EXPERIMENTAL PROJECTS CONSTRUCTION REPORT

ACE FIBERS IN PLANT MIX ASPHALT

Location: Billings District/Yellowstone County-Billings: Division St. & 6th Ave N (27th-32nd)

Project Name: Division St.-Billings & 6th Ave. N-27th to 32nd

Project Number: UPPIP 1017(2)/UPPIP 1029(4)

Experimental Project: MT-18-03

Type of Project: Sasobit-Aramid Fiber Reinforced Asphalt Cement (FRAC)

Principal Investigator: Craig Abernathy: Experimental Project Manager (ExPM)

Date of Construction: July 2018

Date of Inspection: April 2019 & 2020

Description

This project was nominated through the FHWA Section 1304 of MAP 21; Innovative Project Delivery Methods initiative. The Billings District has approved to incorporate synthetic fibers as an additive to improve asphalt cement (AC) properties. This is the first trial in the state that has used AC fiber reinforcement in a pavement preservation application. The intent of this chosen admixture is to improve resistance to cracking and rutting, a higher dynamic modulus and increased service life.

Experimental Design

Surface Tech is the chosen vendor to supply Ace Fiber (pre-treated aramid fibers coated with Sasobit wax) used in the production of fiber reinforced asphalt cement (FRAC). Surface Tech (ST) was on site to monitor the inclusion of the Ace Fiber during AC production. ST also furnished the Ace Fiber Line-Vac delivery System which is the device that introduces the fibers into the drum mixer. It is estimated that over 18 million Aramid fibers (AKA clips) is dispersed for each ton of mix to provide 3-dimensional reinforcement.

Because untreated aramid fiber is a very lightweight and difficult material to work with, the fibers are soaked in a wax binder. This pre-treatment adds weight to the fiber clips and prevents them from blowing away or clumping during the delivery and feeding process; If untreated the fibers do not distribute evenly in the plants mixing chamber.
The reinforced asphalt cement was produced by a Gencore Ultraplant 400 located at the Knife River Commercial Hot Plant in Billings. The plant mix surfacing on this project will consist of 3/8" nominal aggregate mix.

**Evaluation Procedures**

**Construction Documentation (June/July):** As applicable the Research Section will document the construction methods and equipment, material placement, and specification conformance etc.,

**Post Documentation:** Research staff will conduct full site inspections annually (late fall) to document visual appearance of the pavement. In addition to include any maintenance or other Department inspection information associated with this project.

**Evaluation Schedule**

Research will monitor and report on performance for a minimum period of five years annually, with every year up to *ten years (informally). This is in accordance with the Department’s “Experimental Project Procedures”. Delivery of a construction/installation report, interim, annual or semi-annual reports is required as well as a final project report (responsibility of Research). A web page will be dedicated to display all reporting from the project.

2018: Installation/Construction Report

2019-2022: Annual Inspections/ Annual Evaluation Reports

2023: Final Evaluation/Final Report

*If considered the extra data collection and analysis will add value to the overall results of the project.

**Process**

The purpose of an experimental features report is to document the phases and events of any given project to gain the reader an understanding of the general activities required to install or incorporate the research element into an active construction or maintenance project as an in-service evaluation. This report also establishes a baseline for defining performance for any given feature under actual service conditions to determine its relative merits. The following documentation is a general representation of the fiber reinforcement application, paving phase and subsequent site evaluations.

No visible distress was found during the April 2019 site evaluation.

The April 2020 inspection found some minor diagonal cracking at the intersection of Division St. and 4th Ave N., no rutting or other visible distress apparent to date. Next formal reporting will be in spring of 2021.

Refer to page sixteen (16) for project layout.
Representative images of pavement distress in areas on Division St. Top image shows fatigue cracking (view south near Lewis Ave.). Lower image shows heavy rutting at the intersection of Division St. & Broadwater Ave. (view south).
Additional images of pavement distress on 6th Ave N. Top image shows fatigue cracking and previous patching (view west). **Lower image** (Division St.); after milling several sections of pavement needed full replacement prior to paving (view south).
The Ace Fiber arrive on-site at the hot plant packed in 40 lb. cardboard boxes which will produce approximately 153 tons of FRAC.

The wax treated aramid fibers (known as clips) are approximately .75 inch (19mm) in length. With a fiber tensile strength of 400,000 psi and fiber melting temperature of 800F (427C).

Each clip contains over 10,000 individual aramid fibers.

The clips are soaked in Sasol Sasobit (a synthetic hard wax). Each clip by weight, contains 50% wax and 50% fiber; with a wax melting point of 216F (101C).

The wax application gives the fiber the needed weight to adequately be distributed into the mixing drum.

As the Sasobit wax melts, it allows the dry fibers to disperse evenly into the asphalt and aggregate mix.
Overview of the Ace Fiber Line-Vac Delivery System (LVDS) set-up near the hot plant mixing drum.

Based on a production rate of 280 tons per hour fiber insertion (or goal) would be at an application rate of 19.6 oz. per minute (based on a 4.2 oz. per ton).

Each tub would hold 19.6 oz. with four tubs on deck ready for production.

A close-up view of the Ace Fiber LVDS set-up.

The iPhone (red arrow) acts as the timer for the technician to insure each tub is metered in at the one-minute per tub application rate.

The pilot house personnel give the technicians the go ahead to begin vacuuming the pre-weighed fibers from the tubs.

Suction is generated by using an Exair compressed air powered (in-line) vacuum generator (yellow arrow).

The air pressure is regulated at 125 psi.
Per Surface Tech recommendation; the Knife River Hot Plant modified the baghouse fines return chute with an adapter to accept the exhaust end of the fiber vacuum hose (red arrow). This allowed the Aramid fiber to enter the mixing chamber at the same point the asphalt and aggregate are mixed.

No issues were reported in the admixture application phase regarding hot plant production.
**Paving Phase**

✿ Division St (view north); representative image of the paving phase.

The paver operators stated no perceived issues with the enhanced AC during the paving passes.

Those workers handling rakes at the paving edges did state the mix felt somewhat sticky.

The paver used on the project was a Caterpillar AP655D.

✿ Additional image of FRAC paving on Division St. (View South).

Note the area in the right of the image which required an AC patch after milling. It was stated that all AC repaired prior to paving included the Aramid fiber admixture.

✿ Double steel drum rollers provided compaction on the project.
Close-up of uncompacted FRAC: The fibers were almost undetectable in the mix; however, if you handled a clump of the mix and pulled it apart the fibers were visible.

View of compacted FRAC.
Completed Project

Representative image of completed project: 6th St. Ave N (view south).
April 2019 Site Inspection: Representative Images

俵 View south; near the intersection of Yellowstone Ave. & Division St.

俵 View west; at the intersection of 6th Ave. N & N 30th St.
Representative image of AC surface.

Closer view of AC texture.

Image taken near south end of Division St.
Intersection of Reserve St. and Lewis Ave.; view south. Image typical of pavement condition to date.
Several images of pavement texture on project.
Supplemental: Pavement Cracking; Division St. & 4th Ave. N

Low-severity cracking at the intersection of Division St. and 4th Ave. N.; view east. Note that this crack location observed is almost at the same location as seen during the project pre-documentation conducted in May of 2018.
*Project Layout: Fiber Reinforced Asphalt Cement (FRAC)*

Yellowstone County\City of Billings Montana

- UPPIP 1017(1): Division St. (Broadwater Ave. to 6th Ave N) – 2017 AADT 17,577

*All values approximate*
**Disclaimer**

The use of a product and/or procedure in the course of an evaluation does not constitute an endorsement by the Department nor does it imply a commitment to purchase, recommend, or specify the product or procedure in the future.

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