

Sprayed Sealing - Binder Volume Correction

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INTRODUCTION

Bituminous materials expand when heated. The volume of hot bitumen, for example, may be 10%, or more, greater than the volume at ambient temperature. Accurate determination of quantities of bituminous materials, therefore, requires the use of temperature correction factors for all measures of volume.

Volume correction factors for bitumen emulsion and bitumen are provided in Tables 2 and 3 respectively.

Table 1 Typical mass/volume conversion factors

Material	Volume (L/tonne)
Bitumen	970
60% bitumen emulsion	982
70% bitumen emulsion	979
80% bitumen emulsion	976

Converting mass to volume

Typical values for conversion of mass to volume are shown in Table 1. Where more precise measurement of volume is required, actual laboratory test results for density should be used.

EXAMPLES

Example 1.

Quantity of 70% bitumen emulsion sprayed as primer/binder

Quantity at start 6200 L
 Quantity at finish 1550 L
 Temperature of emulsion 80°C
 Area sprayed 480 m x 6.4 m = 3072 m²
 Quantity sprayed (at 80°C) 6200 - 1550 = 4650 L
 From Table 2 the multiplier to correct the volume of 70% emulsion from 80°C to 15°C is 0.9662.
 Corrected Volume is 4650 x 0.9662 = 4493 L
 Quantity sprayed at 15°C 4493/3072 = 1.46 L/m²

Key Summary

This issue of 'pavement work tips' provides a guide to the calculation of the volume of liquid bituminous binders relative to a standard temperature of 15°C

Table 2 Volume Correction – BITUMEN EMULSION

MULTIPLY BY "A" TO REDUCE VOLUME AT T°C TO VOLUME AT 15°C								
MULTIPLY BY "B" TO INCREASE VOLUME AT 15°C TO VOLUME AT T°C								
60% BITUMEN EMULSION			70% BITUMEN EMULSION			80% BITUMEN EMULSION		
A	TEMP (T°C)	B	A	TEMP (T°C)	B	A	TEMP (T°C)	B
1.0000	15	1.0000	1.0000	15	1.0000	1.0000	15	1.0000
.9998	16	1.0002	.9977	20	1.0023	.9974	20	1.0026
.9989	18	1.0011	.9951	25	1.0049	.9948	25	1.0052
.9980	20	1.0020	.9924	30	1.0076	.9921	30	1.0079
.9971	22	1.0029	.9899	35	1.0102	.9895	35	1.0106
.9962	24	1.0038	.9872	40	1.0129	.9868	40	1.0134
.9953	26	1.0047	.9840	46	1.0162	.9837	46	1.0166
.9944	28	1.0056	.9830	48	1.0172	.9826	48	1.0177
.9935	30	1.0065	.9819	50	1.0184	.9816	50	1.0187
.9926	32	1.0074	.9809	52	1.0194	.9805	52	1.0199
.9917	34	1.0083	.9798	54	1.0206	.9794	54	1.0210
.9908	36	1.0092	.9788	56	1.0216	.9783	56	1.0222
.9899	38	1.0102	.9777	58	1.0228	.9773	58	1.0232
.9890	40	1.0111	.9767	60	1.0238	.9762	60	1.0244
.9881	42	1.0120	.9752	62	1.0254	.9751	62	1.0255
.9872	44	1.0129	.9746	64	1.0260	.9740	64	1.0267
.9863	46	1.0138	.9736	66	1.0271	.9730	66	1.0277
.9854	48	1.0148	.9725	68	1.0282	.9719	68	1.0289
.9845	50	1.0157	.9715	70	1.0293	.9709	70	1.0300
.9836	52	1.0166	.9704	72	1.0305	.9698	72	1.0311
.9827	54	1.0176	.9693	74	1.0316	.9687	74	1.0323
.9818	56	1.0185	.9683	76	1.0327	.9677	76	1.0334
.9809	58	1.0194	.9672	78	1.0339	.9667	78	1.0344
.9800	60	1.0204	.9662	80	1.0349	.9656	80	1.0356
.9791	62	1.0213	.9651	82	1.0361	.9643	82	1.0370
.9782	64	1.0222	.9640	84	1.0373	.9630	84	1.0384
.9773	66	1.0232	.9630	86	1.0384	.9616	86	1.0399
.9764	68	1.0241	.9619	88	1.0396	.9603	88	1.0413
.9755	70	1.0251	.9608	90	1.0407	.9590	90	1.0427

continued on reverse

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Table 3 Volume Correction - BITUMEN (including cutback bitumen)

MULTIPLY BY "A" TO REDUCE VOLUME AT T°C TO VOLUME AT 15°C MULTIPLY BY "B" TO INCREASE VOLUME AT 15°C TO VOLUME AT T°C					
A	Temp.(T°C)	B	A	Temp. (T°C)	B
.9856	38	1.0146	.9356	120	1.0688
.9844	40	1.0158	.9344	122	1.0702
.9831	42	1.0172	.9332	124	1.0716
.9819	44	1.0184	.9320	126	1.0730
.9806	46	1.0198	.9308	128	1.0743
.9794	48	1.0210	.9296	130	1.0757
.9782	50	1.0223	.9284	132	1.0771
.9769	52	1.0236	.9272	134	1.0785
.9757	54	1.0249	.9260	136	1.0799
.9745	56	1.0262	.9249	138	1.0812
.9732	58	1.0275	.9237	140	1.0826
.9720	60	1.0288	.9225	142	1.0840
.9708	62	1.0301	.9213	144	1.0854
.9695	64	1.0315	.9201	146	1.0868
.9683	66	1.0327	.9189	148	1.0883
.9671	68	1.0340	.9178	150	1.0896
.9659	70	1.0353	.9166	152	1.0910
.9646	72	1.0367	.9154	154	1.0924
.9634	74	1.0380	.9142	156	1.0939
.9622	76	1.0393	.9130	158	1.0953
.9610	78	1.0406	.9119	160	1.0966
.9597	80	1.0420	.9107	162	1.0981
.9585	82	1.0433	.9095	164	1.0995
.9573	84	1.0446	.9084	166	1.1009
.9561	86	1.0459	.9072	168	1.1023
.9549	88	1.0472	.9060	170	1.1038
.9537	90	1.0486	.9049	172	1.1051
.9524	92	1.0500	.9037	174	1.1066
.9512	94	1.0513	.9025	176	1.1080
.9500	96	1.0526	.9014	178	1.1094
.9488	98	1.0540	.9002	180	1.1109
.9476	100	1.0553	.8990	182	1.1123
.9464	102	1.0566	.8979	184	1.1137
.9452	104	1.0580	.8967	186	1.1152
.9440	106	1.0593	.8956	188	1.1166
.9428	108	1.0607	.8944	190	1.1181
.9416	110	1.0620	.8933	192	1.1195
.9404	112	1.0634	.8921	194	1.1209
.9392	114	1.0647	.8909	196	1.1224
.9380	116	1.0661	.8898	198	1.1239
.9368	118	1.0675	.8886	200	1.1253

For more information on any of the construction practices discussed in "pavement work tips", please contact either your local AUSTROADS Pavement Reference Group representative or AAPA — tel (03) 9853 3595; fax (03) 9853 3484; e-mail: info@aapa.asn.au
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Example 2. Checking quantity of bitumen delivered

Weighbridge docket 21.7 t
Dipstick reading on arrival 23 400 L
Temperature on arrival 184°C

Generally, 1 t of bitumen = 970 L at 15°C (Table 1)
Volume delivered (15°C): 970 x 21.7 = 21 049 L

To check the quantity delivered against the dipstick reading, correct the volume to 184°C.

From Table 3, volume correction factor is 1.1137
Quantity at 184°C: 21 049 x 1.1137 = 23 442 L
(Correlates well with dipstick reading of 23 400 L)

Example 3. Checking available tank capacity

A cutback bitumen primerbinder has been placed in a 20 000 L tank, allowed to cool to 60°C and topped up to a dipstick reading of 19 500 L. Can this material be heated to 140°C without the tank overflowing?

To determine volume at 140°C, it is necessary to first correct volume to 15°C.

Multiplier (Table 3) to correct from 60°C to 15°C: 0.9720
Quantity at 15°C 19 500 x 0.9720 = 18 954 L
Multiplier to correct from 15°C to 140°C: 1.0826
Quantity at 15°C 18 954 x 1.0826 = 20 519 L

Heating is therefore not safe as the tank may overflow. Good practice requires 10% ullage at all times.