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NEW ORLEANS
FULL-SCALE TROMMEL EVALUATION:
INTERIM TEST REPORT

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ABSTRACT

This report presents the data from five tests of a full-scale trommel processing unsegregated municipal solid waste at throughputs ranging from 58% to 175% of design capacity, or 32 to 98 Mg/h (36 to 109 tph). The tests were conducted between December 1980 and March 1981 at the Recovery 1 solid waste processing facility in New Orleans, La. Included in the report are a description of the equipment, discussion of the test procedures and primary summaries of data on the trommel mass balance and separation efficiency and on the analysis of infeed and product samples for size, composition, density and moisture. Heat content and ash values of the trommel oversize and recovery results on surrogate aluminum cans and flakes also are reported.

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The NCRP task manager is Jay Campbell. Participating in the planning and conduct of the tests were Bill Parker, Perry Bagalman, Rich Bolczak, David Mark and Sushant Kapur.

TROMMEL INTERIM TEST REPORT

INTRODUCTION

Under Department of Energy contract No. DE-AC03-80CS-24315, a research and development program on rotary screens as primary separation devices for waste-to-energy processing is being conducted by the National Center for Resource Recovery, Inc.

The program, begun in April 1980, consists of: (1) development and experimental refinement of a stochastic theory of trommel behavior; (2) a two-part hardware study for small community use of trommels and engineering analysis of a full-scale trommel; and (3) full-scale economic evaluation and experimental tests of full-scale trommels at Recovery 1 in New Orleans and at two facilities in England.

This Interim Test Report presents data from the first five experimental tests at the New Orleans facility. The tests were conducted between Dec. 4, 1980, and March 18, 1981. The report provides raw data and primary summaries only; it does not present any assessments, interpretations, extrapolations to the modeling work or statistical treatment of the data. These activities are continuing as part of the research project.

Those utilizing the data and results in this interim report should take caution. There may be occasional errors or other anomalies in the reported data that have not yet been discovered

or for which an explanation will be developed in later treatment of the data by NCRR.

During the tests, various performance parameters were measured and samples of material were taken from the infeed, undersized and oversized fractions. These were analyzed for particle size, moisture, composition, density and fuel characteristics. These data are summarized in this report.

Measurements also were made of leading edge and oversize material residence time in the trommel using surrogate objects (plastic bottles and plastic flakes) and video recording equipment. Data were also collected on trommel screening efficiency of surrogate 12-oz aluminum beverage cans and undersize plastic flakes. The data on the seed cans and flakes are included here; however, the data from residence time measurements are not.

EQUIPMENT DESCRIPTION

General arrangement of the trommel at Recovery 1 and its associated conveying equipment is depicted in Figure 1. Equipment of importance is: tipping floor, pit conveyor (equipment item #150), trommel infeed conveyor #152, trommel #12, trommel fallout conveyor #154, shredder infeed conveyor #155 (trommel oversize conveyor), and trommeled materials conveyor #169. These will be referred to in discussions of the tests.

Tipping Floor

Incoming waste from route collection trucks and transfer trailers is weighed on a 50-ton capacity scale and deposited on the concrete tipping floor of the receiving building. The tipping floor has a capacity of approximately 360 Mg (400 tons) of waste. A front-end loader meters the waste into pit conveyor #150 to begin the processing.

Trommel Infeed System

The trommel infeed system consists of conveyors #150 and #152. Conveyor #150 is a below-grade, hinged metal pan conveyor 2.1 m (7 ft) wide with speed adjustment range of 0.7 to 3.6 meters per minute (2.4 to 12 ft per minute--fpm). This conveyor speed is varied to obtain the desired infeed rate to the trommel. It is driven by a 5.6 kw (7.5 hp) electric motor. Conveyor #150

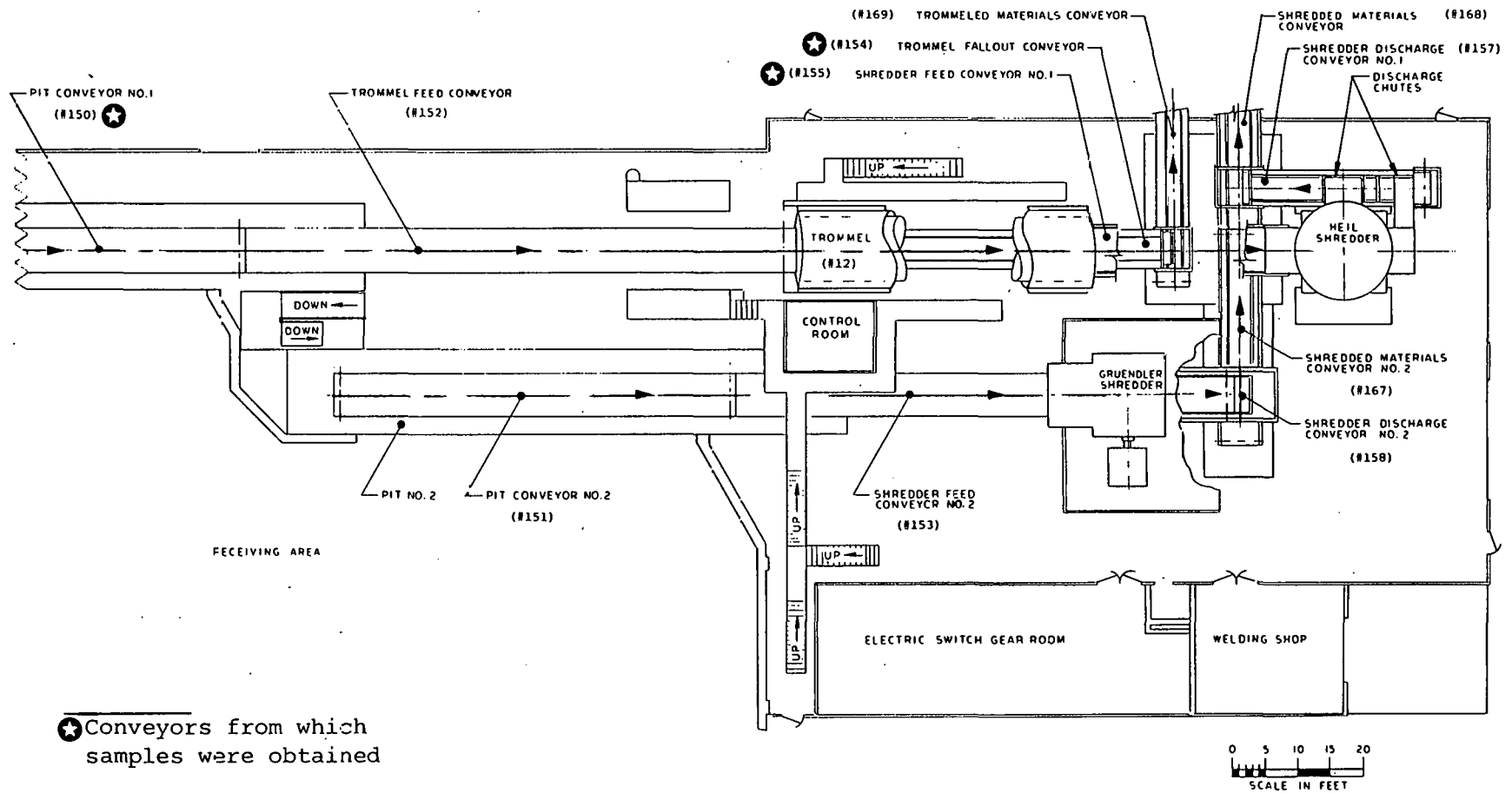


Figure 1. Receiving and shredding buildings equipment arrangement at Recovery 1

is recessed in a pit 1 m (3.4 ft) deep by 18.3 m (60 ft) long.

Unprocessed waste is dropped from conveyor #150 onto conveyor #152, a 2.1 m (7 ft) wide, hinged metal pan conveyor with speed adjustment between 2.2 and 10.8 meters per minute (7.2 and 36 fpm). For approximately half of its 28.7 m (94 ft) length, it is inclined at 35 degrees to the horizontal to elevate the waste from conveyor #150 to a level 5.2 m (17 ft) above floor level. It is then inclined 5 degrees until discharging into the trommel. The conveyor has 1.1 m (3.7 ft) vertical metal sidewalls along its entire length. The drive is 11.3 kw (15 hp). Conveyors #150 and #152 both are designed to carry 67.5 Mg/h (75 tph) of material having a density of 166 kg/m³ (10.4 lb/ft³).

Trommel

The rotary screen consists of four major components: (1) structural support; (2) barrel; (3) barrel drive mechanism; and (4) cylindrical steel dust cover. Key physical and operating parameters for the trommel are provided below.

Key Trommel Physical and Operational Parameters

Design capacity	56.3 Mg/h (62.5 tph)
Length	14.2 m (46.5 ft)
Diameter	3.0 m (9.75 ft)
Rotational speed	11 rpm (fixed)
Declination	5°
V/V _{cr} *	0.448
Lifters/Plows	70 (design); 59 as tested
Holes	120 mm (4.75 in) diameter
Open area	28.3%

* Ratio of actual velocity to critical velocity

The support structure is a conventional network of wide-flange I-beams and welded plate. It is anchored into the concrete floor at each of the four legs and provides support for the two trunnion shafts, trunnion wheels, dust cover and two drive motors with their gearboxes. The dust cover envelopes the upper half of the rotating barrel. It provides approximately 356 mm (14 in) clearance from barrel to cover at the sides, increasing to 660 mm (26 in) at the top.

The drive train consists of two 30 kw (40 hp) electric motors, each driving a hollow tubing shaft through a speed-reducing gearbox. Each drive shaft contains two trunnion wheels which support and friction-drive the barrel by steel rings surrounding the barrel at approximately 20% and 80% of its length. It is turned at nominally 11 rpm. Because the barrel is declined at 5 degrees below horizontal, a thrust roller rides the lower side of the aft steel ring to restrain the barrel from progressing downward.

Overload protection for the trommel drive is provided by monitoring the amperage of both drive motors. Should either motor amperage exceed a preset redline, the infeed conveyors are stopped until the overload condition passes.

The barrel is made of 10 cylindrical sections bolted together. Each is 1.3 m (4.25 ft) long and contains 7 perforated panels around the circumference. Each cylindrical section has 7 angled lifters that act as bag openers and aid in moving the waste down the barrel.

The barrel is 14.2 m (46.5 ft) long with an inside diameter of 3.0 m (9.75 ft). Each of the perforated panels that make up the barrel is rolled 1.2 x 1.2 mm (4 x 4 ft), 22 mm (0.875 in) thick steel. Each panel contains 56 holes of 120 mm (4.75 in) diameter on 150 mm (6 in) staggered centers. The lifters, located in the first 8 segments, are 254 mm (10 in) high and 1.1 m (3.75 ft) long, and are angled at 6 degrees. The last segment incorporates discharge plows instead of lifters; these are angled at 24 degrees to assist in material removal at the barrel exit (11 lifters have fallen off and were not in place during the tests).

There is a theoretical total of 3920 holes, which would give open area of 33.9%. Subtracting holes totally or partially obscured by lifters, plows or structural strapping, there are actually 3257 holes, giving an open area of 37.2 m^2 (400 ft^2) or 28.13%.

Trommel Undersize Discharge

All material falling through the 120 mm (4.75 in) diameter holes, the trommel undersize fraction, is funneled through a diverging chute onto conveyor #154, a horizontal rubber belt conveyor running the length of the trommel. It is 1.5 m (5 ft) wide by 14.2 m (46.5 ft) long, moving at a nominal speed of 35.4 meters per minute (118 fpm) and is driven by a 3.0 kw (5 hp) electric motor. Conveyor #154 discharges at a 90 degree angle onto conveyor #169, a troughed rubber belt 1.1 m (3.5 ft) wide and 36.6 m (120 ft) long, inclined at 18 degrees. Conveyor

#169 is driven by a 5.6 kw (7.5 hp) electric motor and travels at 109 meters per minute (360 fpm). Material on conveyor #169 is passed under a drum electromagnet for ferrous recovery; the remaining material is either air classified for further materials recovery or routed to the landfill for final disposal. Conveyors #154 and #169 are both rated to carry 32.4 Mg/h (36 tph) of material having a density of 160 to 320 kg/m³ (10 - 20 lb/ft³).

Trommel Oversize Discharge

Oversize material from the trommel, aided by the discharge plows, is dropped onto conveyor #155. This is a hinged metal pan conveyor 2.1 m (7 ft) wide and 10.4 m (34 ft) long, inclined at 25 degrees. It is skirted the entire length with 1 m (3.4 ft) sides and has a variable velocity of 2.2 to 10.8 meters per minute (7.2 to 36 fpm). It carries the material into the Heil vertical shaft hammermill for size reduction. Conveyor #155 is driven by a 3.0 kw (5 hp) electric motor and is rated to carry 67.5 Mg/h (75 tph) of material with a density of 96 - 160 kg/m³ (6 - 10 lbs/ft³). Conveyor #155 was the sample point for oversize material collection.

TEST DESCRIPTION

General

The basic objective of the tests was to characterize, at varying throughputs, the performance of the trommel and the effects on the composition, particle size, density and moisture of the oversize and undersize fractions. Other objectives were to determine the trommel's screening efficiency on surrogate cans and flakes, and to estimate the retention or residence time in the trommel of seeded materials reporting to the oversize.

The trommel's design capacity is 56.3 Mg/h (62.5 tph). However, it historically has been operated above that rate-- usually in the 72 - 100 Mg/h (80 - 110 tph) range. Two tests during late 1977 and early 1978 (1,2) documented the trommel characteristics at the design point. In the first part of the current series, 5 tests were planned. Three were to be above design, one at design, and one below. During the course of the tests and in light of the interim results the target throughputs were changed.

Infeed rates were measured using two independent methods. One used the total quantity of waste processed during the test divided by the actual processing time (which excluded stops for sample collection). The second method was by clearing a specific length of the two trommel product conveyors #154 and #155 for sample collection. Knowing the conveyor speeds

and weights of the samples, it was possible to add the two samples and obtain an "inferred infeed rate." The two results generally did not closely agree because of the variability in the mass and distribution of material on the conveyors sampled. And, because of plant configuration, equal time phased samples, i.e., to represent undersize and oversize portions of the same raw waste, could not be obtained. The feed rates computed from the timed input are, therefore, considered more accurate and are used in reporting the results.

Specifically, the targeted and actual infeed rates were:

<u>Test No.</u>	<u>Targeted feed rate</u>	<u>Actual feed rate</u>
5	50.4 Mg/h (56 tph) (90% of nominal)	44.1 Mg/h (49 tph)
1	56.3 Mg/h (62.5 tph) (100% of nominal)	*32.4 Mg/h (36 tph)
2	72.9 Mg/h (81 tph) (130% of nominal)	63.0 Mg/h (70 tph)
3	84.6 Mg/h (94 tph) (150% of nominal)	84.6 Mg/h (94 tph)
4	98.1 Mg/h (109 tph) (175% of nominal)	98.1 Mg/h (109 tph)

* In the course of the tests, a decision was made to abandon the test at nominal design (where two 1977 tests had been run) and aim instead at below design throughput at 31.5 Mg/h (35 tph) (actual 32.4 Mg/h (36 tph)).

Test Procedure

The day of the test, a selected number of transfer trailers deposited their loads onto a cleared area of the tipping floor. This known quantity of raw waste became the designated feedstock for the test series. The amount varied with the target throughput, but generally allowed a test duration of 1 to 1-1/2 hours.

Prior to introducing the waste into the trommel, a walk-through of the barrel was made and all blinded holes were cleared and all holes wholly or partly covered by lifters, discharge plows or structure were noted. As mentioned earlier, in the "as tested" trommel configuration, 3257 of the 3920 holes were open.

Linear speed checks were made on the conveyors and the trommel rotating speed was checked. Conveyor #150 was set at a selected speed to yield the target processing rate. Specific instructions were given to the loader operator to maintain a consistent waste level in the pit of conveyor #150. This prevents surging and was the waste level on which the conveyor #150 set speed was based. The time the first material entered the trommel was noted, and video equipment turned on to record the oversize.

On three occasions, at approximately 15-minute intervals in operating time, 200 aluminum cans and 200 102 x 102 mm (4-in x 4-in) plastic flakes were charged to the trommel. Personnel stationed at the undersize conveyor retrieved both cans and flakes; a second group of personnel farther downstream counted any objects missed by the first group. The oversize surrogates (bottles and flakes) were added during this period.

On three occasions, after the surrogate feeding, all equipment was stopped for sample collection. Conveyor #154 was cleared for a length of 3.0 m (10 ft) for the undersize sample, and conveyor #155 was cleared for 1.2 m (4 ft) for the oversize

sample. A representative sample of raw waste was collected from the designated waste supply on the tipping floor. The raw waste sample was not physically taken from the burden on conveyor #150 as the identification implies; rather, it was taken from various parts of the pile on the tipping floor in order to obtain a more representative sample.

Sample Analysis

The samples were placed in large plastic bags (approximately 0.11 m^3 (4 ft^3) capacity bags) and sealed at the collection points. Each bag was labeled to identify the test number, run number, collection location, bag number, and total number of bags. The bags were transported to a secure location and stored until the test series was complete.

After the test series was completed, sample analysis began with weight and volume measurements to determine density. The raw waste samples collected during the three test runs were combined, weighed, and the bags emptied into containers of known volume. A 0.06 m^3 (2 ft^3) cylindrical drum and a 0.76 m^3 (27 ft^3) box were the containers used. The trommel oversize and undersize fractions were also subjected to weight and volume measurements using the same procedure, except that measurements were made for each individual test run in the series. The samples were not combined, but kept separate according to fraction and test run.

After taking volume measurements, the samples were emptied onto a clean floor and mixed. Samples of less than approximately 50 kg were coned and quartered until approximately one quarter of the total sample was separated. This quarter was placed in large plastic bags, sealed, stored, and later analyzed for moisture content. Particle size distribution (PSD) and composition analyses were conducted on the remaining three-quarters.

Samples greater than approximately 50 kg were coned and quartered until a subsample of approximately 50 kg was separated from the sample. This subsample was divided in the manner described above into one quarter for moisture analysis and three quarters for PSD and compositional analyses.

PSD and compositional analyses on the designated portion began immediately after the weight and volume measurements were taken. (This portion of the sample was subjected to hand screening to separate the +254 mm (10 in), +203 mm (8 in), and +152 mm (6 in) particles. By removing the large objects, which were relatively few in number, the volume of material stored for later analysis was significantly reduced. Particle count and weight by size were recorded. These particles were then analyzed according to their composition and the number and weight of particles in each category was recorded. The five categories used in all the compositional analyses were: (1) Paper and plastics; (2) other organics; (3) aluminum; (4) ferrous, and (5) glass, stones, and other nonferrous.

The -152 mm (6 in) material was placed in bags, labeled, sealed and stored. After all the samples were weighed and the density measured, the -152 mm (6 in) portions of the samples were analyzed according to size and composition. A Gilson screen was used to separate the particles into +102 mm (4 in), +76 mm (3 in), +51 mm (2 in), +25 mm (1 in), +12.7 mm (1/2 in) and -12.7 mm (1/2 in) fines. A compositional analysis was performed on each size range greater than 12.7 mm (1/2 in) using the same five categories mentioned above. Particle count and weight by components in each size range were recorded.

Further analyses on selected samples were conducted. To facilitate comparison with other studies that used different categories for compositional analysis, a more detailed compositional analysis was performed on the trommel over and trommel under fractions from one high throughput and one low throughput test run. The expanded categories were: paper; plastic film; molded, cast, and extruded plastic; yard and food waste; rubber and leather; textiles; wood; aluminum; glass; stones and ceramics; shells; and other nonferrous metals.

A detailed analysis of -12.7 mm (1/2 in) fines for selected test runs was also conducted. The particles were sized using 6.4 mm (1/4 in) and U.S. Standard No. 6, 12, 16, 20, and 40 screens. The categories for compositional analysis were paper and plastic, other combustibles, glass, ferrous, and other non-combustibles.

Finally, samples of the trommel oversize fraction were tested for heating value and ash content. An approximately 2 kg (4.4 lb) sample was taken from the dried moisture samples of each test series. The samples from each test were combined, hand shredded to approximately 76 mm (3 in) particle size, and coned and quartered to a 2 kg sample size. These samples were then shipped to a laboratory. At the laboratory, the first step of analysis consisted of weighing the samples in their as-delivered state. Nongrindable particles (generally larger than 4 mesh and consisting of non-combustible material) were then removed from the sample by hand-sorting in order to prevent damaging of the grinding mill during size reduction of the sample. All nongrindable particles were recorded and weighed.

The samples consisting of combustible and minus 4 mesh material were subsequently size reduced in two steps. First, each sample was coarsely milled in order to prepare it for the final stage of size reduction. After the final stage of milling, the samples were ready for moisture content, ash, and heating value analyses.

A representative 7 - 10 gram subsample of the well-mixed comminuted material was collected for the moisture content and ash content analysis. The ash analysis was conducted in accordance with ASTM test standard D3174.

The heating value of each sample was determined using an adiabatic bomb calorimeter and the procedures designated in ASTM standard D2015.

The values for moisture content, ash content, and heating value for the composite samples (i.e., the original samples with their respective nongrindable materials) were calculated from the equations on the following page using the criteria that the heating value and oven-dry moisture content of the removed nongrindable components are taken to be zero percent, and their ash content to be 100 percent.

$$MF_{iad} = \frac{W_{iad}}{W_{tad}} \times 100 \text{ percent} \quad (1)$$

$$MC_t = (MC_c) (MF_c) \quad (2)$$

$$A_{tod} = \frac{(A_{cod}) (MF_{cod}) (1-MC_c) + (1-MF_{cad})}{(1-MC_t)} \quad (3)$$

$$A_{tad} = (A_{tod}) (1-MC_t) \quad (4)$$

$$HV_{cod} = \frac{HV_{cad}}{1-MC_c} \quad (5)$$

$$HV_{tod} = \frac{(HV_{cad}) (MF_c)}{(1-MC_t)} \quad (6)$$

$$HV_{tad} = (HV_{cad}) (MF_c) \quad (7)$$

where: MF = Mass Fraction
 W = Weight
 A = Ash Content
 HV = Higher Heating Value
 MC = Moisture Content

Subscripts

ad - Refers to as-delivered moisture basis
 od - Refers to oven-dry state
 c - Refers to combustibles and -4 mesh material
 t - Refers to total or composite samples
 i - Refers to component of interest

TEST DATA

Introduction

The 18 tables in this section, as summarized below, present the primary summaries of data from the first five trommel tests conducted at the Recovery 1 facility in New Orleans. As mentioned earlier, this is an interim test report; caution should be taken in interpretation or extrapolation of these data, as there may be occasional errors or other anomalies that have not yet been corrected or are not discussed in this report.

All data are reported in an as-received moisture basis unless otherwise noted.

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Abbreviations

Btu/lb - British thermal units per pound

D.W. - dry weight

kg - kilogram

kg/m³ - kilograms per cubic meter

kJ/kg - kilojoule per kilogram

Mg/h - mega grams (metric tons) per hour

tph - tons per hour

TABLE 1. Summary of Infeed Rates, Mass Splits & Moisture Contents

Ref. Test No.	1	5	2	3	4
Average Infeed Rate, Mg/h (tph)	<u>32</u> (36)	<u>44</u> (49)	<u>63</u> (70)	<u>85</u> (94)	<u>98</u> (109)
Mass Split, % by wt.					
To Undersize	65.5	55.7	54.9	41.5	30.2
To Oversize	34.5	44.3	45.1	58.5	69.8
Moisture Content, % by wt.					
Infeed	27.0	28.2	31.2	38.5	21.6
Undersize	26.8	27.6	26.2	29.2	23.9
Oversize	27.2	25.9	25.9	27.4	24.8

TABLE 2. Trommel Screening Efficiencies by Component

Screening Efficiency, * %

Ref. Test No.	1	5	2	3	4
Average Infeed Rate, Mg/h (tph)	32 (36)	44 (49)	63 (70)	85 (94)	98 (109)
<u>Component</u>					
Paper, plastic	69.4%	61.1%	51.6%	38.0%	24.3%
Other combustibles	86.8	74.6	77.4	60.9	49.1
Ferrous metal	80.1	61.6	50.0	48.6	31.3
Aluminum	93.6	76.7	89.9	64.5	38.3
Glass, stones, other nonferrous	100	96.6	91.5	87.2	70.0
Minus 13.7 mm (½") Fines	98.0	97.0	91.9	85.0	84.0
Overall Screening Efficiency	89.5	81.0	76.0	65.4	47.6

*Screening Efficiency is defined as the proportion, as a percentage, of the weight of a component in the undersize fraction to the weight of the component in the trommel feed.

TABLE 3. Bulk Density Results

Ref. Test No.	1	5	2	3	4
Avg. Infeed Rate, Mg/h (tph)	32 (36)	44 (49)	63 (70)	85 (94)	98 (109)
Infeed Density, kg/m ³	192.3	192.0	217.7	166.8	156.0
Undersize Density, kg/m ³					
Run A	223.9	428.0	353.1	274.5	412.0
Run B	243.6	335.0	358.5	255.8	442.0
Run C	246.3	300.0	334.1	259.6	356.0
Oversize Density, kg/m ³					
Run A	64.6	95.8	116.6	110.9	131.0
Run B	58.0	86.9	87.7	82.0	122.0
Run C	69.5	91.4	115.1	89.9	123.0

TABLE 4. Trommel Oversize Fuel Characteristics

Ref. Test No.	1	5	2	3	4
Average Infeed Rate Mg/h (tph)	32 (36)	44 (49)	63 (70)	85 (94)	98 (109)
Moisture Content, % D.W.	27.2	25.9	25.9	27.4	24.8
Ash Content, % D.W.	15.0	14.3	0.2	16.7	19.8
Heating Value, kJ/kg, D.W. (Btu/lb)	17665 (7596)	17718 (7619)	18522 (7964)	19396 (8340)	15900 (6840)

TABLE 5. Trommel Product Composition:
 Test No. 1; Infeed Rate 32 Mg/h (36 tph)

<u>Component</u>	<u>Trommel Undersize Composition % wt.</u>	<u>Trommel Oversize</u>		<u>Computed Trommel Infeed</u>	
		<u>Composition % wt.</u>	<u>% wt. of Components -102mm (4")</u>	<u>Composition % wt.</u>	<u>% wt. of Components -102mm (4")</u>
Paper, plastic	19.0	59.7	27.3	33.0	54.3
Other combustibles	14.7	23.9	17.9	17.9	62.0
Ferrous metal	2.2	14.3	7.6	6.4	28.1
Aluminum	1.0	0.2	52.9	0.7	100
Glass, stones, other nonferrous	27.9	0.55	54.2	18.5	98.3
Minus 12.7 mm (1/2")	35.1	1.4	100	23.5	100

TABLE 6. Trommel Product Composition:
 Test No. 2; Infeed Rate 63 Mg/h (70 tph)

<u>Component</u>	<u>Trommel Undersize Composition % wt.</u>	<u>Trommel Oversize</u>		<u>Computed Trommel Infeed</u>	
		<u>Composition % wt.</u>	<u>% wt. of Components -102mm (4")</u>	<u>Composition % wt.</u>	<u>% wt. of Components -102mm (4")</u>
Paper, plastic	21.4	78.3	31.9	47.1	48.3
Other combustibles	13.2	10.9	43.0	12.2	76.7
Ferrous metal	2.2	3.0	88.9	1.6	92.7
Aluminum	1.8	0.3	96.4	1.1	99.9
Glass, stones, other nonferrous	23.6	3.5	76.7	14.5	97.7
Minus 12.7 mm (1/2")	37.7	4.0	100	22.5	100

TABLE 7. Trommel Product Composition:
 Test No. 3; Infeed Rate 85 Mg/h (94 tph)

<u>Component</u>	<u>Trommel Undersize Composition % wt.</u>	<u>Trommel Oversize</u>		<u>Computed Trommel Infeed</u>	
		<u>Composition % wt.</u>	<u>% wt. of Components -102mm (4")</u>	<u>Composition % wt.</u>	<u>% wt. of Components -102mm (4")</u>
Paper, plastic	18.1	66.6	31.9	46.5	42.4
Other combustibles	15.5	12.3	57.5	13.6	77.7
Ferrous metal	3.8	11.6	24.7	8.4	38.7
Aluminum	1.1	0.7	61.2	0.9	78.6
Glass, stones, other nonferrous	25.5	4.2	65.5	13.0	93.4
Minus 12.7 mm (1/2")	35.9	4.5	100	17.5	100

TABLE 8. Trommel Product Composition:
 Test No. 4; Infeed Rate 98 Mg/h (109 tph)

<u>Component</u>	<u>Trommel Undersize Composition % wt.</u>	<u>Trommel Oversize</u>		<u>Computed Trommel Infeed</u>	
		<u>Composition % wt.</u>	<u>% wt. of Components -102mm (4")</u>	<u>Composition % wt.</u>	<u>% wt. of Components -102mm (4")</u>
Paper, plastic	19.6	69.3	38.4	54.3	44.8
Other combustibles	13.0	11.4	51.2	11.9	67.2
Ferrous metal	2.7	4.2	61.2	3.8	68.7
Aluminum	1.0	0.7	100	0.8	98.8
Glass, stones, other nonferrous	27.2	7.6	70.2	13.5	87.0
Minus 12.7 mm (1/2")	36.6	6.8	100	15.7	100

TABLE 9. Trommel Product Composition:
 Test No. 5; Infeed Rate 44 Mg/h (49 tph)

<u>Component</u>	<u>Trommel Undersize Composition % wt.</u>	<u>Trommel Oversize</u>		<u>Computed Trommel Infeed</u>	
		<u>Composition % wt.</u>	<u>% wt. of Components -102mm (4")</u>	<u>Composition % wt.</u>	<u>% wt. of Components -102mm (4")</u>
Paper, plastic	20.7	75.0	23.3	44.7	42.2
Other combustibles	15.4	16.1	44.8	15.7	73.2
Ferrous metal	2.5	5.1	38.4	3.6	62.8
Aluminum	1.0	0.5	76.4	0.8	90.8
Glass, stones, other nonferrous	21.8	1.7	57.1	12.9	97.4
Minus 12.7 mm (1/2")	38.5	1.6	100	72.2	100

TABLE 10. Particle Size Distributions:
 Test No. 1; Infeed Rate 32Mg/h (36 tph)

Sample/Run	Sample size, kg	Size Distribution, Cumulative % by wt.								
		+254mm (10")	+203mm (8")	+152mm (6")	+102mm (4")	+76mm (3")	+51mm (2")	+25mm (1")	+12.7mm (1/2")	-12.7mm (-1/2")
Raw Waste	33.54	13.1	18.9	28.9	45.0	56.8	71.7	80.4	88.8	11.2
Oversize										
Run A	32.46	26.6	32.9	54.7	71.2	85.2	93.2	96.3	98.1	1.9
Run B	21.15	12.9	21.3	47.1	75.7	90.9	97.0	98.5	99.1	0.9
Run C	33.38	16.6	45.0	63.6	82.5	92.8	96.7	98.3	99.1	0.9
Mean:										
A, B, & C	29.0	18.7	33.1	55.1	76.5	89.6	95.6	97.7	98.8	1.2
Undersize										
Run A	15.21	0	0	0	2.3	6.6	17.4	37.4	61.3	38.7
Run B	31.57	0	0	0	0	3.4	14.1	37.8	64.4	35.6
Run C	13.03	0	0	0	0.11	10.8	23.8	48.8	70.3	29.7
Mean:										
A, B, & C	21.6	0	0	0	0.84	6.9	18.4	41.3	65.3	34.7

TABLE 11. Particle Size Distributions:
 Test No. 2; Infeed Rate 63 Mg/h (70 tph)

Sample/Run	Sample size, kg	Size Distribution, Cumulative % by wt.								
		+254mm (10")	+203mm (8")	+152mm (6")	+102mm (4")	+76mm (3")	+51mm (2")	+25mm (1")	+12.7mm (1/2")	-12.7mm (-1/2")
Raw Waste	29.79	3.6	7.5	25.5	38.6	44.4	53.2	68.2	79.7	20.3
Oversize										
Run A	17.08	16.8	23.9	29.8	55.5	69.8	82.0	89.0	93.3	6.6
Run B	49.34	20.2	25.7	44.0	63.4	76.8	89.2	94.4	96.9	3.1
Run C	18.65	8.1	18.9	46.1	62.8	75.2	86.0	92.3	96.0	4.0
Mean:										
A, B, & C	28.36	15.0	22.8	40.0	60.6	73.0	85.7	91.9	95.4	4.6
Undersize										
Run A	17.16	0	0	0	0.8	2.4	16.0	43.7	64.2	35.8
Run B	34.0	0	0	0	0.5	3.6	16.5	39.6	61.6	38.4
Run C	11.99	0	0	0	0.1	4.6	18.5	39.2	62.7	37.3
Mean:										
A, B, & C	21.05	0	0	0	0.5	3.5	17.0	40.8	62.8	37.2

TABLE 12. Particle Size Distributions:
Test No. 3; Infeed Rate 85 Mg/h (94 tph)

Sample/Run	Sample size, kg	Size Distribution, Cumulative % by wt.								
		+254mm (10")	+203mm (8")	+152mm (6")	+102mm (4")	+76mm (3")	+51mm (2")	+25mm (1")	+12.7mm (1/2")	-12.7mm (-1/2")
Raw Waste	29.63	18.8	21.2	42.3	54.9	69.5	79.1	86.1	91.9	8.1
Oversize										
Run A	32.74	14.0	22.8	39.2	59.1	71.1	83.4	89.4	94.4	5.6
Run B	27.36	0.2	10.6	28.5	54.9	75.7	86.2	93.0	96.7	3.3
Run C	28.84	28.9	35.3	46.4	69.4	79.1	86.7	92.5	95.9	4.1
Mean:										
A, B, & C	29.65	14.4	22.9	38.0	61.1	75.3	85.4	91.6	95.7	4.3
Undersize										
Run A	28.84	0	0	0	0.9	4.1	13.4	32.5	64.7	35.3
Run B	27.11	0	0	0	0.7	3.7	14.5	37.2	66.7	33.3
Run C	28.73	0	0	0	0.2	5.3	15.9	35.3	64.3	35.7
Mean:										
A, B, & C	28.23	0	0	0	0.6	4.4	14.6	35.0	65.2	34.8

TABLE 13. Particle Size Distributions:
 Test No. 4; Infeed Rate 98 Mg/h (108 tph)

Sample/Run	Sample size, kg	Size Distribution, Cumulative % by wt.								
		+254mm (10")	+203mm (8")	+152mm (6")	+102mm (4")	+76mm (3")	+51mm (2")	+25mm (1")	+12.7mm (1/2")	-12.7mm (-1/2")
Raw Waste	34.47	8.1	19.6	29.8	44.9	51.6	64.8	76.6	86.7	13.3
Oversize										
Run A	57.05	17.8	25.6	46.0	59.5	70.8	82.6	90.0	94.9	4.9
Run B	40.38	13.6	18.5	27.9	42.4	58.3	71.0	84.4	91.6	8.2
Run C	63.05	23.4	29.9	39.2	51.7	66.5	77.8	86.9	92.6	7.3
Mean:										
A, B, & C	53.5	18.3	24.7	37.7	51.2	65.2	77.1	87.1	93.0	6.8
Undersize										
Run A	39.27	0	0	0	0.6	2.4	12.3	33.8	62.3	37.6
Run B	35.74	0	0	0	0.7	4.1	14.2	37.3	68.2	31.8
Run C	20.13	0	0	0	0	2.5	14.0	40.3	62.2	37.7
Mean:										
A, B, & C	31.7	0	0	0	.43	3.0	13.5	37.1	64.2	35.7

TABLE 14. Particle Size Distributions:
 Test No. 5; Infeed Rate 44Mg/h (49 tph)

Sample/Run	Sample size, kg	Size Distribution, Cumulative % by wt.								
		+254mm (10")	+203mm (8")	+152mm (6")	+102mm (4")	+76mm (3")	+51mm (2")	+25mm (1")	+12.7mm (1/2")	-12.7mm (-1/2")
Raw Waste	44.34	21.5	26.8	39.4	47.3	53.3	64.0	75.6	85.4	14.6
Oversize										
Run A	34.86	21.7	32.5	52.4	77.2	91.3	95.2	97.8	98.7	1.3
Run B	30.47	11.3	26.4	47.8	71.8	82.4	93.8	97.5	98.8	1.1
Run C	41.09	7.9	16.1	46.7	63.7	77.6	89.6	96.0	97.9	2.0
Mean:										
A, B, & C	35.47	13.6	25.0	49.0	70.9	83.8	92.8	97.1	98.5	1.5
Undersize										
Run A	25.85	0	0	0	1.1	3.1	13.8	35.1	59.5	40.5
Run B	30.13	0	0	0	2.1	4.2	17.1	39.7	64.3	35.7
Run C	23.07	0	0	0	0.5	4.2	14.9	37.0	60.8	39.2
Mean:										
A, B, & C	26.35	0	0	0	1.2	3.8	15.3	37.3	61.5	38.5

TABLE 16

Secondary Trommel Oversize Product Composition Results

Composition % by Weight		
Ref Test/Run	1C	4B
Avg. Infeed Rate Mg/h (tph)	32(36)	98(109)
Component		
PAPER/PLASTIC		
Paper	54.4	61.3
Plastic Film	2.6	4.2
Plastic Extrusions	4.2	3.5
OTHER COMBUSTIBLES		
Yard and Food	3.2	2.5
Rubber and Leather	1.1	0.05
Textiles	1.2	1.8
Wood	0.7	2.3
FERROUS METAL	31.0	7.2
ALUMINUM	0.12	0.68
GLASS, STONES, ONF		
Glass	0.12	6.9
Stones and Ceramics	0.33	0.73
Shells	-	0.08
Other Non-Ferrous	0.3	0.10
MINUS 12.7 mm ($\frac{1}{2}$ ") FINES	0.87	8.6

TABLE 17
Secondary Size Distribution Results

Size Distribution Cumulative % by Weight				
Ref Test/Run	1C	4B	1C	4B
Avg. Infeed Rate Mg/h (tph)	32(36)	98(109)	32(36)	98(109)
Sample Description	Undersize	Undersize	Oversize	Oversize
Screen Size mm (in.)				
+254 (10)	-	-	16.6	13.6
+203 (8)	-	-	45.0	18.5
+152 (6)	-	-	63.6	27.9
+102 (4)	0.1	0.7	82.5	42.4
+76 (3)	10.8	4.1	92.8	58.3
+51 (2)	23.8	14.2	96.7	71.0
+25 (1)	48.8	37.3	98.3	54.4
+12.7 (1/2)	70.3	68.2	99.1	91.6
+6.4 (1/4)	82.6	83.6	99.4	95.4
+3.3 (0.131)	88.5	92.0	99.6	97.2
+1.7 (0.066)	93.4	97.4	99.7	98.4
+1.2 (0.047)	95.6	99.3	99.8	98.9
+0.83 (0.033)	97.5	99.9	99.9	99.2
+0.425 (0.017)	99.4	99.9	99.9	99.6

TABLE 18. Seed Material Recovery Results

Test No.	Infeed Rate (tph)	Aluminum Cans (% by count)				4" x 4" Flakes (% by count)				
		Run A	Run B	Run C	Mean	Run A	Run B	Run C	Mean	
1	32	(36)	85.0	84.0	87.0	85.3	61.5	45.0	57.0	54.3
5	44	(49)	66.0	84.5	81.0	77.0	46.5	29.5	53.0	43.0
2	63	(70)	68.5	79.0	79.5	74.0	23.5	48.0	42.5	38.0
3	85	(94)	67.5	72.0	60.0	66.5	20.5	29.0	21.0	23.5
4	98	(109)	59.0	59.0	65.0	61.0	20.5	12.5	27.0	20.0

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