USE OF HIGH FLOAT IN ALASKA

A Thirty Year Review
NORWEGIAN EXPERIENCE

• “Otta-surfacing” used by Norway beginning around 1970
  • Used dense graded surface course and medium cure cutback
  • Successfully experimented with CMS-2
  • Concluded Otta-surfacing cost effective compared to gravel roads, but not pavement
  • Used only for roads with AADT < 400
CANADIAN EXPERIENCE

- Began use in around 1974
- Used modified base course
- HS350S High Flat Emulsion
- High Float is very effective for the Alaska Highway where permafrost makes paving difficult.
- Life expectancy between 3 and 7 years mostly based on embankment.
- To replace Canadians disk the existing surface and relay High Float.
ALASKAN EXPERIENCE (1/2)

- Alaska Legislature required ADOT&PF investigate High Float in 1983
- First High Float placed in 1984
  - Three sites
  - Lack of experience resulted in difficulties
  - Distributors and spreaders were inadequate to handle the quantity of material to be placed.
  - Impacts of rain have a significant impact on stockpile moisture
  - Not recommended on grades >6% because HF tended to run
  - Brooming requires much more effort than chip seals
  - HF wicked into surface course better than CMS-2
  - Oil that reaches the surface can cause pickup and potholes
  - Ride quality is not as good as chip seals
• Noted Issues
  • Application rates difficult to determine
  • Few clues exist to ensure application rate is correct
  • There is a tendency to over oil the surface resulting in bleeding during hot weather.
  • There is a tendency to place too much cover aggregate
  • High Float cure time is a function of temperature, relative humidity and surface course. Late season paving a problem.
CURRENT PRACTICE

- Routinely used by M&O for level and patch activities
- Used on rural low volume roads where chips are expensive
- Select a gradation that provides room for the asphalt
SPECIFICATIONS

% Passing
Grading C

<table>
<thead>
<tr>
<th>Material</th>
<th>Estimate Application Rate</th>
<th>Tolerance</th>
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<tbody>
<tr>
<td>HFMS -2s</td>
<td>0.75 gal/yd²</td>
<td>0.4 gal/yd²</td>
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<tr>
<td>Cover Agg.</td>
<td>75 lb/yd²</td>
<td>2.5 lb/yd²</td>
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% Wear

<table>
<thead>
<tr>
<th>Property</th>
<th>Standard</th>
<th>Value</th>
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<tbody>
<tr>
<td>Deg. Value</td>
<td>ATM T-13</td>
<td>30 min</td>
</tr>
<tr>
<td>% Fracture</td>
<td>WAQTC TM-1</td>
<td>70 min</td>
</tr>
<tr>
<td>Sodium Sulfate Soundness</td>
<td>AASHTO T-104</td>
<td>9% max (5 cycles)</td>
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<tr>
<td>Thin/Elongated</td>
<td>AASHTO T-90</td>
<td>3 max</td>
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TIME-DEPENDENT NATURE OF HIGH FLOAT

- The quality of HF develops over time.
  - Don’t expect a hot mix ride overnight
- The initial surface will appear much like a gravel road complete with dust.
- Even after initial brooming the surface will be rough and noisy.
- Over time the surface gets smoother and quieter.
- A limited number of potholes are normal. Fix them as quickly as possible. Alaska typically uses cold mix for this.
STAGES OF HIGH FLOAT PERFORMANCE

- Application of materials
- Initial Densification by Rolling
- Action of Time, Temperature and Traffic
- Brooming
- Final Densification
STAGE 1: APPLICATION OF MATERIALS

- Materials must be compatible
- Use enough HF emulsion and aggregate to produce a final thickness equal to the maximum aggregate thickness. Usually ¾ inch.
- Emulsion should almost fill the voids.
  - Too much results in bleeding
  - Too little results in raveling
- Enforce specifications. Like chip seals, there is little room for error
STAGE 1: OBSERVED PROBLEMS

- Problems are rarely obvious during this stage.
- Poor selection of equipment
- Poor calibration of equipment
- High moisture in surface course causing clumping in spreader
Stage 2: Initial Densification by Rolling

- Roller passes compress the aggregate into the oil and compact
- Ideally the emulsion will rise uniformly into the aggregate and fill available voids
- The target density is similar to hot mix asphalt (around 140 lb/ft³)
- Observed Problems
  - Emulsion may not rise if wetting properties of aggregate are wrong
  - Roller can “walk” on course aggregate and not compact fine material
    - May be the result of course aggregate falling on top of fine aggregate
  - Compaction of base course too low to allow proper compaction
STAGE 3: ACTION OF TIME, TEMPERATURE, AND TRAFFIC

• Allow to compact under traffic for at least 3 days as HF cures.
• Full cure takes about 2 weeks under good conditions
  • Lower temperatures and high humidity will increase cure time
• Anticipate significant aggregate loss under traffic
• Consider enforcing lower speeds

Observed Problems
• Dirty aggregate remain unbonded
• If too much emulsion traffic may cause bleeding
• Anticipate complaints from dust and rocks hitting windshields
STAGE 4: BROOMING

• Remove all loose aggregate; typically after 3 days to a week
• Anticipate multiple passes
• Additional effort may be required if the surface has been wetted due to rain
• In severe cases a rubber grader blade can be used
• Observed problems:
  • Aggregate loss typically in the 20% to 30% range
  • Unpredictable amount of aggregate loss can result in loss of control of residual asphalt content
STAGE 5: FINAL DENSIFICATION

• Traffic will continue to densify the surface especially during hot weather.
• If the base is properly constructed, course aggregate should not be pressed into base course.
• Asphalt content should not change during this period.
• Observed Problems
  • Bleeding may occur if the asphalt content is too high. This may happen years later during unusually hot weather.
  • Densification occurs mainly in wheel path.
MIX DESIGN OUTLINE

- Select aggregate source and gradation
- Determine compacted density of aggregate
- Calculate aggregate application rate
- Calculate residual asphalt content
- Test mix design
STEP 1: SELECT AGGREGATE

- Determine maximum aggregate size
- Check compatibility with emulsion
- Check thin and elongation
- Check fines content and clay content
- Check durability
STEP 2: DETERMINE AGGREGATE DENSITY

• Best to compact in a thin layer to replicate field conditions.
  • No standard exists at this time
  • Can use proctor at appropriate moisture content and calibrate mix design using that
STEP 3: CALCULATE AGGREGATE APPLICATION RATE

**EQUATION HERE.**

\[
\text{aggregate dry density} \times \frac{9 \text{ ft}^2}{\text{yd}^2} \times \frac{\text{design thickness}}{12} + 15% \\
= 0.8625 \times \text{aggregate dry density} \times \text{design thickness}
\]

Example: density = 115 lb/ft\(^3\); max aggregate size = 3/4 in

\[
(0.86)(115)(0.75) = 75 \text{ lb/} \text{yd}^2
\]
STEP 4: COMPUTE RESIDUAL ASPHALT (1/3)

\[
\text{volume occupied by solids} = \frac{\text{aggregate dry density}}{(\text{effective specific gravity})(\text{unit weight of water})}
\]

Assume effective specific gravity = 2.45

\[
= \frac{115}{(2.45)(62.4)} = 0.75
\]
STEP 4: COMPUTE RESIDUAL ASPHALT (2/3)

\[ \text{volume occupied by natural moisture} = \frac{(agg.\ dry\ density)(moisture)}{\text{unit weight of water}} \]

Assume 3% moisture

\[ \text{volume occupied by natural moisture} = \frac{(115)(0.03)}{62.4} = 0.055 \text{ cu. ft. per cu. ft. of AST} \]

95% volume available for emulsion = \[ 1 - (\text{vol. solids} + \text{vol. water}) \times 95\% [1 - (0.75 + 0.055)] = 0.185 \]
STEP 4: COMPUTE RESIDUAL ASPHALT (3/3)

Convert to gal/yd$^2$

$0.185 \times 7.48 \times 9 \times \left[ \frac{0.75}{12} \right] = 0.78 \text{ gal per sq.yd.}$
STEP 5: TEST DESIGN

- Prepare a 3ft X 3ft plywood form using 2 in by 2 in lips
- Place roofing paper in bottom of form to aid in cleanup
- Place form on solid surface
- Carefully spread emulsion in form at the computed quantity
- Add the computed quantity of aggregate
- Compact the aggregate using a weighted roller or rocker panel
- Allow to sit for three days
- Broom off the excess material and inspect
- You may wish to put the sample in an oven at 100° F
  - Roll and inspect for bleeding.
SUMMARY

• High Float Emulsions in combination with graded aggregate have been used in Alaska for 30 years. (40 years in Canada)