

Methods for determination of pulp suspensions drainability

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Abstract: *Methods for determination of pulp suspensions drainability.* This paper presents different apparatus used for measurement of dewatering of fibrous suspensions. Advantages and disadvantages and range of application of each apparatus are listed.

Keywords: dewatering, freeness, drainability, papermaking slurries,

The oldest known method for pulp drainability dates back to 1912 when M. Riegler invented a tester which was popularized by Schopper and now it is commonly known as the Schopper-Riegler apparatus.

The Schopper-Riegler apparatus helps to determine two empirical parameters describing rheological properties of pulp:

- ✓ freeness,
- ✓ drainability.

PULP FREENESS

One of them is freeness. This parameter describes the amount of water from pulp drained to a side cylinder. This parameter is expressed in °SR. The measurement is conducted in accordance with DIN ISO 5267 Part 1.

PULP DRAINABILITY

The other parameter determined in the Schopper-Riegler tester is drainability. The time in which 700 ml of filtrate ran out to the side cylinder is stated as a drainability. A detailed description of drainage test is included in part 2 of the standard dedicated to freeness

Both parameters are widely used by paper industry and nowadays they are used as steering information in automation and quality control systems of a paper machine. The most important advantages of freeness and drainability determination include simplicity of test procedure and short time needed to have a final result. The determination of pulp freeness is used as a parameter showing progress in refining process.

To optimize paper web consolidation, machine runnability and paper quality, it is necessary to test pulp drainability more accurately. For this reason other drainage testers were constructed:

- ♦ modifications of the Schopper-Riegler apparatus – Dynamic Filtration System 02 (DFS-02)
- ♦ Dynamic Drainage Analyzer (DDA)
- ♦ Drainage Freeness Retention (DFR-04)

DYNAMIC FILTRATION SYSTEM

The **modified Schopper-Riegler apparatus** with its trade name of **Dynamic Filtration System** is a significant step to adjust the standard Schopper-Riegler apparatus to determination of drainage kinetics. Numerous modifications were carried out in the apparatus [1,2,3,4]:

- ✓ Scales for gravimetric determination of drainage process were installed
- ✓ Possibility to impose shearing forces by means of a stirrer attached to a sealing cone
- ✓ Automatized data processing

The apparatus is used only to determine pulp drainage time. Due to modifications it is impossible to determine pulp freeness with this apparatus. The method how to prepare a sample is the same as in case of the standard Schopper-Riegler tester.

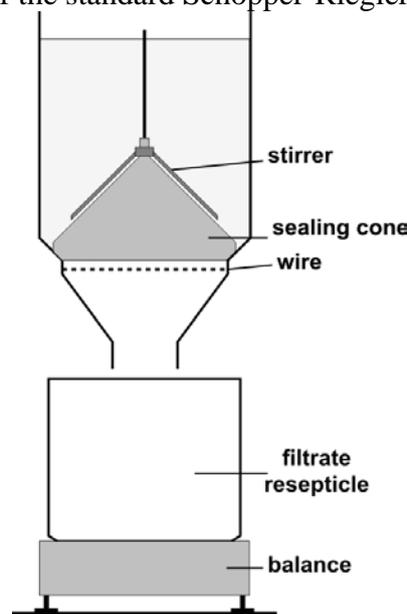


Fig. 1. Schematic illustration of Dynamic Filtration System 02

In the DFS-02, drainability measurement is based on gravimetric determination of water quantity removed from pulp in time. The results are read on the scales and they are collected and processed by the computer system. The final effect of drainability measurement is a curve reflecting the amount of water removed in time and determination of time at which 700 ml of water were removed. This time is also used as a parameter defining filtration properties of pulp.

Despite some modifications facilitating measurements, the modified Schopper-Riegler tester allows to obtain results which are empirical values.

DYNAMIC DRAINAGE ANALYZER (DDA)

The Dynamic Drainage Analyzer (DDA) is a more advanced design of the common retention meter Dynamic Drainage Jar (DDJ) [5,6]. The DDA has a developed function enabling an assessment of pulp drainability. Retention, drainability and freeness can be tested within one measurement.

Basic design elements of the Dynamic Drainage Analyzer include a container, stirrer with motor and wire (Fig 5 – 8). Additionally it is possible to connect vacuum under the wire (in the range from 0.02 to 0,04 MPa). The DDA's control and service is fully computerized.

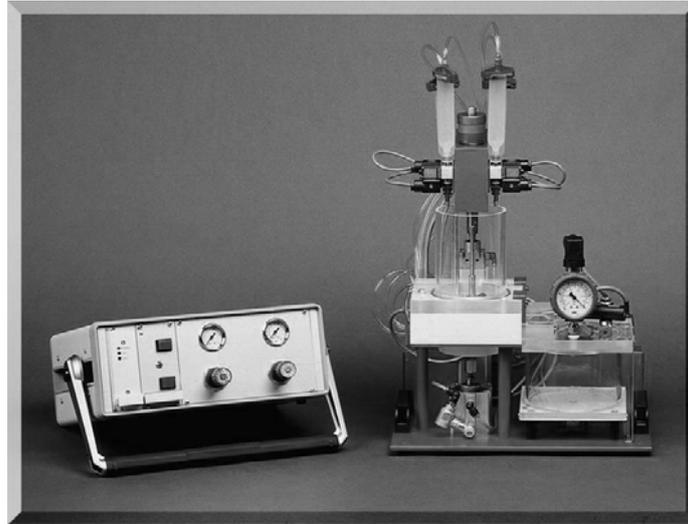


Fig. 2. Dynamic Drainage Analyzer

It should be noted that the results obtained are very vulnerable to the measurement conditions such as volume of prepared sample of fibrous suspension, its consistency, stirring time and others. Unfortunately any standard defining standard testing conditions does not exist. Therefore the conditions should be defined for each measurement individually.

DRAINAGE FREENESS RETENTION (DFR)

The Drainage Freeness Retention (DFR-04) is a completely automated apparatus enabling an assessment of the retention, drainage and refining degree of pulp. As regards the measurement method, the DFR design reminds the standard Schopper-Riegler tester. The DFR 04 is equipped with a mixer with a cone which closes the chamber from the bottom. It also has a built-in stirrer enabling to stir fibrous suspension before conducting an assessment [4].

When measuring pulp drainability, the Drainage Freeness Retention 04 makes the same systematic error as the modified Schopper-Riegler tester (DFS-02). The results obtained by the DFR-04 are much closer to an actual curve of drainage kinetics, as the diameter of the outflow from the funnel is higher and there is no pipe removing the liquid to the cylinder as in case of the modified Schopper-Riegler apparatus. However, despite this fact, it cannot be assumed that the obtained drainage curve is identical with the curve of the drainage kinetics. Therefore, similarly to the testers discussed, the obtained value of drainage time is only an empirical value.

Another disadvantage of the Drainage Freeness Retention 04 is the fact that it does not enable the dryness measurement of a filtrating cake.

COMPARISON BETWEEN PULP DRAINAGE TESTERS

All the pulp drainage testers discussed are designed to determine the empirical values – from freeness to drainage times defined by means of different methods. These parameters enable a comparison of pulp filtration properties, however they do not allow to have deeper analyses of the filtration process.

Additionally, none of the meters presented here does not allow to obtain the actual curve of the drainage kinetics and simultaneous measurement of the filtration cake dryness. The characteristics of all the meters discussed are listed in (Tab. 1).

Apparatus	Parameter	Drainage kinetics	Dryness of filtration cake
Schoppera-Riegler	freeness drainability	no	no
DFS-02	drainability dewatering curve	yes	no
DDA	drainability	no	yes
DFR-04	drainability dewatering curve	yes	no

Tab. 1. Characteristics of pulp drainage testers

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Streszczenie: „Porównanie metod oceny odwadnialności papierniczych zawiesin włóknistych”. Artykuł przedstawia zestawienie stosowanych metod pomiaru odwadnialności zawiesin włóknistych. Zawarto w nim informacje dotyczące zakresu stosowania poszczególnych urządzeń oraz ich zalet i wad.

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