CROWN CAPITAL ENTERPRISE LIMITED

WANCHAI, HONG KONG

Demonstration of Rejuvaseal™ Highway G220, Jinan, Shandong, Peoples Republic of China

May 2002

TS^2 Consulting Inc.
Lamma, Hong Kong

CROWN CAPITAL ENTERPRISE LIMITED

Demonstration of RejuvaSeal
Highway G220, Jinan, Shandong,
Peoples Republic of China

May 2002

TABLE OF CONTENTS

FIGURES

TABLES

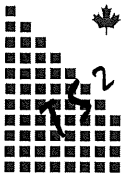
CROWN CAPITAL ENTERPRISE LIMITED

Demonstration of RejuvaSeal
Highway G220, Jinan, Shandong,
Peoples Republic of China

May 2002

APPENDICES

No.	Description
A	Rejuvaseal™ – Technical Seminar, Ping-Gu (Beijing) China, August 2001
B	Rejuvaseal Descriptive Literature
C	Kunming Copper Slag – Technical Data



TS² Consulting Inc.
Lamma, Hong Kong

CROWN CAPITAL ENTERPRISE LIMITED

Demonstration of RejuvaSeal™
Highway G220, Jinan, ShanDong
Peoples Republic of China

May 2002

1.0 INTRODUCTION

Crown Capital Enterprise Limited of Hong Kong entered into an arrangement with the Highway Administration Department of ShanDong Province, China in May 2002. This arrangement calls for the analysis of the performance of RejuvaSeal™, a sealer/rejuvenator for asphalt pavement on highways within ShanDong Province.

ShanDong Province straddles the Yellow River (HuangHe) at it's confluence with the Bohai Sea. ShanDong is bordered by Henan, Hebei and JiangSu Provinces. ShanDong has seen a major growth in the highway system, due to a government drive to build national highways linking ShanDong with major cities in the adjoining provinces. Jinan, the capital city of ShanDong lies on the south bank of the Yellow River The present population of Jinan is estimated at approximately 6 million. See figure 1.0 for a map showing the location of ShanDong. The majority of the area lies at 10 to 20 metres in elevation, on the extensive plain that borders the Sea of Bohai and the East China Sea. The regions' latitude (36 degrees north), mean that there are four seasons, with temperatures ranging from 45 Celsius in the long, hot summer to minus 5 Celsius in the short winter. Their is no rainy season per-se, just thunderstorms and these occur primarily in June thru August, but can extend into September.

In the immediate Jinan area, a significant unconsolidated sedimentary sequence predominates and this is due to the site adjoining the delta of the Yellow River. There are no outcrop exposures available. Drainage channels feeding into the Yellow River also afford no opportunities to see the bedrock. The asphalt in the area is manufactured from imported materials, which is comprised of crushed and screened sandstone and diorites hauled in from quarries elsewhere in ShanDong Province, as well as washed gravels from the various rivers. The bitumen binder for the asphalt is sourced from various locations. Since ShanDong Province has it's own indigenous oil fields and petroleum refining capacity, there is some domestic asphalt production. Since ShanDong Province borders the East China Sea, the possibility of bitumen being sourced from offshore is a distinct possibility so refineries in Singapore and the like should not be forgotten.

2.0 CO-OPERATIVE PROGRAM

The intent of the arrangement with ShanDong Province is to demonstrate RejuvaSeal™ at different locations selected by the Highways Administration Bureau. The demonstration will subsequently allow analysis of the performance of Rejuvaseal™ on a variety of asphalt surfaces. A demonstration was undertaken on Highway G220, within the city of Jinan on May 29, 2002. The portion of the highway that was treated was composed of asphalt pavement of 1996 vintage. No details are known about the subgrade, but inspection of the shoulders show a sandy-silty material. Knowing construction techniques in highways in China in general, minimal gravel would be used for an immediate coarse base, beneath the asphalt pavement. The surface of the asphalt is quite smooth and concern had been expressed about hydroplaning during heavy rains and also water percolating through cracks in the asphalt pavement and softening the sub-grade. Furthermore, this asphalt pavement is approaching the end of its useful life and keen interest was expressed in having the life extended.

3.0 REJUVASEAL™

RejuvaSeal™ is a proprietary product that is supplied by Crown Capital Enterprise Limited of Wanchai, Hong Kong. Rejuvaseal™ has been proven in numerous applications in North and South America to rejuvenate asphalt pavement at various stages of its life and economically extend the life of the pavement. Rejuvaseal™ is a three component, asphalt sealer rejuvenator that is comprised of Coal Tar, Coal Tar Oils and Petroleum Solvents.

3.1 PRIOR EXPERIENCE

Refer to Appendix A for a copy of the brochure provided to participants at a seminar held in Ping-Gu (Beijing Municipality) in August 2001. This outlines the experience with Rejuvaseal™ at various locations in North America and South America. Further information is available from Crown Capital Enterprise Limited. Rejuvaseal™ has been used at numerous airports in North and South America, as well as highways in Alberta, Canada; Cearo State, Brazil and North Dakota and Texas, as well as other locations in the U.S.A.

4.0 TEST PROGRAM

Since ShanDong Province is located in a semi-tropical climate (Latitude: 36 North) at a low altitude (10 to 20 metres), it's a demanding setting for asphalt, given the year round warm climate (extremes of 45 Celsius in summer and minus 5 Celsius in the winter) and intense exposure to ultraviolet radiation, all which contribute to the oxidation and breakdown of the asphalt binder.

ShanDong has the greatest concentration of highways in China, with some 14,000 kms of National and Provincial highway.The City of Jinan is responsible for 1,000 kilometres of National Highway, within it's jurisdiction (distances as of year-end 2000) and approximately 500 kms of Provincial Highway, as well as 3000 kms of City Streets.

In view of this extensive network of roads and the relatively short life of the asphalt surface, ShanDong is definitely interested in determining how to economically extend the life of the asphalt road surface. To this end, ShanDong has agreed to try RejuvaSeal™ on Highway G220, within the city of Jinan. The arrangement led to a committee being struck to suggest appropriate locations for the testing of RejuvaSeal™. See Figure 4.0, showing the location of this street with respect to Jinan and ShanDong

On May 28, three test patches on the inside lane (adjacent to the dividing centreline) of Highway G220 were treated with RejuvaSeal™. The test patches were at the following geographic location:

Table 4.1	**Geographic Location of Test Patch Site**	
System	**Northing**	**Easting**
Geographic (deg, min)	36^0 39.040'	116^0 53.488'
Universal Transverse Mercator Grid (50S) (metres)	4056140	0490300

See Figure No 4.1 for a photo showing the test patches as implemented. Particulars of the test patches are as follows:

Table 4.2				**Particulars of the test patch**						
Test Patch Number	**Patch Width (m)**	**Patch Length (m)**	**Total Area m^2**	**Total Area ft^2 approx**	**RejuvaSeal™ Applied**		**Application Rate**			
					US gals	**litres**	**US Gal /ft^2**	**US Gal /yd^2**	**Litres /m^2**	**m^2 /Litre**
One	1.00	1.00	1.00	11	0.07	0.25	0.006	0.055	0.25	4.0
Two	1.00	1.125	1.125	12	0.07	0.25	0.005	0.049	0.22	4.5
Three	1.00	1.250	1.250	13	0.07	0.25	0.005	0.044	0.20	5.0

Subsequent inspection of the test patches on May 29, showed that the application rate of 5.0 m^2/litre (test patch three) was appropriate for the

asphalt pavement at this location and could be used as a guide for other locations with similar physical characteristics.

The west end of the 260 metre long demonstration section on Highway G220 is located within the City of Jinan. This strip is entirely asphalt pavement. See figure 4.0, which follows, for a location of the general locale. The location of the test patch with respect to the demonstration portion of the street is graphically shown in figure 4.1, which follows.

the demonstration section, on Highway G220 was selected by the ShanDong Highway Administration Department, and is geographically located as follows:

Table 4.3	Location of Demo Site	
System	**Northing**	**Easting**
Geographic (deg, min)	36^0 39.040'	116^0 53.488'
Universal Transverse Mercator Grid (metres) 50S	4056140	0490300

This is at the same location as the test patch. Refer to Figure 4.0 for the location. Work commenced on the demonstration section at 8:55 am on May 29, on a warm, sunny day, where the mid-day temperature reached 21 Celsius. This was the first sunny day, following a lengthy extended rainy period. A strip, 226.5 metres long, on the two inside eastbound lanes on the eastbound segment of this six-lane highway was treated. The test section is located on a straight section. There is a slight camber to the road, which causes water to run off toward the shoulder, rather than puddle on the road. The asphalt surface on the section treated, was reputedly 6 years old (1996 vintage). No significant oil spills were observed, just the occasional drop of transmission oil, crankcase oil or hydraulic fluid. The asphalt pavement surface was not appreciably worn with no rutting due to traffic wear. There was aging and oxidation of the bitumen, which extended to a depth of several millimetres. There were no longitudinal cracks, although there were some lateral cracks. The entire portion of the treated highway section was on a compacted silty-clay, sub-grade

On May 29, an initial five segments (panels) were marked off in 11.5 metre increments. The width of the two inside lanes is 7.6 metres between the painted lane dividing line and the outside lane (adjacent to the shoulder) marker line. A five U.S. gallon (17.9 litres) pail of RejuvaSeal^{TM} was assigned to each panel. The RejuvaSeal^{TM} was applied to each of the panels, using paint rollers and paint roller pans, to ensure uniformity in the application.

An additional 13 segments (panels) were subsequently marked off, with the length extended to13 metres, and RejuvaSeal^{TM} effectively covered the surface. The last panel was completed at 10:45 am.

Details of the application are summarized in the table that follows:

Table 4.4				Details on RejuvaSeal™ Demonstration Section on Highway G220						
Work Schedule	Work Time (hrs)	No. of Panels	Test Length (m)	Total Area m^2	Total Area yd^2	RejuvaSeal™ Applied		Application Rate		
						US gals	litres	US Gal /yd2	Litres /m2	m2 /Litre
8:55-9:20	0.42	5	57.5	437	532	25	95	0.048	0.22	4.68
9:20-11:45	2.17	13	169	1,234	1535	65	246	0.042	0.19	5.23
Totals	2.58	18	226.5	1,721	2,058	90	341	0.044	0.20	5.26

In view of concern expressed by the ShanDong Highway Administration Department that the RejuvaSeal™ treated road gave the appearance of a slippery surface, Copper Slag from a smelter in Kunming was applied to the road surface immediately following the application of RejuvaSeal™. The application rate was approximately 0.46kgs/sq metre (1.0 lbs/sq yard). This was applied to the most easterly panels treated (No. 1 thru 5). Further information on this copper slag is contained in technical data sheets in Appendix C. The approximate size consist for copper slag is as follows: >98% passing #8 mesh (2.5 mm) and <5% passing #30 mesh (0.5mm). A 15 tonne, pneumatic-tired roller was used following the slag application to roll the slag into the softened asphalt pavement surface

Ambient temperatures at the time of the application were in the 16 to 21 degree Celsius range, with humidity in the 55% range. The application ceased at 11:15 pm and the lane remained closed until 8 pm on May 29, when it was re-opened for traffic. Photos showing the test application of RejuvaSeal™ follow in figures 4.2, 4.3 and 4.4. on the following pages.

The site was visited on May 30 around 9:30 pm and a difference was readily perceived between the RejuvaSeal™ treated section and the adjoining untreated lanes. A screwdriver was used to dig two small holes in the asphalt pavement, to a depth of 3 centimetres, some 45 metres west of the extreme east end of the demonstration section, to determine the penetration of the RejuvaSeal™. This was one day after the application of RejuvaSeal™ and at these two locations the newly rejuvenated surface was evident, by the black resilient surface layer, which was now approximately 1 millimetre thick. Below that depth, the grey, oxidized layer of asphalt was evident. The copper slag remained embedded in surface of the road, and most had cemented to the RejuvaSeal™. Little carryover of the RejuvaSeal™ was observed from vehicle tires at the east end of the demonstration strip, so it can be presumed that the surface was dry shortly after the site was vacated at 8 pm on May 29.

4.1 RejuvaSeal™ Testing

To date the comparison of the asphalt treated with Rejuvaseal™ has been compared on a subjective basis over a very short period at the test site on Highway G220. Testing equipment brought to the site for comparison on a more disciplined, objective basis solely consisted of an Outflow meter manufactured by Humble Equipment Co. of Reston, Louisiana, U.S.A. This was to establish the Water Dissipation (Hydroplaning Comparison).

Testing equipment will be brought to the site for comparison on a more disciplined, objective basis in the future, and to this end, the following tests will be undertaken.

- Fuel Resistance Comparison
- Elasticity/Ductility Testing

. 4.2 Water Dissipation

An "Outflow Meter" manufactured in the U.S.A. by Humble Equipment Company of Ruston, Louisiana and sold under the trademark "Outflow Meter" (see figure 4.5) was used to measure the asphalt pavement's capability to dissipate water, as concern has been expressed about hydroplaning on the RejuvaSeal™ treated surface, versus the untreated surface. The Outflow Meter gives readings in seconds for the dissipation of a known quantity of water. It is suggested that any readings between 3 and 10 seconds are satisfactory results for an asphalt surface, if hydroplaning is to be minimized.

Readings were taken with this aforesaid Outflow Meter at five locations on the portion of the street, where the RejuvaSeal™ demonstration was conducted. The initial two were on the segment treated with copper slag. These readings were taken at 9:30 am on May 29. The results are shown in the table that follows:

Table 4.5		**Outflow Meter Readings**		
Test	Location relative to centerline of highway	Location relative to east end of test section	Before RejuvaSeal™ (secs)	After RejuvaSeal™ (secs)
May 29	1.0 metres south	30 metres east	n/a	11
May 29	2.0 metres south	60 metres east	n/a	11
May 29	0.5 metres north	60 metres east	50	n/a
May 29	4.0 metres south	65 metres east	n/a	50
May 29	5.0 metres south	70 metres east	n/a	50

- **Readings in the 3 to 10 second range are quite acceptable from a skid resistance viewpoint.**

4.3 Fuel Resistance Comparison

Fuel Resistance Comparison will be undertaken on several sections of the untreated and RejuvaSeal™ treated sections in close proximity to the Outflow meter tests in the near future. This comparison will consist of pouring about a cupful of diesel fuel onto the road surface and then later checking the penetration of the fuel. If the fuel readily penetrated the asphalt pavement surface, then resistance to this form of chemical attack was presumed to be lower than if the fuel pooled on the surface of the asphalt pavement and slowly evaporated.

4.4 Elasticity/Ductility Testing

This aspect of the testing is beyond the capabilities of the field equipment available to both Crown Capital Enterprise Limited and RejuvaSeal™ personnel and as such, external assistance has been sought from outside experts in the field of Asphalt Testing. To this end, Dr John Emery in Toronto, Canada has been contacted for advise on independent testing.

5.0 Test Completion Schedule

The team of technicians from the Hong Kong office will be dispatched to undertake further testing on the trial section in the near future. The projected completion of this testing is scheduled as shown in the following chart.

CROWN CAPITAL ENTERPRISE LIMITED

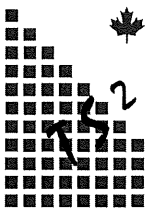
WANCHAI, HONG KONG

Demonstration of Rejuvaseal™ Highway G220, Jinan, Shandong, Peoples Republic of China

May 2002

APPENDICES

No.	Description
A	Rejuvaseal™ – Technical Seminar, Ping-Gu (Beijing) China, August, 2001
B	Rejuvaseal™ Descriptive Literature
C	Kunming Copper Slag - Technical Data



TS² Consulting Inc.
Lamma, Hong Kong

CROWN CAPITAL ENTERPRISE LIMITED

WANCHAI, HONG KONG

Demonstration of Rejuvaseal™ Highway G220, Jinan, Shandong, Peoples Republic of China

May 2002

Appendix A

Rejuvaseal™ – Technical Seminar, Beijing, Peoples Republic of China, August 2001

TS^2 Consulting Inc.
Lamma, Hong Kong

CROWN CAPITAL ENTERPRISE LIMITED

WANCHAI, HONG KONG

Demonstration of Rejuvaseal™ Highway G220, Jinan, Shandong, Peoples Republic of China

May 2002

Appendix B

Rejuvaseal™ Descriptive Literature

TS^2 Consulting Inc.
Lamma, Hong Kong

CROWN CAPITAL ENTERPRISE LIMITED

WANCHAI, HONG KONG

Demonstration of Rejuvaseal™ Highway G220, Jinan, Shandong, Peoples Republic of China

May 2002

Appendix C

Kunming Copper Slag

Technical Data

TS^2 Consulting Inc.
Lamma, Hong Kong