Laboratory screening of pulp
(MasterScreen-type instrument)
(Reaffirmation of T 274 sp-08)
(no changes from Draft 1)

1.  Scope

1.1  A general purpose practice for screening pulp using a specific screening device is described, which separates from a slurry of pulp fibers a contaminant fraction with size dimensions which are significantly greater than the diameter of a pulp fiber.

1.2  Separated contaminants include, but are not limited to, shives in virgin fibers, or macro stickies that are captured by the barrier screen plate, scleroids, dirt, stone cells, plastics, pitch, white pitch, and other contaminants in virgin and recycled fibers.

1.3  There are numerous screening instruments used for separation, classification, or quantitation of contaminants from pulp fibers, including T 278 “Pulp Screening (Valley-Type Screening Device)” and T 275 “Screening of Pulp (Sommerville-Type Equipment).” This procedure covers a specific screening procedure to concentrate contaminants by fiber removal, and does not cover use of screens for pulp size classification.
1.4 While this practice does not describe the specific procedure required to quantitatively measure the contaminant fraction separated, it should be noted that where this is done by the user of this practice, slightly different quantitative results may be found among or between results calculated using the device described in this Practice and the various devices in 1.3.

2. Significance

2.1 The qualitative and quantitative measurement of the contaminants in a pulp may be used to indicate the manner of production of the pulp and the effectiveness of the processes used to decontaminate the pulp.

2.2 Measuring the characteristic and nature of the contaminants in any pulp is fundamental to the control and reduction and elimination of its contaminant content.

2.3 Before measurement of the quantity or assessing quality of the contaminants present in a pulp may be achieved, the contaminants must be separated from the fibers. So, separation of contaminants from fiber is an significant step in evaluation and improvement of the pulping process and measurement of the quality of the resulting pulp.

3. Apparatus

3.1 The central features of the MasterScreen-type instrument are as follows:

3.1.1 Cylindrical screening chamber, 8 in. in diameter and 1 in. thick, and containing baffles and a mixing bar, which, in combination with the volume and design of the chamber, ensure that all fibers when in the screening chamber, are maintained in a dispersed state.

3.1.2 Cylindrical screening chamber front plate, a removable plate forming the front of the screening chamber

3.1.3 Cylindrical screening chamber back plate, a metal plate with slits of specified dimensions forming the back of the cylindrical screening chamber.

3.1.3.1 Screen plates in 3.1.3 may be used having slit sizes in the range from 0.075 mm to 0.375 mm (0.003 to 0.015 in.) in width. The total length of all the slits on a screen is 3556 mm (140 in.).

3.1.3.2 For a specified (nominal) slit width, the repeatability between screen plates (the ability of two different screen plates with the same specified (nominal) slit size to yield the same retention value when processing the same pulp) depends on the actual distribution of slit sizes. For use in compliance with this practice, the slit width average must be within 0.005mm (0.0002 in.) of the specified (nominal) value e.g. an 0.015mm (0.006 in.) slit size screen plate will have an actual average slit width in the range 0.0145 to 0.0155mm (0.0058 in. to 0.0062 in.), and a single slit may not be more than 0.015mm (0.0006 in.) from that actual average value.

3.1.4 The screening chamber is fitted into an apparatus which automatically controls the rate of delivery of pulp slurry into the screening chamber from the top feed tank through the top feed tube, allows an appropriate period for fiber-contaminant separation to proceed to completion within the chamber, and then flushes out all contaminants from the

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1Names of suppliers of testing equipment and materials for this method may be found on the Test Equipment Suppliers list, available as part of the CD or printed set of Standards, or on the TAPPI website general Standards page.
screening chamber at the end of the cycle to either collect contaminants for weighing or display.

3.1.5 *Hydrotor*, a device which produces a high frequency, pulsed reverse flow of water through the screen plate slits.

3.1.6 *Top entry tube*, a tube connecting the top of the cylindrical screening chamber to a top feed tank, and allowing pulp slurry to enter the cylindrical screening chamber.

3.1.7 *Top feed tank*, the reservoir holding the slurry of pulp which is to be screened

3.1.8 *Bottom entry tube*, a tube connected to the bottom of the cylindrical screening chamber used for the addition of dilution water.

3.2 Additional laboratory equipment as follows:

3.2.1 *Disintegration equipment*, as specified in T 205.

3.2.2 *Portable electrically driven laboratory stirrer*, for sample agitation.

3.2.3 *Container (plastic bucket or similar)*, to contain the dilute pulp slurry during agitation.

3.2.4 *Dipper (convenient type and style)*, for removing aliquot portions of slurry for testing.

3.2.5 *Balance*, accurate to 0.01 grams, for determining pulp dry weight.

3.2.6 *Oven*, controlled to 105º ± 3ºC

3.2.7 *Filter paper*, qualitative fast flowing, for use with the screening device and the Büchner funnel, if used.

3.2.8 *Graduated cylinder*, as required for pulp dilution.

3.2.9 *Büchner funnel and flask*. Convenient size, for further treatment of contaminant fraction, if desired.

3.2.10 *Balance*, accurate to ± 0.0002g, for determining contaminant weights.

4. **Sampling**

4.1 Sample the lot or process in a manner that will ensure that a representative random sample has been taken.

4.2 The sample size will vary depending upon the level of contaminants present. The test specimen required for screening may be as small as 2 grams or less, or as large as 100 grams or more, depending upon the level of contaminants present.

4.3 Special care must be taken in the sampling of pulp slurries, because of the highly non-uniform distribution of contaminants therein.

4.4 For a properly sampled pulp or pulp slurry, the combination of low consistency, intensive agitation and sampling of aliquot portions (see section 5) will minimize the impact of non-uniformity of contaminant distribution, and allow multiple test repeatability of contaminant retention from the same source pulp to be ± 5%. 
5. **Preparation of a specimen for screening**

5.1 If the pulp is not already in the form of a pulp slurry follow the procedures in T 205 for presoaking and disintegration to form the pulp slurry.

5.2 Dilute the entire sample (pulp slurry) or a representative aliquot of it to a consistency of 1.0% or less with water.

5.3 Agitate the slurry using a portable electric laboratory stirrer to maintain uniform consistency within the dilute slurry without changing the nature of the contaminants.

5.4 Remove the required total volume of pulp for delivery to the screening device in a series of aliquot portions from the agitated slurry sample in 5.3.

5.4.1 The required total volume of pulp slurry for delivery to the screening device will depend upon the nature of the pulp (e.g. softwood, hardwood, groundwood, TMP, recycled office waste, recycled OCC, etc.), the slit size of the screen plate employed, the level of contaminants in the pulp, and the screening cycle selected (section 3.2) which determines the rate of screening and hence the overall test time. The volume (and thus weight) of the stock screened is adjusted so a significant, but not excessive, amount of contaminants is collected.

5.4.1.1 For example, if one wishes to collect 0.010 grams of contaminants from a pulp known to contain 0.1% contaminants, 10 grams of pulp would be required. At a 1.0% consistency, the volume required in 5.4.1 would be 1 liter. If the consistency was reduced, the volume screened would need to be increased proportionately.

5.4.1.2 Based on these considerations an amount of pulp used in testing a given lot could vary from 2 grams or less to 100 grams or more.

5.4.1.3 Likewise, the volume of slurry tested may vary over a wide range, however, the consistency must be diluted to less than 1.0% prior to charging the instrument.

5.4.1.4 The practical maximum capacity of the screening device’s top feed tank (3.1.6) is approximately 15 liters. For slurries where a volume greater than 15 liters must be screened to comply with that predicted by calculations such as those in the example in 5.4.1.1, the volume taken in 5.4.1.2 must be divided into two (or more) portions.

6. **Preparation of instrument**

6.1 Standard operating conditions during screening for any particular application is an empirical process which includes the dry weight and consistency of the pulp screened as described in section 5, as well as choice of the appropriate screen plate slit size to use and the “on/off” control water cycle of the instrument.

6.2 Recommended screen plate slot sizes for a given material are as follows:

6.2.1 Virgin Kraft softwood; 0.0150mm (0.006 in.).

6.2.2 Virgin Kraft hardwood; 0.0150mm or 0.0100mm (0.006 in. or 0.004 in.).

6.2.3 Virgin mechanical pulps; 0.0150mm, 0.0100mm, or 0.0075mm (0.006 in., 0.004 in., or 0.003 in.).

6.2.4 Recycled pulps; 0.0150mm (0.006 in.).

6.2.5 Particle board pulps; 0.0200mm or 0.0250mm (0.008 in. or 0.010 in.).
6.3 A second possible variable is the timing sequence during screening whereby on some instruments the control water “on/off” cycle can be varied.

6.3.1 The optimum screening cycle selected depends on the amount and consistency of the pulp slurry delivered to the unit, as described in 5.4.1.

6.3.2 Where contaminant levels are relatively high, small total amounts of pulp (i.e. 2 - 20 grams) are adequate to give good precision in respect to retained contaminants, and the fastest screening cycle can be used.

6.3.3 Where contaminant levels are relatively low, larger amounts of pulp (i.e. 25 -100 grams) are required to achieve satisfactory reproducibility of the screening process, and slower screening cycles are required.

6.3.4 In the case where the screening equipment being used does not permit changing the screening cycle, changes in slurry consistency (generally to lower consistencies) may be used to optimize screening.

6.4 If the optimum dry weight of the pulp charge is not known, run a trial test to determine if the quantity of the screened contaminants is adequate for the intended purpose. To adjust the level of contaminants collected, increase or decrease the pulp charge accordingly.

6.5 Upon completion of screening of a sample, always inspect the screen, dilution chamber and bottom collection chamber for cleanliness. The dilution chamber and collection chamber may be wiped with a lint free cloth. The system may also be flushed with water in the absence of a pulp sample. Examine the screen for any evidence of plugged slits.

7. Procedure

7.1 Follow the manufacturer’s instructions to operate the screening apparatus. See Figure 1.

7.2 Contaminants can be filtered, dried and weighed to determine the contaminant content as a percent of the original pulp by weight. Contaminants can also be displayed for further analysis (subjective, optical microscopy, automated image analysis, etc.).

7.3 Where the level of contaminants present will be determined by weight, use one of the following procedures:

7.3.1 When using the collection device, place a piece of laboratory filter paper in the AutoFilter, after first drying the filter paper for one hour at 105°C and determining its tare weight.

7.3.2 When using the collection basket, after completion of screening, place a piece of laboratory filter paper, dried and tared as in 7.3.1, into a Büchner funnel on a vacuum flask. Transfer the contaminants from the basket onto the filter paper, flushing with water as necessary. Apply vacuum to de-water the contaminants.

7.3.4 Dry the collected contaminants on the filter paper for one hour at 105°C. Cool and determine the gross weight of filter paper and contaminants present on a balance accurate to ± 0.0002g. Subtract the tare weight of the filter paper to determine the dry weight of the collected contaminants.
8. **Report**

No report is required for Standard Practices.

![Diagram of screening process](image)

**Fig. 1.** Phases in the screening process.

9. **Precision**

A precision statement is not applicable for Standard Practices.

10. **Keywords**

Pulp, Impurities, Separation, Screening, Stickies, Shives

11. **Additional Information**
Effective date of issue: to be assigned.

Your comments and suggestions on this procedure are earnestly requested and should be sent to the TAPPI Standards Department.