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WORKING PAPER

PILOT-SCALE TROMMEL:

EXPERMENTAL TEST DESCRIPTIONS

AND DATA

by

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INTRODUCTION

In July 1980, testing on a pilot scale trommel began at the National Center for Resource Recovery's Resource Recovery Laboratory in Upper Marlboro, Maryland. This activity was initiated to support theoretical work on development of a model on trommel performance reported in an accompanying set of working papers (1), and to supplement data collected in full-scale testing at Recovery 1 in New Orleans reported in Reference 2. This report provides descriptions and summaries of testing through July 1981 at which time all work on this contract was terminated.

The pilot trommel was 3.2 m (10.5 ft) long and had an inside diameter of 0.9 m (3.0 ft). The drum was driven by a variable speed motor/reducer and trunion wheel/rim drive. For all tests it was inclined down from feed to discharge at 4-1/2°. The surface of the barrel consisted of a 0.3 m (12 in) solid ring at the feed end, a 1.3 m (48 in) section of transparent perforated Lexan screen, a 0.15 m (6 in) solid structural ring, a 1.2 m (48 in) section of perforated steel screen, and a 0.3 m (12 in) solid structural ring at the discharge end. On the inside surface, 8 equally spaced rows of 35 mm (1-3/8 in) high lifters ran axially across the inlet and 2 screen sections. The screen sections contained 51 mm (2 in) diameter holes on staggered centers. The pattern is shown in Figure 1.

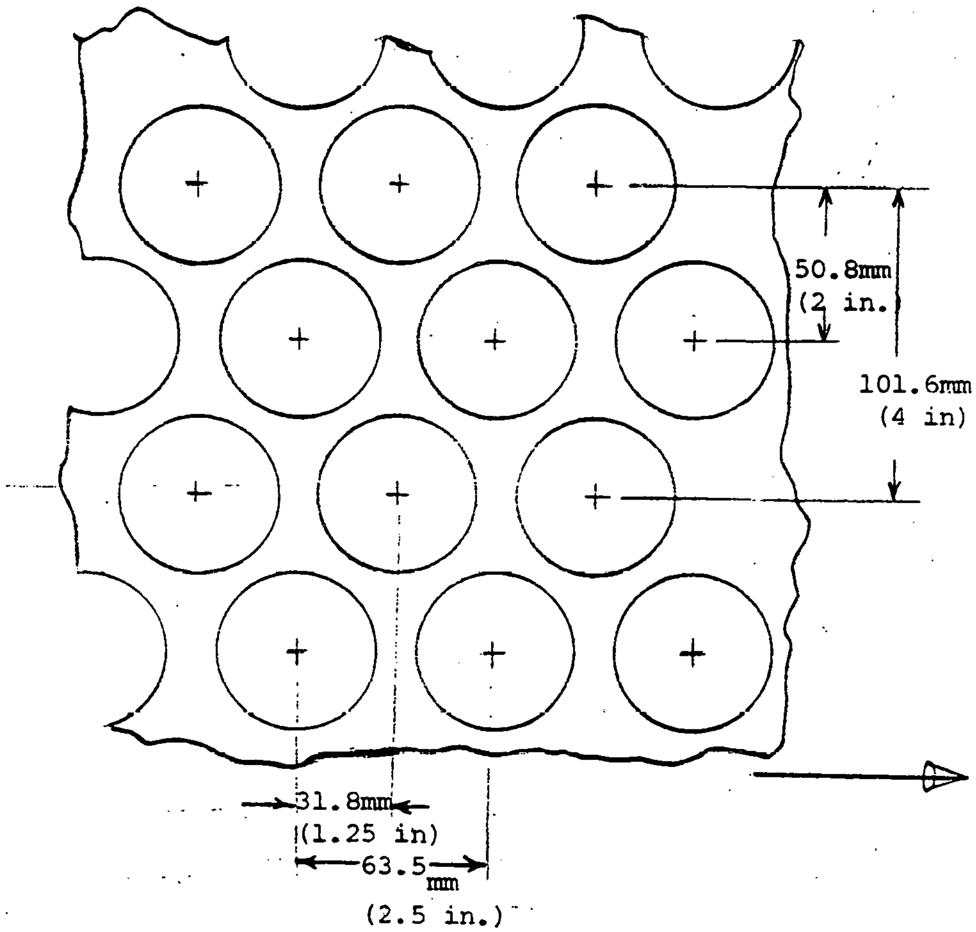

Figure 1. Trommel Screen Pattern 50.8mm (2 in) Diameter Holes

All the experiments on the pilot trommel during this period were conducted utilizing prepared feedstocks of identical nearsized flakes and wooden blocks. Although the program planning called for testing on other sizes of prepared feedstocks, mixtures of flakes and eventually some actual waste feedstocks, the program was terminated before these later experiments could be conducted.

A further comment should be made on the reasons for selection of prepared, uniformly-sized, nearsized block and flake feedstocks for the pilot trommel testing. Such feedstocks offer the advantage of reducing or eliminating the effect of material property variations - a problem particularly significant in testing MSW. The trends and relationships between trommel equipment and operating variables can be more easily obtained and reliably evaluated without concerns of representative sampling, material degradation and moisture variations present with use of MSW feedstock. The uniformity in particle and batch properties is also helpful in initial development and refinement of modeling functions. If predictions on dynamic behavior and screening relationships can be verified for selected feedstocks, then the process and confidence of extending the model to mixtures and eventually actual waste feedstocks is enhanced. The selection of flakes and blocks sized near the hole size also provides increased sensitivity to changes in trommel performance.

Prepared feedstocks were not intended as the only feedstocks to be tested in the pilot trommel. Rather they were to have served as important starting points with sized fractions and mixtures of MSW to follow. Such tests on real MSW would be needed to be able to relate the pilot results model verifications to full-scale test results in New Orleans and the United Kingdom. However, as mentioned, such testing on prepared feedstocks was not conducted prior to the termination of the contract so the results are not available to report here.

This report provides the test results in a topical format since data applicable to more than one group of results was often gathered simultaneously. For example, residence time and separation efficiency data were collected during the same test but here are reported separately. There are three groupings of results. The first group, Feedstock Tests contains data on feedstock properties. This group includes description of the feedstocks and results of tests on the probability of passage, the dynamic angle of repose, and the coefficient of friction for the test flakes. The second test group on Residence Time and Impingement Tests contains data on the movement of flakes and blocks through the trommel. The last group, Mass Split, Screening Efficiency and Undersize Distribution contains data on flake and block mass splits to the undersize and oversize products and the axial and sectorial distribution in the undersize.

It should be noted that video tape recordings were made of most of the trommel tests described in the report for use in making specific test measurements (angles of detachment, dynamic bulk density, etc.) and to preserve a record of the test conditions for future reference. These tapes were submitted to the Department of Energy at the same time as this report.

FEEDSTOCK TESTS

Probability of Passage - Test Flakes

Black and white paper flakes of the same size were procured for the trommel tests. The white flakes were used almost exclusively as the feedstock in the tests described in this report. The flake size was experimentally determined (see below) to provide for single drop probability of passage of 10-15% on a 51 mm (2 in) hole pattern. A random sample of 10 white flakes indicated a long side mean length of 44.0 mm (standard error of the samples, s = 0.21 mm) and a short side mean length of 44.4 mm (s = 0.45). The flakes were 0.23 mm thick and weighed 0.29 g.

A pattern duplicating the screen surface of the trommel was prepared out of Lexan (see Figure 1) and used to measure the probability of passage of a single flake impinging on its surface. Fifty flakes were dropped on the pattern, one at a time, from a height of 0.6 m (2 ft) and the number of flakes passing through the screen pattern recorded. The test was repeated 60 times. The highest number of flakes which passed through was 11 (3 times) and the lowest 1 (one time). The mean value passing for the 60 tests was 6.1 (s = 2.57). Converting this to a percent and calculating a 95% confidence interval resulted in a probability of passage between 11.0% and 13.4% with a mean of 12.2%.

Dynamic Angle of Repose

In a 1927 Bureau of Mines report, "Passage of Solid

Particles Through Rotary Cylindrical Kilns" (3) the dynamic angle of repose defined as the maximum angle which material may be carried up a trommel without sliding down the drum. The data on dynamic angle of repose was collected here for use in the theoretical investigation of the material dynamics and associated flow and impingement characteristics of the flake feedstock. During the testing, two different angles were measured. The angle of first slide was the angle at which the first several flakes slid down as the test drum was rotated. The angle of collapse was the angle at which the mass of flakes collapsed onto itself as the test drum was rotated.

White paper flakes (45 mm x 45 mm) were placed in a cardboard test drum 0.28 m (11 in) wide and 0.56 m (22 in) in diameter. About 1.9 Kg (4.25 lb) of flakes, enough to fill ~18% of the drum volume as recommended in the Bureau of Mines report, were placed in the drum and the ends covered with clear plastic. The material was mixed prior to the measurements using two methods. To create a random flake orientation, the drum was flipped side-over-side. To create a stratified orientation, the drum was slowly revolved until the flakes lined up with each other in groups, forming strata. Such groups would take different orientations in relation to each other and the flakes tended to act with a group rather than individually. After mixing, using one of these two techniques, the drum was placed on its side on a flat surface, and the point of contact between the drum and the surface was marked to begin the test. The drum was slowly rolled until the indicated flake movement was observed. The distance the point of contact traveled through was recorded, then later converted to an angular displacement, i.e., the dynamic angle of repose. This procedure was repeated 30 times. A summary of the results is presented in Table 1.

Coefficient of Friction

Depending on the coefficient of friction between particles, and between particles and the drum in a rotating system like a trommel, particles will be carried higher, or to a greater angular displacement by the centrifugal forces of rotation. To obtain an estimate of the coefficient of friction between the paper flakes, a series of tests were developed and conducted. The project scope and schedule did not permit sufficient testing to statistically verify the precision or accuracy of the test methods or results.

There were several basic assumptions made about the coefficient of friction, namely:

1. The coefficient of friction for dry, sliding surfaces is mainly a function of contacting materials;
2. The coefficient of friction is largely independent of the load and surface roughness; and
3. The coefficient of friction is only slightly dependent on the sliding velocity.

Two types of tests were performed. One type used a hanging weight with a support string running over a pulley and attached to a second weight on a horizontal surface. By placing the second weight on top of a test flake and then removing small increments of weight until the test flake moved, a measure of the coefficient of static friction was obtained. When the particles moved without acceleration, the system was in equilibrium and the force exerted by the hanging weight was equal to the friction force. From this, the coefficient of kinetic friction was obtained.

The second method for determining static coefficients involved placing a weight on the test flake then inclining the surface on which it rested until the flake and weight began to slide. Similar tests were conducted to determine the angle at which it would slide at a constant speed to measure the kinetic coefficient of friction. Table 2 presents a summary of the data for different test surfaces and black and white test flakes. Two types of surface were used: flat sheets of paper and flakes of paper strewn to represent a bed of material.

RESIDENCE TIMES AND IMPINGEMENT TESTS

A series of tests were conducted on the pilot trommel to determine the residence times and number of impingements of flakes and blocks as they moved through the trommel. Residence time here refers to the time interval between the moment an oversize particle enters and the moment it leaves the discharge end of the trommel. However, residence time of an undersized flake or block may also be measured. In that case, the axial distance traveled in the trommel must be measured to obtain a meaningful residence time.

Impingement refers to the impact between a flake or block on the surface of the trommel screen or on flakes or blocks that are laying on the trommel screen. As a particle moves through the trommel, it is carried by lifters or friction up the side wall. In the idealized case, the particle will be carried up to a point determined by the rotational speed and surface interactions, leave the surface, fly downward, and impact near the bottom surface of the trommel (See Reference 1 for a more complete discussion of particle dynamics). In practice, the flakes and blocks did not undergo these two distinct "riding" and "flying" phases. Specifically, the flakes particles tended to slide downward over the screen while the blocks would typically bounce and roll across and down the drum. Judgments had to be made as to what constituted an impingement. Although no strict guidelines were developed, the observers tended to agree closely on the total number of impingements during a test.

Residence times and impingements were determined under various loading and operating conditions. A "seed" flake was introduced into the trommel along with other white flakes. The seed flake would carry distinguishing markings, usually fluorescent paint. The undersize seed flakes were the same size as the prepared feedstocks, 45 mm square, and weighed 0.29 g while the overside seed flakes were 51 mm (2 in) square and weighed 0.45 to 0.55 g. The flake tests fell into three categories: batch tests with undersize seed flakes, batch tests with oversize seed flakes, and steady state tests with oversize flakes.

In the batch tests, 100 to 1000 undersize flakes were introduced into the trommel. The seed flakes were either painted (0.40 g), black (0.34 g) or marked white (0.29 g). They were fed into the trommel along with the batch of white flakes. Observers at the feed and discharge ends measured residence times with stop watches while counting the number of impingements. Often the seed flake would pass through the screen to the undersize. When this happened, the axial position of the flake was estimated using a scale with 152 mm (6 in) increments marked on the inside of the trommel. Air currents, particularly at very dilute loadings, occasionally caused the particle to move forward with an uneven velocity and at times even reverse direction. At times, a seed flake would wedge under a lifter; when this occurred, the period that it was wedged was subtracted from the total residence times. In this series, 4 or 5 tests were conducted at each operating condition. The averages of the observations of resident times and impingements for each test are presented in Table 3.

A shortcoming of the first series of tests was the lack of data on residence times for the full length of the trommel due to loss of the seed flakes to the undersize. In the next series of tests, oversize seed flakes were fed in batches with 1000 white flakes. Observers at the feed and discharge end measured the residence time and counted the impingements. The observer at the feed end counted and timed the movement in the first half (actually 1.7 m (5.5 ft)) of the trommel and the observer at the discharge end did the same in the second half (1.4 m (4.5 ft)). The hand signals of test engineers noting the entry, impingement, and discharge times were recorded on video tapes for later replay and documenting of data.

The results of these batch tests are presented in Table 4 for the two halves of the trommel length indicate that a flake proceeded at different rates depending on which half of the trommel in which it was moving. This difference was attributed to the more dilute loadings in the second half due to loss of flakes to the undersize in the first half. As noted above, at very dilute loadings the flakes tended to stall for long periods, in which case the particular run was terminated and repeated.

The next series of tests were similar in procedure to the batch tests but designed to represent steady state loading. Pre-weighed bags were charged at 15 sec intervals. Initially, the oversize discharge was collected and weighed at 30 sec intervals. The purpose was to determine if steady state had been achieved, i.e., the discharge rate was steady. Under conditions of very light loading and high trommel speeds the data indicated that flakes discharged from the trommel in random frequency pulses. This data was confirmed by observation. Under higher loadings no similar indications of such pulsing was apparent. However, the measuring equipment and techniques were considered too crude to produce consistent and reliable data, and because the lower loading conditions were not those of primary interest, the weighing of flakes at the discharge was discontinued.

The tests were 5 to 15 min in duration, depending on the feedrate and the number of flakes available. The data was statistically reduced and is presented in Tables 5 and 6. Table 5 presents the mean and standard error of residence times and number of impingements for seed flakes. As noted in the table, the weight of seed flakes varied depending on the thickness of paint. This also applies to the data in Table 6 which presents, in order, the low, median, and high values.

One other measure of residence time for which data was collected is the "leading edge." With the trommel empty and rotating, the time of entry of the first charge of flakes was noted. The time when the leading edge of the flakes reached the discharge end was noted. The elapsed time from feed to discharge is considered the leading edge time. The leading edge does not refer to the first flake, but to the first flakes which are moving through the trommel in a group. Again, subjective judgments were involved, but the observer agreement was close. Leading edge times are presented in Table 7. It should be kept in mind that the test was performed during simulated steady state operation, i.e., bags of flakes were continually being fed at 15 sec intervals.

Additional tests to determine residence times were conducted, at a higher loading rate, specifically 0.9 Mg/h (1 tph) which was achieved by feeding 13,000 flakes every 15 sec into the trommel. At this rate it was not possible to follow a seed flake visually, so impingements could not be counted. Residence times were measured by timing a number of oversize painted seed flakes (51 mm x 51 mm, 0.45 to 0.55 g) from input to discharge. The residence times measured during this series of tests are shown in Table 8, along with the mean and standard error.

Using the same techniques developed to determine impingements and residence times for flakes, similar data was gathered for wooden blocks. The blocks were made of oak, were cube-shaped at 33.3 mm (1.31 in) on each side and weighed 25.0 g. Residence times and impingements were measured by recording the signals of observers on video tape, then playing the tape back, counting the impingement signals and the time between entry and exit. The seed blocks were painted oversize blocks (40.4 mm each side, 44.7 g). Table 9 presents mean residence times and the standard error and Table 10 presents the low-median-high data.

MASS SPLIT, SEPARATION EFFICIENCY AND UNDERSIZE DISTRIBUTION TESTS

The results of separation tests on the pilot trommel are included in this section. These data were gathered from the tests reported in the previous section where collection of flake and block residence time and impingement data was the major objective. The 45 mm square flakes, 33.3 mm cubes or a mixture of flakes and blocks were charged varying rates at 15 sec. intervals. After the tests, the oversize and undersize fractions were collected and the mass split calculated.

In this section, the fraction of the input that passed through the screen is termed the undersize fraction and the fraction of the input that exited the trommel at the discharge end is termed the oversize fraction. Note this use of terminology. Since all of the test flakes and blocks were small enough to pass through the screen holes, undersize and oversize should not be confused with the actual particle size.

Since only a single undersize feedstock (flakes or blocks) was used for the tests reported here, the screening efficiency and mass split are defined by the same formula.

$$\text{Separation Efficiency} = \text{Mass Split (\% to undersize)} = \frac{\text{Mass of Undersize}}{\text{Mass of Oversize + Mass of Undersize}} \times 100$$

The summary of the results of flake tests is presented in Table 11. Note that the mass split in Tables 11 - 15 reported as "% to the oversize" which is simply 100% minus the mass split as "% to the undersize."

Comparing the results of tests conducted near the beginning of the test series with those conducted near the end revealed higher flake separation efficiencies for the same conditions, for the later tests. This inconsistency can be attributed to wear on the flakes. As the edges or corners are bent, the flake dimensions are reduced and more of such smaller flakes will be screened into the undersize.

A series of tests were performed to determine the separation efficiencies for the wooden blocks under simulated steady state operation. A summary of those test results is included in Table 12. The block separation tests yielded higher efficiencies than did the flake tests. Relatively few blocks were observed to reach the second half of the trommel or the oversize. To obtain more representative mass splits, the tests were re-run with the second half of the trommel blanked off with aluminum sheets, thereby reducing the screening area by half. The results are shown in Table 13.

The final series of separation tests were conducted on mixtures of the flakes and blocks. Measured proportions of blocks and flakes were combined and then fed into the trommel at 15 sec intervals. The trommel speed was kept constant at 20 rpm. The composition of the mixture was varied from test to test. The results are shown in Table 15.

Undersize Distribution

To gain more insight into the distribution of the particles reporting to the undersize, a wooden compartmentalized structure was placed under the trommel. The structure was divided along the axis of the trommel into four divisions of equal 0.61 m (2 ft) length. They were numbered consecutively from 1 to 4, beginning with the section nearest the feed end. Table 15 summarizes the axial distribution data for blocks recorded during steady state loading. Table 16 summarizes the axial distribution data for mixtures of flakes and blocks recorded during simulated steady-state operation.

The undersize collection box was also subdivided to collect material passing through 6 sectors around the circumference of the trommel. The layout of the collection structure in relation to the trommel is shown in Figure 2. Looking down the barrel, along the axis of the trommel from the feed end, vertical partitions parallel to the axis of the trommel were located so that material passing through a sector from 0 to 45° to the left of center fell in one compartment, and 0 to 45° to the right of center fell in another. Material falling through sectors from 45° to 90° left (or right) fell in separate compartments as did particles exiting the screen in sectors over 90°, right or left. Tables 17 through 29 summarize the sectional distribution data for flakes gathered during steady state loading.

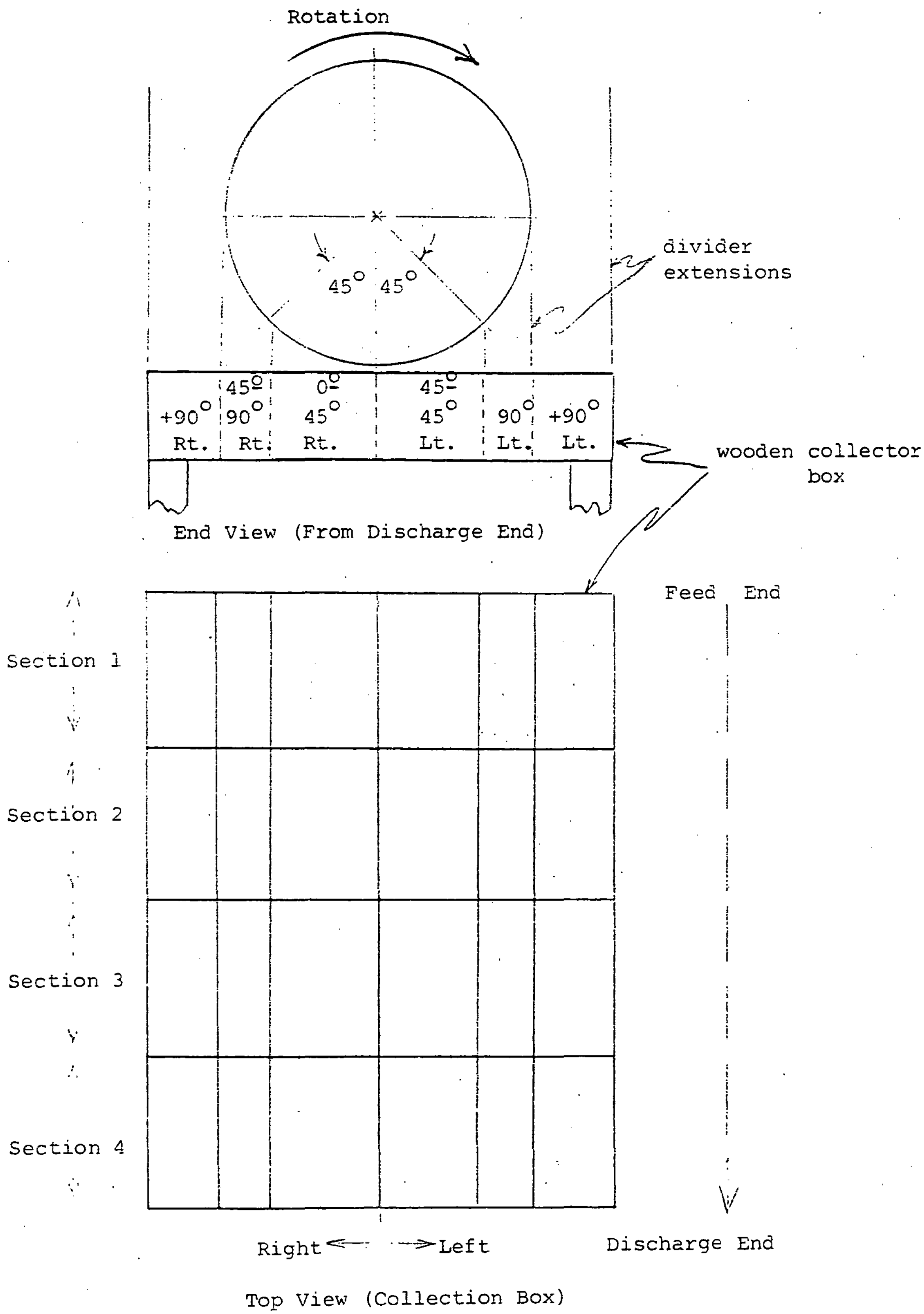

Figure 2. UNDERSIZE COLLECTION BOX LAYOUT

TYPE OF TEST	MEAN ANGLE OF MOVEMENT, $\bar{\alpha}$ AND STANDARD ERROR [S]
FIRST SLIDE, NON-STRATIFIED	35° [6.3°]
FIRST-SLIDE, NON STRATIFIED	35° [7.6°]
FIRST-SLIDE, STRATIFIED	37° [7.2°]
COLLAPSE, NON STRATIFIED	72° [9.1°]
COLLAPSE, STRATIFIED	72° [8.1°]

Table 1. Summary of Dynamic Angle of Repose

TEST PARTICLES	COEFFICIENT OF STATIC FRICTION		COEFFICIENT OF KINETIC FRICTION	
	PULLEY TEST	INCLINED PLANE TEST	PULLEY TEST	INCLINED PLANE TEST
BLACK FLAKE W/WEIGHT ON BLACK SHEET	0.287	0.358	0.248	0.318
WHITE FLAKE W/WEIGHT ON WHITE SHEET	0.418	0.302	0.335	0.273
BLACK FLAKE W/ WEIGHT ON GLUED BED OF FLAKES	0.428	0.281	0.400	0.263
BLACK FLAKE W/ WEIGHT ON LOOSE BED OF FLAKES	0.340	0.305	0.328	0.290
BLACK FLAKE W/ NO WEIGHT ON BLACK SHEET	—	0.647	—	0.589
BLACK FLAKE W/ NO WEIGHT ON GLUED BED OF FLAKES	—	0.718	—	0.655
MEAN	0.37	0.31	0.33	0.29
STANDARD ERROR	0.067	0.033	0.062	0.024

Table 2. Summary of Coefficient of Friction

SPEED (RPM)	LOADING (# OF FLAKES)	SEED FLAKE	IMPINGE-MENTS	AXIAL DIS-PLACEMENT (ft)	RESIDENCE TIME (s)
5	100	BLACK	20	6.5	67
5	100	BLACK	6	2.3	20
5	100	BLACK	13	3.5	45
5	100	BLACK	15	6.5	49
5	100	BLACK	23	8.5	75
10	100	BLACK	20	8.0	42
10	100	BLACK	11	4.5	26
10	100	BLACK	10	3.5	24
10	100	BLACK	4	2.5	9
10	100	BLACK	6	2.0	19
15	200	BLACK	5	3.0	16
15	200	BLACK	8	4.3	15
15	200	PINK	10	2.8	19
15	200	PINK	17	4.5	41
15	200	PINK	25	6.0	45
20	200	PINK	9	3.0	17
20	200	PINK	7	3.0	11
20	200	PINK	5	3.0	9
20	200	PINK	23	9.0	41
20	200	PINK	23	7.0	40
20	200	BLACK	9	5.0	22
20	200	MARKED	14	2.5	30
20	200	MARKED	8	5.5	19
20	200	MARKED	22	6.0	42
20	200	MARKED	35	6.5	35
25	200	MARKED	3	1.5	8
25	200	MARKED	23	3.0	45
25	200	MARKED	21	4.5	43
25	200	MARKED	4	4.5	9
25	200	MARKED	3	1.5	6

Table 3. Flake Retention Time and Impingements - Batch Feed and Dilute Loadings

SPEED (RPM)	LOADING (# OF FLAKES)	SEED FLAKE	IMPINGE-MENTS	AV[illegible] DIS[illegible]	RESIDENCE TIME (S)
[illegible]	[illegible]	MARKED	6	[illegible].8	10
30	300	PINK	6	1.8	10
30	300	ORANGE	11	5.5	18
30	300	?	18	4.5	28
37.2	500	MARKED	3	2.5	6
37.2	500	PINK	7	3.8	15
37.2	500	MARKED	8	3.0	13
37.2	500	ORANGE	10	3.5	27
37.2	500	PINK	7	3.8	18
20	1000	BLACK LIGHT	—	10.0	40
20	1000	PINK	17	5.5	32
60	1000	MARKED	6	5.0	14
60	1000	PINK	25	10.0	40
[illegible]	1000	PINK	11	6.8	25
10	1000	ORANGE	28	10.0	60
10	1000	ORANGE	20	10.0	59
10	1000	ORANGE	12	7.0	34
10	1000	ORANGE	34	9.0	75
10	1000	ORANGE	15	7.0	35

Table 3 (continued). Flake Retention Time and Impingements - Batch Feed and Dilute Loadings

SPEED rpm	ENTIRE TROMMEL LENGTH: IMPINGEMENTS				ENTIRE TROMMEL LENGTH: RESIDENCE TIME, SEC.				FIRST 1.00m OF TROMMEL: IMPINGEMENTS				FIRST 1.00m OF TROMMEL: RESIDENCE TIME, SEC.			
	HIGH	MX	LOW	b	HIGH	MX	LOW	b	HIGH	MX	LOW	b	HIGH	MX	LOW	b
10	52	28	16	6.6	116	60	36	14.1	17	14	7	3.1	39	28	14	6.4
15	35	23	15	6.2	53	41	28	6.5	18	11	5	3.8	25	19	8	5.3
20	33	22	14	4.8	55	37	25	6.8	14	10	8	2.8	26	18	6	4.8
25	38	28	17	5.8	63	41	29	14.3	14	11	7	2.8	25	17	10	4.1
30	-	-	-	-	-	-	-	-	16	13	7	2.8	39	21	10	6.0

Table 4. Residence Time and Impingements - Batch Feed - 1000 Flakes

LOADING, FLAKES/15 SEC	TROMMEL SPEED, RPM	NUMBER OF TESTS	FIRST HALF (5S) IMPINGEMENTS $\bar{x}$ [s]	FIRST HALF (5S) RESIDENCE TIME, SEC $\bar{t}$ [s]	SECOND HALF IMPINGEMENTS $\bar{x}$ [s]	SECOND HALF RESIDENCE TIME, SEC $\bar{t}$ [s]	TOTAL LENGTH IMPINGEMENTS $\bar{x}$ [s]	TOTAL LENGTH RESIDENCE TIME, SEC $\bar{t}$ [s]
1000	5	6	24 [5.4]	78 [16.0]	16 [2.6]	52 [9.9]	40 [4.2]	130 [illegible]
* 1000	10	11	13 [3.5]	31 [7.6]	11 [1.6]	29 [7.3]	24 [3.8]	60 [11.7]
1000	15	10	12 [4.8]	25 [10.7]	14 [2.7]	28 [illegible]	26 [5.2]	53 [11.9]
* 1000	20	12	10 [2.4]	19 [5.0]	11 [6.6]	30 [14.7]	21 [6.5]	49 [14.9]
1000	25	13	10 [2.5]	18 [4.4]	14 [6.6]	23 [4.8]	24 [7.4]	42 [6.5]
* 1000	30	11	11 [5.4]	17 [9.1]	23 [12.5]	40 [24.4]	34 [10.2]	57 [21.3]
1000	35	7	17 [5.8]	30 [17.2]	36 [28.1]	54 [35.1]	47 [25.8]	84 [37.7]
2000	10	11	17 [2.2]	36 [3.9]	12 [2.4]	27 [5.4]	29 [3.8]	62 [6.1]
* 2000	20	16	10 [2.6]	17 [4.7]	10 [2.4]	18 [4.8]	19 [3.4]	35 [6.3]
2000	30	14	11 [2.6]	18 [4.5]	14 [6.1]	21 [10.8]	[illegible]	38 [9.5]
3000	10	14	15 [2.8]	32 [4.2]	10 [1.4]	20 [3.4]	[illegible]	56 [4.1]
3000	20	19	11 [2.6]	18 [3.3]	9 [illegible]	14 [4.2]	[illegible]	32 [4.9]
3000	30	19	8 [2.4]	13 [3.1]	[illegible]	15 [4.8]	11 [1.4]	27 [5.0]

NOTE: TOTALS MAY NOT EQUAL SUM OF HALVES DUE TO ROUNDING. TESTS MARKED WITH "*" USED A SEED FLAKE WEIGHING 0.48 g (50.8 mm x 50.8 mm x 0.[illegible] mm). ALL OTHER TESTS USED A SEED FLAKE WEIGHING 0.55 g (50.8 mm x 50.8 mm x 0.315 mm).

Table 5. Mean Residence Times ($\bar{t}$) and Impingements ($\bar{x}$) and Standard Errors (s) for Seed Flakes During Steady State Loading

LOADING, FLAKES/15 SEC	[illegible] SPEED, L.F.M.	NUMBER OF TESTS	FIRST HALF (5.5') IMPINGE-MENTS	RESIDENCE TIME, SEC	SECOND HALF IMPINGE-MENTS	RESIDENCE TIME, SEC	TOTAL LENGTH IMPINGE-MENTS	RESIDENCE TIME, SEC
1000	5	6	18-23-34	63-71-99	12-16-19	43-48-70	33-41-46	112-131-144
1000	10	11	10-12-22	23-30-48	9-16-14	19-27-43	20-23-32	47-56-83
1000	15	10	6-10-21	11-23-43	9-13-18	20-30-57	15-27-34	31-55-66
1000	20	12	8-10-14	14-17-28	6-13-31	15-27-70	14-23-39	34-46-84
1000	25	13	6-9-13	10-19-23	6-13-24	9-23-47	16-21-41	29-34-40
1000	30	11	7-9-24	10-13-39	5-20-52	9-33-101	22-31-60	35-48-114
1000	35	7	5-12-20	10-29-62	12-26-92	12-44-118	18-44-97	32-79-151
2000	10	11	14-17-22	27-37-40	8-12-16	20-24-39	25-29-38	55-61-77
2000	20	16	6-10-17	12-16-29	6-9-13	10-17-29	13-19-27	27-35-47
2000	30	14	7-10-16	11-17-27	5-14-26	7-20-44	13-25-33	25-40-56
3000	10	14	12-15-19	25-31-41	8-10-13	15-23-27	22-25-31	50-57-64
3000	20	19	6-11-14	13-17-25	7-8-13	9-12-24	16-19-24	25-32-47
3000	30	19	5-9-12	6-13-17	4-8-19	8-14-26	11-17-31	20-27-43

Table 6. Low-Median-High Impingements and Residence Times For Seed Flakes During Steady State

LOADING, FLAKES 15 SEC	TROMMEL SPEED, RPM	LEADING EDGE, SEC
1000	5	100
1000	10	60
1000	15	45
1000	20	40
1000	25	45
1000	30	60
1000	35	130
2000	10	45
2000	20	30
2000	30	45
3000	10	45
3000	20	25
3000	30	30

Table 7. Leading Edge Times -
Steady State Operation

TROMMEL SPEED, RPM	RUN NO.	RESIDENCE TIMES, SEC
10	1	64, 67, 68, 69, 70, 71, 76, 85
	2	42, 51, 52, 54, 58, 61, 62
	3	43, 44, 46 47, 48, 49, 50, 51, 53, 57
	4	42, 46, 47, 53, 58, 59, 61
	TOTAL	$\bar{t}$ = 56 s = 10.6
15	1	32, 36, 37, 38, 39, 40
	2	32, 33, 35, 36, 37, 38, 39, 40, 41, 42
	3	28, 31, 32, 33, 34, 35, 36, 37, 38
	4	32, 33, 34, 35, 36, 37, 41, 42
	TOTAL	$\bar{t}$ = 36 s = 3.4
20	1	24, 25, 26, 27, 27, 28, 30, 30, 31, 32
	2	26, 27, 32, 32, 33, 33, 34, 37, 39, 46
	3	26, 27, 29, 31, 32, 33, 34, 38, 39
	4	28, 33 34, 36, 36, 37, 38, 40
	TOTAL	$\bar{t}$ = 32 s = 5.7
30	1	17, 19, 20, 21, 22, 23, 23, 24
	2	19, 20, 21, 22, 23, 27, 30, 42, 53
	3	16, 20, 21, 23, 24, 25, 29, 30, 36, 42
	4	17, 22, 25, 26, 29, 32, 35, 41, 44
	TOTAL	$\bar{t}$ = 26 s = 7.4

Table 8. Residence Times for Flakes for a 0.9 Mg/h (1 tph) Loading

LOADING BLOCKS/15 SEC	TROMMEL SPEED, RPM	SAMPLE SIZE	FIRST HALF (5.5')		SECOND HALF		TOTAL LENGTH	
			IMPINGEMENTS $\bar{x}$ [s]	RESIDENCE TIMES, SEC $\bar{t}$ [s]	IMPINGEMENTS $\bar{x}$ [s]	RESIDENCE TIMES, SEC $\bar{t}$ [s]	IMPINGEMENTS $\bar{x}$ [s]	RESIDENCE TIMES, SEC $\bar{t}$ [s]
200	5	7	9 [4.4]	39. [17.2]	7 [1.9]	30 [7.2]	16. [5.1]	68 [16.9]
200	10	12	7 [2.2]	17 [5.4]	5 [3.6]	13 [8.6]	12 [4.0]	30 [6.0]
200	15	9	4 [1.9]	9 [3.5]	4 [1.9]	10 [2.5]	9 [3.0]	17 [6.0]
200	20	15	7 [1.5]	12 [3.1]	6 [3.5]	9 [3.1]	13 [4.1]	20 [6.7]
200	25	15	6 [1.8]	8 [2.1]	5 [2.3]	9 [3.4]	11 [3.3]	17 [4.6]
200	30	18	7 [2.6]	11 [3.8]	5 [3.1]	7 [4.4]	12 [4.4]	18 [6.3]
200	35	17	6 [1.8]	8 [2.5]	5 [3.1]	7 [4.0]	10 [3.3]	15 [4.4]
300	10	6	7 [2.1]	16 [4.4]	6 [3.7]	14 [6.7]	13 [4.8]	30 [9.6]
300	20	10	5 [1.4]	9 [2.6]	5 [2.3]	8 [3.3]	10 [2.7]	17 [4.1]
300	30	12	6 [1.2]	8 [1.9]	4 [2.0]	6 [2.8]	10 [2.9]	14 [4.1]
400	10	6	6 [2.3]	17 [5.8]	6 [1.6]	14 [3.7]	12 [1.8]	30 [5.4]
400	20	5	8 [0.6]	13 [1.6]	5 [0.5]	9 [1.1]	12 [0.9]	22 [2.5]
400	3	8	7 [1.6]	11 [2.4]	4 [1.7]	7 [2.6]	12 [1.1]	18 [3.1]

NOTE: TOTALS MAY NOT EQUAL SUM OF HALVES DUE TO ROUNDING.

Table 9. Mean Residence Times ($\bar{t}$), Impingements ($\bar{x}$), and Standard Errors (s) for Seed Blocks During Steady State Loading

LOADING, BLOCKS/15 SEC	TROMMEL SPEED, RPM	NUMBER OF TESTS	FIRST HALF (1.7m)		SECOND HALF		TOTAL LENGTH	
			IMPINGE-MENTS	RESIDENCE TIMES, SEC	IMPINGE-MENTS, SEC	RESIDENCE TIMES, SEC	IMPINGE-MENTS	RESIDENCE TIMES, SEC
200	5	7	4-7-16	19-32-63	5-7-11	20-29-42	9-15-22	43-65-91
200	10	12	5-5-12	12-16-23	1-4-11	5-9-29	6-12-18	18-28-47
200	15	12	5-7-12	10-15-27	2-3-6	5-7-15	7-12-14	19-25-32
200	20	15	6-7-11	9-12-21	2-5-15	4-9-15	8-13-25	14-22-28
200	25	15	2-5-10	5-8-13	1-6-9	2-9-13	5-10-16	9-18-23
200	30	18	4-6-13	5-9-18	2-4-11	3-6-16	7-11-23	11-16-33
200	35	17	3-6-11	3-8-15	1-4-11	2-6-15	4-10-16	5-15-21
300	10	6	4-8-9	10-17-21	3-4-12	8-12-25	7-13-19	20-29-44
300	20	10	4-5-8	6-8-9	2-5-10	3-9-14	7-9-17	11-17-27
300	30	12	5-5-9	6-7-13	1-3-8	2-6-11	6-9-17	9-14-24
400	10	6	5-5-11	12-15-28	4-5-8	9-13-20	10-11-15	24-29-39
400	20	5	7-8-8	11-13-15	4-5-5	8-9-11	11-13-13	20-22-29
400	30	8	5-8-9	8-12-14	2-4-7	3-6-11	9-11-15	14-17-24

Table 10. Low-Median-High Impingement and Residence Times for Seed Blocks During Steady State Loading

TROMMEL SPEED, RPM	MASS FEED RATE, LBS/HR	MASS SPLIT, % TO OVERS	TEST DURATION, MIN	TEST DATE
5	153	78.9	15	2-20-81
10	153	58.0	15	2-17-81
10	307	84.8	15	2-24-81
10	307	74.2	5	4-9-81
10	460	90.4	15	2-25-81
10	460	89.2	5	4-9-81
10	750	92.0	5	4-7-81
10	1250	95.1	5	4-6-81
10	2000	97.0	5	3-31-81
15	153	53.0	15	2-20-81
20	153	40.8	15	2-18-81
20	153	39.4	5	4-9-81
20	307	76.3	15	3-5-81
20	307	65.5	5	4-9-81
20	460	83.3	15	2-23-81
20	460	75.8	5	4-9-81
20	750	88.4	5	4-2-81
20	1000	90.4	5	4-2-81
20	1250	92.8	5	4-2-81
20	1500	94.8	5	4-2-81
20	2000	96.1	5	4-1-81
25	153	48.3	15	2-26-81
30	153	7.1	5	3-24-81
30	307	67.5	15	3-6-81
30	307	54.1	5	4-8-81
30	307	52.7	15	4-8-81
30	307	50.4	5	4-8-81
30	460	83.4	15	2-24-81
30	460	68.4	5	4-3-81
30	460	68.8	5	4-6-81
30	460	72.8	15	4-7-81
30	750	84.5	5	4-3-81
30	1250	90.7	5	4-3-81
30	2000	95.1	5	3-30-81
30	2000	94.9	5	4-1-81
35	153	20.0	15	2-23-81

Table 11. Mass Split to Overs for Flakes During Steady State Loading

TROMMEL SPEED, RPM	BLOCK FEED RATE, BLOCKS/MIN	MASS FEED RATE, LBS/HR	MASS SPLIT, % TO OVERS	TEST DURATION, MIN	TEST DATE
5	800	1620	6.4	7.0	3-11-81
10	800	1620	15.0	7	3-11-81
10	1200	2440	12.7	4.5	3-12-81
10	1600	3240	12.3	2.5	3-12-81
15	800	1620	24.2	7	3-18-81
20	800	1620	38.6	7	3-10-81
20	1200	2440	32.5	4.5	3-13-81
20	1600	3240	31.2	2.5	3-12-81
25	800	1620	28.8	7	3-16-81
30	800	1620	27.7	7	3-11-81
30	1200	2440	20.6	4.5	3-13-81
30	1600	3240	23.5	2.5	3-12-81
35	800	1620	17.2	7	3-13-81

Table 12. Mass Split to Overs (Full Trommel Length) For Blocks During Steady State Loading

TROMMEL SPEED, RPM	BLOCK FEED RATE, BLOCKS/min	MASS FEED RATE, LBS/HR	MASS SPLIT % TO OVERS	TEST DATE
10	800	1620	17.4	4-15-81
10	1600	3240	16.8	4-14-81
10	3200	6480	17.4	4-14-81
10	6400	12960	21.5	4-14-81
20	800	1620	42.1	[illegible]
20	1600	[illegible]	40.8	4-16-8
20	3200	6480	37.2	4-15-81
20	6400	12960	34.2	4-15-81
30	800	1620	29.5	4-16-81
30	[illegible]	[illegible]	27.4	4-16-81
30	3200	6480	25.0	4-16-81
30	6400	12960	23.2	4-16-8

Table 13. Mass Split to Overs (Half Trommel Length) for Blocks During Simulated Steady State Operation

MASS FLOW RATE, LBS/HR	FLAKE MASS FLOW RATE, LBS/HR	BLOCK MASS FLOW RATE, LBS/HR	PERCENT FLAKES BY WEIGHT, %	MASS SPLIT TO OVERS (TROMMEL SPEED = 20 RPM)		
				MIXTURE, %	BLOCKS, %	FLAKES, %
528	475	53	10	82	90	81
528	396	132	25	79	84	77
528	317	211	40	74	82	69
528	158	370	70	65	73	45
528	-0-	528	100	40	40	-0-
2112	1584	528	25	94	93	94
2112	1267	845	40	92	91	92
2112	634	1478	70	79	75	82
2000	2000	-0-	-0-	96	-0-	96
460	460	-0-	-0-	84	-0-	-0-

Table 14. Mass Splits to Overs for Mixtures of Flakes and Blocks Under Steady State Loading at a Trommel Speed of 20 RPM

MASS FLOW RATE, lbs/hr	PERCENT BLOCKS BY WEIGHT, %	PARTICLE TYPE	AXIAL DISTRIBUTION OF UNDERS							
			BY WEIGHT, g				BY % UNDERS, %			
			1	2	3	4	1	2	3	4
528	10	FLAKE	1600	2300	1400	1500	24	34	21	22
		BLOCK	150	125	150	50	32	26	32	11
528	25	FLAKE	1500	2200	1600	1500	22	32	24	22
		BLOCK	400	775	225	200	24	48	14	13
528	40	FLAKE	1700	2300	1600	1600	24	32	22	22
		BLOCK	700	1450	450	425	23	48	15	14
528	70	FLAKE	1300	2100	1400	1400	21	34	23	23
		BLOCK	2450	3150	875	950	33	42	12	13
528	100	BLOCK	7820	12390	2410	1790	32	51	10	7
2112	25	FLAKE	830	1300	880	780	22	34	23	21
		BLOCK	550	675	175	50	38	47	12	3
2112	40	FLAKE	990	1250	830	820	25	32	21	21
		BLOCK	400	1375	400	275	31	47	14	9
2112	70	FLAKE	850	1450	920	920	21	35	22	22
		BLOCK	3240	5760	2030	1360	26	46	16	11

NOTE: Weights appear as lbs in flow rate, but grams in sectional distribution.

Table 16. Axial Distribution of Mixtures of Blocks and Flakes Under Steady State Loading at a Trommel Speed of 20 RPM

LOADING BLOCKS/MIN	TERMINAL SPEED, FPM	AXIAL DISTRIBUTION OF BLOCKS							
		BY WEIGHT, LBS				BY % NUMBERS, %			
		1	2	3	4	1	2	3	4
800	5	230.0	64.3	6.2	5.8	75	21	2	2
800	10	169.8	65.9	10.7	8.0	67	26	4	3
800	15	140.8	71.5	17.5	11.8	58	30	7	5
800	20	76.0	75.8	17.0	17.0	41	41	9	9
800	25	130.0	62.6	20.1	15.9	57	27	9	7
800	30	104.0	77.8	20.8	19.4	47	35	9	9
800	35	131.4	95.1	13.1	13.7	52	38	5	5
1200	10	181.8	64.3	11.1	6.3	69	24	4	3
1200	20	88.7	76.1	16.1	20.8	44	38	8	10
1200	30	136.5	77.5	13.4	13.7	57	32	6	6
1600	10	180.5	64.4	11.7	7.7	68	24	4	3
1600	20	96.1	48.8	13.7	11.9	56	29	8	7
1600	30	127.4	75.9	18.3	15.1	54	32	8	6

Table 15. Axial Distribution of Blocks for
Steady State Loading

TROMMEL SPEED 5 RPM

LOADING 1000 FLAKES / 15 SEC

TEST DURATION MIN

FLOW IS FROM FEED END (SECTION 1) TO DISCHARGE END (SECTION 4). ROTATION IS CLOCKWISE WHEN VIEWED FROM DISCHARGE END. "RIGHT" AND "LEFT" ARE DETERMINED IN DIRECTION OF FLOW FROM FEED END.

SEPARATION BY WEIGHT

RIGHT	+90	90-45	45-0	0-45	45-90	+90	LEFT	TOTAL
1	195	165	[illegible]	142	[illegible]	—	1	
2	76	183	[illegible]	105	[illegible]	[illegible]	2	
3	178	449	307	77	10	1	3	
4	91	[illegible]	[illegible]	66	[illegible]	1	4	
TOTAL							TOTAL	

SEPARATION BY PER CENT WEIGHT

RIGHT	+90	90-45	45-0	0-45	45-90	+90	LEFT	TOTAL
1		[illegible]	12.5	[illegible]	0.6	—	1	27.1
2	[illegible]	[illegible]	15.[illegible]	[illegible]	0.9	0.1	2	24.7
3	[illegible]	[illegible]	8.4	[illegible]	0.3	—	3	28.3
4		7.9	[illegible]	1.6	0.4	—	4	19.6
TOTAL	5.1	30.2	41.3	10.3	2.2	0.1	TOTAL	100

Table 17. Screening Separation for Flakes at a Trommel Speed of 5 RPM and a Loading Rate of 1000 Flakes/15 Sec.

TROMMEL SPEED 10 RPM

LOADING 1000 FLAKES / 15 SEC

TEST DURATION MIN

FLOW IS FROM FEED END (SECTION 1) TO DISCHARGE END (SECTION 4). ROTATION IS CLOCKWISE WHEN VIEWED FROM DISCHARGE END. "RIGHT" AND "LEFT" ARE DETERMINED IN DIRECTION OF FLOW FROM FEED END.

SEPARATION BY WEIGHT

RIGHT	+90	90-45	45-0	0-45	45-90	+90	LEFT	TOTAL
1	114	675	771	172	58	2	1	
2	125	575	567	230	54	1	2	
3	154	738	678	184	41	2	3	
4	168	713	536	146	41	2	4	
TOTAL							TOTAL	

SEPARATION BY PERCENT WEIGHT

RIGHT	+90	90-45	45-0	0-45	45-90	+90	LEFT	TOTAL
1	1.7	10.0	11.4	2.5	0.9	-0-	1	26.0
2	1.9	8.5	8.4	3.4	0.8	-0-	2	23.0
3	2.3	10.9	10.0	2.7	0.6	-0-	3	26.5
4	2.5	10.6	7.9	2.2	0.6	-0-	4	23.8
TOTAL	8.4	40.0	37.7	10.8	2.9	-0-	TOTAL	99

Table 18. Screening Separation for Flakes at a Trommel Speed of 10 RPM and a Loading Rate of 1000 Flakes/15 Sec.

TROMMEL SPEED 15 RPM

LOADING 1000 FLAKES/15 SEC

TEST DURATION MIN

FLOW IS FROM FEED END (SECTION 1) TO DISCHARGE END (SECTION 4). ROTATION IS CLOCKWISE WHEN VIEWED FROM DISCHARGE END. "RIGHT" AND "LEFT" ARE DETERMINED IN DIRECTION OF FLOW FROM FEED END.

SEPARATION BY WEIGHT (g)

RIGHT	+90	90-45	45-0	0-45	45-90	+90	LEFT	TOTAL
1	200	591	680?	245	96?	28?	1	
2	183	920	583?	348?	144?	33?	2	
3	246	921	492	269	115	20?	3	
4	410	715	517	205	98	21?	4	
TOTAL							TOTAL	

SEPARATION BY PERCENT WEIGHT

RIGHT	+90	90-45	45-0	0-45	45-90	+90	LEFT	TOTAL
1	2.5?	[illegible]	9.5?	[illegible]	[illegible]	[illegible]	1	22.8
2	[illegible]	[illegible]	7.2	[illegible]	[illegible]	[illegible]	2	27.4
3	[illegible]	11.4	6.1	3.3	[illegible]	0.2	3	25.4
4	[illegible]	8.8	[illegible]	[illegible]	[illegible]	0.3	4	24.4
TOTAL	[illegible]	38.4?	[illegible]	[illegible]	[illegible]	1.2	TOTAL	100

Table 19. Screening Separation for Flakes at a Trommel Speed of 15 RPM and a Loading Rate of 1000 Flakes/15 Sec.

TROMMEL SPEED 20 RPM

LOADING 1000 FLAKES / 15 SEC

TEST DURATION MIN

FLOW IS FROM FEED END (SECTION 1) TO DISCHARGE END (SECTION 4). ROTATION IS CLOCKWISE WHEN VIEWED FROM DISCHARGE END. "RIGHT" AND "LEFT" ARE DETERMINED IN DIRECTION OF FLOW FROM FEED END.

SEPARATION BY WEIGHT

RIGHT	+90	90-45	45-0	0-45	45-90	+90	LEFT	TOTAL
1	205	480	449	148	81	15	1	
2	261	865	470	228	148	9	2	
3	454	745	442	207	171	19	3	
4	430	711	453	194	142	12	4	
TOTAL							TOTAL	

SEPARATION BY PER CENT WEIGHT

RIGHT	+90	90-45	45-0	0-45	45-90	+90	LEFT	TOTAL
1	2.8	6.5	6.1	2.0	1.1	0.2	1	18.7
2	3.6	11.8	6.4	3.1	2.0	0.1	2	27.0
3	6.2	10.2	6.0	2.8	2.3	0.3	3	27.8
4	5.9	9.7	6.2	2.6	1.9	0.2	4	26.5
TOTAL	18.5	38.2	24.7	10.5	7.3	0.8	TOTAL	100

Table 20. Screening Separation for Flakes at a Trommel Speed of 20 RPM and a Loading Rate of 1000 Flakes/15 Sec.

TROMMEL SPEED 25 RPM

LOADING 1000 [illegible]/15 SEC

TEST DURATION MIN

FLOW IS FROM FEED END (SECTION 1) TO DISCHARGE END (SECTION 4). ROTATION IS CLOCKWISE WHEN VIEWED FROM DISCHARGE END. "RIGHT" AND "LEFT" ARE DETERMINED IN DIRECTION OF FLOW FROM FEED END.

SEPARATION BY WEIGHT (g)

RIGHT	+90	90-45	45-0	0-45	45-90	+90	LEFT	TOTAL
1	314	499	706	144	91	39	1	
2	430	603	859	215	129	76	2	
3	616	640	651	336	185	78	3	
4	745	615	658	195	256	222	4	
TOTAL							TOTAL	

SEPARATION BY PERCENT WEIGHT

RIGHT	+90	90-45	45-0	0-45	45-90	+90	LEFT	TOTAL
1	3.4	5.4	7.6	1.5	1.0	0.4	1	14.3
2	4.6	6.5	9.2	2.3	1.3	0.8	2	24.7
3	6.6	6.9	7.0	3.6	2.0	0.8	3	26.9
4	8.0	6.6	7.1	2.1	2.8	2.4	4	29.0
TOTAL	22.6	25.4	30.9	9.5	7.1	4.4	TOTAL	100.0

Table 21. Screening Separation for Flakes at a Trommel Speed of 25 RPM and a Loading Rate of 1000 Flakes/15 Sec.

TROMMEL SPEED 30 RPM

LOADING 1000 FLAKES/15 SEC

TEST DURATION MIN

FLOW IS FROM FEED END (SECTION 1) TO DISCHARGE END (SECTION 4). ROTATION IS CLOCKWISE WHEN VIEWED FROM DISCHARGE END. "RIGHT" AND "LEFT" ARE DETERMINED IN DIRECTION OF FLOW FROM FEED END.

SEPARATION BY WEIGHT

RIGHT	+90	90-45	45-0	0-45	45-90	+90	LEFT	TOTAL
1	320	389	522	396	289	277	1	
2	679	464	820	638	451	243	2	
3	872	492	703	563	628	322	3	
4	646	558	692	575	675	318	4	
TOTAL							TOTAL	

SEPARATION BY PERCENT WEIGHT

RIGHT	+90	90-45	45-0	0-45	45-90	+90	LEFT	TOTAL
1	2.6	3.1	4.2	3.2	2.3	2.2	1	17.6
2	5.4	3.7	6.5	5.1	3.6	1.9	2	26.2
3	7.0	3.9	5.6	4.5	5.0	2.6	3	28.6
4	5.2	4.5	5.5	4.6	5.4	2.5	4	27.7
TOTAL	20.2	15.2	21.8	17.4	16.3	9.2	TOTAL	100

Table 22. Screening Separation for Flakes at a Trommel Speed of 30 RPM and a Loading Rate of 1000 Flakes/15 Sec.

TROMMEL SPEED 35 RPM

LOADING 1000 FLAKES/15 SEC

TEST DURATION MIN

FLOW IS FROM FEED END (SECTION 1) TO DISCHARGE END (SECTION 4). ROTATION IS CLOCKWISE WHEN VIEWED FROM DISCHARGE END. "RIGHT" AND "LEFT" ARE DETERMINED IN DIRECTION OF FLOW FROM FEED END.

SEPARATION BY WEIGHT (g)

RIGHT	+90	90-45	45-0	0-45	45-90	+90	LEFT	TOTAL
1	497	369	675	692	548	187	1	
2	647	[illegible]	734	979	1186	279	2	
3	734	340	537	814	805	412	3	
4	484	232	375	459	449	307	4	
TOTAL							TOTAL	

SEPARATION BY PERCENT WEIGHT

RIGHT	+90	90-45	45-0	0-45	45-90	+90	LEFT	TOTAL
1	3.7	2.6	5.1	5.2	4.1	1.4	1	22.3
2	4.9	3.9	5.5	7.4	8.9	2.1	2	32.7
3	5.5	2.6	4.0	6.1	6.1	3.1	3	27.4
4	3.7	1.7	2.8	3.5	3.4	[illegible]	4	17.4
TOTAL	17.8	11.0	17.4	[illegible]	22.5	8.9	TOTAL	

Table 23. Screening Separation for Flakes at a Trommel Speed of 35 RPM and a Loading Rate of 1000 Flakes/15 Sec.

TROMMEL SPEED 10 RPM

LOADING 2000 FLAKES/15 SEC

TEST DURATION MIN

FLOW IS FROM FEED END (SECTION 1) TO DISCHARGE END (SECTION 4). ROTATION IS CLOCKWISE WHEN VIEWED FROM DISCHARGE END. "RIGHT" AND "LEFT" ARE DETERMINED IN DIRECTION OF FLOW FROM FEED END.

SEPARATION BY WEIGHT

RIGHT	+90	90-45	45-0	0-45	45-90	+90	LEFT	TOTAL
1	119	290	722	108	21	4	1	
2	89	477	744	121	42	7	2	
3	170	342	342	90	29	4	3	
4	184	336	336	62	28	0.5	4	
TOTAL							TOTAL	

SEPARATION BY PER CENT WEIGHT

RIGHT	+90	90-45	45-0	0-45	45-90	+90	LEFT	TOTAL
1	2.3	5.6	13.9	2.1	0.4	0.1	1	24.4
2	1.7	9.2	14.3	2.3	0.8	0.1	2	28.4
3	3.3	6.6	12.7	1.7	0.6	0.1	3	25.0
4	3.5	6.5	10.5	1.2	0.5	0.0	4	22.2
TOTAL	10.8	27.9	51.4	7.3	2.3	0.3	TOTAL	

Table 24. Screening Separation for Flakes at a Trommel Speed of 10 RPM and a Loading Rate of 2000 Flakes/ 15 Sec.

TROMMEL SPEED 20 RPM

LOADING 2000 FLAKES/15 SEC

TEST DURATION MIN

FLOW IS FROM FEED END (SECTION 1) TO DISCHARGE END (SECTION 4). ROTATION IS CLOCKWISE WHEN VIEWED FROM DISCHARGE END. "RIGHT" AND "LEFT" ARE DETERMINED IN DIRECTION OF FLOW FROM FEED END.

SEPARATION BY WEIGHT (g)

RIGHT	+90	90-45	45-0	0-45	45-90	+90	LEFT	TOTAL
1	213	425	805	113	67	29	1	
2	211	729	844	144	88	22	2	
3	281	756	720	125	118	41	3	
4	549	690	672	123	85	49	4	
TOTAL							TOTAL	

SEPARATION BY PERCENT WEIGHT

RIGHT	+90	90-45	45-0	0-45	45-90	+90	LEFT	TOTAL
1	2.7	5.4	10.2	1.4	0.8	0.4	1	20.9
2	2.7	9.2	10.7	1.8	1.1	0.3	2	25.8
3	3.6	9.6	9.1	1.6	1.5	0.5	3	25.9
4	7.0	8.7	8.5	1.6	1.1	0.6	4	27.5
TOTAL	16.0	32.9	38.5	6.4	4.5	1.8	TOTAL	100.0

Table 25. Screening Separation for Flakes at a Trommel Speed of 20 RPM and a Loading Rate of 2000 Flakes/15 Sec.

TROMMEL SPEED 30 RPM

LOADING 2000 FLAKES/15 SEC

TEST DURATION ~~[illegible]~~

FLOW IS FROM FEED END (SECTION 1) TO DISCHARGE END (SECTION 4). ROTATION IS CLOCKWISE WHEN VIEWED FROM DISCHARGE END. "RIGHT" AND "LEFT" ARE DETERMINED IN DIRECTION OF FLOW FROM FEED END.

SEPARATION BY WEIGHT (g)

RIGHT	+90	90-45	45-0	0-45	45-90	+90	LEFT	TOTAL
1	336	548	868	333	167	63	1	2315
2	490	349	887	557	182	85	2	2550
3	634	548	764	471	365	148	3	2930
4	572	522	769	452	294	270	4	2879
TOTAL	2032	1967	3288	1813	1008	566	TOTAL	10 674

SEPARATION BY PER CENT WEIGHT

RIGHT	+90	90-45	45-0	0-45	45-90	+90	LEFT	TOTAL
1	3.1	5.1	8.1	3.1	1.6	0.6	1	21.7
2	4.6	3.3	8.3	5.2	1.7	0.8	2	23.9
3	5.9	5.1	7.2	4.4	3.4	1.4	3	27.4
4	5.4	4.9	7.2	4.2	2.8	2.5	4	27.0
TOTAL	19	18.4	30.8	16.9	9.5	5.3	TOTAL	100.00

Table 26. Screening Separation for Flakes at a Trommel Speed of 30 RPM and a Loading Rate of 2000 Flakes/15 Sec.

TROMMEL SPEED 10 RPM

LOADING 3000 FLAKES/15 SEC

TEST DURATION MIN

FLOW IS FROM FEED END (SECTION 1) TO DISCHARGE END (SECTION 4). ROTATION IS CLOCKWISE WHEN VIEWED FROM DISCHARGE END. "RIGHT" AND "LEFT" ARE DETERMINED IN DIRECTION OF FLOW FROM FEED END.

SEPARATION BY WEIGHT (g)

RIGHT	+90	90-45	45-0	0-45	45-90	+90	LEFT	TOTAL
1	127	224	718	133	48	6	1	
2	126	284	750	134	40	5	2	
3	166	248	620	103	23	15	3	
4	219	257	591	64	15	10	4	
TOTAL							TOTAL	

SEPARATION BY PERCENT WEIGHT

RIGHT	+90	90-45	45-0	0-45	45-90	+90	LEFT	TOTAL
1	2.6	4.5	14.6	2.7	1.0	0.1	1	25.5
2	2.6	5.8	15.2	2.7	0.8	0.1	2	27.2
3	3.4	5.0	12.6	2.1	0.5	0.3	3	23.9
4	4.4	5.2	12.0	1.3	0.3	0.2	4	23.4
TOTAL	13.0	20.5	54.4	8.8	2.6	0.7	TOTAL	100

Table 27. Screening Separation for Flakes at a Trommel Speed of 10 RPM and a Loading Rate of 3000 Flakes/15 Sec.

TROMMEL SPEED 20 RPM

LOADING 3000 FLAKES/15 SEC

TEST DURATION MIN

FLOW IS FROM FEED END (SECTION 1) TO DISCHARGE END (SECTION 4). ROTATION IS CLOCKWISE WHEN VIEWED FROM DISCHARGE END. "RIGHT" AND "LEFT" ARE DETERMINED IN DIRECTION OF FLOW FROM FEED END.

SEPARATION BY WEIGHT

RIGHT	+90	90-45	45-0	0-45	45-90	+90	LEFT	TOTAL
1	246	554	862	182	118	31	1	
2	262	902	645	258	141	42	2	
3	449	604	664	227	154	47	3	
4	348	589	637	207	129	57	4	
TOTAL							TOTAL	

SEPARATION BY PERCENT WEIGHT

RIGHT	+90	90-45	45-0	0-45	45-90	+90	LEFT	TOTAL
1	2.9	6.6	10.3	2.2	1.4	0.4	1	23.8
2	3.1	10.8	7.7	3.1	1.7	0.5	2	26.9
3	3.4	7.2	8.0	2.7	1.8	0.6	3	23.7
4	4.2	7.0	7.6	2.5	1.5	0.7	4	23.5
TOTAL	15.6	31.6	33.6	10.5	6.4	2.2	TOTAL	100

Table 28. Screening Separation for Flakes at a Trommel Speed of 20 RPM and a Loading Rate of 3000 Flakes/15 Sec.

TROMMEL SPEED 30 RPM

LOADING 3000 FLAKES/15 SEC

TEST DURATION MIN

FLOW IS FROM FEED END (SECTION 1) TO DISCHARGE END (SECTION 4). ROTATION IS CLOCKWISE WHEN VIEWED FROM DISCHARGE END. "RIGHT" AND "LEFT" ARE DETERMINED IN DIRECTION OF FLOW FROM FEED END.

SEPARATION BY WEIGHT

RIGHT	+90	90-45	45-0	0-45	45-90	+90	LEFT	TOTAL
1	301	387	371	339	145	51	1	
2	394	575	896	539	235	102	2	
3	667	393	176	491	312	146	3	
4	647	349	675	522	200	158	4	
TOTAL							TOTAL	

SEPARATION BY PER CENT WEIGHT

RIGHT	+90	90-45	45-0	0-45	45-90	+90	LEFT	TOTAL
1	3.3	4.3	4.1	3.7	1.6	0.6	1	17.6
2	4.3	6.4	9.9	5.9	2.6	1.1	2	30.2
3	7.4	4.3	1.9	5.4	3.4	1.6	3	24.0
4	7.1	3.8	7.4	5.8	2.2	1.7	4	28.0
TOTAL	22.1	18.8	23.3	20.5	9.8	5.0	TOTAL	100

Table 29. Screening Separation for Flakes at a Trommel Speed of 30 RPM and a Loading Rate of 3000 Flakes/15 Sec.