Feed Mill Operational Challenges

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Watch the pennies and the dollars will take care of themselves.

~ Benjamin Franklin

Management –
Underworked and Over Paid

- OWNERSHIP/BOARD OF DIRECTORS
- FDA
- OSHA
- EPA
- DOT
- HUMAN RESOURCES
- PURCHASING
- TRUCKING
- NUTRITIONISTS
- VETERINARIANS
- CUSTOMERS
- MAKING FEED

- Quality Control
- Receiving
- Grinding
- Batching/Mixing (Premix/Medicated Articles)
- Pelleting
- Packaging
- Delivery

- FSMA

Compressed Air Leaks
Recognized and Underappreciated

- Waste as much as 20%-30% of the compressor’s output.
- Fluctuating system pressure, which can cause air tools and other air-operated equipment to function less efficiently, possibly affecting production
- Excess compressor capacity, resulting in higher than necessary costs
- Decreased service life and increased maintenance of supply equipment (including the compressor package) due to unnecessary cycling and increased run time.

Compressed Air Leaks – Action

Common problem areas include:
couplings
hoses
tubes
fittings
pipe joints
quick disconnects
FRLs (filter, regulator, and lubricator)
condensate traps
valves
flanges
packings
thread seal-ants
point-of-use devices

Compressed Air Leaks

Leakage rates[a] (cfm) for different supply pressures and approximately equivalent orifice sizes[b]

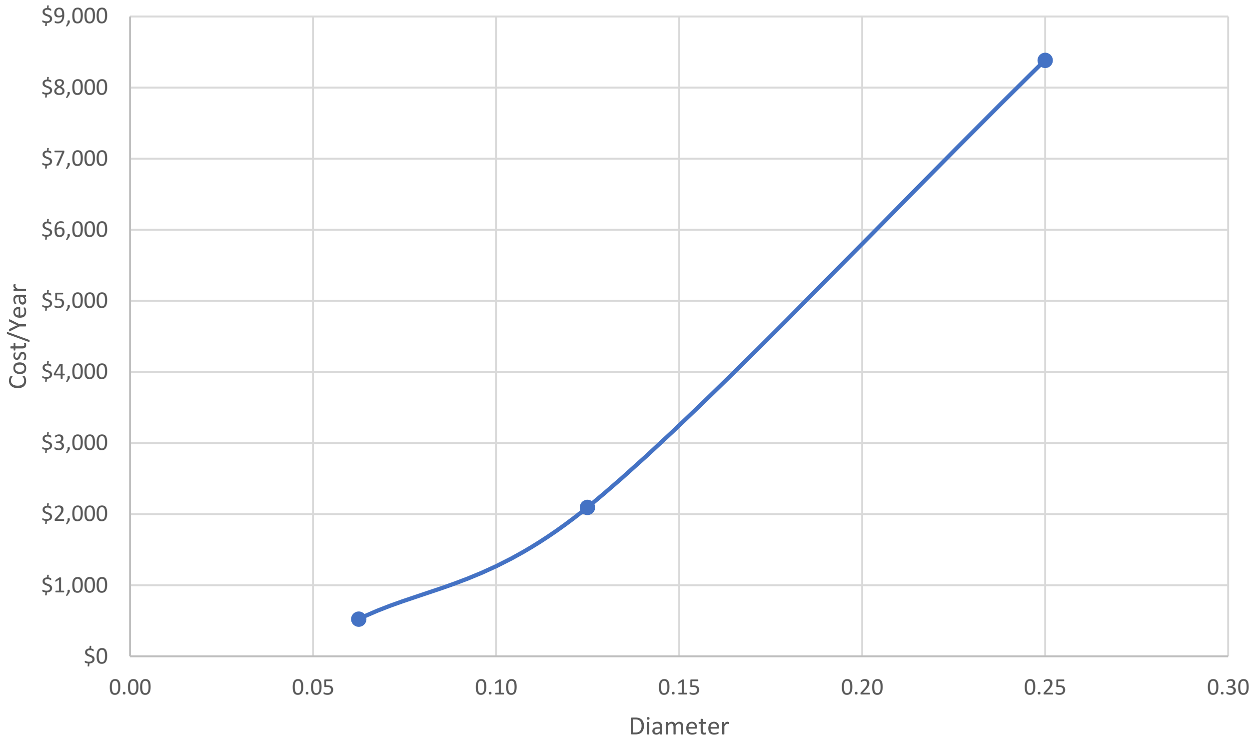
Pressure		Orifice Diameter (inches)				
(psig)	1/64	1/32	1/16	1/8	1/4	3/8
70	0.29	1.16	4.66	18.62	74.4	167.8
80	0.32	1.26	5.24	20.76	83.1	187.2
90	0.36	1.46	5.72	23.10	92	206.6
100	0.40	1.55	6.31	25.22	100.9	227
125	0.48	1.94	7.66	30.65	122.2	275.5

a For well-rounded orifices, values should be multiplied by 0.97 and by 0.61 for sharp ones.

Leakage rates identified in cubic feet per minute (cfm) are proportional to the square of the orifice diameter.

	Size	Cost per Year
●	1/16"	$523
●	1/8"	$2,095
●	1/4"	$8,382

Costs calculated using electricity rate of $0.05 per kilowatt-hour, assuming constant operation and an efficient compressor.



Compressed Air Leaks - Example

100 leaks 1/32” at 90 psig
50 leaks of 1/16” at 90 psig
10 leaks of 1/4” at 100 psig.

7,000 annual operating hours
Electric rate of $0.05 kilowatt-hour (kWh)
Compressed air generation requirement ~ 18 kilowatts (kW)/100 cfm.

Cost savings = # of leaks x leakage rate (cfm) x kW/cfm x # of hours x $/kWh

Cost savings from 1/32” leaks = 100 x 1.46 x 0.61 x 0.18 x 7,000 x 0.05 = **$5,611**
Cost savings from 1/16” leaks = 50 x 5.72 x 0.61 x 0.18 x 7,000 x 0.05 = **$10,991**
Cost savings from 1/4” leaks = 10 x 100.9 x 0.61 x 0.18 x 7,000 x 0.05 = **$38,776**
Total cost savings from eliminating these leaks = $57,069

Note that the savings from the elimination of just 10 leaks of 1/4” account for almost 70% of the overall savings. As leaks are identified, it is important to prioritize them and fix the largest ones first.

Compressed Air – Self Analysis

Identification and tagging, tracking, repair, verifying, and employee involvement. Set a reasonable target for cost-effective leak reduction:
**5%-10% of total system flow is typical for industrial facilities.

Compressed air is one of the most expensive sources of energy in a plant. The over-all efficiency of a typical compressed air system can be as low as 10%-15%. For example, to operate a 1 hp air motor at 100 psig, approximately 7-8 hp of electrical power is supplied to the air compressor.

$$\text{Cost (\$)} = \frac{(\text{bhp}) \times (0.746) \times (\text{\# of operating hours}) \times (\text{\$/kWh}) \times (\text{\% time}) \times (\text{\% full-load bhp})}{\text{Motor Efficiency}}$$

bhp—Motor full-load horsepower (frequently higher than the motor nameplate horsepower—check equipment specification)
0.746—conversion between hp and kW
% time—percentage of time running at this operating level
% full-load bhp—bhp as percentage of full-load bhp at this operating level
Motor efficiency—motor efficiency at this operating level

www.energy.gov

Compressed Air – Self Analysis Example

200-hp compressor (which requires 215 bhp)
6800 operating hours annually.
Fully loaded 85% time (motor efficiency = 0.95)
Unloaded 15% time (25% full-load bhp and motor efficiency = 0.90)
Electric rate is $0.05/kWh.

Cost when fully loaded =

$$\frac{(215\text{ bhp}) \times (0.746) \times (6800\text{ hrs}) \times (\$0.05/\text{kWh}) \times (0.85) \times (1.0)}{0.95} =$$

=$48,792

Cost when unloaded =

$$\frac{(215\text{ bhp}) \times (0.746) \times (6800\text{ hrs}) \times (\$0.05/\text{kWh}) \times (0.15) \times (0.25)}{0.90} =$$

=$2,272

Annual energy cost = $48,792 + $2,272 = **$51,064**

Annual Savings for Premium versus Old Standard Efficiency Motors

	Motor Efficiency at 75% Load		Annual Savings from Using a Premium Efficiency Motor	
Horsepower	Old Standard Efficiency Motor	Premium Efficiency Motor	Annual Energy Savings, kWh	Dollar Savings $/year
10	86.7	92.2	3,105	250
25	89.9	93.8	5,160	410
50	91.6	95.0	8,630	690
100	92.2	95.3	15,680	1,255
200	93.3	96.2	29,350	2,350

Note: Based on purchase of a 1,800 RPM TEFC motor in operation 8,000 hours per year (hrs/year) at 75% load at an electrical rate of $0.08/kilowatt-hour (kWh).

Feed Mill Energy Audit Form

1. Natural gas cost per 1000 cubic ft.–or propane cost per gallon? NG________Propane____________
2. Fuel oil #2 cost per gallon? ____________
3. Fuel oil #6 cost per gallon? ____________
4. Average monthly power bill? ____________
5. Monthly cost/kwh power bill ÷ monthly kilowatt hour usage = cost/kwh ? ____________
6. Cubic foot reading of gas usage from the meter for 30 minutes with all gas burning equipment off? Start: ______ | End: ______
7. Fuel oil loss per year – pressurize tank to 5 psi and determine if pressure drops over 8 hour period. Was there a pressure drop? Yes________No________
8. Stack temperature of boiler ^{0}F? High Fire: ______ | Low Fire: ______
9. Temperature of air into boiler burner ^{0}F? ____________
10. O_2 or CO_2 reading of stack gas? ____________
11. Boiler in efficiency using 8, 9, 10 above and Charts B, C, D, or E, depending on fuel used? ____________
12. Average monthly fuel bill? ____________
13. Is the boiler well insulated? Yes________ No________
14. The length of uninsulated steam pipe (not including return line)? ____________
    14.a. Uninsulated pipe diameter. ____________
15. Number of steam leaks in plant observed? ____________
16. Number of traps stuck open? ____________
17. Is fat tank insulated? Yes________ No________
18. Is molasses tank insulated? Yes________ No________
19. Number of space heaters in service but not required? ____________
20. Obtain comparison from power company showing past 12 months cost of other available schedules. The annual potential savings would be:____________
21. Check your schedule with State Commerce Commission and your invoice against your schedule. ____________
22. Number of power meters billed from? ____________
23. If more than one billing meter, ask power company for potential annual savings if only one meter was used. ____________
24. Make five spot checks of the plant and estimate the number of horsepower hours running per day but not being used. ____________
25. Make five spot checks of the plant and estimate volt-amperage hours not being used. ____________
26. Power factor cost savings for 12 months? ____________
27. Peak demand less average demand in kilowatts? ____________
28. Demand cost/kilowatt from utility supplier schedule? ____________
29. Watt-hours of lights used but not needed per day? ____________
30. Total watt-hours of incandescent lights that could be fluorescent per day? ____________

32-33. Total watt-hours of fluorescent lights that could be sodium vapor, Mercury vapor or metal-halide per day? ____________

34. Air compressor pressure? ____________

35. Air compressor horsepower? ____________

36. Air compressor **annual** running hours? ____________

37. Number of air leaks? ____________

38. Is the air compressor intake drawing inside or outside air? ____________

39. Heated areas temperature setting? ____________

1. Monthly cost per kW/hr. from power bill monthly kW/hr. usage = cost per kW.
2. Number of power meters _____________ .
3. If more than 1 meter, cost savings to eliminate additional meters savings.
4. Complete power factor tested under normal load conditions___________________.
5. Calculated power factor savings if less than 90 percent _________ savings
6. Peak demand less average demand in kW.

Peak__________ - Average _______ = Demand Opportunity ________________

7. Demand cost/Kw from supplier.

Demand Opportunity ______ x Cost/Kw ________ = Potential Savings__________

8. Air compressor leak test. Record pressure at compressor with no air users operating.

15 min_____ 30 min_____ 45 min_____ 60 min_____

9. If more than a 10 lb drop in 1 hour, identify all air leaks. Number __________

10. Does air compressor draw air from outside? Yes ___________ No__________
11. Record watts of lights used, but not necessary.

Watts per hr./day_______ / 1000 = kW/hr.________

12. List equipment systems and number of HP hours running day, but not being used.

HP. Running System Not Used Hr./Day

Steam Generation

1. Percentage of steam lines insulated _____________ %.
2. Percentage of condensate lines insulated __________ %.
3. Does Condensate return to the feedwater tank?
   Yes ___________ No _______
4. Complete an inspection of steam traps and note any that are leaking.

Traps leaking_____ / total traps = ______percent leaking

5. List liquid tanks and heating source.

Is Tank Insulated? Product Stored?
Heating Method?
Temperature Control Range
Product Temperature

6. Natural gas/propane meter reading with all gas uses off.
Reading Time
_________ 30 min
_________ 60 min
7. Are the boiler insulation and shell in good condition?
Yes________No________
8. Identify any steam openings into sewer or into the atmosphere.
   Number of openings _________
9. Number of space heaters in service and not required.
____
10. Test boiler efficiency. ______(Should be above 82 percent).
11. Measure average thickness of scale on boiler tubes
   (1/32 in = 7% fuel waste. 1/16 in. = 13% fuel waste).
12. Natural gas cost/1000 cu ft on propane cost/gal
NG___________ Propane________

Compressed Air System Evaluation

Date: ____________________ Completed by:________________________

1. Evaluate all equipment using air and determine the highest air pressure required in plant. Set compressor air to that pressure.
2. Shut down entire plant so that every area is quiet.
3. Run air compressor so the lines are at maximum pressure.
4. Shut off compressor.
5. Walk through plant and mark all leaks with caution tape or anything to make it visible.
6. Write general location of leaks below.
7. Record time that it takes until pressure has decreased to 40psi.

Example:

If maximum required pressure is 100psi and it takes 20 minutes until pressure is 40psi.

100psi - 40psi = 60psi lost in 20 minutes.

60psi/20min = 5psi/min

Recording Time and Pressure Drop

End time______________- Start time________________=Total time

Bagging pressure_________________psi - 40psi. = ___________psi pressure drop

Pressure drop______________psi/___________min (total time) =___________min

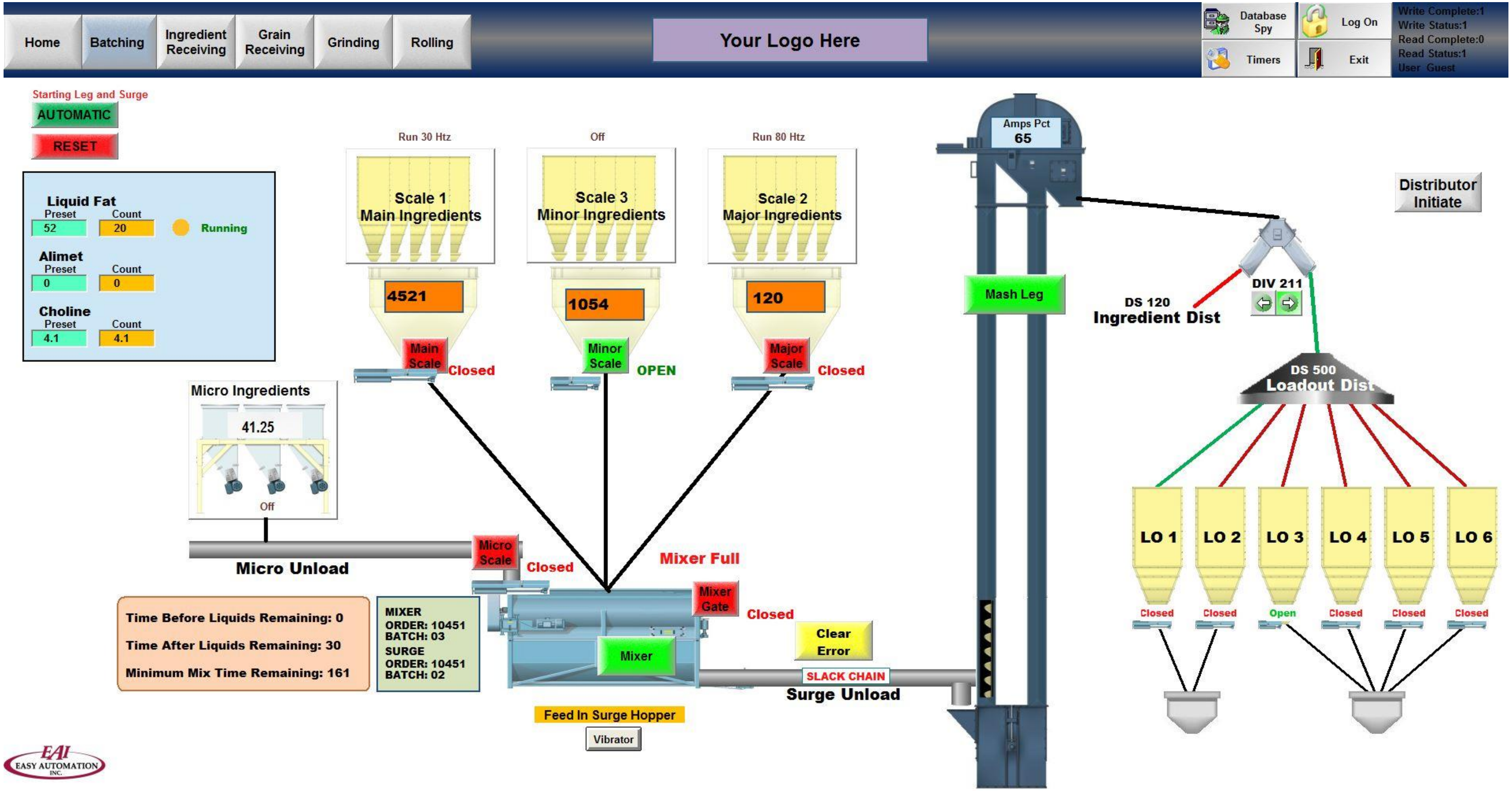
Repeat after leaks are fixed and record improvement.

1. ____
2. ____
3. ____
4. ____
5. ____
6. ____

Mixing – The Heart of Every Feedmill

Batch Cycles

Operation	Time (sec)
Scaling	60
Scale Discharge	30
Dry Mix	60
Wet Mix	100
Mixer Discharge	10
Surge Discharge	100
TOTAL TIME	360 sec


Home
Batching
Ingredient Receiving
Grain Receiving
Grinding
Rolling
Your Logo Here
Database Spy
Log On
Timers
Exit
Write Complete:1
Write Status:1
Read Complete:0
Read Status:1
User Guest
Starting Leg and Surge
AUTOMATIC
RESET
Liquid Fat
Preset
52
Count
20
Running
Alimet
Preset
0
Count
0
Choline
Preset
4.1
Count
4.1
Run 30 Htz
Scale 1 Main Ingredients
4521
Main Scale
Closed
Off
Scale 3 Minor Ingredients
1054
Minor Scale
OPEN
Run 80 Htz
Scale 2 Major Ingredients
120
Major Scale
Closed
Amps Pct
65
Mash Leg
Distributor Initiate
DS 120
Ingredient Dist
DIV 211
DS 500
Loadout Dist
LO 1
LO 2
LO 3
LO 4
LO 5
LO 6
Closed
Closed
Open
Closed
Closed
Closed
Micro Ingredients
41.25
Off
Micro Unload
Micro Scale
Closed
Mixer Full
Mixer Gate
Closed
Time Before Liquids Remaining: 0
Time After Liquids Remaining: 30
Minimum Mix Time Remaining: 161
MIXER
ORDER: 10451
BATCH: 03
SURGE
ORDER: 10451
BATCH: 02
Mixer
Clear Error
SLACK CHAIN
Surge Unload
Feed In Surge Hopper
Vibrator
EAI
EASY AUTOMATION INC.

Mixer Volume Audit

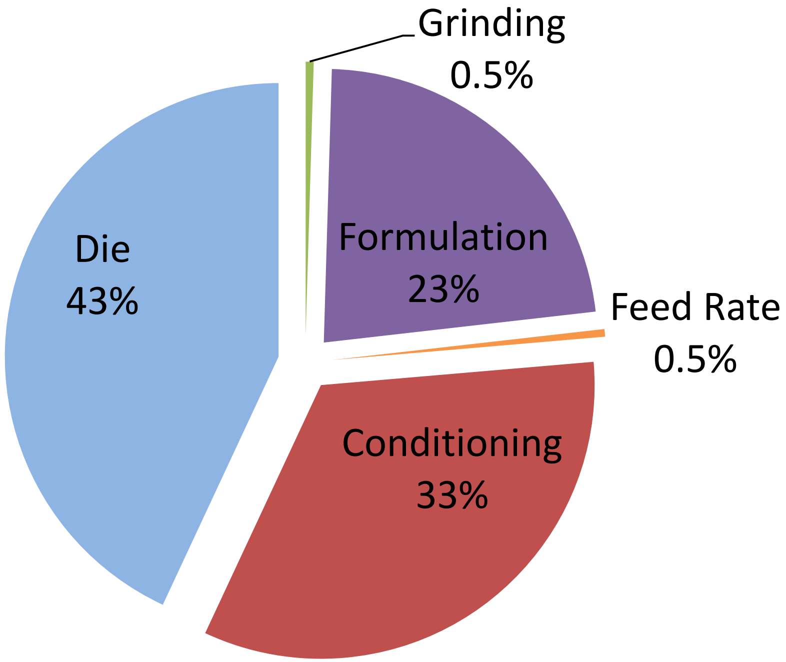
Animal Feed						
Bulk Density(lb/cu ft)	32		0.512 g/cc		0.561 g/cc	
			32	32	35#	35#
Volume (Cubic Ft)	Width (in)	Length (in)	Capacity (#)	Capacity (Ton)	Capacity (#)	Capacity (Ton)
10	22	44	320	0.2	350	0.2
15	26	50	480	0.2	525	0.3
30	32	64	960	0.5	1050	0.5
42	36	72	1344	0.7	1470	0.7
58	40	80	1856	0.9	2030	1.0
86	46	92	2752	1.4	3010	1.5
114	50	100	3648	1.8	3990	2.0
128	52	104	4096	2.0	4480	2.2
196	60	120	6272	3.1	6860	3.4
238	64	128	7616	3.8	8330	4.2
286	68	136	9152	4.6	10010	5.0
339	72	144	10848	5.4	11865	5.9
398	78	144	12736	6.4	13930	7.0
464	78	168	14848	7.4	16240	8.1
571	86	172	18272	9.1	19985	10.0
662	90	180	21184	10.6	23170	11.6

Mixing Cycle Audit

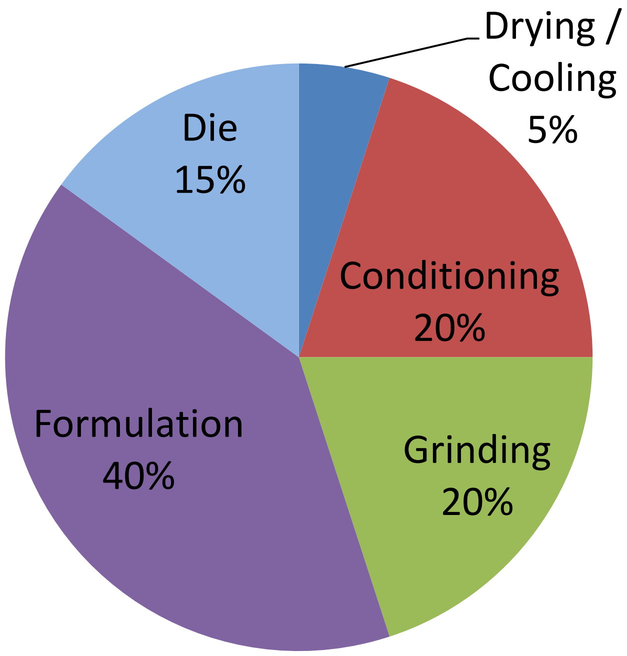
Animal Feed						
Bulk Density(lb/cu	35					
			35	35	35#	35#
Volume (Cubic Ft)	Width (in)	Length (in)	Capacity (#)	Capacity (Ton)	Capacity (#)	Capacity (Ton)
10	22	44	350	0.2	350	0.2
15	26	50	525	0.3	525	0.3
30	32	64	1050	0.5	1050	0.5
42	36	72	1470	0.7	1470	0.7
58	40	80	2030	1.0	2030	1.0
86	46	92	3010	1.5	3010	1.5
114	50	100	3990	2.0	3990	2.0
128	52	104	4480	2.2	4480	2.2
196	60	120	6860	3.4	6860	3.4
238	64	128	8330	4.2	8330	4.2
286	68	136	10010	5.0	10010	5.0
339	72	144	11865	5.9	11865	5.9
398	78	144	13930	7.0	13930	7.0
464	78	168	16240	8.1	16240	8.1
571	86	172	19985	10.0	19985	10.0
662	90	180	23170	11.6	23170	11.6

	AS IS	15 Sec "Found"
Mixer Size	**5.0**	5.0
Hourly Capacity (TPH)	**100**	109.2
Batches/HR	**19.98**	21.82
Cycle Time (min)	**3.00**	2.75
Cycle Time (sec)	**180**	165
Assumptions		
Mixer Fill (Scale Discharge) (sec)	**15**	10
Mixer Discharge (sec)	**15**	10
Mixing Time	**150**	145
Dry Mix Time	**50**	50
Wet Mix Time	**100**	95
80 Hour Work Week @ 80%	**6400**	**6989**

Factors Affecting Pellet Quality



Fahrenholz, 2012



Behnke, 1994

Factors that Affect Pelleting

- Moisture
- Ingredient Composition
- Ingredient Quality
- Ingredient Source
- Die specifications
- Die Condition

- OPERATOR

The machine doesn’t change………

Pellet Mill Journal

Machine No.									
Date	**Time**	**Operator**	**Throughput**	**% Load (Amp)**	**Conditioning Temp**	**Product**	**Hot pellet Temp**	**Die**	**Comments**

Inspection and Maintenance Instruction Sheet

Initial each block for every time you check the following:

Things to Do Daily

Week of / /	Mon	Tues	Wed	Thurs	Fri	Sat	Sun
Clean off magnet							
Clean off thermometer							
Check roller setting							
Lubricate rollers every 4 hours*							
Check die for tramp metal							
Check gearbox oil level							
Check oil pressure gauge							
Lubricate mainshaft bearing							
*Should be done every 4 hours on each shift							

Things to Check Weekly

Week of / /

Oil level in feeder drive		Clean gearbox off	
Check deflectors & wipers		Drain out condensation from oil in gearbox	
Clean out steam manifold		Grease feeder & mixer bearings	
Check die hoist cable			

Things to Check Monthly

Month of

Check all drive chains for tension and wear, lube the same	
Check all drive belts for wear and tension	
Check the oil level in all gearboxes	
Check the cooler pan chain for tension	
Grease the crumbler shaft bearings 3-4 shots each	
Look over all equipment for oil leaks (repair any found)	
Clean the fins on the oil-to-air cooler (if you have one)	
Clean the mesh on the strainer in your water supply line to the heat exchanger (if you have one)	
Check the limit switch on the shear pin assembly	
Check the oil pressure safety switch (if you have one)	

Things to Check When the Die is off the Pellet Mill

Date / /

Use your quill gauge and check the quill for wear	
Use your die clamp gauge to check the die clamp	
Check the die driving key for wear	
Check roller shaft bushings	
Check feed cone for cracks and oblong holes	
Check quill wear insert	

*NOTE use anti-seize on the die and quill contact area. Use anti-seize on the die clamp contact area. Check the manual for die clamp bolt torque and USE IT.

Things to Do Every 2000 Hours

Date / /

Change gearbox oil	
Flush out inside gearbox	
Clean magnet inside gearbox	
Check mixer pick for wear	
Check your recommended spare parts list against your in-house supply	
Repack your pellet mill drive coupling	

CPM – California Pellet Mill

Pellet Mill Journal – Why Have One?

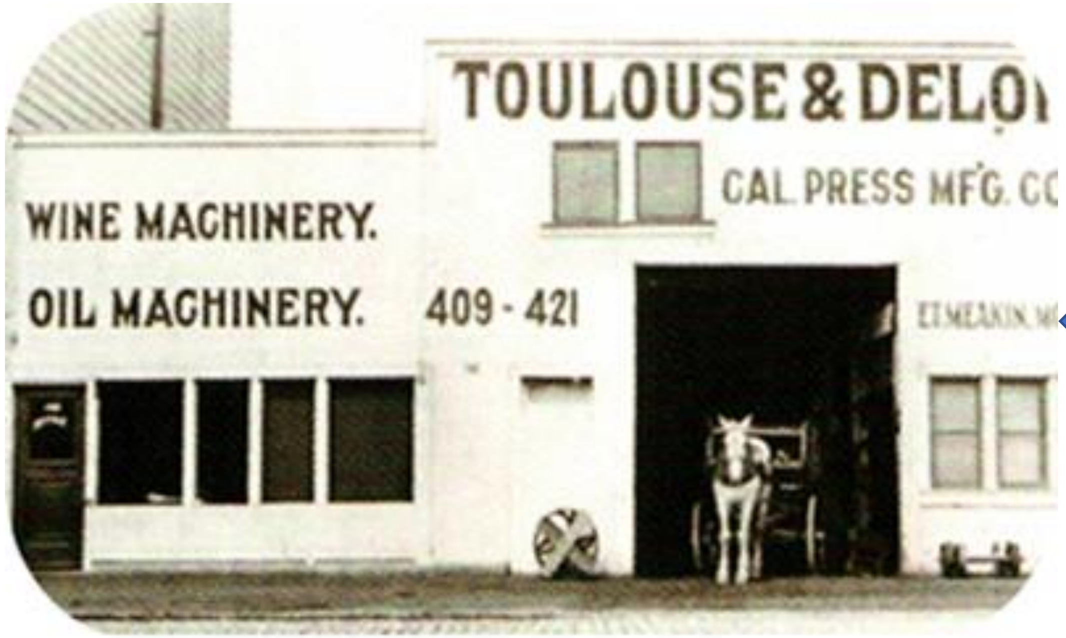
- Communication
  - Between Management and Operators
- Documentation
  - Nutritionists and Live Production
- Equipment Manufacturers
  - Problems can be prevented or resolved
- Quality Control
  - Consistency
- Formula Complexity/Seasonality
  - New/Old Crop
  - Excellent purchase opportunity

The machine doesn’t change………


06.04.2011


06.04.2011


FEED MILL
Harry
Dad



1 HP

???? TPH

30 HP (25kW)

10 TPH

800 HP (600kW)

100 TPH+