looks reasonable. However, unless the price is decreased from present bids, conventional surface treatments are more attractive. Remember, though, the embankment must be strong in any case.

In summary, the high float surface treatment may have application in areas where only a dust palliative is required. It does not appear to be a good for high volume roads. Only close monitoring of the three test sections will provide performance information.

Conclusions and Recommendations:

1) The high float surface treatment method does not appear to be a cost effective construction technique in Alaska at present unless the cost can be significantly reduced. Costs of any new construction method are typically higher due to contractor uncertainties and inexperience. Only time and experience can resolve the ultimate costs.

2) It should be used only as a maintenance technique on low volume roads where thaw settlement controls the frequency of patching. Because only a single layer is applied, pothole development is the primary mode of failure. Therefore, the pothole patching effort must be intensified to properly maintain this surface type.

3) It may be used as a maintenance alternative to gravel roads where funds are unavailable and where higher performance pavements cannot be justified.
4) The initial ride quality of the high float surface treatment is inferior to either conventional surface treatments or hot asphaltic concrete.

5) High float emulsion surfaces must not be applied over low-strength roadway structures since they are very sensitive to their foundation.

It is generally recommended that high float emulsion surface treatments be used as a maintenance tool until the performance can be firmly established.
ACKNOWLEDGEMENTS

The author gratefully acknowledges the personnel of the Yukon Territory, Canada, for their unselfish assistance throughout these projects. Without their help, progress would have been much more difficult.

The assistance of all the Alaska DOT&PF personnel is also acknowledged. Each person involved added his expertise which insured the best possible chance of success.
REFERENCES


2 Memo from Larry Geise to Dale Miller dated July 19, 1984.