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E-MAIL MEMORANDUM

TO: Bai Xiaolu E-Mail: sundata@online.sh.cn
cc: Bill Vandemark E-Mail: wjvan@gvtc.com
FROM: John Emery/George Wang E-Mail: jemery@jegel.com
DATE: April 3, 2002
SUBJECT: Review of SMERI's Proposed RejuvaSeal Testing Program

Mr. Bai:

As requested by Bill Vandemark, JEGEL (John Emery) has completed an overview of the RejuvaSeal testing program proposed by SMERI as briefly described in your facsimiles of March 22nd and April 2nd, 2002. As you know, RejuvaSeal is a high quality, proven performance, proprietary (TM) coal-tar rejuvenator/sealer meeting North and South American agency specification requirements. There is no doubt, from our JEGEL positive highway and airport technical experience with Echelon and RejuvaSeal for over ten years, that the comprehensive SMERI field/laboratory testing program (outlined in March 22nd facsimile) and complementary laboratory testing program (outlined in April 2nd facsimile) will provide positive and supporting information (results) to support your important RejuvaSeal marketing activities. The proposed SMERI standard penetration (ASTM D5, at 25°C), absolute viscosity (ASTM D2171, at 60°C) and ductility (ASTM D113, at 25°C) testing to ASTM is the same as JEGEL generally follows for comparing untreated (control) and RejuvaSeal-treated cores to determine the extent of rejuvenation achieved. The general proposed SMERI field and laboratory testing program clearly addresses the appropriate evaluation of RejuvaSeal. However, there are some details that JEGEL suggests Sundata and SMERI consider for your important RejuvaSeal evaluation program.

As you know, and as covered in your web site's excellent "RejuvaSeal" technology section and the pending CCEL (Tony Speed and John Emery) 4th ICPT presentation "RejuvaSeal

Asphalt Pavement Preservation Treatment, Canadian Experience and Chinese Field Trials” (attached), RejuvaSeal can be used for rejuvenation or sealing (including frictional sand sealer – Sand RejuvaSeal) or rejuvenation and sealing in conformance with rather strict specifications (Canadian DND and American FAA for instance). As such, the RejuvaSeal can be formulated for specific applications. It should be noted that the rejuvenating action is most effective for higher air voids, deteriorated, old, oxidized, ravelling asphalt concretes that are still structurally adequate (can carry the loads) but in poor functional surface condition (a real maintenance problem for many asphalt pavements in China and a prime RejuvaSeal market) where the coal-tar rejuvenator/sealer can penetrate and soften the old asphalt cement, which is clearly the focus of the SMERI program. (RejuvaSeal is not as effective in rejuvenating lower air voids, intact asphalt concrete or where a surface treatment (tight surface) limits penetration, but is still a very effective sealer or sand sealer that enhances the life expectancy of the asphalt concrete.) This brief RejuvaSeal technology background has been outlined to assist Sundata/SMERI with your testing program objectives – confirming the benefits of RejuvaSeal use for deteriorated, aged asphalt concrete.

Turning to the testing program, the following comments may be of assistance:

Field Program and Laboratory Testing of Recovered Asphalt Cement from Field Cores
(Please see attached for standard field sampling and laboratory testing program notes.)

1. Typical, deteriorated, old, oxidized asphalt concrete pavement locations (roads) selected (poor functional surface condition, but structurally adequate) with surface (wearing) course ages of about 5, 10 and 15 years (one location each);
2. Each selected location is then marked out as three areas of comparable size and asphalt pavement condition – Control Area (left untreated); Treated Area One; and Treated Area Two. (Additional areas can be selected if the asphalt pavement condition is variable.) Standard RejuvaSeal (proprietary formulation for mainly rejuvenation purposes) is then applied to Treated Area One at 0.18 litres/m² (0.04 US Gal/yd²) and Treated Area Two at 0.27 litres/m² (0.06 US Gal/yd²). This RejuvaSeal can be applied, uniformly at the selected application rate, as indicated in Photo 13 of the attached paper, noting care should be taken with relevant health and safety (MSDS) requirements. Please note that if the 0.18 and 0.27 litres/m² application rates appear to be too ‘dry’ or too ‘rich’ (want the RejuvaSeal to penetrate, not simply ‘pond’), the application rate can be field adjusted as necessary. The test areas should be allowed to rejuvenate and cure for a minimum of seven days, and preferably 14, under favourable weather (ambient) conditions (‘full’ rejuvenation can take up to 90 days).

3. The field sampling (three locations, each with a control and two treated areas; total of 9 test areas) is then completed (please see attached notes).
4. The cores from the field sampling are then examined and the recovered asphalt cements tested in the laboratory (please see attached notes).
5. A comparison of the test results for each location between treated and control areas indicates the rejuvenation achieved. (It will be positive!)

[If more rejuvenation testing information is required, ring-and-ball softening testing, kinematic viscosity testing and performance graded binder (SHRP) testing of the recovered asphalt cements can be completed. However, the proposed penetration, absolute viscosity and ductility testing of the recovered asphalt cements should be more than adequate. Additionally, JEGEL could, if wished, complete comparative testing of submitted cores in Toronto and/or assist as necessary to ensure the testing program meets the Sundata/SMERI objectives.]

Laboratory Testing of 60/70 Penetration Grade Asphalt Cement Mixed With RejuvaSeal
(Please note that the Field Program on actual old asphalt concretes may be more realistic than the Laboratory Program for assessing potential rejuvenation.)

1. Starting with original Shell 60/70 penetration grade asphalt cement appears to be appropriate as this is quite a 'stiff' asphalt cement.
2. The proposed heating to simulate 'aged' asphalt concrete asphalt cement properties may not give the desired simulation (not severe enough). It is suggested that the three asphalt cement test samples be as follows: Sample One – original 60/70 penetration grade asphalt cement (similar to new asphalt concrete, essentially a control); Sample Two – original 60/70 penetration grade asphalt cement subjected to one standard ASTM D1754 thin film oven test (TFOT) cycle ('similar' to 3 to 5 year old asphalt concrete, i.e. somewhat oxidized); and Sample Three – original 60/70 penetration grade asphalt cement subjected to two standard ASTM D1754 thin film oven test cycles ('similar' to 10 to 15 year old asphalt concrete, i.e. very oxidized). (Alternatively, the SHRP RTFOT and PAV procedures could be used for this 'aging'.)
3. Each of the three asphalt cement samples – Sample 1/Original, Sample 2/TFOT and Sample 3/2TFOT – are then treated (blended) with standard RejuvaSeal: each asphalt cement sample (three sublots of each) is heated to 150°C; RejuvaSeal (at 60°C, please observe MSDS requirements) is then thoroughly blended (mixed) with the asphalt cement samples as follows (all additions of RejuvaSeal by percent mass of asphalt cement):

Sample 1, Sublot 1 (1-1)	0% RejuvaSeal	(Control 1-1)
Sample 2, Sublot 1 (2-1)	0% RejuvaSeal	(Control 2-1)
Sample 3, Sublot 1 (3-1)	0% RejuvaSeal	(Control 3-1)

Sample 1, Sublot 2 (1-2)	4.4% RejuvaSeal	(Treated 1-2)
Sample 2, Sublot 2 (2-2)	4.4% RejuvaSeal	(Treated 2-2)
Sample 3, Sublot 2 (3-2)	4.4% RejuvaSeal	(Treated 3-2)
Sample 1, Sublot 3 (1-3)	8.8% RejuvaSeal	(Treated 1-3)
Sample 2, Sublot 3 (2-3)	8.8% RejuvaSeal	(Treated 2-3)
Sample 3, Sublot 3 (3-3)	8.8% RejuvaSeal	(Treated 3-3)

(The percent RejuvaSeal added is based on having untreated controls and simulating treatment of a typical old asphalt concrete (2350 kg/m³, 4.5 percent effective asphalt cement content and about 10 mm RejuvaSeal penetration depth; ~ 1 kg of oxidized asphalt cement to be treated by m²) at an average RejuvaSeal application rate of 0.22 litres/m² (~ 0.05 US Gal/yd²) and overall estimated penetrating/softening effectiveness of 20 percent (4.4 percent RejuvaSeal blended) or 40 percent (8.8 percent RejuvaSeal blended).

4. The nine samples (Sublots 1-1 through 3-3) are then allowed to cool to laboratory ambient temperature and kept at laboratory ambient temperature (~ 20°C) for 72 hours prior to testing (the rejuvenating process is time dependent).
5. The nine control and blended asphalt cement samples (Sublots 1-1 through 3-3) are then each tested for penetration (ASTM D5), absolute viscosity (ASTM D2171) and ductility (ASTM D113). (Please make sure that enough material is prepared for the specific testing requirements.)
6. A comparison of the test results for each Sample (Sublot 1-3 compared to Sublot 1-2 compared to Sublot 1-1; Sublot 2-3 compared to Sublot 2-2 compared to Sublot 2-1; and Sublot 3-3 compared to Sublot 3-2 compared to Sublot 3-1) indicates the rejuvenation achieved. (Again, it will be positive!)

[Again, if more rejuvenation testing information is required, ring-and-ball softening testing, kinematic viscosity testing and performance graded binder (SHRP) testing of the control and blended asphalt cement samples can be completed. However, the proposed testing should be more than adequate. Additionally, JEGEL could, if wished, complete comparative testing of submitted materials in Toronto and/or assist as necessary to ensure the testing program meets the Sundata/SMERI objectives.]

It is hoped that these comments will be of assistance, and please do not hesitate to contact JEGEL with any questions or comments. Best wishes for a successful testing program.

I look forward to our meeting in Shanghai April 21st. Regards,

John Emery