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Textiles — Tests for colour fastness —

Part Z05:

Determination of the dusting behaviour of
dyes

Textiles — Essais de solidité des teintures —

Partie Z05: Détermination du comportement des colorants au saupoudrage

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Reference number
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Foreword

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Draft International Standards adopted by the technical committees are circulated to the member bodies for voting. Publication as an International Standard requires approval by at least 75 % of the member bodies casting a vote.

International Standard ISO 105-Z05 was prepared by Technical Committee ISO/TC 38, *Textiles*, Subcommittee SC 1, *Tests for coloured textiles and colorants*.

ISO 105 was previously published in thirteen "parts", each designated by a letter (e.g. "Part A"), with publication dates between 1978 and 1985. Each part contained a series of "sections", each designated by the respective part letter and by a two-digit serial number (e.g. "Section A01"). These sections are now being republished as separate documents, themselves designated "parts" but retaining their earlier alphanumeric designations. A complete list of these parts is given in ISO 105-A01.

Annexes A and B of this part of ISO 105 is for information only.

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Introduction

The dustiness of dyestuffs is an important feature when considering aspects of hygiene, health and safety in the dyestuff-consuming industry. It is important therefore that a reliable and reproducible method exists to measure this property.

Although other methods for dust measurement exist, the method given in this part of ISO 105 is both more representative of and comparable with actual practice when handling dyestuffs. In respect of a comparison of dyestuffs or the reliability of limits, it should be understood that the resulting value is not a specific value like density.

Details of reproducibility data are given in annex A.

Textiles — Tests for colour fastness —

Part Z05:

Determination of the dusting behaviour of dyes

1 Scope

This part of ISO 105 specifies a method for determination of the dusting behaviour of dyes.

2 Normative references

The following standards contain provisions which, through reference in this text, constitute provisions of this part of ISO 105. At the time of publication, the editions indicated were valid. All standards are subject to revision, and parties to agreements based on this part of ISO 105 are encouraged to investigate the possibility of applying the most recent editions of the standards indicated below. Members of IEC and ISO maintain registers of currently valid International Standards.

ISO 105-A01:1994, *Textiles — Tests for colour fastness — Part A01: General principles of testing.*

ISO 105-A03:1993, *Textiles — Tests for colour fastness — Part A03: Grey scale for assessing staining.*

3 Definition

For the purposes of this part of ISO 105, the following definition applies.

3.1 dust: Particles of solid material dispersed in a gas.

NOTES

1 Dyestuff dust is formed during handling operations such as dispensing, transferring, sprinkling, etc.

2 Solid dyes are sold in different physical forms (powdered, granulated, etc.). The particle-size distribution of commercial products varies considerably. The mean particle diameter may be less than 50 μm or as much as several millimetres. The range of the particle-size distribution of a solid dye may also be narrow or wide.

3 The particle-size distribution of dyestuff dust is largely independent of the physical form of the dyestuff. Two typical particle-size distributions for dyestuff dust are shown in figure 1.

4 Principle

Dust is generated from a dye sample by means of a dust-generating device, extracted from the dust-bearing air by vacuum and conveyed to a detection point, where the amount of dust generated is estimated visually or determined quantitatively by a gravimetric or photometric method.

5 Apparatus

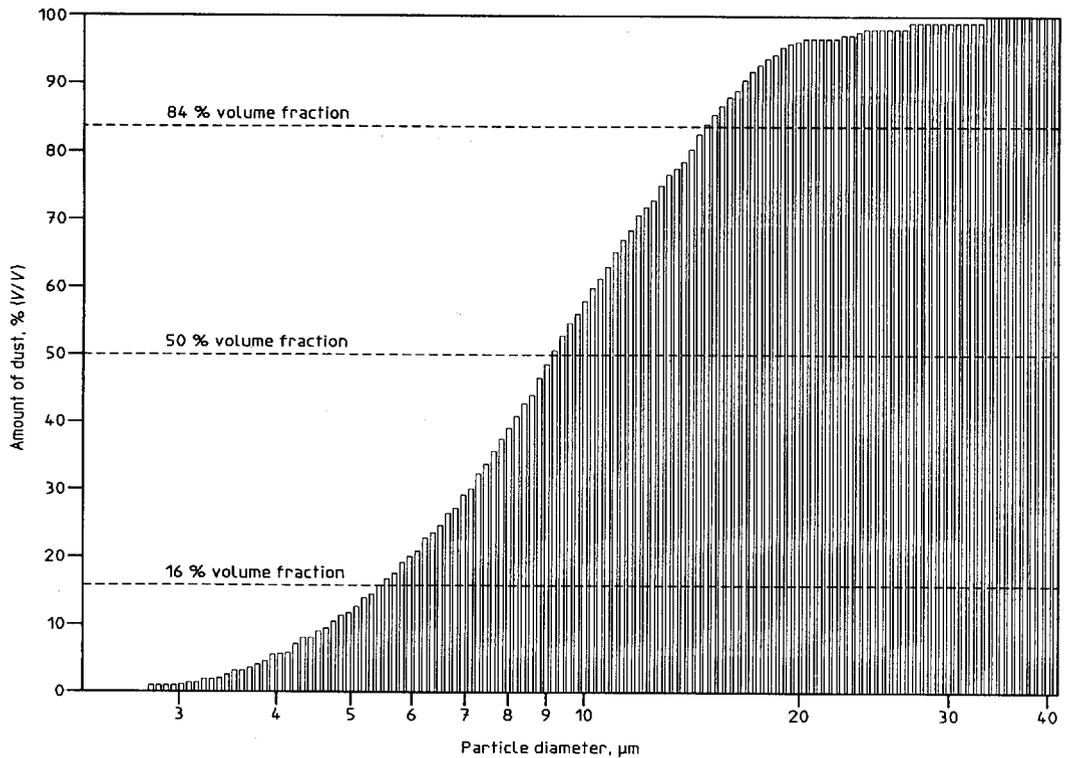
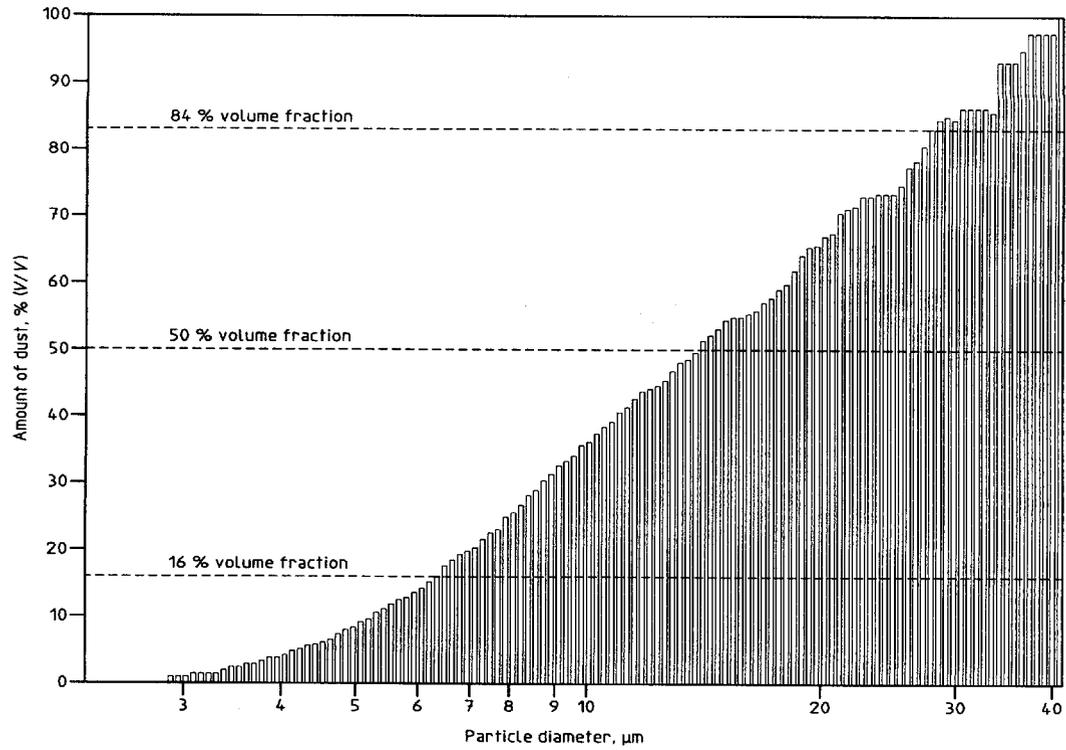
5.1 Balance, accurate to $\pm 0,1$ g, for weighing out the dye.

5.2 Dust-generating device, with filter holder and connecting joints, and incorporating the following additional components (see figures 2 and 3).

NOTES

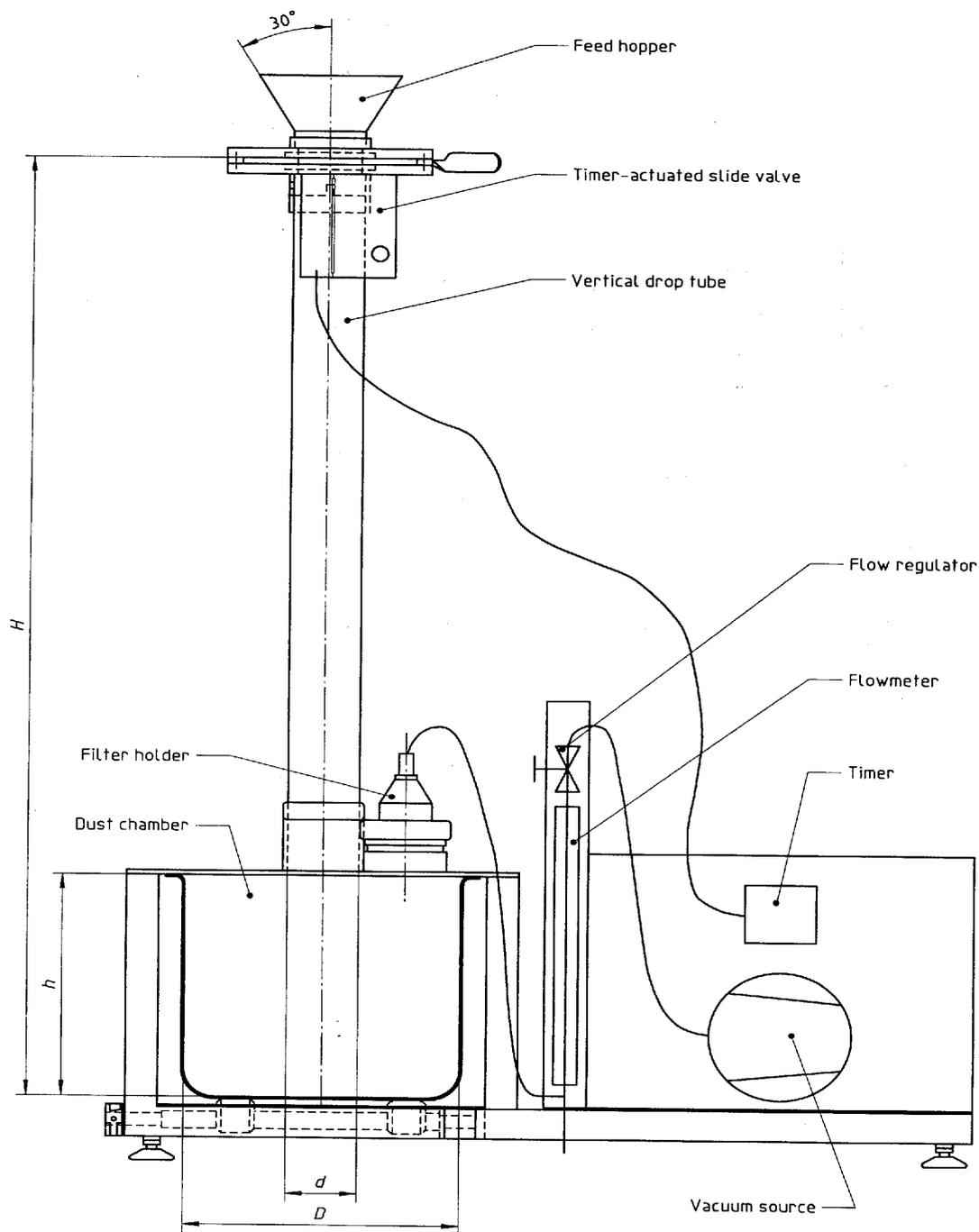
1 Instead of a filter and filter holder, other dust-detection devices may be fitted to the apparatus, such as an impactor or an optical particle counter.

2 For information on sources of supply of the dust-generating device and the filter, apply to the organizations listed in clause 8 of ISO 105-A01:1994.



NOTE — The x-axis of both graphs has a logarithmic scale.

Figure 1 — Typical graphical representations of the amount of dyestuff dust (by volume) as a function of the dust-particle diameter



<i>H</i>	Total fall height ¹⁾	815 mm	± 5 mm
<i>h</i>	Dust chamber height	195 mm	± 5 mm
<i>D</i>	Dust chamber diameter	Ø 210 mm	± 5 mm
<i>d</i>	Drop tube diameter	Ø 47 mm	± 1 mm

1) Total fall height is measured from the top side of the slide valve plate to the inside face of the dust chamber.

Figure 2 — Apparatus for dust determination

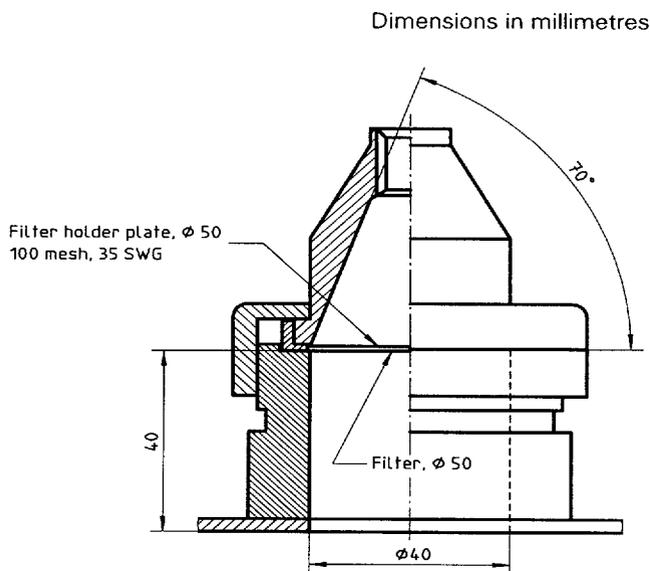


Figure 3 — Filter holder

5.2.1 Filter, white, diameter (50 ± 2) mm, capable of trapping the dust quantitatively (pore size $\leq 5 \mu\text{m}$).

- a) For the gravimetric and photometric methods, made of cellulose nitrate.
- b) For the visual method, suitable glass-fibre filters can be used.

5.2.2 Vacuum pump, with a suction capacity of at least 20 l/min.

5.2.3 Regulator, for adjusting the air flowrate.

5.2.4 Flowmeter, capable of monitoring air flowrate between 10 l/min and 20 l/min.

5.2.5 Timer, for opening the slide valve to start suction, and for timing the period of suction.

5.3 Grey scale for assessing staining, complying with ISO 105-A03.

5.4 Analytical balance, accurate to $\pm 0,01$ mg, for weighing the dust collected on the filter (5.2.1) (gravimetric assessment method), and/or **photometer**, for extinction measurement of the dust collected and dissolved in a suitable solvent (photometric assessment method).

5.5 Cleaning device, e.g. brush or vacuum cleaner, for cleaning the apparatus.

5.6 Tweezers, for removing filter paper from holder after dust generation.

6 Procedure

Place the filter holder containing the filter (5.2.1) in the dust-generating apparatus (5.2) and close it to give an airtight fit. If the gravimetric method of assessment is used, condition and weigh the filter before insertion into the filter holder.

Using the balance (5.1), carefully weigh out $10 \text{ g} \pm 0,1 \text{ g}$ of the dye and place it in the hopper at the top of the apparatus. Start the timer (5.2.5) to open the slide valve with a sudden action, allowing the dye to drop down through the tube into the dust chamber below.

Five seconds after the slide has opened, apply a vacuum to extract the dust from the chamber for collection on the filter (5.2.1) under the following conditions:

- air flowrate: 15 l/min;
- extraction time: 120 s (starting 5 s after dye has dropped);
- height of fall: (815 ± 5) mm.

Using tweezers (5.6), carefully remove the dust-laden filter from the holder and evaluate it by one of methods given in clause 7.

Clean the equipment thoroughly (5.5) after each test. If the equipment is wet-cleaned, take particular care that it is dried thoroughly.

7 Assessment of filter

7.1 Visual method

Compare the dust-laden filter visually with the grey scale for assessing staining (5.3), where Rating 1 = very dusty and Rating 5 = no dust.

Half-ratings may be used.

NOTE — It is also possible to carry out a visual assessment of colourless solid materials. However, special care has to be exercised in such cases. Black filters may be helpful, but require separate preliminary trials. It is preferable to use the gravimetric or photometric method.

7.2 Gravimetric method

Weigh the dust-laden filter on the analytical balance (5.4). Since with low-dusting products the mass of dust is very small ($< 1 \text{ mg}$), considerable errors are to be expected with the gravimetric method. In such

cases, preference should be given to photometric measurement.

7.3 Photometric method

For photometric measurement of the amount of dust, dissolve the dyestuff by shaking well the dust-laden filter in a suitable solvent at room temperature. When a clear solution has formed, measure the transmission with a photometer and read the corresponding amount of dust off a previously prepared calibration graph.

NOTE — Further details may be found in the literature. See for example annex B.

8 Expression of results

The generation and detection of dust depend on a great number of parameters. For this reason, the determination of the amount of dust yields results which are valid only for the specified test conditions. This means that a direct comparison of either the visual or the quantitative results of dust behaviour with results from other test methods is not possible. However, the relative order of the results of a set of test specimens from one test method is likely to be comparable with that from other test methods.

8.1 Visual method

Express the result of the visual method as the grey scale rating obtained in 7.1.

A quantitative determination of the amount of dust produced by a dye is not possible by the visual method. The main reasons for this are different particle size distributions, particle sizes and shades of the dust in each case.

Visual assessment is subjective, and depends on factors such as the experience of the examiner, the hue of the layer of dust and the nature of the filter surface (smooth or rough). Variations of up to half a rating unit are inherent in this system. Empirically, the total error under repeatability conditions (same apparatus and laboratory) does not exceed this value.

8.2 Quantitative methods

Express the results obtained from 7.2 or 7.3 as milligrams of dyestuff dust collected.

In both quantitative methods (gravimetric and photometric), the determination is based on the amount of dust trapped on the filter. Since the amounts of dust are measured in milligrams, in the gravimetric method variations in the conditioning of the filter and electrostatic influences can lead to substantial errors. If the amount of dust is determined by photometry, care must, of course, be taken that the transmission is measured on clear solutions. According to the experience of various laboratories, a reproducibility of about 10 % (coefficient of variation) can be attained under favourable conditions.

8.3 Scatter of results

In some cases, scattering of the results may occur. The main causes of this are:

- a) factors specific to the apparatus, e.g.:
 - the air flowrate is incorrectly adjusted;
 - the air flow through the apparatus is not constant, or the vacuum is incorrectly applied;
 - the timing control is imprecise.

These errors can be minimized by making appropriate adjustments to the apparatus.

- b) external factors:
 - humidity;
 - electrostatic charges inside the vertical tube and the dust chamber;
 - inhomogeneous distribution of the dust within the sample.

9 Test report

The test report shall include the following information:

- a) the number and year of publication of this part of ISO 105, i.e. ISO 105-Z05:1996;
- b) a full description of the sample tested;
- c) the exact mass of the test portion taken;
- d) the air flowrate;
- e) the extraction time;
- f) the filter grade;
- g) the assessment method used and the result obtained, expressed as in 8.1 or 8.2;
- h) details of any deviations from the procedure;
- i) the date of the test.

Annex A (informative)

Reproducibility of the method

The reproducibility data relate to dustiness determinations carried out in the laboratories of major dyestuff manufacturers in Europe on the following dyestuffs.

Dyestuff 1 = Erionyl Violet B 240 %

Dyestuff 2 = Acidol Blue BE NW

Dyestuff 3 = Indosol Rubine SFR GN

Dyestuff 4 = Sapracen Crocein

The series of tests were carried out both in individual laboratories and in different laboratories on different days.

The dustiness of dyestuffs 1, 2 and 3 were evaluated by both gravimetric and photometric measurements in laboratories 1, 2, 3 and 4. On any one day, 10 samples of the same dye were subjected to the dusting behaviour test, in the same laboratory. The exercise was repeated on two further days. For each series of 10 determinations of the mean mass of dust collected, the average, the standard deviation (s) and the coefficient of variation (V , %) were calculated. Results are given in tables A.1, A.2 and A.3.

As mentioned in 8.3, external influences such as humidity, electrostatic charges and inhomogeneous distribution of dust within the sample are the most

important factors affecting the reproducibility of the determination of the dusting behaviour of dyestuffs. Among these influences, the inhomogeneous distribution of dust can be minimized by use of a sample divider. However, one should take into account the mechanical stress on the sample. Therefore general use of a sample divider cannot be recommended. Warnings as to the effect on dustiness as a result of using such a device are given.

Laboratory 5 and dyestuff 4 were used to demonstrate the benefit to reproducibility of using a sample divider (or riffler) to ensure the homogeneity of the dye samples before evaluation. The test results are given in tables A.4 and A.5.

As can be seen from the variation coefficients of the photometric result ($V = 5,76$ %) and the gravimetric result ($V = 9,82$ %) of the test with the sample divider, the reproducibility of the determination of the amounts of dust is very good with this method of sample preparation.

Fluctuating results within a test series on different days and in different laboratories cannot be attributed to the test method, but rather to the influences described in 8.3. Every test carried out may be affected by these influences.

Table A.1 — Dusting behaviour of dyestuff 1

Test	Gravimetric results mg/filter											
	Laboratory 1			Laboratory 2			Laboratory 3			Laboratory 4		
	1	1,40	1,00	1,30	1,13	1,37	1,21	1,36	1,01	1,20	1,50	1,30
2	1,35	1,20	1,10	1,03	1,28	1,16	1,48	0,87	3,20	1,10	0,80	
3	1,20	0,90	1,10	0,84	1,14	1,12	1,12	1,06	1,10	0,90	1,50	
4	1,25	1,10	1,10	1,20	1,11	1,05	1,05	1,21	1,40	0,80	1,50	
5	1,45	1,35	1,00	1,19	1,32	1,02	1,22	1,16	0,60	1,10	1,60	
6	1,20	0,95	1,00	1,02	1,54	1,02	1,04	0,85	2,40	1,20	2,10	
7	1,10	1,00	1,20	1,08	1,16	1,02	1,17	1,12	1,40	1,10	0,80	
8	1,40	1,10	1,10	1,25	1,33	1,04	1,20	1,38	1,80	1,60	1,10	
9	2,10	0,75	1,40	1,16	1,19	1,22	0,95	1,27	1,10	1,00	1,00	
10	1,20	0,90	1,30	1,20	1,15	1,27	1,18	1,51	1,50	1,10	0,90	
Average	1,37	1,02	1,16	1,11	1,26	1,11	1,18	1,14	1,57	1,14	1,26	
<i>s</i>	0,28	0,17	0,13	0,12	0,13	0,09	0,16	0,21	0,74	0,25	0,42	
V (%)	20,20	16,70	10,60	10,81	10,31	8,11	13,60	18,36	47,38	21,60	33,30	
Test	Photometric results mg/filter											
	Laboratory 1			Laboratory 2			Laboratory 3			Laboratory 4		
	1	1,56	1,13	1,56	1,13	1,75	1,55	1,41	1,27	1,43	1,77	1,62
2	1,33	1,34	1,42	1,07	1,49	1,55	1,49	0,80	1,85	1,54	1,37	
3	1,28	1,10	1,30	0,96	1,30	1,34	1,18	1,09	1,31	1,07	1,40	
4	1,21	1,37	1,25	1,14	1,32	1,30	1,09	1,25	1,67	1,30	1,38	
5	1,58	1,70	1,25	1,10	1,39	1,41	1,20	1,18	2,00	1,36	1,16	
6	1,16	1,30	1,20	1,08	1,54	1,16	1,04	1,14	1,62	1,39	1,98	
7	1,26	1,23	1,45	1,02	1,27	1,34	1,06	1,27	1,47	1,43	0,90	
8	1,42	1,39	1,28	1,32	1,37	1,23	1,26	1,43	1,53	1,51	1,75	
9	1,67	0,99	1,63	1,02	1,20	1,30	0,92	1,40	1,37	1,22	1,51	
10	1,60	1,20	1,38	1,09	1,30	1,41	1,05	1,33	1,46	1,65	1,44	
Average	1,41	1,27	1,37	1,09	1,40	1,36	1,17	1,22	1,57	1,42	1,45	
<i>s</i>	0,18	0,20	0,14	0,10	0,16	0,12	0,18	0,18	0,22	0,20	0,30	
V (%)	13,00	15,50	10,40	9,20	11,40	8,80	15,40	15,05	13,90	14,40	20,60	

Table A.2 — Dusting behaviour of dyestuff 2

Test	Gravimetric results mg/filter											
	Laboratory 1			Laboratory 2			Laboratory 3			Laboratory 4		
	1	2,20	1,50	1,30	1,46	1,49	1,43	1,27	1,40	2,70	3,00	2,40
2	2,10	1,60	1,50	1,44	2,08	1,83	1,24	1,62	2,20	2,50	2,80	
3	1,40	1,20	1,50	1,30	1,10	1,50	1,40	1,19	2,20	3,70	2,50	
4	1,40	1,50	1,00	1,55	1,64	1,37	1,45	1,35	2,20	2,70	2,50	
5	1,70	1,30	1,15	1,20	1,97	1,51	1,06	1,60	2,90	2,10	2,60	
6	2,20	1,60	1,50	1,31	1,78	1,08	1,07	1,43	2,10	2,50	2,30	
7	1,60	1,50	1,15	1,40	1,66	1,44	1,02	1,47	3,50	2,90	2,00	
8	1,70	1,30	1,30	1,42	1,18	1,41	1,19	1,45	2,30	2,80	2,50	
9	1,40	1,40	1,50	1,09	1,60	1,03	0,83	0,99	3,00	2,10	2,00	
10	1,30	1,35	1,20	1,75	1,37	1,37	0,86	1,29	2,60	2,70	2,30	
Average	1,70	1,42	1,31	1,40	1,60	1,40	1,14	1,38	2,57	2,70	2,39	
<i>s</i>	0,35	0,14	0,18	0,18	0,31	0,22	0,21	0,19	0,46	0,46	0,25	
V (%)	20,60	9,60	14,00	12,90	19,40	15,70	18,40	13,65	17,80	17,20	10,50	
Test	Photometric results mg/filter											
	Laboratory 1			Laboratory 2			Laboratory 3			Laboratory 4		
	1	2,60	1,34	1,38	1,75	1,74	1,67	1,44	1,74	3,20	2,82	3,09
2	2,40	1,52	1,58	1,66	2,08	2,01	1,38	2,11	2,55	2,58	4,19	
3	1,30	1,05	1,57	1,53	1,26	1,65	1,58	1,53	2,19	3,13	3,24	
4	1,50	1,54	1,07	1,77	1,88	1,57	1,85	1,66	3,15	3,44	2,95	
5	2,00	1,37	1,20	1,47	2,07	1,78	1,35	1,72	3,71	2,38	3,13	
6	2,15	1,54	1,52	1,73	1,93	1,40	1,26	1,79	3,24	2,40	3,05	
7	1,60	1,85	1,23	1,63	1,82	1,80	1,29	1,74	3,23	3,53	2,47	
8	1,95	1,48	1,39	1,49	1,40	1,67	1,41	1,82	2,67	3,59	3,04	
9	1,45	1,52	1,52	1,30	1,73	1,06	1,23	1,23	3,42	2,74	2,55	
10	1,52	1,50	1,24	1,63	1,56	1,19	1,09	1,56	3,58	2,43	2,70	
Average	1,84	1,46	1,37	1,59	1,75	1,58	1,39	1,69	3,09	2,91	3,04	
<i>s</i>	0,43	0,18	0,18	0,15	0,27	0,29	0,21	0,23	0,48	0,48	0,48	
V (%)	23,60	12,40	12,90	9,40	15,40	18,40	15,10	13,46	15,50	16,60	15,70	

Table A.3 — Dusting behaviour of dyestuff 3

Test	Gravimetric results mg/filter																																																																																																																						
	Laboratory 1			Laboratory 2			Laboratory 3			Laboratory 4																																																																																																													
	1	1,45	1,70	0,80	0,56	0,96	1,04	1,43	0,80	4,70	2,40	2,20	2	2,10	1,85	1,15	0,82	0,86	1,51	1,39	1,00	1,90	1,70	4,20	3	1,10	0,85	0,80	0,71	1,06	1,31	1,29	1,00	1,80	2,30	1,80	4	1,40	1,20	1,80	0,80	1,19	2,09	1,57	0,80	2,00	1,40	2,70	5	1,40	0,90	1,40	0,57	1,18	1,30	1,67	1,40	3,00	3,70	1,70	6	1,35	1,10	0,85	1,06	1,02	1,23	1,77	1,10	2,70	4,30	2,20	7	1,60	1,50	1,00	0,73	0,69	1,99	1,96	0,60	1,70	1,90	1,20	8	1,80	1,95	1,20	1,25	1,00	0,84	1,36	1,90	2,70	1,90	2,70	9	1,40	1,30	0,95	0,52	0,79	2,49	1,66	1,40	1,90	2,40	1,80	10	1,10	1,85	1,80	0,85	0,83	1,21	1,71	0,60	2,20	2,80
Average	1,47	1,42	1,17	0,79	0,96	1,50	1,58	1,00	2,46	2,48	2,32	<i>s</i>	0,30	0,41	0,38	0,23	0,16	0,52	0,21	0,41	0,90	0,91	0,38	V (%)	20,60	28,70	32,50	29,10	16,70	34,70	13,30	38,57	36,72	36,60	35,70																																																																																				
Test	Photometric results mg/filter																																																																																																																						
	Laboratory 1			Laboratory 2			Laboratory 3			Laboratory 4																																																																																																													
	1	0,95	1,65	0,66	0,45	0,88	0,78	1,34	0,80	3,88	2,31	1,96	2	1,65	1,76	1,03	0,74	0,77	1,12	1,27	0,82	2,04	1,52	3,59	3	0,87	0,84	0,69	0,65	0,91	0,89	1,23	0,89	1,65	2,04	1,64	4	1,15	1,11	1,65	0,74	1,08	1,58	1,44	0,81	1,51	1,82	2,53	5	1,15	0,83	1,36	0,49	1,12	1,02	1,51	1,43	3,05	3,20	1,60	6	1,45	1,07	0,80	0,93	0,91	0,87	1,64	1,23	1,88	3,76	1,86	7	1,42	1,47	0,88	0,61	0,69	1,74	1,75	0,75	1,49	1,89	1,24	8	1,50	1,83	1,05	1,01	0,85	0,91	1,12	1,69	2,13	1,77	2,22	9	1,15	1,26	0,80	0,44	0,78	2,03	1,58	1,36	2,03	2,21	1,84	10	0,78	1,76	1,52	0,72	0,78	0,83	1,56	0,63	2,02	2,50
Average	1,19	1,36	1,14	0,68	0,87	1,18	1,44	1,04	2,17	2,30	2,06	<i>s</i>	0,29	0,38	0,36	0,19	0,14	0,44	0,20	0,36	0,75	0,69	0,65	V (%)	24,40	28,40	31,90	27,90	16,10	37,30	13,90	34,32	34,50	30,20	31,30																																																																																				

Table A.4 — Dusting behaviour — Sample prepared without a sample divider

Test	Gravimetric result mg	Photometric result/drop mg	Visual result Grey scale rating
1	1,8	1,8	1,5
2	1,9	2,0	1,5
3	1,9	2,0	1,5
4	1,3	1,4	2,0
5	1,7	1,9	1,5
6	1,9	2,3	1,5
7	1,6	1,6	1,5
8	1,9	1,9	1,5
Average	1,75	1,86	1,56
<i>s</i>	0,20	0,25	0,17
<i>V</i> (%)	11,43	13,44	

Table A.5 — Dusting behaviour — Sample prepared with a sample divider

Test	Gravimetric result mg	Photometric result/drop mg	Visual result Grey scale rating
1	1,8	2,1	1,5
2	1,7	2,0	1,5
3	1,3	1,8	2,0
4	1,8	1,9	1,5
5	1,6	2,0	1,5
6	1,7	1,9	1,5
7	1,5	1,8	1,5
8	1,6	1,8	1,5
Average	1,63	1,91	1,56
<i>s</i>	0,16	0,11	0,17
<i>V</i> (%)	9,82	5,76	

Annex B

(informative)

Bibliography

- [1] Bestimmung der relativen Farbstärke in Lösung. *Melliand Textilberichte*, **67**, 1986, pp. 499-502.
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