INSTITUTE FOR TEXTILE AND
PROCESS ENGINEERING
DENKENDORF
of the GERMAN INSTITUTES FOR
TEXTILE AND FIBRE RESEARCH

TEST REPORT No. E-0061-TT-07

Technical Textiles Test Laboratory

Laboratory Director: Dipl.-Ing. (FH) J. Mavely

Test laboratory accredited by the DAP Deutsches Akkreditierungssystem Prüfwesen GmbH in accordance with DIN EN ISO/IEC 17025 : 2005.
The accreditation applies to the test methods specified in the certificate (indicated in the test report with *)

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Client:	**Order data:**	
Walter Krause GmbH	Your order dated:	02.03.2007
Mr Jürgen Krause	Test specimen received on:	15.02.2007
Karlstr. 7	Date of test:	21 – 22.03.2007
74399 Walheim	Your Order No.	----

Terms of reference:

Determination of the filter effect of a fabric on wood pellet dust

Specimen(s) received:

Specimen designation	**Description of the specimen**
A. Fabric quality # 030 N	White fabric with grey diamond
C. Wood pellet dust	Fine dust, beige

Performance and Results of the Test

1. Test methods / test standards applied

1.1 Determination of the degree of fraction separation of filter media
(by analogy with VDI 3926)*

2. Sampling and performance of the test

The laboratory specimens are selected by the Client.

2.1 Determination of the degree of fraction separation of filter media

The filter test stand described in VDI Guideline 3926 is used for the examination. It consists essentially of a vertically arranged tube with a specimen holder to hold the measurement specimen in its wall. At the upper inlet end of the tube is a particulate metering device, at the outlet end is a pump with which the raw gas main flow is drawn through the tube. A second suction pump draws off a raw gas partial flow through the measurement specimen (measurement gas flow). The inflow velocity and the filter surface load are determined from the volume of the measurement gas flow and the measurement specimen surface area.

The measurement specimen plane lies parallel to the raw gas main flow. The measurement gas flow is thus drawn through the measurement specimen perpendicularly to the raw gas main flow and leaves the filter test stand as a clean gas. Raw gas main flow and measurement gas flow can be regulated independently of one another.

A given particle concentration is set in the raw gas using the particulate metering device. The particulate concentration on the raw gas and clean gas sides is measured in parallel using a stray light meter and from this a value is calculated for the degree of separation in relation to the test duration and the particulate size.

The degree of separation is defined as

$$1 - \frac{\text{Clean gas particulate concentration}}{\text{Raw gas particulate concentration}}$$

for each measured particulate size. We then refer here to the degree of fraction separation. The higher the degree of separation, the better the filtration effect of the textile.

Particulate type, particulate size distribution, particulate concentration in the raw gas and the inflow velocity can be selected as desired, but have a significant influence on the result of the measurement. Since fabrics act as surface filters, the test duration cannot be freely varied. It must be at least long enough to allow a filter cake to build up. A high raw gas concentration and longer test duration improve the filtration effect, since a filter cake builds up relatively quickly.

Test conditions

1. Measurement with a filter surface load of 90 m^3/m^2h

During the 1st measurement it was assumed that the silo is empty and the whole fabric surface area is available as a filter surface area. This corresponds to a low filter surface load of 90 m^3/m^2h:

Measurement specimen surface area:	310 cm²
Test particulate:	wood pellet dust
Raw gas concentration:	5 g/m³
Inflow velocity:	2.5 cm/s
Particulate measuring system:	Welas 2000, manufacturer Palas
Test duration:	30 minutes, with the particulate concentration in the clean gas and raw gas being measured after 6, 15 and 30 minutes
Measurement time for the respective particulate concentrations	2 minutes
Number of measurement specimens	2
Exposed filter side:	underside

2. Measurement with a filter surface load of 1800 m³/m²h

During the 2nd measurement it was assumed that the filter surface area is reduced with increasing silo filling, and hence the filter surface load is increased. For this measurement it was 1800 m³/m²h, 20 times that of the first measurement.

Measurement specimen surface area:	15.5 cm²
Test particulate:	wood pellet dust
Raw gas concentration:	5 g/m³
Inflow velocity:	50 cm/s
Particulate measuring system:	Welas 2000, manufacturer Palas
Test duration:	30 minutes, with the particulate concentration in the clean gas and raw gas being measured after 6, 15 and 30 minutes
Measurement time for the respective particulate concentrations	2 minutes
Number of measurement specimens	2
Exposed filter side:	underside

3. Test results

The results of the tests of the degree of fraction separation of wood pellet dust are summarised in the table below. The table contains the values for the total retention capacity for all particulates > 0.3 µm after 6, 15 and 30 minutes test duration and for all particulates > 5.0 µm after 6, 15 and 30 minutes test duration.

Feature	Test conditions	Value	Unit	Fabric # 30N	
Filter surface load				**90 m³/m²h**	**1800 m³/m²h**
Degree of separation with wood pellet dust (5 g/m³)	> 0.3 µm/6 min.	x_1/x_2		0.9690 / 0.9759	0.9964 / 0.9973
	> 5.0 µm/6 min.	x_1/x_2		0.9998 / 0.9971	0.9997 / 0.9998
	> 0.3 µm/15 min.	x_1/x_2		0.9888 / 0.9893	0.9982 / 0.9990
	> 5.0 µm/15 min.	x_1/x_2		0.9999 / 1.0000	1.0000 / 1.0000
	> 0.3 µm/15 min.	x_1/x_2		0.9964 / 0.9999	0.9995 / 0.9995
	> 5.0 µm/15 min.	x_1/x_2		1.0000 / 1.0000	1.0000 / 1.0000

A degree of separation of 0.9888 corresponds to a filtration efficiency of 98.88%.

The results of the tests of the degree of fraction separation of wood pellet dust are also contained in the diagrams attached to this report. The degree of separation is shown for each measurement specimen as a function of the particulate size and test duration. In addition, the individual frequency of the particulates in the raw gas is plotted in each diagram.

4. Test results

At the beginning of the silo filling, the whole fabric surface area of the silo is available as a filter surface area. At this point 97% of all particulates > 0.3 µm are already retained by the fabric #030N. The exposure of the fabric to wood pellet dust causes the pores to be closed by the trapped dust during the course of the silo filling and a “filter cake” forms. With increasing thickness of the filter cake, the filtration effect of the fabric improves, i.e. after 30 minutes more than 99% of all particulates > 0.3 µm are retained. At the same time, the free filter surface area is reduced with increasing silo filling, accelerating the filter cake formation and further improving the filtration effect. If we assume a filling time of approx. 30 minutes, the filter achieves a filtration of efficiency of 99.95% towards the end of the silo filling.

In view of the different applications and demands, no limit values for the filtration efficiency are set for the field of process gas dedusting. On the other hand, “filter classes” exist for room air filter materials. The highest demands are made on high-efficiency particulate air (HEPA) filters for the separation of small particles (< 1.0 µm). HEPA filters of Class 11 are used, for example, as air filters for clean rooms in pharmaceuticals, optics and electronics production. A degree of separation of 95% is demanded here.

With a degree of separation of 97%, the fabric #030N achieves a very good filtration effect right from the beginning of the initial filling. It can be expected that part of the filter cake remains on the fabric even when the silo is emptied, so that even better filtration conditions can be assumed with each further filling. Very low emissions are therefore to be expected during the filling of the silo.

Denkendorf, 25.05.2007

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(Laboratory Director)	(Clerk)

Annex: 4 diagrams

Notes:

Legende zu den Anhängen

Auftraggeber	Client
Auftragsnummer	Order No.
Probenbezeichnung	Specimen designation
Zeitabhängiger Trenngrad von Barriere-Textilien	Degree of separation over time of barrier textile
Teststaub	Test dust
Holzpellet-Staub	Wood pellet dust
Rohgaskonzentration	Raw gas concentration
Anströmgeschwindigkeit	Inflow velocity
Trenngrad	Degree of separation
Partikeldurchmesser	Particulate diameter
Einzelhäufigkeit von Partikeln im Rohgas	Individual frequency of particles in raw gas