Dulux® PROTECTIVE COATINGS

HANDY CALCULATIONS - VOLUME SOLIDS AND SPREADING RATE

WHAT IS VOLUME SOLIDS?

All paints are made up of resin, pigments, additives (such as stabilisers, anti-foams and thickeners) and solvent. After the paint is applied, the solvent evaporates, leaving only the dry SOLIDS in the form of a continuous coating.

The solids can be expressed as a volume percentage of the entire volume of the can of paint. For example, if solvent takes up half the paint volume, then one can say that the paint is 50% solids. One can therefore expect that if a wet coat of paint is applied to a wet film thickness of 100 µm, the dry paint film will be 50 µm in thickness.

$$\text{\% Volume Solids} = \frac{\text{Dry Film Thickness} \times 100}{\text{Wet Film Thickness}}$$

So, for a product that, when applied, had a measured wet film thickness of 100 µm, and after the solvent had evaporated, left a dry film of 50 µm, the volume solids would be:

$$\text{\% Volume Solids} = \frac{50 \times 100}{100} = 50\% \checkmark$$

We rarely need to calculate volume solids, though, as it is quoted on the product data sheet.

But knowing the volume solids value can help you calculate theoretical spreading rates, the wet film thickness to deliver the required dry film thickness, and corrected wet and dry film thicknesses when thinned by a known amount of solvent.

RELATIONSHIP BETWEEN SPREADING RATE AND VOLUME SOLIDS

If you have the volume solids value, and know what dry film thickness you require, then you can calculate what the wet film thickness needs to be using some simple mathematical formulae:

$$\text{Wet Film Thickness} = \frac{\text{Dry Film Thickness} \times 100}{\text{\% Volume Solids}}$$

$$\text{Spreading Rate (m}^2\text{/litre)} = \frac{\text{\% Volume Solids} \times 10}{\text{DFT Required}}$$

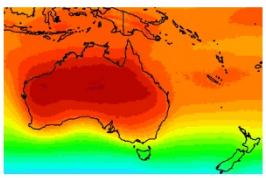
EXAMPLE

A section of steel needs to be coated in 125 µm (DFT) of Duremax® GPE, which is 71% solids. What is the wet film thickness required?

$$\text{Wet Film Thickness} = \frac{125\ \mu m \times 100}{71} = 176\ \mu m \checkmark$$

To achieve this wet film thickness, what should the spreading rate be (in square metres per litre)?

$$\text{Spreading Rate (m}^2\text{/litre)} = \frac{\text{\% Volume Solids} \times 10}{\text{DFT Required}} = \frac{71 \times 10}{125} = 5.7\ \text{m}^2\text{/litre} \checkmark$$

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EFFECT OF THINNER ON VOLUME SOLIDS AND WET FILM THICKNESS

We often need to thin a product down to slow down the drying rate or to spray it more easily in certain conditions.

If we know the volume solids of a product and the dry film thickness required, and add a precisely known amount of thinner, the wet film thickness and the spreading rate required can be calculated thus:

Corrected % Volume Solids = $\frac{\text{\% Volume Solids x 100}}{\text{(100 + \% Thinner added)}}$

Corrected Wet Film Thickness = $\frac{\text{Dry film thickness x (100 + \% Thinner added)}}{\text{\% Volume solids}}$

EXAMPLE:

If we are to apply Duremax® GPE, with a Volume Solids of 71%, to a dry film thickness of 125 µm **after adding 5% thinner**:

Corrected % Volume Solids = $\frac{\text{\% Volume Solids x 100}}{\text{(100 + \% Thinner added)}}$ = $\frac{71 \times 100}{100 + 5}$ = **67.6 %** ✓

Wet Film Thickness = $\frac{\text{Dry film thickness x 100}}{\text{Corrected \% Volume Solids}}$ = $\frac{125 \times 100}{67.6}$

= **185 µm** ✓

Spreading Rate (m^2/litre) = $\frac{\text{Corrected \% Volume Solids x 10}}{\text{DFT Required}}$ = $\frac{67.6 \times 10}{125}$

= **5.4 m^2/litre** ✓

CONVERTING FROM THEORETICAL TO PRACTICAL SPREADING RATE

Theoretical spreading rates are based on the volume solids of each product and offer a factual starting point from which to estimate practical spreading rates. The amount necessary to reduce theoretical rate to arrive at practical rate is best determined by experience with similar jobs, since it depends on:

1. Type of object being painted.
2. Material needed to fill in the surface depressions caused by pitting and by abrasive blasting.
3. Excessive film thickness over the required minimum.
4. Material losses due to: wastage in pots, hoses, brush, rollers, overspray, wind losses, etc.
5. Skill and experience of spray painter and painters.
6. Porosity of surfaces.

Practical spreading rates may be estimated using the following rule of thumb:

- Application by brush or roller — 10 – 15% reduction in theoretical spreading rate
- Application by airless spray — 10 – 15% reduction in theoretical spreading rate
- Application by conventional spray — 40 – 50% reduction in theoretical spreading rate

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ESTIMATION OF PAINT REQUIRED

Volume of paint (litres) = $\frac{10 \times \text{Area (sqm)} \times \text{Dry film thickness}}{\%\ \text{Volume Solids} \times (100 - \%\ \text{Wastage})}$

WET FILM THICKNESS (µm)

Volume Solids (%)	SPECIFIED DRY FILM THICKNESS (µm)																
	20	25	30	35	40	50	60	75	90	100	125	200	250	300	350	500	1000
10	200	250	300	350	400	-	-	-	-	-	-	-	-	-	-	-	-
15	133	166	200	233	266	333	-	-	-	-	-	-	-	-	-	-	-
20	100	125	150	175	200	250	300	-	-	-	-	-	-	-	-	-	-
25	80	100	120	140	160	200	240	300	-	-	-	-	-	-	-	-	-
30	66	83	100	117	133	166	200	250	300	-	-	-	-	-	-	-	-
35	57	71	85	100	114	142	171	214	257	285	357	-	-	-	-	-	-
40	50	62	75	87	100	125	150	187	225	250	312	500	-	-	-	-	-
45	44	55	66	77	88	111	133	166	200	222	277	444	555	-	-	-	-
50	40	50	60	70	80	100	120	150	180	200	250	400	500	-	-	-	-
55	36	45	54	63	72	90	109	136	163	181	227	363	454	545	-	-	-
60	30	41	50	58	66	83	100	125	150	166	208	333	416	500	-	-	-
65	-	38	46	53	61	76	100	115	138	153	192	307	384	461	538	-	-
70	-	35	42	50	57	71	85	107	128	142	178	285	357	428	500	-	-
75	-	-	40	46	53	66	80	100	120	133	166	266	333	400	466	666	-
80	-	-	37	43	50	62	75	93	112	125	156	250	312	375	437	625	-
85	-	-	-	41	47	58	70	88	105	117	147	235	294	352	411	588	-
90	-	-	-	38	44	55	66	83	100	111	138	222	277	333	388	555	1111
95	-	-	-	-	42	52	63	78	94	105	131	210	263	315	368	526	1052
100	-	-	-	-	40	50	60	75	90	100	125	200	250	300	350	500	1000

THEORETICAL SPREADING RATE (m^2/L)

DFT (µm)	VOLUME SOLIDS (%)																
	20	25	30	35	40	45	50	55	60	65	70	75	80	85	90	95	100
20	10.0	12.5	15.0	17.5	20.0	22.5	25.0	27.5	30.0	32.5	35.0	37.5	40.0	42.5	45.0	47.5	50.0
25	8.0	10.0	12.0	14.0	16.0	18.0	20.0	22.0	24.0	26.0	28.0	30.0	32.0	34.0	36.0	38.0	40.0
30	6.7	8.3	10.0	11.7	13.3	15.0	16.7	18.3	20.0	21.7	23.3	25.0	26.7	28.3	30.0	31.7	33.3
50	4.0	5.0	6.0	7.0	8.0	9.0	10.0	11.0	12.0	13.0	14.0	15.0	16.0	17.0	18.0	19.0	20.0
75	2.7	3.3	4.0	4.7	5.3	6.0	6.7	7.3	8.0	8.7	9.3	10.0	10.7	11.3	12.0	12.7	13.3
100	2.0	2.5	3.0	3.5	4.0	4.5	5.0	5.5	6.0	6.5	7.0	7.5	8.0	8.5	9.0	9.5	10.0
125	1.6	2.0	2.4	2.8	3.2	3.6	4.0	4.4	4.8	5.2	5.6	6.0	6.4	6.8	7.2	7.6	8.0
150	1.3	1.7	2.0	2.3	2.7	3.0	3.3	3.7	4.0	4.3	4.7	5.0	5.3	5.7	6.0	6.3	6.7
175	1.1	1.4	1.7	2.0	2.3	2.6	2.9	3.1	3.4	3.7	4.0	4.3	4.6	4.9	5.1	5.4	5.7
200	1.0	1.3	1.5	1.8	2.0	2.3	2.5	2.8	3.0	3.3	3.5	3.8	4.0	4.3	4.5	4.8	5.0
250	0.8	1.0	1.2	1.4	1.6	1.8	2.0	2.2	2.4	2.6	2.8	3.0	3.2	3.4	3.6	3.8	4.0
300	0.7	0.8	1.0	1.2	1.3	1.5	1.7	1.8	2.0	2.2	2.3	2.5	2.7	2.8	3.0	3.2	3.3
400	0.5	0.6	0.8	0.9	1.0	1.1	1.3	1.4	1.5	1.6	1.8	1.9	2.0	2.1	2.3	2.4	2.5
500	0.4	0.5	0.6	0.7	0.8	0.9	1.0	1.1	1.2	1.3	1.4	1.5	1.6	1.7	1.8	1.9	2.0

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CORRECTED VOLUME SOLIDS AFTER THINNING (%)

Original Volume Solid (%)	PERCENTAGE THINNER ADDED (%)						
	5	10	15	20	25	33	50
15	14	13.6	13	12.5	12.	11	10
20	19	18	17	16.7	16	15	13
25	24	23	22	21	20	19	17
30	29	27	26	25	24	23	20
35	33	32	30	29	28	26	23
40	38	36	35	33	32	30	27
45	43	41	39	37	36	34	30
50	48	45	43	42	40	38	33
55	52	50	48	46	44	41	37
60	57	55	52	50	48	45	40
65	62	59	56	54	52	49	43
70	67	64	61	58	56	53	47
75	71	68	65	62	60	56	50
80	76	73	70	67	64	60	53
85	81	77	74	71	68	64	57
90	86	82	78	75	72	68	60
95	90	86	83	79	76	71	63
100	95	91	87	83	80	75	67

For more information, please contact the Dulux Protective Coatings Technical Consultant in your state, or refer to the Dulux Protective Coatings Product Manual