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Standard Test Method for Determination of the Recovery of a Product in a Materials Separation Device[1]

This standard is issued under the fixed designation E1108; the number immediately following the designation indicates the year of original adoption or, in the case of revision, the year of last revision. A number in parentheses indicates the year of last reapproval. A superscript epsilon (ε) indicates an editorial change since the last revision or reapproval.

1. Scope

1.1 This test method covers the determination of the recovery of a desired product in a device processing solid waste for the purpose of concentrating a component of interest. The recovery is determined with respect to the amount of the desired component in one output stream (accepts) as opposed to another output stream (rejects). The results of this calculation determine the effectiveness of component separation when coupled with a measure of product purity as described in Test Method E889.

1.2 The values stated in SI units are to be regarded as standard. No other units of measurement are included in this standard.

1.3 *This standard does not purport to address all of the safety concerns, if any, associated with its use. It is the responsibility of the user of this standard to establish appropriate safety and health practices and determine the applicability of regulatory limitations prior to use.* Specific precautionary information is given in Section 7.

2. Referenced Documents

2.1 *ASTM Standards:*[2]

E889 Test Method for Composition or Purity of a Solid Waste Materials Stream

E1107 Test Method for Measuring the Throughput of Resource-Recovery Unit Operations

3. Terminology

3.1 *Definitions of Terms Specific to This Standard:*

3.1.1 *accepts*—the output stream from the materials separation device that contains the highest concentration (purity) of the component(s) that the device is designed to separate.

3.1.2 *binary separator*—a device that separates a single input feed stream into two output or product streams.

3.1.3 *component*—any identifiable and defined fraction of solid waste.

3.1.4 *feed*—the input stream.

3.1.5 *gross sample*—a sample representing one lot and composed of a number of increments on which neither reduction nor division has been performed.

3.1.6 *laboratory sample (or analysis sample)*—a portion of one gross sample representative of a lot and taken at random from the gross sample.

3.1.7 *polynary separator*—a device that separates a single input feed stream into three or more output product streams.

3.1.8 *purity*—the purity of a stream is defined in terms of one or more identifiable components, *x, y, z*, etc. as separated by hand sorting. The composition for any component such as *x* is the mass of *x* in a stream divided by the total mass of that stream. Purity is expressed as a fraction, decimal fraction or percent.

3.1.9 *recovery*—the fraction (on a percentage basis) of a specific component, *x*, in an input process stream (feed) captured or recovered into an output process stream (accepts). Recovery is calculated as a mass of *x* in the output stream per unit time divided by the mass of *x* in the input stream per the same time, and the fraction is multiplied by 100. Alternatively, the concentration of the component(s) of interest (defined as purity in Test Method E889) are measured in all input and exit streams and used to calculate recovery.

3.1.10 *rejects*—the output stream(s) that have low concentrations of the component(s) of interest.

NOTE 1—In mass per time terms, Feed = Accepts + Rejects for any conservation component if there is no storage term or loss of mass, for example, moisture.

3.1.11 *steady state operation*—a condition in which the materials separator is achieving a constant recovery performance over a given time.

4. Summary of Test Method

4.1 Percent recovery of a component can be calculated either by measuring the throughput of component *x* (mass per

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[2] For referenced ASTM standards, visit the ASTM website, www.astm.org, or contact ASTM Customer Service at service@astm.org. For *Annual Book of ASTM Standards* volume information, refer to the standard's Document Summary page on the ASTM website.

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unit time) in the input (feed) and the throughput of component *x* in the output (accepts) process streams or by measuring the purity of the input and output streams.

4.1.1 The throughputs are measured as described in Test Method E1107.

4.1.2 The purity analyses are described in Test Method E889.

5. Significance and Use

5.1 This test method is used to document the ability of a solid waste resource recovery separator to capture the component(s) of interest in the desired process stream.

5.2 The recovery determined in this way is used in conjunction with the purity of the product, as described in Test Method E889.

6. Precautions

6.1 This procedure calls for the hand-picking of solid waste and its processed fractions. Because the origin of all of the materials is generally unknown, workers must use proper safety precautions when handling samples. Workers shall wear gloves and safety glasses. When appropriate, dust masks shall be worn. Workers must be cautioned to wash their hands thoroughly before eating or smoking.

6.2 Safety precautions must be taken when collecting samples or working near moving equipment.

7. Sampling

7.1 If throughputs are to be measured, samples are taken from input and output process streams, in accordance with procedures included in Test Method E1107.

7.2 For a binary separator, only the input and one output or both output streams are sampled. If only one output stream is sampled, it should be the one in which the component(s) of interest is concentrated (the accept). The output stream is always sampled before the input stream in order not to disturb the steady state operation of the separator.

7.3 For a polynary separator, only the throughput method is used. Input plus the output containing the component(s) of interest are sampled.

7.4 Sampling and containment must be done in a manner to preserve the integrity of the component(s) of interest and the mass of the entire sample.

8. Test Specimens and Samples

8.1 If throughput is to be measured, follow the procedures in Test Method E1107.

8.2 If purity is to be measured, follow the procedures in Test Method E889.

9. Conditioning

9.1 If the throughput method is to be used, follow the procedure in Test Method E1107.

9.2 If the purity method is to be used, follow the procedure in Test Method E889.

10. Procedure

10.1 It is necessary that the separator attain steady state operation before sampling is done. Performing only one recovery analysis does not ensure steady state conditions. The separator must be operating without changes in feed quantity or composition, and without changes in operation mode, for at least 30 min before sampling. The results of a series of recovery determinations will confirm the presence of steady state operation.

10.2 If the throughput method is to be used, follow the procedures in Test Method E1107.

10.2.1 Sample the input stream and the output stream that contains the concentrated fraction of the component(s) of interest.

10.3 If the purity method is to be used, follow the procedures in Test Method E889.

10.3.1 Sample the input stream and both output streams.

11. Calculations

11.1 If throughputs are measured, calculate the percent recovery of a component *x* as follows:

$$\text{Percent recovery of } x = R_x = Q_A \times (100)/Q_F \quad (1)$$

where:

Q_A = the throughput of *x* in the concentrated output stream (accepts) as kg/s, and

Q_F = the throughput of x in the input stream, as kg/s.

11.2 If purity is measured, compute the percent recovery of a component *x* in a binary separator as follows:

$$\text{Percent recovery of } x = R_x = P_A[P_F - P_B] \times (100)/P_F[P_A - P_B] \quad (2)$$

where:

P_F = the purity of the input stream, as mass of *x* in the stream divided by the total mass of the stream,

P_A = the purity of the concentrated output stream (accepts), and

P_B = the purity of the dilute process stream (rejects), with purity expressed as before.

11.3 If a polynary separator is employed, calculate the recovery of *x* in any one output stream as in 11.1.

12. Report

12.1 If throughput is used, calculate the recovery and record on the report form shown as Fig. 1.

12.2 If purity is used, calculate the recovery and record on the report form shown as Fig. 2.

12.2.1 A modified form is needed for polynary separators.

Determination of the Recovery of a Product in a Materials Separation Device

NOTE—This calculation sheet is to be used when recovery is based on throughput.

Throughput of input (feed stream (Q_F)		__________	kg/s
Throughput of concentrated (accepts) output stream(Q_A)		__________	kg/s
Recovery = $\frac{(Q_A \times (100)}{Q_F}$	=	__________	%

FIG. 1 Sample Throughput Report Form

Determination of the Recovery of a Product in a Materials Separation Device

NOTE—This calculation is to be used when recovery is based on purity.

Purity of input (feed) stream (P_F)	______________
Purity of concentrated (accepts) output stream (P_A)	______________
Purity of dilute (rejects) output stream (P_B)[A]	______________

$$\text{Recovery} = \frac{P_A(P_F - P_B) \times (100)}{P_F(P_A - P_B)} = \text{\_\_\_\_\_\_\_\_\_\_\_\_\_\_}\ \%$$

[A]If a polynary separator is employed, the purity of the rejects is a weighed average as described in 12.3.

FIG. 2 Sample Purity Report Form

13. Precision and Bias

13.1 Since recovery is a calculation based on other standard sampling methods, the precision and bias is a function of their standard methods.

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