MASTER

DIRT FEEDLOT RESIDUE EXPERIMENTS

QUARTERLY PROGRESS REPORT

FOR THE PERIOD DECEMBER 1977 - MARCH 1978

HAMILTON STANDARD DIVISION

UNITED TECHNOLOGIES CORPORATION

WINDSOR LOCKS, CONNECTICUT 06096

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1.0 Introduction

This progress report describes the program activities for the Hamilton Standard mobile fermentation system at the Monfort feedlot during the December 1977-March 1978 period.

2.0 Activities During the Reporting Period

2.1 Objectives

During the reporting period the objectives established for the field experimental program were:

- Establish fermentation performance with aged pen residue from pen #94 of the Gilcrest feedlot at the nominal loading rate of 0.25 lbs. volatile solids/ft.³/day with a 10-day retention time and a fermentation temperature of 57°C.
- Complete an experimental cattle feeding trial utilizing the protein in the fermentor liquid effluent as a replacement for standard protein supplements.
- Complete the evaluation of the capture efficiency of the system centrifuge both with and without a chemical flocculant.
- Initiate an experimental cattle feeding trial utilizing the protein fermentation product (PFP) harvested by the centrifuge as replacement for the standard protein supplement.
- Continue the characterization of the cattle residues found in various cattle pens, feedlots, and locations.
- Initiate an investigation into methods of separating the organic content of the feedlot residue from the sand and grit content.

2.2 Performance

Early in the reporting period (December 10, 1977) the last of Kurer Feedlot Pen #307 residue was utilized and loading with the residue collected from Gilcrest Feedlot Pen #94 was started. On February 11, 1978, loading was changed over to residue collected from Kurer Feedlot Pen #343, and again on March 2, 1978, it was switched to Kurer Feedlot Pen #265 which is still being used as of the end of the reporting period.

The process operating conditions were maintained constant at: a daily organic loading of 0.25 lbs. volatile solids per cubic foot, a retention time of 10 days, and a system liquid volume of 100 cubic feet until the beginning of March at which time both the cattle feeding trial and the centrifuge capture evaluation had been completed. During this period

the specific methane yield averaged 2.75 ft³ per lb. volatile solids loaded. The TVA during this period varied from 3,500 mg/L down to 1,500 mg/L and back up to 2,000 mg/L. The significant reduction down to 1,500 mg/L appears to be associated with the use of the pen waste obtained from the Gilcrest feedlot. After loading was resumed with pen waste from the Kurer feedlot, the TVA began to increase. The variations in TVA and source of residue did not have any apparent effect upon the specific methane yield nor the process stability.

Over the period of March 4 to March 16, the system volume was increased from 100 cubic feet to 200 cubic feet by the continued loading of the fermentor without any discharge of fermentor contents. This increase and the concomitant increase in total organics loaded was required in order to provide sufficient PFP cake for the planned cattle feeding trial. During this period the TVA increased slightly from 2,000 mg/L to a high of 3,000 mg/L and the daily specific methane yield increased from 2.75 to over 4.0 cubic feet per lb. volatile solids loaded. The 10-day average specific methane yield peaked at about 3.5 cubic feet per lb. volatile solids loaded. The initiation of daily fermentation discharge and a reduced retention time caused this specific methane yield to reduce to the previous average of 2.75 cubic feet per lb. volatile solids loaded.

The daily organic loading will be increased during the next reporting period from the 0.25 lbs. per cubic foot in order to increase the total PFP cake available and to establish the effect upon methane yield and stability.

The performance of the system for this period is presented in Figures 1 thru 4.

Cattle Feeding Trial With Fermentor Liquid Effluent

The objective of this feeding trial was to feed 20 head of cattle for a period of 69 days with a portion of the normal supplemental protein replaced by Protein Fermentation Product in a liquid suspension (PFP liquid).

The experimental protocol consisted of utilizing an experimental diet based upon the standard ration being fed to the production cattle at the Monfort Kurer feedlot. This standard ration consisted of: flaked corn, corn silage, beet pulp, and a standard supplement which includes protein, vitamins and minerals and pharmaceuticals all contained in a hominy carrier. This supplement supplies about 0.7 lb. of crude protein per head per day. The test diet consisted of all the same standard ingredients and proportions with the exception that the supplement was a specific test supplement formulated with only one

half the crude protein content. PFP liquid was intended to supply the balance of the supplemental protein. The standard and test diets, as averaged for the total 69-day test period, are shown in Table I. The amount of crude protein supplied in the experimental diet was limited by the amount of liquid which could be mixed into and absorbed by the standard feed ingredients without making the feed mechanically unmanageable. The resultant experimental diet was able to provide 75% of the supplemental protein of the standard diet.

The test procedure consisted of selecting 20 head of cattle at random from an incoming group of purchased cattle and assigning them to the test. These cattle were weighed and placed in pen #52/53 at the hospital for the test period of 69 days. The first few days the cattle were fed a normal high silage ration with steam-flaked corn and no supplemental protein. On the third day the ration was changed, as is normally done, to a diet with less silage, more corn, with beet pulp and a special supplement formulation. On succeeding days the ration was progressively changed to increased corn, decreased silage, and PFP liquid culminating in a cattle finishing ration.

A standard Monfort mixer/feed truck was used each day to receive a ration of corn, silage, and beet pulp from the Kuner feedmill, as prescribed by the Monfort nutritionist. These instructions defined which of ten standard rations were to be fed and the daily amount of the ration. These rations would progress from the starter ration up to the finishing ration. The ingredients were weighed and dumped into the truck and then mixed automatically by four self-contained augers. The truck was then driven to the Anaerobic Fermentation Facility where a prescribed weight of experimental supplement was added by hand while the fermentor liquid effluent was added to the mixture as it was discharged from the fermentation tank. The entire feed was continuously mixed within the truck. The truck was then driven to the test cattle in pen 52/53, and the steaming feed mixture was side augered into the feed bunk. Any feed which had been left from the previous day was manually mixed into the new feed. Records were kept of the amounts of each ingredient that was delivered each day to the cattle. On the 41st day the entire pen of cattle were weighed as a check on performance and then returned to the pen. On the 69th day the cattle were given a final weighing for the completion of the testing.

The results of this feeding trial were very favorable and encouraging. Fed cattle performance is measured in terms of: daily weight gain, feed weight to gain weight ratio, and the cost of gain. Table II shows the daily gain and feed to gain ratio for the 69-day test period. The Monfort nutritionists have compared this performance with that experienced in the feedlot

TABLE I
CATTLE DIETS
(69-Day Average)

<u>Ingredient</u>	Standard ⁽¹⁾ <u>Diet</u>	Test ⁽¹⁾ <u>Diet</u>
Steam-Flaked Corn	16.52	16.52
Corn Silage	3.68	3.68
Beet Pulp	1.01	1.01
Supplement	1.80 ⁽²⁾	1.80 ⁽³⁾
PFP Liquid	-	0.55 ⁽⁴⁾⁽⁵⁾

Notes:

- (1) Weights are in pounds per head per day, as fed, except for silage which is air-dried value.
- (2) Standard supplement contains 0.70 lbs. crude protein.
- (3) Experimental supplement contains 0.35 lbs. crude protein.
- (4) Average crude protein content 0.17 lbs.
- (5) Value shown is on a dry matter basis.

TABLE II
CATTLE PERFORMANCE SUMMARY

Initial Weight of 20 Test Cattle 11/29/77	14,405 lbs.
Final Weight of 20 Test Cattle 02/07/78	19,500 lbs.
Feed Consumed Test Diet	31,941 lbs.
Test Period	69 days
Weight Gained 20 Test Cattle	5,095 lbs.
Daily Gain per Animal	3.7 lbs.
Feed Consumed to Weight Gain Ratio	6.3:1

with production cattle during the same test time period and have found that these test cattle have performed equal to that of the production cattle over this initial feeding period.

The cost of gain cannot be realistically calculated since there is no market value for the PFP liquid other than the equivalent cost that could be saved by the elimination of a standard purchased commodity. The experimental diet allowed the cattle to perform as well as cattle which normally have an additional 0.35 lbs. of crude protein included in their diet and this in spite of the fact that the test diet replaced about one half of this missing protein. Based upon \$150/ton, the market value of 41% crude protein cottonseed meal, the value of crude protein is 18.3 cents per lb. Since the use of the experimental diet could eliminate purchased cottonseed meal, a savings in feed cost of 6.4 cents per head per day can be realized. At the present time, the market value of the averaged daily feed normally fed is about \$1.20 per day per head, and the value of the commercial ingredients in the experimental feed is about \$1.14 per day per head. The major cost of fattening cattle is the cost of feed, and a typical example of the economic profitability is shown in Table III. From this it can be seen that the increased profitability for the experimental diet is 15%. This increased profitability is most significant since it is based upon a period of time when the cattle feeding industry is enjoying a better than normal profitability. The normal profit for fattening cattle would be more like \$15-\$25 per head; and under those circumstances, the reduced cost of feeding would significantly increase the percentage of profitability.

2.4 Centrifuge Capture Evaluation

The ability of the system centrifuge to capture both total solids and suspended solids from the fermentor liquid effluent was experimentally evaluated. The evaluation consisted of varying the flow thru the centrifuge both with and without the addition of a chemical flocculant. Samples of both the flow entering the centrifuge and the centrate discharged were analyzed for total dry matter and suspended solids and the discharged cake was analyzed for dry matter and crude protein content.

The sample analyses and data reduction required to determine total solids and suspended solids capture efficiency is very sensitive to small variations in the sample analyses. The results of the extensive amount of data taken without the use of chemical flocculant shown in Figure 5 is indicative of this. There has been no attempt made to screen this data and throw out obviously bad points. The lines drawn thru the data represent an approximate best fit based upon local averages.

TABLE III

ECONOMICS OF CATTLE FEEDING

Selling Price of Slaughter Cattle:	\$530	1061 lb animal @ \$50/cwt (4/78)
Minus		
Purchase Price of Feeder Cattle:	\$301	700 lb animal @ \$43/1 cwt (12/77)
Minus		
Feeding Cost:	\$155	(129 days @ \$1.20/head/day)
Minus		
Management Cost for Feeding Cattle:	\$19	(129 days @ 15¢/head/day)
Equals		
Normal Profit:	\$55	
Feeding Cost Experimental Diet:	\$147	(129 days @ \$1.14/head/day)
Profit Using Experimental Diet:	\$63	

Much less data was taken with the chemical flocculant. The flocculant rates used were: 25, 50, 100, and 200 ppm. The testing with 200 ppm flocculant did not yield any useful data due to coagulation and plugging in the centrifuge. The reduced data for the three other flocculant rates is shown in Figures 6 and 7. The high degree of variability is again evident. The lines representing capture efficiency without the use of flocculants is also shown in these figures. It would appear that the 25 and 50 ppm flocculant rates do not provide any significant improvement in capture efficiency over that achievable without any flocculant. The 100 ppm flocculant rate does indicate a significant improvement at centrifuge flow rates around 1.0 gallon per minute. This operating condition was selected for the harvesting of PFP cake for a cattle feeding trial with the expectation that it will result in a significant increase in total solids. The additional data collected during the feeding trial will establish the magnitude of the increased capture.

2.5 Cattle Feeding Trial With Cake Harvested by Centrifugation

A feeding trial will be initiated early in the next reporting period similar to the feeding trial just concluded with the exception that cake harvested from the fermentor effluent will be utilized in place of the whole liquid effluent.

The cake will be harvested by the centrifuge with the aid of a chemical flocculant. The centrifuge will be operated with a flow of 1 gpm and with a flocculant rate of 100 gpm, as established by the recently completed centrifuge evaluation. This flocculant rate is the same as that successfully used during Hamilton Standard's prior refeeding experiments.

2.6 Pen Residue Characterization Study

Sampling of cattle residue from various pens and locations within these pens at both the Kurer feedlot and other feedlots, continued during the reporting period. The additional results available are shown in Table IV.

2.7 Sand and Grit Removal Study

Extensive preparatory activities for the sand and grit study were accomplished through contact with university personnel familiar with ore separation techniques as well as library investigation into any commercially available material separation techniques. An arrangement has been established with Denver Equipment Co. (a local manufacturing corporation that also provides research facilities) to evaluate several different promising separation methodologies. This includes: concentrating table, jigging, floatation, and spiral classification.

TABLE IV

PEN RESIDUE CHARACTERIZATION STUDY

<u>Date</u>	<u>Pen</u>	<u>Location</u>	<u>Dry Matter (%)</u>	<u>Ash (%)</u>
1/30	333	Pen Stockpile	59.63	25.73
1/30	333	Pen Stockpile	74.23	59.75
1/31	329	Pen Stockpile	65.28	31.46
1/31	329	Pen Stockpile	62.67	65.10
2/01	120	Pen Stockpile	75.79	70.63
2/01	120	Pen Stockpile	77.06	68.46
2/01	120	Pen Stockpile	76.57	73.28
2/01	120	Pen Stockpile	74.31	72.11
2/02	114	Pen Stockpile	75.26	64.85
2/02	114	Pen Stockpile	80.21	67.09
2/02	116	Pen Stockpile	89.11	81.07
2/02	116	Pen Stockpile	83.37	73.32
2/03	121	Pen Stockpile	78.34	76.51
2/03	121	Pen Stockpile	83.29	79.64
2/03	121	Pen Stockpile	86.37	77.62
2/03	121	Pen Stockpile	82.59	74.40
2/06	120	Pen Stockpile	73.46	71.63
2/06	120	Pen Stockpile	73.72	70.58
2/06	114	Pen Stockpile	82.86	65.53
2/06	114	Pen Stockpile	77.35	65.86
2/07	116	Pen Stockpile	75.54	75.60
2/07	116	Pen Stockpile	75.63	73.78
2/07	116	Pen Stockpile	76.00	73.17
2/07	116	Pen Stockpile	74.51	74.54
2/10	52	Pen Stockpile	40.64	25.29
2/10	265	Pen Stockpile	49.26	22.77
2/10	265	Pen Stockpile	40.53	19.44
2/10	265	Pen Stockpile	43.32	27.35
2/23	265	Pen Stockpile	56.64	36.21
2/23	265	Pen Stockpile	60.93	40.57
2/23	265	Pen Stockpile	62.84	37.78
2/23	265	Pen Stockpile	60.29	35.93

The degree of separation provided by each of these different methods will then be compared to the settling technique currently employed.

3.0 Problems

None.

4.0 Planned Effort

During the next quarterly period, it is planned to complete the following activities which will conclude the investigatory tasks of this program:

- . Cattle feeding trial with PFP cake
- . Pen residue characterization study
- . Sand and grit removal study
- . Evaluate the effect of centrate recycle

FIGURE 1

FIGURE 1 (CONTINUED)

FIGURE 1 (CONTINUED)

FIGURE 1 (CONTINUED)

FIGURE 2

FIGURE 2 (CONTINUED)

FIGURE 3

FIGURE 3 (CONTINUED)

FIGURE 4

FIGURE 4 (CONTINUED)

FIGURE 5

CENTRIFUGE PERFORMANCE WITHOUT FLOC

FIGURE 6
CENTRIFUGE PERFORMANCE WITH FLOC
| TOTAL SOLIDS

FIGURE 7

CENTRIFUGE PERFORMANCE WITH FLOC
SUSPENDED SOLIDS

PROCESS GAS YIELD TOTAL GAS

FIGURE 1

GAS PRODUCTION RATE

FIGURE 2

PROCESS GAS QUALITY METHANE GAS

FIGURE 3

FERMENTOR GAS YIELD METHANE GAS

FIGURE 4

FIGURE 5

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NO. 340-20 DIETZGEN GRAPH PAPER
20 X 20 PER INCH

PROTEIN FERMENTATION PRODUCTS TOTAL WEIGHT

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POUNDS/DAY

5-A

1/1 1/2 1/3 2/3 1/4 3/4 1/5 2/5 3/5 4/5 1/6 2/6 3/6 4/6 5/6 1/7 2/7 3/7 4/7 5/7 6/7 1/8 2/8 3/8 4/8 5/8 6/8 7/8 1/9 2/9 3/9 4/9 5/9 6/9 7/9 8/9 1/10 2/10 3/10 4/10 5/10 6/10 7/10 8/10 9/10 1/11 2/11 3/11 4/11 5/11 6/11 7/11 8/11 9/11 10/11 1/12 2/12 3/12 4/12 5/12 6/12 7/12 8/12 9/12 10/12 11/12 1/13 2/13 3/13 4/13 5/13 6/13 7/13 8/13 9/13 10/13 11/13 12/13 1/14 2/14 3/14 4/14 5/14 6/14 7/14 8/14 9/14 10/14 11/14 12/14 1/15 2/15 3/15 4/15 5/15 6/15 7/15 8/15 9/15 10/15 11/15 12/15

PROTEIN FERMENTATION PRODUCT DRY A MATTER

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PERCENT

DIETZGEN CORPORATION
MADE IN U.S.A.

NO. 340-20 DIETZGEN GRAPH PAPER
20 X 20 PER INCH

PROTEIN FERMENTATION PRODUCT CRUDE PROTEIN

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PERCENT

1/7 2/7 3/7 4/7 5/7 6/7 7/7 8/7 9/7 10/7 11/7 12/7 13/7 14/7 15/7 16/7 17/7 18/7 19/7 20/7 21/7 22/7 23/7 24/7 25/7 26/7 27/7 28/7 29/7 30/7 31/7 32/7 33/7 34/7 35/7 36/7 37/7 38/7 39/7 40/7 41/7 42/7 43/7 44/7 45/7 46/7 47/7 48/7 49/7 50/7 51/7 52/7 53/7 54/7 55/7 56/7 57/7 58/7 59/7 60/7 61/7 62/7 63/7 64/7 65/7 66/7 67/7 68/7 69/7 70/7 71/7 72/7 73/7 74/7 75/7 76/7 77/7 78/7 79/7 80/7 81/7 82/7 83/7 84/7 85/7 86/7 87/7 88/7 89/7 90/7 91/7 92/7 93/7 94/7 95/7 96/7 97/7 98/7 99/7 100/7

FERMENTOR LOADING VOLATILE MATTER

FIGURE 8

FERMENTOR RESIDENCE TIME

FIGURE 9

RAW WASTE TOTAL WEIGHT

RAW WASTE DRY MATTER

FIGURE 11

RAW WASTE VOLATILE MATTER

FIGURE 12

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20 X 20 PER INCH

RECYCLE WASTE (CENTRATE) TOTAL WEIGHT

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1/2 2/3 1/4 3/10 3/12 3/16 3/20 3/24 3/28 3/32 1/3 1/4 1/5 1/6 1/7 1/8 1/9 1/10 1/11 1/12 1/13 1/14 1/15 1/16 1/17 1/18 1/19 1/20 1/21 1/22 1/23 1/24 1/25 1/26 1/27 1/28 1/29 1/30 1/31 1/32 1/33 1/34 1/35 1/36 1/37 1/38 1/39 1/40 1/41 1/42 1/43 1/44 1/45 1/46 1/47 1/48 1/49 1/50 1/51 1/52 1/53 1/54 1/55 1/56 1/57 1/58 1/59 1/60 1/61 1/62 1/63 1/64 1/65 1/66 1/67 1/68 1/69 1/70 1/71 1/72 1/73 1/74 1/75 1/76 1/77 1/78 1/79 1/80 1/81 1/82 1/83 1/84 1/85 1/86 1/87 1/88 1/89 1/90 1/91 1/92 1/93 1/94 1/95 1/96 1/97 1/98 1/99 1/100

POUND

RECYCLE WASTE (CENTRATE) DRY MATTER

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PERCENT

1/7	1/6	2/10	2/14	2/18	2/22	2/26	3/2	3/6	3/10	3/14	3/18	3/22	3/26	4/2	4/6	4/10	4/14	4/18	4/22	4/26	5/2	5/6	5/10	5/14	5/18	5/22	5/26	6/2	6/6	6/10	6/14	6/18	6/22	6/26	7/2	7/6	7/10	7/14	7/18	7/22	7/26	8/2	8/6	8/10	8/14	8/18	8/22	8/26	9/2	9/6	9/10	9/14	9/18	9/22	9/26	10/2	10/6	10/10	10/14	10/18	10/22	10/26	11/2	11/6	11/10	11/14	11/18	11/22	11/26	12/2	12/6	12/10	12/14	12/18	12/22	12/26
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RECYCLE WASTE (CENTRATE) VOLATILE MATTER

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PERCENT

1/15
1/11
1/7
4/3
3/20
3/16
3/13
3/11
3/10
3/6
3/2
2/16
2/12
2/11
2/10
2/6
2/5
1/1

MAKE-UP WATER TOTAL WEIGHT

RESIDUAL GRIT VOLATILE MATTER

PROCESSED WASTE LOAD TOTAL WEIGHT

FIGURE 18

PROCESSED WASTE LOAD DRY MATTER

40
A-19
30

PERCENT

20

10

1/1 1/2 2/6 2/10 2/14 2/18 2/22 2/26 3/2 3/6 3/10 3/14 3/18 3/22 3/26 3/30 4/3 4/7 4/11 4/15

FIGURE 19

PROCESSED WASTE LOAD VOLATILE MATTER

FIGURE 20

PROCESSED WASTE LOAD pH

FIGURE 21

PROCESSED WASTE LOAD ALKALINITY

FIGURE 22

PROCESSED WASTELOAD TOTAL VOLATILE ACIDS

FERMENTOR CONTENTS DRY MATTER

5.0

4.0

3.0

2.0

1.0

PERCENT
A-24

1/27

2/2

2/6

2/10

2/14

2/18

2/22

2/26

3/2

3/6

3/10

3/14

3/18

3/22

3/26

3/30

4/3

4/7

4/11

4/15

FIGURE 24

FERMENTOR CONTENTS VOLATILE MATTER

FERMENTOR CONTENTS pH

FIGURE 26

FERMENTOR CONTENTS ALKALINITY

FIGURE 27

FERMENTOR CONTENTS TVA

FERMENTOR TEMP

FIGURE 29

Figure 30 consists of four vertically stacked plots sharing a common x-axis representing time from 1/1 to 4/15. The y-axis for all plots ranges from 0 to 3000 ppm, with major grid lines every 1000 ppm and minor grid lines every 200 ppm. The data points are marked with inverted triangles.

- K (ppm):** Shows a relatively stable trend around 1500-1800 ppm. Data points are approximately at (1/10, 1500), (1/15, 1500), (1/20, 1500), (1/25, 1500), (1/30, 1500), (2/5, 1500), (2/10, 1800), (2/15, 1800), (2/20, 1500), (2/25, 1500), (3/5, 1500).
- CA (ppm):** Shows a general upward trend from 1000 ppm to 2000 ppm. Data points are approximately at (1/10, 1000), (1/15, 1000), (1/20, 1000), (1/25, 1000), (1/30, 1000), (2/5, 1000), (2/10, 1000), (2/15, 1000), (2/20, 1000), (2/25, 1000), (3/5, 1000), (3/10, 1000), (3/15, 1000), (3/20, 1000), (3/25, 1000), (4/5, 1000), (4/10, 1000), (4/15, 1000).
- A-30 (ppm):** Shows a general upward trend from 1000 ppm to 2000 ppm. Data points are approximately at (1/10, 1000), (1/15, 1000), (1/20, 1000), (1/25, 1000), (1/30, 1000), (2/5, 1000), (2/10, 1000), (2/15, 1000), (2/20, 1000), (2/25, 1000), (3/5, 1000), (3/10, 1000), (3/15, 1000), (3/20, 1000), (3/25, 1000), (4/5, 1000), (4/10, 1000), (4/15, 1000).
- C1 (ppm):** Shows a general upward trend from 1000 ppm to 2000 ppm. Data points are approximately at (1/10, 1000), (1/15, 1000), (1/20, 1000), (1/25, 1000), (1/30, 1000), (2/5, 1000), (2/10, 1000), (2/15, 1000), (2/20, 1000), (2/25, 1000), (3/5, 1000), (3/10, 1000), (3/15, 1000), (3/20, 1000), (3/25, 1000), (4/5, 1000), (4/10, 1000), (4/15, 1000).

FIGURE 30

FERMENTOR CONTENTS-MISCELLANEOUS ANALYSES

FIGURE 31

SCF/LB.V.S.

1-V

1/12 1/10 1/8 1/6 1/5 1/4 1/3 1/2

FIGURE 1

GAS PRODUCTION RATE

Figure 3 is a line graph plotted on a grid. The vertical axis (y-axis) is labeled "PERCENT" and has major tick marks at 20, 40, 60, 80, and 100. The horizontal axis (x-axis) is labeled "PROCESS" and has major tick marks labeled with fractions: 1/12, 1/22, 1/26, 1/30, 1/4, 1/8, 1/12, 1/16, 1/20, 1/24, 1/28, 1/32, 1/5, 1/7, 1/13, 1/17, 1/21, 1/25, 1/29, and 1/2. The data is represented by a series of inverted triangles connected by a line. The values fluctuate slightly around a mean of approximately 55%.

Process	Percent A-3
1/12	52
1/22	53
1/26	51
1/30	54
1/4	52
1/8	55
1/12	53
1/16	51
1/20	54
1/24	52
1/28	55
1/32	53
1/5	51
1/7	54
1/13	52
1/17	55
1/21	53
1/25	51
1/29	54
1/2	52

FIGURE 3

FIGURE 4

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DILTZER CORPORATION
MADE IN U.S.A.

PROTEIN FERMENTATION PRODUCTS TOTAL WEIGHT

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POUNDS/DAY

11/18
11/22
11/26
11/30
12/4
12/8
12/12
12/16
12/20
12/24
12/28
1/1/48
1/5
1/9
1/13
1/17
1/21
1/25
1/29
2/2

PROTEIN FERMENTATION PRODUCT DRY MATTER

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PERCENT

11/18 11/22 11/26 11/30 12/4 12/8 12/12 12/16 12/20 1/1 1/5 1/9 1/13 1/17 1/21 1/25 1/29 2/2

A-7

1.0

0.8

A-8

0.6

0.4

0.2

LB V.S./FT3 DAY

[illegible]

FIGURE 9

RAW WASTE TOTAL WEIGHT

FIGURE 10

RAW WASTE DRY MATTER

FIGURE 11

FIGURE 12

RAW WASTE VOLATILE MATTER

FIGURE 13

DIEITZGEN CORPORATION
MADE IN U.S.A.

NO. 340-20 DIETZGEN GRAPH PAPER
20 X 20 PER INCH

RECYCLE WASTE (CENTRATE) TOTAL WEIGHT

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POUND
A-13

11.7 11.2 11.0 10.5 10.0 9.5 9.0 8.5 8.0 7.5 7.0 6.5 6.0 5.5 5.0 4.5 4.0 3.5 3.0 2.5 2.0 1.5 1.0 .5 0

ND. 340-20 DIETZEN GRAPH PAPER
20 X 20 PER INCH

DIETZGEN CORPORATION
MADE IN U.S.A.

NO. 340-20 DIETZGEN GRAPH PAPER
20 X 20 PER INCH

RECYCLE WASTE (CENTRATE) VOLATILE MATTER

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PERCENT

11/18 11/12 11/10 11/30 12/4 12/8 12/12 12/16 12/20 1/4 1/2 1/3 1/7 1/10 1/20 2/2

MAKE-UP WATER TOTAL WEIGHT MATTER

RESIDUAL GRIT VOLATILE MATTER

PROCESSED WASTE LOAD TOTAL WEIGHT

FIGURE 18

PROCESSED WASTE LOAD DRY MATTER

40
A-19
30
20
10

PERCENT

FIGURE 19

PROCESSED WASTE LOAD VOLATILE MATTER

PROCESSED WASTE LOAD PH

A-21

6.0 6.5 7.0 7.5 8.0 8.5

1/18 1/12 1/10 1/8 1/6 1/5 1/4 1/3 1/2

PROCESSED WASTELOAD TOTAL VOLATILE ACIDS

FERMENTOR CONTENTS DRY MATTER ANALYSIS

FERMENTOR CONTENTS VOLATILE MATTER

A graph on a grid showing the function $f(x) = \frac{1}{1+x^2}$. The x-axis is labeled with values from $\frac{1}{2}$ to $\frac{1}{2}$, and the y-axis is labeled from 0 to 1. The curve is a bell-shaped curve centered at $x = \frac{1}{2}$, with a maximum value of 1 at $x = \frac{1}{2}$. The curve approaches 0 as x approaches 0 or 1.

FIGURE 26

FERMENTOR CONTENTS ALKALINITY

FIGURE 27

FIGURE 28

FERMENTOR TEMP.

FERMENTOR CONTENTS-MISCELLANEOUS ANALYSES

FERMENTOR CONTENTS-MISCELLANEOUS ANALYSES