GLOBAL
ACETATE
MANUFACTURERS'
ASSOCIATION

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CAPABILITY LINE FOR ACETATE TOW - RECOMMENDATIONS FOR BEST PRACTICE

INTRODUCTION

In this document, the Global Acetate Manufacturer's Association provides guidelines for the preparation of a capability line. In the qualification process, the capability line (sometimes also referred to as the "capability curve") is an important tool for the performance characterization of a particular acetate tow specification.

Two methods are used in the industry:

- "Dry" capability line - without the use of a plasticizer
- "Wet" capability line - with the use of a plasticizer in the intended concentration

The "dry" version has the benefit of simplicity and of eliminating the possibility of error due to inaccurate plasticizer measurement, while the "wet" version provides results comparable to the finished products, a lower tendency of recessed ends at the minimum operation point and less pressure drop variation. Because of these differences, it is important to indicate the test basis used i.e. "Dry" or "Wet" when discussing test results. As both methods have their specific advantages with slightly different intentions, both methods will be described.

In addition, options are described for determining the rod weight at ambient, plug room conditions or for equilibrating the rods to standard conditioning before weighing.

This information is provided by manufacturers of Cellulose Acetate Filter Tow and is based on best practices known to the industry*. For more information on GAMA and its members please visit the GAMA website on:

http://www.acetateweb.com/membership.htm

* *Although the information presented here is presented in good faith and is believed to be correct, neither GAMA, the GAMA Members, nor those acting on behalf of GAMA or its Members (such as their employees, officers or directors) make any representations or warranties as to its completeness or accuracy.*

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CONTENT

1 TERMS AND DEFINITION

Capability Line	linear equation (or as curve)	Plot of the relation between pressure drop and acetate weight for a defined rod dimension (length, diameter) and tow specification
Pressure drop (PD) or Resistance to Draw (RTD)	[mm WG]	Fully encapsulated resistance to draw typically expressed in mm Water Gauge [CORESTA Recommended Method No. 41]
Effective diameter	[mm]	Diameter [mm] – 2.x.paper thickness[µm]
Acetate weight	[mg per rod]	Weight of the tow only (without plasticizer, paper and glue)
Operational points - minimum - maximum: - range	[mm WG]	 Defined as the point where filter rod recess is 1mm. Beginning of : - high variations of diameter (coefficient of variations (CoV): >0,35%) - unstable tow delivery - opening of the rod seam - wrapping of tow on delivery rollers The robust performance range for processing the tow with reasonable variations; usually in the range of approximately 20 to 80% of the capability line
Plasticizer content	[mg per rod]	- Usually triacetin; - expressed as weight per rod *

The plasticizer content is often expressed as a ratio [%] which can cause some misunderstanding due to different possible bases for this ratio i.e. plasticizer weight as percent of total tow only or as percent of total gross weight of the rod.

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2. PREPARATORY STEPS

- Bales should be conditioned to the environment of the production room (particularly its temperature) before opening the packaging.
- Rods should be prepared without an anchor line to allow a more accurate determination of the weight of the plug wrap with seam glue.
- The determination of three or four operational points should be planned. These points include the minimum and maximum operational points as well as one or two points in between.

3 PROCEDURE

3.1 General

- Set up the plugmaker for the desired rod length and circumference.
- Start up the plugmaker with the desired tow item.
- Ensure that the tow is processing optimally at a speed close to the middle of the expected capability range:
    - Set banding air to spread tow band properly.
    - Adjust tow processing unit to obtain good bloom and good relaxation.
- Operate the rod maker at least for 5 minutes at the processing conditions and speed.
- After 5 minutes, check the processing unit adjustments to ensure proper bloom and relaxation.
- Adjust diameter to within +/- 0.02mm of the target (circumference +/-0.06mm).
- If a 'Wet' capability line is being collected, ensure that the plasticizer application is at the target level.
- If a 'Dry' capability line is being collected, ensure that the plasticizer applicator is turned off.
- Operate the plugmaker at this stable condition for at least two minutes.

3.2 Minimum Operational Point

- Slowly reduce the transport jet air pressure and the tow delivery speed until the minimum point is achieved (1 mm recess).
- Ensure that the diameter is within +/- 0.02 mm of target (circumference +/- 0.06mm).
- Collect 30 rods randomly over the period of one minute as described in section 3.5.

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3.3 Maximum Operational Point

- Slowly increase the transport jet air pressure and tow delivery speed until stable rod production is no longer possible (see criteria for Maximum Point under Section 1).
- Ensure that the diameter is within +/- 0.02 mm of target (circumference +/- 0.06mm).
- Collect 30 rods randomly over the period of one minute as described in section 3.5.

3.4 Intermediate Operational Point(s)

- Reduce the transport jet air pressure and slowly reduce the tow delivery speed to achieve one or more intermediate operation points. These may include a Mid Point about half way between the Minimum and Maximum point tow delivery speeds and/or some known PD target point for the given tow item application.
- Ensure that the diameter is within +/- 0.02 mm of target (circumference +/- 0.06mm).
- Collect 30 rods randomly over the period of one minute as described in section 3.5.

3.5 Rod Collection - At each capability point, collect rods as follows:

- Collect 30 rods randomly over the period of one minute.
- If the non-conditioned tow weight is desired, weigh the rods as a group within 10 minutes of collection (see comments under section 3.6 regarding Weight of Rods).
- Hold the rods under standard laboratory conditions for later testing.
- If the *Wet Method* is being followed:
    - Turn off the plasticizer applicator unit and continue to run the plugmaker for 2 minutes to ensure there is no residual plasticizer in the rods.
    - Collect a second set of 30 dry rods randomly over the period of one minute.
    - Weigh the rods as a group within 10 minutes of collection.
    - Hold the rods under standard lab conditions for later testing.
    - Turn on the plasticizer once again before moving on to the next operational point.

3.6 Analyses

Conditioning

For the determination of pressure drop and circumference it is recommended that the rods be conditioned for a minimum of 24 hours at 22°C and 60%rH, according to CORESTA Recommended Method No. 21.

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Paper and glue

Determine the weight of paper and glue from at least 10 rods after carefully removing the fibers.

Different thicknesses of the paper (as for porous and non porous plugwraps) have an impact on the effective diameter. Therefore knowledge of the paper thickness is important.

Weight of rods

There are two ways to measure filter rod weight:

1) Non-Conditioned: Immediate measurement of the filter rods, reflecting the standard working conditions on the work floor taking into account the drying of the tow in the blooming unit depending on the relative humidity of the compressed air. For this reason the weight determination of the rods should be done within 10 minutes after the processing and preferably performed as group weight from at least 30 rods. It is suggested to store the rods covered to avoid fast conditioning.
2) Conditioned: Fully conditioned measurement after 24hours.

- When reporting results, it must be noted whether the rod weights are based on conditioned or non-conditioned filter rods, as the methods can lead to a different tow weights (up to a 1% increase for conditioned rods).
- “Semi”-conditioned measurement is not recommended due to a reduced reproducibility.

Pressure drop (PD) and Diameter (D)

At least 30 rods are used for the determination of pressure drop and circumference mean and standard deviations values.

The diameter of the rods might change during the storage depending on the plugwrap used. Therefore the determination of all physical parameters should be performed within the same day as each other.

Plasticizer level (in case of the "wet capability line")

The content of plasticizer is determined from the difference of group weights between "wet" and "dry" filter rods.

4 CALCULATION AND PRESENTATION

4.1 "Dry" Capability Line (without plasticizer)

For each operational point following data are needed for the reporting and calculation

- Rod weight dry m_{rod}
- Acetate weight: $m_{rod} - m_{paper+glue}$
- Diameter: D_{mean}
- Pressure drop: PD_{mean}
- PD_{corr} (corrected PD): $= PD_{mean} \times (D_{mean}/D_{target})^{5,8}$

The corrected PD (corrected to the target diameter) and the acetate weight of the rod are used in the graph, which can be displayed linearly or in a curve.

4.2 "Wet" Capability Line (with plasticizer)

For each operational point the following data are needed for the reporting and calculation

- Rod weight dry (m_{dry}) and "wet" (m_{wet})
- Plasticizer amount per rod [mg per rod]: $m_{wet} - m_{dry}$
- Acetate weight: $m_{dry} - m_{paper+glue}$
- Diameter from "wet" rods: D_{mean}
- PD from "wet rods: PD_{mean}
- PD_{corr} (corrected PD): $= PD_{meas} \times (D_{meas}/D_{target})^{5,8}$

The corrected PD (corrected to the target diameter) and the acetate weight of the rod are used in the graph, which can be displayed linearly or in a curve.

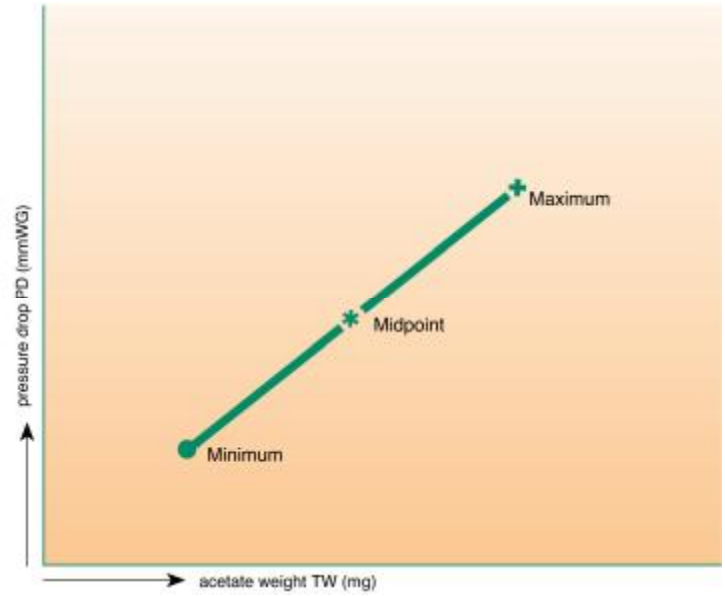

Fig. Capability Line

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5 TOLERANCES / RELIABILITY

The diameter of the rods between the different operating points should be within 0,02 mm of the target diameter (circumference +/-0.06mm).

6 REPORTING

The following information should be covered in the report:

- Tow item
- Dimension of the rods: Length and Diameter, including the measurement method (laser or tape) and the paper type (porosity and thickness)
- Method used: as "dry" only, or "wet"
    - In case of the "wet" method, indicate the type of plasticizer and the amount in mg per rod, and by percentage. (Note that % plasticizer can be expressed in several ways, including plasticizer weight per a) total dry rod weight, or b) total wet rod weight, or c) net tow weight. Therefore, when mentioning the plasticizer as a percent, the basis must be stated).
- Determination of the PD: ambient air conditions, type of instrument, number of rods at each operational point
- Tow weight: conditioned or non-conditioned
- Basis for the maximum point: based on wrapping on rollers, high variation, etc.