3 - AR No. 1 - Install a Hog Fuel Sorting System

Recommendation

Install a sorting system for the hog fuel scraps collected from the ground. This will allow the facility to reassign 80% of the associated labor hours to other productive tasks.

Annual Savings Summary

Source	Quantity	Units	Cost Savings
Personnel Changes	1,200	hrs	$35,903

Implementation Cost Summary

Description	Cost	Payback (yrs)
Implementation Cost	$29,900	0.8

Facility Background

The facility currently uses two boilers for steam generation: a hog fuel boiler and a natural gas boiler. The hog fuel boiler produces a majority of the steam and is rated for 300 psi steam at 40,000 lb/hr. The facility's primary source of hog fuel is scrap collected directly from the process line and from sweeping the landing area/ground beneath the process lines. According to facility personnel, the hog fuel collected from the landing area and ground beneath the process lines has to be separated manually from rocks and other materials. One worker performs the separation process for six hours each production day by feathering material from a loader and separating the hog fuel from other non-combustibles.

Opportunity Background

Hog fuel boilers burn a variety of waste biomass material such as bark, sawdust, planer shavings, and wood chunks. Often times, non-combustible material will get mixed in with the biomass through the debarking process where rocks may have become stuck in the bark during transportation of the log [1]. Feeding non-combustible material into the boiler results in accumulation of rocks in the combustion chamber and subsequent downtime to clean the boiler. If left uncleaned, a hog fuel boiler may see decreased heat output due to the non-combustible materials acting as heat sinks.

Installing a separation unit that takes advantage of the density or size differences between hog fuel and non-combustible materials would optimize separation. The hog fuel needs to be relatively dry so the separation needs to be performed using a system that controls the moisture content of the hog fuel entering the separation system.

Proposal

Install an optimized hog fuel sorting system for the hog fuel collected from the ground. Annual cost savings are estimated at $35,903 after an implementation cost of $29,900, resulting in a simple payback period of 0.8 years.

Vendor Data

West Salem Machinery, TANA, and TerraSource were contacted for quotes and operation data on sorting systems. Given the facility's requirements, a disc screen separation unit was recommended. A unit cost and motor power consumption was provided for calculating implementation and operation costs.

Implementation

A disc screen separation unit uses a combination of rotating discs to remove undesired materials from a biomass mixture based on size. The mixture is placed on one end of the unit and when the material reaches the end of the series of discs, most of the undesired materials will have been removed. Smaller units, such as the one recommended in this analysis, use small enough motors that their power consumption is negligible for this analysis.

Because the units usually have a high processing rate, it is proposed that the daily collection and separation be performed over one shift rather than every day.

Incentives

This recommendation does not decrease energy consumption and will likely not qualify for typical incentives. This does not necessarily mean incentives are unavailable; custom incentives can sometimes be arranged.

Calculation Methodology

Annual cost savings were calculated assuming that the worker assigned to the manual separation of hog fuel and non-combustible scraps will be assigned to other tasks for the facility. The annual cost savings are then equivalent to the hours spent separating the materials each year multiplied by the hourly rate of the worker. Because the recommended system will not be fully automated, there will still be labor associated with separating materials. Analysts assumed the separation can be completed during one shift on the weekend.

Notes

Additional cost savings may arise from reducing hog fuel purchased during shortages. This was not considered in this analysis due to the rarity of hog fuel purchasing and subsequent low cost savings.

References

[1] Advancedbiomass.com. (2016). *Rock Removal From Woody Biomass, 2016 Biomass Handling* . [online] Available at: http://www.advancedbiomass.com/2016/02/rock-removal-from-woody-biomass/ [Accessed 5 Apr. 2018].

3 - AR No. 1 - Analysis

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Data Collected

Labor Data

Daily Collection Time	(t_C)	*6*	hrs	**(N. 1)**
Labor Cost	(C_L)	*$30*	/hr	**(N. 1)**

Operation Data

Operation Days	(t_{OD})	*5*	/wk	**(N. 1)**
Operation Weeks	(t_{OW})	*50*	/yr	**(N. 1)**

Labor Analysis

Current Conditions

Annual Labor Hours	(H_{LC})	***1,500***	hrs	**(Eq. 1)**
Annual Labor Cost	(C_{LC})	***$45,000***	/yr	**(Eq. 2)**

Proposed Conditions

Annual Labor Hours	(H_{LP})	***300***	hrs	**(Eq. 3, N. 2)**
Annual Labor Cost	(C_{LP})	***$9,000***	/yr	**(Eq. 4)**

Savings Analysis

Savings

Labor Hours Savings	(H_{SL})	***1,200***	hrs	**(Eq. 5)**
Labor Cost Savings	(S_L)	***$36,000***	/yr	**(Eq. 6)**

Equations

Eq. 1) Current Annual Labor Hours (H_{LC})

$$t_C \times t_{OD} \times t_{OW}$$

Eq. 2) Current Annual Labor Cost (C_{LC})

$$H_{LC} \times C_L$$

Eq. 3) Proposed Annual Labor Hours (H_{LP})

$$t_C \times t_{OW}$$

Eq. 4) Proposed Annual Labor Cost (H_{LP})

$$H_{LP} \times C_L$$

Eq. 5) Labor Hour Savings (H_{SL})

$$H_{LC} - H_{LP}$$

Eq. 6) Labor Cost Savings (S_L)

$$C_{LC} - C_{LP}$$

Notes

N. 1) Obtained on site through discussion with facility personnel.

N. 2) Based on operating the new sorting system once per week. The value may vary depending on actual usage.

Vendor Data

Vendor Quote #1	(V_1)	*$29,900*		**(N. 3)**

Implementation Cost Analysis

Material Costs

Disc Screen	(C_{M1})	*$29,900*	/unit	**(N. 3)**
Quantity	(Q)	*1*	units	
Total Material Cost	(C_M)	*$29,900*		**(Eq. 7)**

Operating Cost

Motor Power	(P_M)	*7.5*	kW	**(N. 3)**
Annual Operation	(t_O)	*300*	hours	**(N. 2)**
Annual Electrical Consumption	(E_E)	*2250*	kWh	**(Eq. 8)**
Incremental Electricity Cost	(IC_E)	*$0.04296*	/kWh	**(N. 4)**

Economic Results

Disc Screen Electrical Cost	(EC_{DS})	*$97*	/year	**(Eq. 9)**
Annual Cost Savings	(S)	*$35,903*	/year	**N. 5, Eq. 10)**
Implementation Cost	(C_I)	*$29,900*		**(Eq. 7)**
Simple Payback	(t_{PB})	*0.8*	years	**(Eq. 11)**

Equations

Eq. 7) Total Material Cost (C_M)

$$C_{MI} \times Q$$

Eq. 8) Annual Electrical Consumption (E_E)

$$P_M \times t_O$$

Eq. 9) Disc Screen Electrical Cost (EC_{DS})

$$E_E \times IC_E$$

Eq. 10) Annual Cost Savings (S)

$$S_L - EC_{DS}$$

Eq. 11) Simple Payback (t_{PB})

$$\frac{C_I}{S}$$

Notes

N. 3) Obtained through a phone conversation with a disc screen vendor.

N. 4) Developed in the Utility Analysis in the Site Data section of this report.

N. 5) Annual cost savings are calculated by subtracting the disc screen power consumption cost from the annual labor savings.

3 - AR No. 1 - Analysis

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Key Input Data

Recommendation Data

Current Operation Time	(t_C)	*8,760*	hrs./yr.	**(N. 1)**
Total System Energy	(E_T)	*1,000*	MMBtu	

Utility Data

Incremental Natural Gas Cost	(IC_E)	*$0.0500*	MMBtu	**(N. 3)**
Current Energy Consumption	(E_C)	*100.0*	MMBtu	**(N. 2)**
Proposed Energy Consumption	(E_P)	*50.0*	MMBtu	**(N. 2)**

Energy Analysis

Current Conditions

Current Energy Consumption	(E_C)	*100*	MMBtu	**(N. 2)**
Current Energy Cost	(C_C)	*$5*	/yr.	**(Eq. 1)**

Proposed Conditions

Proposed Energy Consumption	(E_P)	*50*	MMBtu	**(N. 2)**
Proposed Energy Cost	(C_P)	*$3*	/yr.	**(Eq. 1)**

Savings

Energy Savings	(E_S)	*50*	MMBtu	**(Eq. 2)**
Cost Savings	(S)	*$3*	/yr.	**(Eq. 3)**

Equations

Analysis Equations

Eq. 4) Energy Cost (C)

$$E \times IC$$

Eq. 5) Energy Savings (ES)

$$E_C - E_P$$

Eq. 6) Cost Savings (S)

$$S_C - S_P$$

Notes

N. 1) Current operating hours of the energy consuming system.

N. 2) Developed on the Data Preparation page of this recommendation.

N. 3) Developed in the Utility Analysis section of this report.

Key Input Data

Recommendation Data

Current Operation Time	(t_C)	*8,760*	hrs./yr.	(N. 1)
Total System Energy	(E_T)	*1,000*		

Natural Gas Data

Incremental Natural Gas Cost	(IC_N)	*$5.00*	MMBtu	(N. 3)
Current Natural Gas Consumption	($E_{C,N}$)	*100.0*	MMBtu	(N. 2)
Proposed Natural Gas Consumption	($E_{P,N}$)	*50.0*	MMBtu	

Electricity Data

Incremental Electricity Cost	(IC_E)	*$0.05*	/kWh	(N. 3)
Current Electrical Consumption	($E_{C,E}$)	*50.0*	kWh	(N. 2)
Proposed Electrical Consumption	($E_{P,E}$)	*25.0*	kWh	

Demand Data

Incremental Demand Cost	(IC_D)	*$5.00*	/kW·mo	(N. 3)
Current Electrical Demand	($E_{C,D}$)	*10.0*	kW·mo	
Proposed Electrical Demand	($E_{P,D}$)	*5*	kW·mo	

Source Data

Incremental Source Cost		*$1.00*		
Current Source Cost		*4.0*		
Proposed Source Cost		*2*		

Energy Analysis

Current Conditions

Current Natural Gas Consumption	($E_{C,N}$)	*100*	MMBtu	(N. 2)
Current Electrical Consumption	($E_{C,E}$)	*50*		
Current Electrical Demand	($E_{C,D}$)	*10*		
Current Source Cost		*4*		
Current Energy Cost	(C_C)	*$553*	/yr.	(Eq. 1)

Proposed Conditions

Proposed Natural Gas Consumption	($E_{P,N}$)	*50*	kWh	(N. 2)
Proposed Electrical Consumption	($E_{P,E}$)	*25*		
Proposed Electrical Demand	($E_{P,D}$)	*5*		
Proposed Source Cost		*2*		
Proposed Energy Cost	(C_P)	*$276*	/yr.	(Eq. 1)

Savings

Natural Gas Savings	($E_{S,N}$)	*50*	kWh	(Eq. 2)
Electrical Savings	($E_{S,E}$)	*25*		(Eq. 2)
Demand Savings	($E_{S,D}$)	*5*		(Eq. 2)
Cost Savings	(S)	*$276*	/yr.	(Eq. 3)

Equations

Analysis Equations

Eq. 4) Energy Cost (C)

$$\sum E \times IC$$

Eq. 5) Energy Savings (ES,N)

$$E_C - E_P$$

Eq. 6) Cost Savings (S)

$$C_C - C_P$$

Notes

N. 1) Current operating hours of the energy consuming system.

N. 2) Developed on the Data Preparation page of this recommendation.

N. 3) Developed in the Utility Analysis section of this report.

3 - AR No. # - Incentive Analysis

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Incentive Data

Annual Energy Savings	(E_s)	*417*	MMBtu	**(Rf. 1)**
Annual Energy Savings	(E_s)	*4,170*	Therms	**(Rf. 2)**
Annual Cost Savings	(S)	*$357,967*	/yr	**(Rf. 1)**
Implementation Cost	(C_I)	*$669,217*		**(Rf. 1)**
Simple Payback	(t_{PB})	*1.9*	years	**(Rf. 1)**

Incentive Analysis Summary

Description	*Incentive*	*After Incentive*	*Payback* (yrs)	*Notes*
Energy Trust of Oregon	*$8,340*	*$660,877*	*1.8*	*$2.00 per annual therm saved*
Investment Tax Credit	*$181,080*	*$479,797*	*1.3*	*27.4% of after ETO incentive value*
Totals	*$189,420*		*1.3*	

No Incentives Found

This recommendation does not reduce utility consumption and will likely not qualify for typical incentives. This does not necessarily mean incentives are unavailable; custom incentives can sometimes be arranged.

Energy Trust of Oregon (ETO)

Companies paying a public purpose charge may qualify for Energy Trust of Oregon cash incentives. Incentives are calculated on a case-by-case basis and are based on the results of a technical analysis study. Natural gas trimming projects may qualify for an incentive of $2.00 per annual therm saved, up to 50% of the project cost.

Energy Smart Industrial (ESI)

Bonneville Power Administration's Energy Smart Industrial reimbursement incentive is available to help pay for implementation of energy saving measures that are deemed cost effective and have a minimum 10-year life span. Incentives can be anticipated to equal minimum of 70% of total project cost or $0.25 per kWh saved.

Investment Tax Credit (ITC)

You may also be eligible for a Federal Business Investment Tax Credit. These grants are available to industrial producers and the credit is equal to 27.4% (as of March 1st, 2013 the incentive was reduced from 30% to its current value) of expenditures for solar, fuel cells, small wind turbines, and 10% of expenditures for geothermal systems, microturbines and combined heat and power with no maximum credit. The credits are for eligible systems placed in service on or before December 31, 2016.

References

Rf. 1) Developed in this recommendation on the previous pages.

Rf. 2) 1 MMBtu is approximately equivalent to 10 Therms.