LEITHS

Summary of Test Results:

Resistance of Asphalt to Konsin and Clearway De-Icing Fluid.

Introduction

A tender for taxiway rehabilitation at Edinburgh Airport came out in April 2012. The Specification required compliance with BS EN 12697-41: resistance to de-icing fluids. The asphalt was required to meet a category B requirement, 85% of retained cohesion. The purpose of carrying out this series of tests was to determine that a mix with a certain blend and type of aggregates and bitumen could be used to meet the specification requirements.

The aggregate selected for this project was sourced from a quarry close to the intended works and was a greywacke. Two Marshall asphalt mix designs were developed; the coarse aggregate was combined with fine aggregate from the same quarry and also a granite quarry in Aberdeen both of these types of crushed rock fines were combined with a natural sand. The SMA mixes were all manufactured with coarse and fine greywacke aggregate. A greywacke aggregate was the preferred choice in this case because most of the aggregate quarries in the central belt of Scotland are predominantly quartz dolerite and these aggregates generally have high water absorption values. The greywacke and granite aggregates generally have water absorption values of the order of 1% and the quartz dolerites are approaching 2%. Therefore, the effective bitumen content for dolerite mixes is less when compared with mixes made with greywacke aggregates at the same bitumen content. Limestone filler was used in all mixes rather than hydrated lime which may react adversely with some PMB binders.

The test requires that specimens be conditioned in de-icing fluid for 70 days. Therefore, the time required to carry out the test including sample preparation and compaction is of the order of 90 days.

Mix designs were prepared and laboratory samples were made with different types of aggregate and binder. Water sensitivity testing was also carried out on some samples. The intention of this report is to summarise and compare the results of testing .

Testing

Two types of test were undertaken

BS EN 12697-41 Resistance to De-icing Fluids: Results in Tables 1 and 2 below.

BS EN 12697-12 Water Sensitivity Testing: Results in Tables 3 and 4 below.

The specimens manufactured for these tests were prepared in the laboratory by blending and combining aggregates and then dividing the sample into specific sizes and recombining to the required target grading. The target grading had been determined from a laboratory mix design formulated for both types of mix (Marshall and SMA) which met all the asphalt specification parameters.

The concentration of Konsin and Clearway used in the test was 100%. The materials were supplied by Univar the manufacturer and we have a record of the product code and batch number. All of the bitumen was supplied by Nynas with the exception of the Cariphalte HP which was supplied by Shell.

The Marshall mixes were compacted to 50 blows each side as required by Clause 7.2 of EN 12697-41:2005. The Contract specification required that the design method required 75 blows. The SMA mixes were compacted to 35 blows each side, the compaction level required by the Contract specification for the SMA was 50 blows. The density and the maximum density of the laboratory compacted specimens were determined and voids contents were calculated. The density of the specimens measured from this lower level of compaction than that used in the design process are more representative of the densities that would be experienced in the pavement.

Results & Discussion

The results of the de-icing tests show quite conclusively that a Marshall mix with straight run bitumen does not perform well whereas the mixes made with the Nynas Endura Z4 perform well. Some of the mixes made with straight run bitumens fell into category E.

All mixes performed well in the water sensitivity tests carried out in accordance with BS EN 12697-12 and this was not a good predictor of performance in the de-icing test.

Conclusion

A mix made with Edston greywacke aggregates can be formulated as a Marshall or an SMA and when used with a Nynas Endura Z4 binder the mix will be resistant to attack by Konsin and Clearway de-icing fluids.

Konsin is a glycol based de-icing fluid and Clearway is a potassium acetate based fluid. The tests carried out demonstrate that Clearway is more aggressive than Konsin with respect to attack on asphalt pavements.

Table1. AC 14 Marshall Surface

Resistance to De-Icing Fluid (BS EN 12692-41:2005)

Test Ref	Sample No.	Mix	Source Coarse Agg.	Source Fine Agg.	Binder	No. of Blows per side of Specimens	Density (Leiths) Mg/m^3	Max. Density Mg/m^3	Voids	De-Icing Agent	TS (Dry)	TS (Wet)	Retained Strength
M1	P14348	AC 14 Marshall surf	Edston	Cove Dust/ Temple Sand (74:26)	70/100 5.6%	50	2.377	2.462	3.5	Konsin	0.976	0.428	44
M1	P14348	AC 14 Marshall surf	Edston	Cove Dust/ Temple Sand (74:26)	70/100 5.6%	50	2.383	2.462	3.2	Clear way	1.014	0.273	27
M2	P14349	AC 14 Marshall surf	Edston	Cove Dust/ Temple Sand (74:26)	Nynas Endura Z4 5.6%	50	2.375	2.467	3.7	Konsin	1.643	1.364	83
M2	P14349	AC 14 Marshall surf	Edston	Cove Dust/ Temple Sand (74:26)	Nynas Endura Z4 5.6%	50	2.372	2.467	3.8	Clear way	1.552	0.881	58
M4	P14385	AC 14 Marshall surf	Edston	Edston Dust / Temple Sand (75:25)	70/100 5.5%	50	2.371	2.470	4.0	Konsin	1.631	0.694	43
M4	P14385	AC 14 Marshall surf	Edston	Edston Dust / Temple Sand (75:25)	70/100 5.5%	50	2.366	2.470	4.2	Clear way	1.590	0.855	54
M3	P14384	AC 14 Marshall surf	Edston	Edston Dust / Temple Sand (75:25)	Nynas Endura Z4 5.5%	50	2.374	2.469	3.9	Konsin	1.894	1.578	84
M3	P14384	AC 14 Marshall surf	Edston	Edston Dust / Temple Sand (75:25)	Nynas Endura Z4 5.5%	50	2.373	2.469	3.9	Clear way	1.873	1.586	85

Table2. SMA 14 surf.

Resistance to De-Icing Fluid (BS EN 12692-41:2005)

Test Ref	Sample No.	Mix	Source Coarse	Source Fine	Binder	No. of Blows per side of Specimens	Density (Leiths) Mg/m^3	Max. Density Mg/m^3	Voids	De-Icing Agent	TS (Dry)	TS (Wet)	Retained Strength
S2	P14345	SMA 14 surf	Edston	Edston	Nynas Endura Z4 6.0%	35	2.400	2.453	2.2	Konsin	1.704	1.637	96

Table 3. AC 14 Marshall Surf

Water Sensitivity (BS EN 12697-12)

Test Ref	Sample No.	Mix	Source Coarse	Source Fine	Binder	No. of Blows per side of Specimens	Density (Leiths) Mg/m^3	Max. Density Mg/m^3	Voids	ITS (Dry) at 15°C	ITS (Wet) at 15°C	ITSR (%)
M1	P14348	AC 14 Marshall surf	Edston	Cove Dust / Temple Sand (74:26)	70/100 5.6%	35	2.373	2.462	3.6	1.78	1.82	103
M2	P14349	AC 14 Marshall surf	Edston	Cove Dust / Temple Sand (74:26)	Nynas Endura Z4 5.6%	35	2.369	2.467	4.0	2.77	2.69	97
M4	P14385	AC 14 Marshall surf	Edston	Edston Dust / Temple Sand (75:25)	70/100 5.5%	35	2.369	2.470	4.1	1.76	1.75	100
M3	P14384	AC 14 Marshall surf	Edston	Edston Dust / Temple Sand (75:25)	Nynas Endura Z4 5.5%	35	2.368	2.469	4.1	2.67	2.45	92

Table 4. SMA 14 Surf

Water Sensitivity (BS EN 12697-12)

Test Ref	Sample No.	Mix	Source Coarse	Source Fine	Binder	No. of Blows per side of Specimens	Density (Leiths) Mg/m^3	Max Density Mg/m^3	Voids	ITS (Dry) at 15°C	ITS (Wet) at 15°C	ITSR (%)
S1	P14344	SMA 14 surf	Edston	Edston	40/60 6.0%	35	2.386	2.453	2.7	2.02	2.00	99
S2	P14345	SMA 14 surf	Edston	Edston	Nynas Endura Z4 6.0%	35	2.397	2.453	2.3	2.16	2.32	108
S3	P14346	SMA 14 surf	Edston	Edston	Cariphalte HP 6.0%	35	2.397	2.453	2.3	1.84	1.89	102
S4	P14347	SMA 14 surf	Edston	Edston	Nynas S89 6.0%	35	2.398	2.453	2.2	1.42	1.55	109

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