ASI GSB-88/Runway Preservation System (RPS)
History and Performance - Executive Summary

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This summary was prepared by Dr. Peter E. Sebaaly based on his reviews of the field performance data and the laboratory experiment conducted at the U.S. Army Corps of Engineers Waterways Experiment Station.

As long as pavements are subjected to traffic loads and environmental actions, they will experience deterioration and eventual failure. A preventive maintenance program puts pavement engineers and managers in full control of the system's long-term behavior: to prevent failures from occurring. Through preventive maintenance, the owner can decide on the level of service provided by the facility and the length of time prior to a major rehabilitation activity. Figure 1 compares the two concepts: preventive maintenance and major rehabilitation in terms of the present serviceability index (PSI). Preventive maintenance provides excellent conditions over extended time period while a major rehabilitation offers luxurious conditions for a short time period. Typical pavement users have short memory span: no one will remember the luxurious conditions that prevailed during the first few years while they are stuck using a poor (rough) facility in years 7-10. On the other hand the boundary between luxurious and excellent conditions (year 10) is very narrow and most users would not be able to differentiate between the two levels. The excellent level of service coupled with the significant savings offered by a preventive maintenance program makes it a wise choice for most agencies.

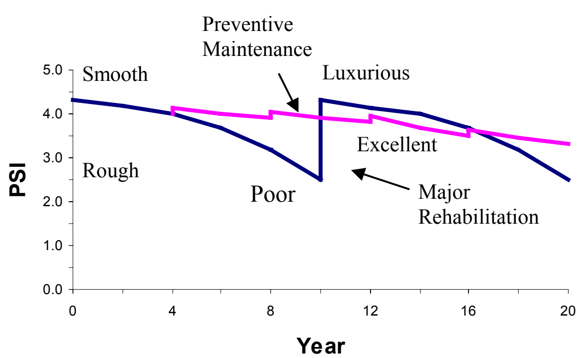

Figure 1. Typical performance of pavements subjected to rehabilitation and preventive maintenance.

ASI-RPS TECHNICAL INFORMATION

The GSB-88/RPS is a chemically engineered asphalt pavement sealer comprised of a cationic emulsion of Gilsonite ore, and specially selected plasticizers. GSB-88/RPS provides a durable, yet flexible topcoat, while special plasticizers and oils penetrate and rejuvenate asphalt pavements. The gilsonite seal provides a long wearing anti-oxidative seal for the surface of the asphalt pavement. The GSB-88/RPS is available in either a concentrate or ready to use form. It is stored and handled like any standard asphalt emulsion and can be applied with standard bituminous distributors. The rate of spread is normally determined by the texture, porosity, and age of the asphalt pavement to be sealed. Application rate can vary from 0.08 to 0.15 gallons per square yard. Under normal conditions, cure time for the GSB-88/RPS is 1 to 4 hours.

FIELD EXPERIMENTS

Documented long-term field performance represents the backbone of pavement engineering and management. The performance of a pavement is affected by numerous factors: traffic, materials, construction, and environment. It takes a well-documented field experiment to realistically assess the performance of a specific pavement maintenance technology under the combined actions of the various factors and to validate laboratory experiments. During the 1990s, the GSB-88/RPS sealer was evaluated through two independent field trials: Portland International Airport (PDX) and Mulino Regional Airport. In both cases, the sealer was applied as a part of a preventive maintenance program and its long-term performance was monitored.

Figure 3 shows the performance of the GSB-88/RPS sealer on PDX taxiway C. The visual Condition Index (VCI) is based on the Micropaver Pavement Condition Index (PCI) with minor modifications to magnify the impact of raveling and weathering which are the most common failure modes of taxiways and runways. VCI ranges between 1 and 100 with 56-70 representing good pavement conditions. The performance data of PDX Taxiway C shows that the GSB-88/RPS was able to maintain the taxiway pavement at an excellent level for a period of 8 years.

Figure 4 shows the performance of the GSB-88/RPS sealer on the runway of Mulino Regional Airport in Western Oregon. The runway was constructed in 1987 and was sealed two years later (1989) due to its dry appearance and the evidence of some raveling. The performance data of the Mulino runway showed that the GSB-88/RPS sealer kept the runway at excellent conditions for 10 years by interrupting its aging process, and therefore, stopping the progress of raveling and weathering.

The GSB-88/RPS sealer has a proven history of success through wide applications and great tolerance for extreme environmental conditions. Throughout the past decade, the GSB-88/RPS sealer has been successfully applied on commercial and general aviation runways (grooved and un-grooved), taxiways, and ramps. The sealer's environmental performance has been tested under all four regions of the U.S.: wet-freeze, dry-freeze, wet-no freeze, and dry-no freeze (applications list is available upon request).

The GSB-88/RPS sealer's versatility and excellent performance have landed it over 11 million square yards on over100 airports with the great majority of the cases being repeated applications. Implementing a sound preventive maintenance program with the field-proven GSB-88/RPS sealer results in long lasting pavements with significant savings. With such a system, airport managers have been able to do what pilots have been doing for decades: "put the system on auto-pilot."

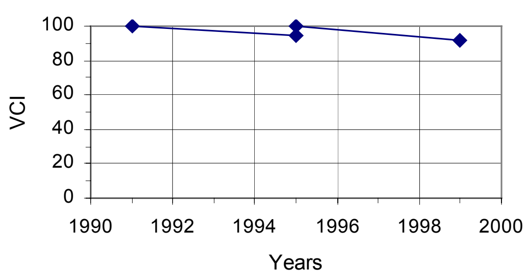

Figure 2. Performance of sealed pavement at PDX Taxiway C

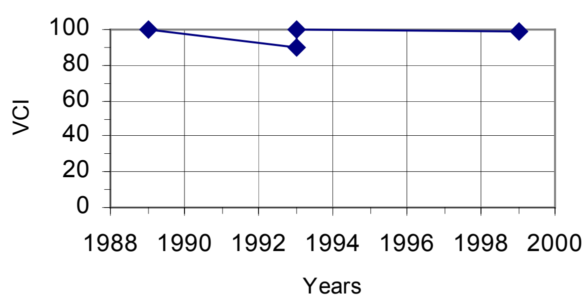

Figure 3. Performance of sealed pavement at Mulino Runway

LABORATORY EXPERIMENTS

During 2000-2002, the U.S. Army Corps of Engineers, Waterways Experiment Station (WES), conducted a laboratory experiment to assess the ability of the GSB-88/RPS sealer in protecting the asphalt binder from aging and to hold the sand particles under the abrasive action of traffic loads. The experiment compared the performance of the GSB-88/RPS sealer to a standard asphalt emulsion (CSS-1) and a refined coal tar sealer. The GSB-88/RPS sealer was applied at two rates: light and heavy. A total of five conditions were evaluated and compared: (1) uncoated, (2) CSS-1 emulsion, (3) coal tar, (4) light GSB-88/RPS, and (5) heavy GSB-88/RPS.

The five coating conditions were applied on asphalt concrete cylindrical samples (4.0" diameter by 2.5" height) compacted using the Marshall hammer. After coating, the asphalt concrete samples were aged in the oven for 1 and 60 hours at 60^{o}C (140^{o}F). The Marshall stability was used to assess the degree of aging of the asphalt concrete mix. The higher the Marshall stability the more aging the asphalt concrete mix would have experienced. Figures 4 and 5 compare the Marshall stabilities of the samples under the 1 and 60 hours aging, respectively. Three replicate samples were tested for each condition which allows a statistical analysis of the data. The letters on the bars of Figures 4 and 5 indicate the statistical grouping of the results. Having the same letter on any two or three bars indicates that these conditions have similar Marshall stabilities (e.g. experienced similar aging). For example, the heavy GSB-88/RPS in Figures 4 and 5 are represented by the letter "A" while all other conditions have different letters. This indicates that the heavy GSB-88/RPS sealer was the most effective condition in reducing the aging of the asphalt concrete mix under 1 and 60 hours of oven curing. The C/D label on the CSS-1 emulsion bar in Figure 5 indicates that the ability of the CSS-1 emulsion to protect the asphalt mixture from aging was not significantly better than the uncoated condition.

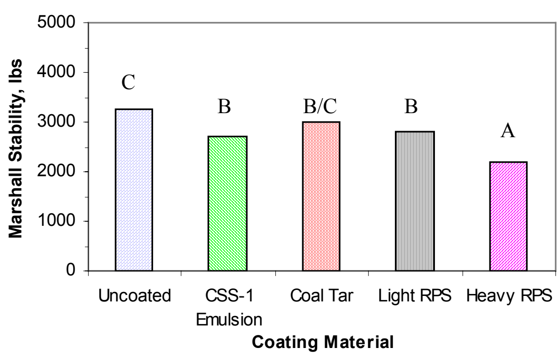

Figure 4. Effect of various coatings on Marshall Stability, one-hour oven cure.

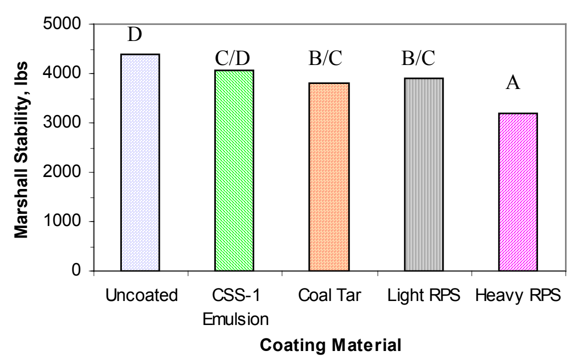

Figure 5. Effect of various coatings on Marshall Stability, 60-hours oven cure.

The objective of the sand retention experiment was to assess the ability of the various sealers to hold the sand particles in place under the abrasive action of traffic loads which is directly related to the skid resistance characteristics of the sealed pavement surface. Based on their review of the existing field data, the WES researchers reported: *"Tests at PDX and other locations have shown that the GSB-88/RPS does not have an adverse effect on skid resistance."*

This experiment compared the retention capabilities of the GSB-88/RPS and CSS-1 emulsion sealers under 24 hr at 60°C, 144 hours at 60°C, and 120 hours at 120°C oven curing conditions. The scrub tester specified in ASTM D2486, modified to use wire brush and surcharge weight, was used to measure the ability of the sealer to hold the sand particles in place. The percentage weight loss defined as the difference in sample weight before and after abrasion (1,000 or 3,000 cycles) was used as a measure of the sealer's ability to hold the sand particles in place. A higher percentage of weight loss represents a lower ability of the sealer to retain the sand. Figures 6 and 7 compare the ability of the GSB-88/RPS and CSS-1 emulsion to retain the sand. Again the letters on the bar indicate the statistical grouping of the results. The data show that the GSB-88/RPS ability to retain the sand under the abrasive action of traffic loads is superior than the ability of the CSS-1 emulsion.

Both the aging and sand retention experiments showed the superior qualities of the GSB-88/RPS sealer. Protecting the asphalt mixture from aging would result in great long term benefits which include improved resistance to fatigue cracking, low temperature cracking, block cracking, and raveling of the asphalt pavement. Keeping the asphalt binder flexible as the pavement goes through its service life would improve its ability to absorb the movements caused by traffic loads and temperature variations. Also a flexible binder would adhere better to the aggregate surface making it more resistant to moisture damage which is the main cause of raveling. Having the ability to retain the sand particles would offer improved skid resistance.

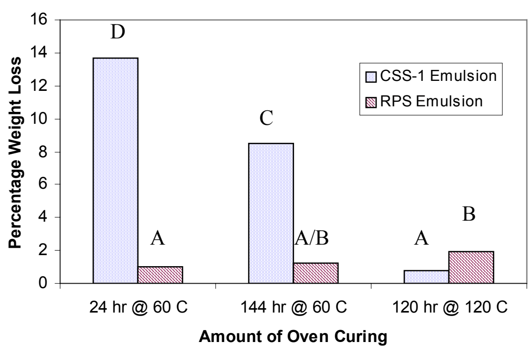

Figure 6. Effect of curing on mass loss after 1,000 scrub cycles

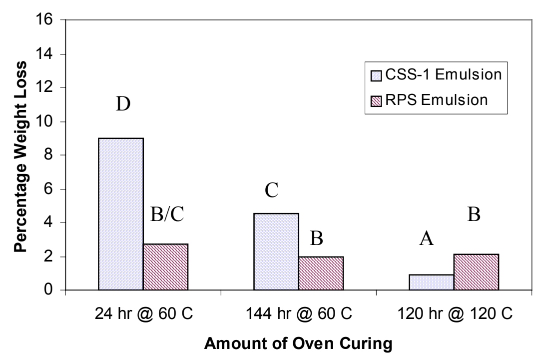

Figure 7. Effect of curing on mass loss after 3,000 scrub cycles

The results of the laboratory experiment validated the field observations on the performance of the GSB-88/RPS sealer. The field and laboratory experiments showed that by applying the GSB-88/RPS sealer multiple benefits are realized: the pavement surface is kept free of cracking which slows down the aging process of the binder and eliminates the penetration of moisture into the asphalt mixture. The GSB-88/RPS has a validated proven record of protecting airport pavements from their most notorious enemies: aging and moisture damage.