Coverage and Spreading Rate

Helping understand paint consumption calculations

Introduction

The amount of paint used for a certain area depends on a few main factors:

- Required thickness
- Volumes solids of the paint
- Surface roughness
- Application conditions (wind, temperature, etc.)
- Application technique
- General wastage (material left in the drum, over application, etc.)

Only the first 2 are taken into consideration for a theoretical calculation of spreading rate. The other 3 play a role in the so called “loss factor” and prediction of practical spreading rate.

In Transocean Coatings datasheets theoretical spreading rates are tabulated for the products. In our “Guidance to Product Data Sheets” we describe the related terminology as follows:

Volume solids The volume solids figure (VS%) given on the product data sheet is the percentage of the wet film, which remains as the dry film after evaporation of solvents and curing. The value is obtained from a given wet film thickness under specified application method and conditions. These figures have been determined under laboratory conditions (practical value) or calculated from the formula contents (theoretical value). As the value will be dependent on climate conditions during drying and the applied film thickness, the actual value in practice will vary within ±2% from the value stated in the datasheet.

Spreading rate The theoretical spreading rate indicates how large an area can be coated per litre of product at a given thickness and is expressed in m²/L @ …µm on the PDS. This value is the inverse of the consumption which can be calculated in L/m² @ …µm. This value can be used to predict the required volume of paint for a project of known area to be coated.

The practical spreading rate achieved during application is impacted by many factors that are captured under the Loss Factor. As the loss factor varies, it is not part of the product datasheet.

Loss Factor The losses encountered vs. the theoretical values for spreading rate can be expressed as a percentage of the paint consumed. This includes material left in the drum and hoses of spray equipment to material spillage or missing the substrate due complicated designs and small dimension parts.

As described in our coverage & spreading rate document, each application technique has its own expected loss factor

- brush or roller — typical loss factor: 10-15%
- conventional (air) spray — 50% is no exception
- airless spray — usually 30% is assumed

Other loss factors are the ‘*dead volume*’ in the blasting profile (primers only), absorption into the substrate (concrete for instance), roughness of the substrate (5-20% loss), uneven application (5-10% loss) and windy conditions (dependent on the wind force may range from 5 to above 30% losses).

Introduction of the loss factor in the calculation leads to the terms practical spreading rate (m² /l) and finally to the practical consumption (l/m²).

It is should be clear that the loss factor always is an estimation based on the local conditions, the experience of the painter and many other factors.

A correction factor can be added to the spreading rate calculation shown in above to calculate expected paint consumption.

Theoretical spreading rate

Theoretical spreading rates can be calculated from the paint's volume solids percentage and the specified dry film thickness using the following equation.

$$Theoretical\ spreading\ rate\ [m^2/L] = \frac{10\ x\ VS\%}{DFT[\mu m]}$$

Example: Suppose a dry film thickness of 100 micron has to be achieved with a paint having 50% volume solids. From the table the theoretical spreading rate would be 5,0 m2/l.

Table 1 gives the Theoretical spreading rate in m²/L for a desired dry film thickness at a given Volume Solids percentage.

Table 1: Theoretical spreading rate in m²/l

	Required dry film thickness (µm)											
Volume solids (%)	**25**	**50**	**75**	**100**	**125**	**150**	**175**	**200**	**225**	**250**	**300**	**400**
100	40,0	20,0	13,3	10,0	8,0	6,7	5,7	5,0	4,4	4,0	3,3	2,5
95	38,0	19,0	12,7	9,5	7,6	6,3	5,4	4,8	4,2	3,8	3,2	2,4
90	36,0	18,0	12,0	9,0	7,2	6,0	5,1	4,5	4,0	3,6	3,0	2,3
85	34,0	17,0	11,3	8,5	6,8	5,7	4,9	4,3	3,8	3,4	2,8	2,1
80	32,0	16,0	10,7	8,0	6,4	5,3	4,6	4,0	3,6	3,2	2,7	2,0
75	30,0	15,0	10,0	7,5	6,0	5,0	4,3	3,8	3,3	3,0	2,5	1,9
70	28,0	14,0	9,3	7,0	5,6	4,7	4,0	3,5	3,1	2,8	2,3	1,8
65	26,0	13,0	8,7	6,5	5,2	4,3	3,7	3,3	2,9	2,6	2,2	1,6
60	24,0	12,0	8,0	6,0	4,8	4,0	3,4	3,0	2,7	2,4	2,0	1,5
55	22,0	11,0	7,3	5,5	4,4	3,7	3,1	2,8	2,4	2,2	1,8	1,4
50	20,0	10,0	6,7	5,0	4,0	3,3	2,9	2,5	2,2	2,0	1,7	1,3
45	18,0	9,0	6,0	4,5	3,6	3,0	2,6	2,3	2,0	1,8	1,5	1,1
40	16,0	8,0	5,3	4,0	3,2	2,7	2,3	2,0	1,8	1,6	1,3	1,0
35	14,0	7,0	4,7	3,5	2,8	2,3	2,0	1,8	1,6	1,4	1,2	0,9
30	10,0	5,0	3,3	2,5	2,0	1,7	1,4	1,3	1,1	1,0	0,8	0,6

Theoretical Consumption

The theoretical quantity of paint required for a job can be calculated as follows:

$$Theoretical\ \ Quantity\ [L] = \frac{Area\ to\ be\ coated [m^2]}{Theoretical\ Spreading\ rate\ [m^2/L]}$$

Example: Suppose 1000 square meter to coated with a paint having a theoretical spreading rate of 5 m²/L. The theoretical quantity would be 1000/5 = 200 litres of paint.

This formula does not take loss factors into account.

Loss factor and Practical Spreading rate

Loss Factor

The choice of application method has a great influence on the total loss factor. This is the percentage of the paint consumed that does not contribute to the resulting applied (dry) film thickness.

Application by brush or roller typically has loss factors of 10-15 % whereas application by conventional spray loss factors of 50% is no exemption. For airless spray usually a loss factor of 30% is assumed.

Other loss factors are: roughness of the substrate (5-20% loss), uneven application (5-10% loss) and windy conditions (dependent on the wind force may range from 5 to 30% losses).

Introduction of the loss factor in the calculation leads to the terms practical spreading rate (m²/l) and finally to the practical quantity of paint required for a paint job.

It is clear that the loss factor always is an estimation. This estimation is based on the equipment factors mentioned before, the local conditions and the experience of the painter.

The practical spreading rate follows from;

$$Practical\ Spreading\ Rate\ [m^2/L] = \left(1 - \frac{\%loss}{100}\right)\ Theoretical\ Spreading\ rate$$

Example: Suppose a 40% loss factor and using a paint with a 5 m² /L theoretical spreading rate.

The practical spreading rate would then be (1-40/100) x 5 = 3 m²/L.

- Subsequently, the practical quantity required to paint 1000 square meters would be 1000/3 ≈ 333 litres.
- Compared to the 200 calculated before without any losses, this is 133 more.
- The loss factor being equal to the % the paint consumed that does not contribute to the resulting applied (dry) film thickness: 133/333≈40%

Deduction of new volume solids after thinning.

Thinning may be necessary to achieve a good painting result. Of course one should always take the correct thinner and use the appropriate amount. This information is mentioned in the product's datasheet but if in doubt always crosscheck with the local Transocean representative or the inspector on duty.

When thinning one has to realize the volume solids of the paint is lowered. As a result more wet film thickness has to be applied to achieve the necessary dry film thickness. From the table below it can be deducted how volume solids change when adding a certain amount of thinner.

Table 2: Volume solids after thinning

	Percentage of thinner added									
Volume solids (%) before thinning	**1**	**2**	**3**	**4**	**5**	**7**	**10**	**12**	**15**	**20**
100	99	98	97	96	95	93	91	89	87	83
95	94	93	92	91	90	89	86	85	83	79
90	89	88	87	87	86	84	82	80	78	75
85	84	83	83	82	81	79	77	76	74	71
80	79	78	78	77	76	75	73	71	70	67
75	74	74	73	72	71	70	68	67	65	63
70	69	69	68	67	67	65	64	63	61	58
65	64	64	63	63	62	61	59	58	57	54
60	59	59	58	58	57	56	55	54	52	50
55	54	54	53	53	52	51	50	49	48	46
50	50	49	49	48	48	47	45	45	43	42
45	45	44	44	43	43	42	41	40	39	38
40	40	39	39	38	38	37	36	36	35	33
35	35	34	34	34	33	33	32	31	30	29
30	30	29	29	29	29	28	27	27	26	25
25	25	25	24	24	24	23	23	22	22	21
20	20	20	19	19	19	19	18	18	17	17

Example: When a paint having a volume solids of 50% is thinned down 10%, the table shows that the new volume solids will be 45%. This lowering in solids impacts the required wet film thickness (WFT) to reach the specified dry film thickness (DFT).

The required wet film thickness follows from:

$$\mathrm{WFT} = \frac{100 \times \mathrm{DFT}}{\mathrm{VS\%}} \text{ [µm]}$$

For a dry film thickness of 100µm of a paint with 50% volume solids, 200µm un-thinned wet film has to be applied. However, if the paint is diluted with 10% thinner, the new volume solids form table will be 45%. As a result new wet film thickness to reach 100 micron dry is 10.000/45= 222 microns.

Finally, taking into account thinning and loss factors, the quantity required can be calculated applying the following equation:

$$\textbf{Practical quantity required (L)} = \frac{\textbf{10 x Area (m}^2\textbf{) x dry film thickness (µm)}}{\textbf{Volume Solids\% x (100 - \% loss)}}$$

In the given example the following parameters are known:

Area to be coated	= 1000 m²
Dry film thickness	= 100 µm
% loss	= 40%
VS% paint after 10% thinning	= 45%

$$\text{Then practical quantity of paint required} = \frac{10 \times 1000 \times 100}{45 \times (100 - 40)} = 370{,}4 \text{ litres}$$

An excel “Paint Calculation” spreadsheet taking the mentioned variable into account can be downloaded from the documents section of transocean-coatings.com.