

# Evaluation of Emulsified Sealers/binders Used For Extending The Life of Asphalt Pavements

## - WORK PLAN -

### EVALUATION OF SEALERS/REJUVINATING AGENTS

#### Introduction

Traditionally, highway agencies have allowed the ride quality and the structural condition of the pavement to deteriorate substantially before taking steps to rehabilitate the pavement. This is costly. An effective preventative maintenance program can provide an agency with considerable monetary savings

The oxidative aging of pavements begins at the time of construction and continues throughout a pavement's life. However, most oxidative aging occurs within the first two to four years of service life. This results in the top ½ inch of the pavement surface becoming more brittle than the underlying material due to the oxidative actions of water, ultra violet, and environmental actions. This can result in raveling and or premature cracking, which often will begin at the pavement surface.

Maintenance personnel in many agencies have combated this aging process by applying spray-applied treatments using distributor trucks. Two major types of spray applied treatments are commonly used; products that seal the surface and products that rejuvenate the surface. Sealers consist of products such as SS-1h or CSS-1h that are applied to seal pavement surfaces against intrusion of air and water, and to eliminate or minimize raveling of the fine aggregate due to aging of the asphalt binder. These treatments can begin immediately after construction but more typically occur many years later when some form of distress is observed. Sealers have been used in approximately two thirds of the states.

Rejuvenators are products such as Reclamite or Pass Oil that are formulated to penetrate into the pavement and then enhance the properties of the asphalt binder of the existing the pavement. These treatments are most commonly used in the western states where ultraviolet exposure appears to promote greater oxidation.

To use spray applied sealers and rejuvenators as part of a pavement preservation tool kit,

maintenance personnel face several important questions: Namely, what are the right products to place on a given section of pavement, what is the right time to apply them, and what is the proper application rate to apply them at. Although these questions may seem relatively simple, the answers are difficult to quantify, as pavement preservation requires solutions predicated upon cost effectiveness.

Historically, the use of sealer and rejuvenators has been based upon simple infiltration tests such as the ring test and upon maintenance personal experience. Little quantitative data exists to develop design procedures for application or to determine the cost effectiveness of specific applications

### **Research Objectives**

The objectives of the field studies are:

1. To establish the cost effectiveness of the use of a sealer or rejuvenator
2. To evaluate the changes in roadway properties with time and the ability of these products to extend the life of an HMA pavement.
3. To develop guidelines for when the use of a sealer/rejuvenator is appropriate.
4. To develop a laboratory procedure for evaluating sealers.
5. To evaluate tools and techniques for establishing when to apply a sealer or rejuvenator

### **Overview of Work Effort**

To accomplish the objectives listed above it is planned to develop a design concept for the use and evaluation of sealers/rejuvenators and then test that concept by the construction of field test sections at eight locations – at least two sections in each of the four LTPP Climatic regions.

The research is a collaborative effort between five different research agencies: the FHWA, the National Center for Asphalt Technology (NCAT), Western Research Institute (WRI), the University of Texas – El Paso, and the Arizona Department of Transportation. The

research is looking at leading edge technologies in non-destructive testing such as seismic analysis and nuclear magnetic resonance. Both these technologies are being evaluated as systems for detecting when to apply a treatment. Although the technologies themselves are complicated, the actual application is relatively simple and straightforward.

Another important aspect of this research will be the use of sophisticated chemical analysis conducted by Western Research Institute (WRI) for asphalt binder material characterization and finger printing of sealer/rejuvenator materials. Since the crude source of the original pavement asphalt is paramount to predicting pavement performance and in determining capability with sealer/rejuvenator, this aspect will be thoroughly investigated.

This research will also evaluate changes in frictional properties of the roadway as a result of applying sealers/rejuvenators. The two important questions to be answered are; how much, if any, change occurs and for what period of time does it occur over.

Construction of field test sections can be performed on any of three pavement types; dense graded, open graded, or chip sealed surfaces. It is desirable to have the pavement age between two and six years. This is to allow for evaluation of the timing of the treatment application.

Field test section construction will consist of five test sections representing four material types and a control or untreated section. Each test section will represent one product. Initially, test sections will consist of two hundred foot long test sections with 400-foot transitions between each test section. See Attachment 1 for a typical layout

In subsequent years it is planned to apply additional applications within the transitions. The purpose of the additional treatment sections is to address the effect of application timing and the effect a second cycle of treatment. The additional treatments designed to address timing would be placed 2 yrs, 4 yrs and 6 yrs after the initial application. Each of these subsequent test sections would be one hundred feet in length and placed as shown in Attachment 1.

The application designed to address the effect of a second cycle of treatment would be placed one hundred feet in length in year four. This would consist of placing the sealer over the second one hundred feet of the first application. At the same time, the next one feet of transition would be placed with this same material for the year four timing applications as shown in Attachment 1.

The sealers/rejuvenators used will be chosen by each individual DOT – but it is desired that Reclamite or other rejuvenator, Pass Oil and a CSS-1h or SS-1h be included at each test location.

## **FIELD TESTING PLAN**

The field testing program will be accomplished at eight locations – two in each LTPP Climatic Region. It is divided into three phases: design or pre-construction, construction, and monitoring. The description of these phases follows:

### **Design Phase**

The design phase of the research is intended to develop or simulate procedures that would allow an agency to “design” the treatment application and to “predict” its effect on pavement performance. This is an important aspect of the research as it is intended to provide answers to the “what treatment to apply” and “how much to apply”.

The field testing to be conducted during this phase consists of:

- Friction and texture testing
- Infiltration testing
- Seismic analysis of the material properties
- Roadway profile evaluation
- Noise Evaluation
- Core Retrieval
- Chemical Analysis of the Existing Materials
- Chemical Analysis of the Proposed Sealer/Rejuvenators

To accomplish this, activities are required of both the research team and the participating agency. The respective activities are listed below:

To be accomplished by the research team:

- a. Two-foot by two-foot sections will be treated with different application rates of each product and tested for skid resistance and surface texture and

compared to the properties of the untreated section. This is to determine the impact of applying sealers/rejuvenators on frictional properties of the pavement surface.

- b. Infiltration testing will be conducted using the NCAT testing device and skid abrader outflow meter where possible.
- c. Conduct portable seismic analysis testing on each of the test sections. This is to characterize the modulus of the upper layers of the pavement structure.
- d. Establish locations for installation of two weather recording devices.
- e. Prepare test section layout map.
- f. Conduct profile testing using ARAN equipment. This will characterize roughness, surface texture, and rutting of the existing pavement prior to any treatment.
- g. Conduct chemical analysis of material obtained from cores. See item h in following section.

Support needed from the DOT during the Design Phase:

- a. Furnish traffic data and pavement historical information
- b. Layout and mark test sections
- c. Provide all traffic control
- h. Provide personnel and equipment for core retrieval and shipping. Seven cores will be taken from each of the test sections. The cores will be shipped to NCAT where they will be treated with the sealers/rejuvenators, sliced into ¼ inch slices and the slices shipped to WRI for extraction of the asphalt and subsequent chemical and physical testing of the treated and untreated binders.
- d. Provide container with 55 gallons of potable water
- e. Designation of the products for testing and their respective suppliers
- f. Agreement to receive and store a “tool chest” containing equipment. A large tool chest containing the equipment necessary to conduct field

testing would be shipped to an agency designated site location. The agency would have to receive the chest from the freight company and store it for several days until the field personnel arrived. The tool chest is on wheels and just needs to be wheeled into a secure, indoor location. Upon completion of the field testing, store the tool chest again for a day or two and turn the container over to the freight company.

### **Construction Phase**

The construction phase represents the actual sealer/rejuvenator application and test section construction. During this phase the sealers/rejuvenators will need to be applied to each of the different test sections within the test site by the agency. This phase may continue over a period of six years as shown I attachment one. In Attachment 1, time zero represents the first application of products. Years two, four and six are applied to evaluate the effect of both the timing of the treatment application and the effect of the second application of treatment. This should help answer the questions of “when to apply the treatment” and “what is the long term benefit of the treatment.”

The field testing to be conducted during this phase consists of the following:

- Friction and texture testing
- Evaluation of equipment application conformance
- Verification of field application rates
- Sampling of emulsions
- Record climatic conditions

The respective activities of each of the groups follow:

To be accomplished by the research team:

- a. Coordinating with the DOT personnel the application of the sealer/rejuvenators
- b. Verifying Equipment Capability
- c. Monitoring of the application rates and spray pattern
- d. Sampling of the distributor truck to obtain samples of the actual material

spread.

- e. Prior to and one day after application of the sealer/rejuvenators, friction and surface texture measurements will be conducted.
- f. Install two operational weather-recording devices at the project site. One for recording temperature and humidity and one for rainfall.

#### Support needed from the DOT during the construction phase

- a. Furnish products and equipment necessary to apply sealer/rejuvenators using commercially available distributor trucks.
- b. Construction management during the construction phase
- c. Traffic control on the day of placement of the sealer/rejuvenator and the next day when the research team does the friction and surface texture measurements. During the placement of the sealer/rejuvenators it is necessary that the sections not receive traffic for a minimum of two hours. The agency will determine when it is safe to open the sections to traffic, but a minimum of two hours of no traffic is required to prevent tracking of the material. Based on the prevailing conditions, the agency may elect to go with a longer no-traffic condition.
- d. Receipt and storage of tool chest as outlined in the design phase item f.
- e. Retrieval and shipment of two weather recording devices. Shipping containers will be provided. The agency needs to remove two devices from the field location, place in supplied boxes, and ship to designated location. These are very small boxes and devices, probably 5 lbs total.

#### **Monitoring Phase:**

The monitoring phase provides the post construction evaluation of the test sections. It will provide the data for determining the cost effectiveness and performance improvements associated with application of sealers/rejuvenators. The testing required for this phase is outlined

in Table 1. The activities for the respective groups follow:

To be accomplished by the research team:

- a. The monitoring testing and sequence for that testing is shown in table one.

**Table 1 – Monitoring Testing**

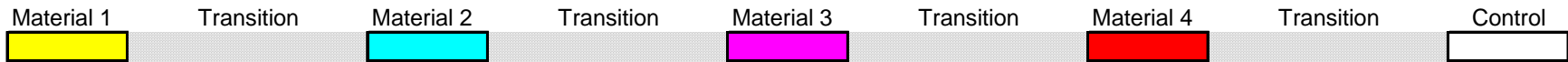
	One Month	3 Months	1 Yr	2 Yr	3 Yr	4 yr	5yr
Permeability	X	X	X	X	X	X	X
Friction	X	X	X	X	X	X	X
Surface Texture	X	X	X	X	X	X	X
Spectral Wave Analysis	X	X	X	X	X	X	X
Chemical & physical properties of cores	X	X	X		X		X
Roughness, texture, rut depth & noise characteristics	X	X	X		X		X

**Support Required from the DOT**

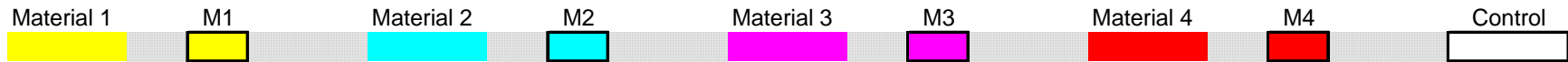
- a. Traffic control during the field testing
- b. Coring of each of the test sections within the test site (two cores per section). Containers would be provided and the agency would ship the cores. Coring interval is the same as that for Chemical & Physical Properties of Cores
- c. Receipt and storage of tool box as defined in design phase, item F.

# ATTACHMENT 1 Test Section Layout

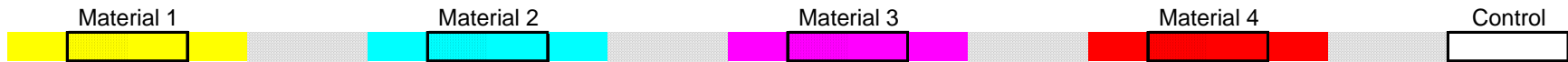
## Year Zero



## Year Two



## Year Four



Indicates second application on same area

## Year Six (Future)<sup>4</sup>



### Legend

- = Control (Untreated Section)
- = Material 1
- = Material 2
- = Material 3
- = Material 4
- = Represents Transition Areas with no treatment applied

- Note: (1) Direction of traffic is right to left  
 (2) Cell Width equals 100 ft on road  
 (3) Cells with border outlined represent material placed in the referenced year  
 (4) Experiment is currently only funded for 5 year duration