Recommendation

Install a rotary drum dryer to remove moisture from filter cake. This will reduce associated waste cost by 100%.

Annual Savings Summary

Source	Quantity	Units	Cost Savings
Electrical Consumption	235,164	kWh (site)	-$11,845
Electrical Demand	322	kW Months / yr	-$2,964
Natural Gas	5,519	MMBtu	-$24,945
Solid Waste (non-haz)	7,440,000	Pounds	$268,800
Total			**$229,046**

Implementation Cost Summary

Description	Cost	Payback (yrs)
Before Incentives	405,000	1.8
No Incentives Found	-	-

Facility Background

The facility filters out chemicals and aluminum from its anodizing line process. These substances are pressed into filter cakes and discarded into a 20-yard dumpster bin. The dumpsters are filled and sent to a landfill an average of five times a week. Facility Personnel provided analysts with filter cake waste cost data. Currently, the facility spends an average of $22,440 per month to discard approximately 310 tons of filter cake.

Technology and Opportunity Background

Facility personnel estimate that the filter cake waste contains 50% water by mass. With the current water content, the filter cake has little value and must be discarded. Facility personnel indicated that removing the water content would make the filter waste a sellable commodity. Analysts considered installing rotary dryers to dry the filter cake. A rotary dryer would evaporate most of the liquid out of the filter cake by bringing it into direct contact with a heated gas.

Proposal

Dry the filter cake using a rotary dryer. This will result in an annual cost savings of $268,800 after an implementation cost of $405,000 for a simple payback period of 1.8 yrs.

Calculation Methodology

Installing an external rotary dryer will eliminate the cost of discarding filter cake. Analysts used Stoichiometric analysis to calculate the net heat required to dry the filter cake. Based on the energy required to dry the filter cake, analysts obtained the required sizing of rotary dryer. Equipment Purchase Cost, Installation Cost and Operating Cost of a rotary dryer is included in this analysis. Annual savings is the difference between the annual filter cake waste cost, and the annual operating cost of rotary dryer.

Notes

Analysts assumed the particle size distribution selected for the rotary dryer would be efficient enough for the Oregon DEQ.

Facility personnel estimate that the income they will make by selling the cake will be negated by the cost to transport the material to the buyer.

If the filter cake is not sold, implementing a drum dryer will still result in a $134,400 reduction in solid waste charges.

Analysts also considered using waste heat to dry the filter cake, but concluded there was not enough thermal energy to completely dry the filter cake.

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General Data

Filter Cake Data

Mass of the Waste Filter Cake	(M_{ton})	*3720*	tons/yr	**(Rf. 1)**
Water Content by Mass	(W_c)	*50%*		**(Rf. 1)**
Temperature of Cake	(T_c)	*70*	°F	**(Rf. 1)**

Utility Data

Incremental Natural Gas Cost	(IC_{NG})	*$4.52*	/MMBtu	**(Rf. 2)**
Incremental Electricity Cost	(IC_E)	*$0.0554*	/kWh	**(Rf. 2)**
Incremental Demand Cost	(IC_D)	*$9.20*	/kW-mo	**(Rf. 2)**

Rotary Dryer Data

Rotary Dryer Control Type		*Automatic on/ off*		**(Rf. 3)**
Equipment Rating	(E_R)	*36*	hp	**(Rf. 3)**
Efficiency of System	(η)	*90%*		**(Rf. 3)**
Operation Time	(T_{OP})	*24*	hrs/day	**(N. 1)**
Input Heat Required	(Q_{req})	*0.63*	MMBtu/hr	**(Rf. 3)**
Power Draw	(P_D)	*27*	kW	**(Eq. 1)**

Energy Analysis

Current Conditions

Natural Gas Consumption	(NG_C)	*0*	MMBtu/yr	**(N. 2)**
Electrical Consumption	(E_C)	*0*	kWh/yr	**(N. 2)**
Electrical Demand	(D_C)	*0*	/kWmo/yr	**(N. 2)**
Natural Gas Cost	($C_{NG,C}$)	*$0*	/yr	**(N. 2)**
Energy Cost	($C_{E,C}$)	*$0*	/yr	**(N. 2)**
Demand Cost	($C_{D,E}$)	*$0*	/yr	**(N. 2)**

Proposed Conditions

Natural Gas Consumption	(NG_P)	*5,519*	MMBtu/yr	**(Eq. 2)**
Electrical Consumption	(E_P)	*235,164*	kWh/yr	**(Eq. 3)**
Electrical Demand	(D_P)	*322*	kWmo/yr	**(Eq. 4)**
Natural Gas Cost	($C_{NG,P}$)	*$24,945*	/yr	**(Eq. 5)**
Electricity Cost	($C_{E,P}$)	*$11,845*	/yr	**(Eq. 6)**
Demand Cost	($C_{D,P}$)	*$2,964*	/yr	**(Eq. 7)**

Notes

N. 1) Analysts made a conservative estimate as to the operation time of the rotary dryer. Any reduction in operation time will reduce the associated cost of operating the drum dryer.

N. 2) Current operations do not require any input energy.

Equations

Eq. 1) Power Draw (P_D)

$$\frac{E_R}{\eta} \times \frac{0.7457KW}{1hp}$$

Eq. 2) Natural Gas Consumption (NG_P)

$$Q_{req} \times T_{OP} \times \frac{365days}{1yr}$$

Eq. 3) Electrical Consumption (E_P)

$$P_D \times T_{OP} \times \frac{365days}{1yr}$$

Eq. 4) Electrical Demand (D_P)

$$P_D \times \frac{12months}{1yr}$$

Eq. 5) Natural Gas Cost ($C_{NG,P}$)

$$IC_{NG} \times NG_P$$

Eq. 6) Energy Cost ($C_{E,P}$)

$$IC_E \times E_P$$

Eq. 7) Demand Cost ($C_{D,P}$)

$$IC_D \times D_P$$

References

Rf. 1) Information provided by facility personnel during facility visit.

Rf. 2) Average incremental energy costs developed in the Utility Analysis located in the Site Data section of this report.

Rf. 3) Information obtained from vendor quote.

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Energy Analysis

Savings

Natural Gas Consumption	(NG_S)	*-5,519*	MMBtu/yr	**(Eq. 8)**
Electrical Consumption	(E_S)	*-235,164*	kWh/yr	**(Eq. 9)**
Electrical Demand	(D_S)	*-322*	kWmo/yr	**(Eq. 10)**
Natural Gas Cost	($C_{NG,S}$)	*-$24,945*	/yr	**(Eq. 11)**
Electricity Cost	($C_{E,S}$)	*-$11,845*	/yr	**(Eq. 12)**
Demand Cost	($C_{D,S}$)	*-$2,964*	/yr	**(Eq. 13)**

Waste Cost Analysis

Current Conditions

Filter Cake Waste Cost	($C_{W,C}$)	*$268,800*	/yr	**(Rf. 1)**

Proposed Conditions

Proposed Waste Cost	($C_{W,P}$)	*$0*	/yr	**(N. 4)**

Savings

Waste Cost Savings	($C_{S,W}$)	*$268,800*	/yr	**(Eq. 14)**

Implementation Cost Analysis

Cost of New Rotary Dryer	(C_D)	*$250,000*	/unit	**(Rf. 3)**
Installation Cost	(C_{IN})	*$85,000*		**(Rf. 3)**
Spare Parts Cost	(C_{SP})	*$50,000*		**(N. 5, Rf. 3)**
Miscellaneous Cost	(C_{MIS})	*$20,000*		**(N. 6)**

Economic Results

Annual Cost Savings	(S)	*$229,046*	**(Eq. 15)**
Implementation Cost	(C_I)	*$405,000*	**(Eq. 16)**
Simple Payback	(t_{PB})	*1.8*	**(Eq. 17)**

Notes

N. 4) Analysts are proposing to dry the filter cake and sell it to secondary users of the material. This will eliminating all waste cost associated with disposing the filter cake.

N. 5) Local vendor informed analysts the cost of spare parts over 5 years is approximately 20% of the equipment cost.

N. 6) Local vendor recommended analysts include miscellaneous cost to account for any additional costs during equipment installation.

Equations

Eq. 8) Natural Gas Savings (NG_S)

$$NG_C - NG_P$$

Eq. 9) Electrical Consumption Savings (E_S)

$$E_C - E_P$$

Eq. 10) Electrical Demand Savings (D_S)

$$D_C - D_P$$

Eq. 11) Natural Gas Cost Savings ($C_{NG,S}$)

$$C_{NG,C} - C_{NG,P}$$

Eq. 12) Electricity Cost Savings ($C_{E,S}$)

$$C_{E,C} - C_{E,P}$$

Eq. 13) Demand Cost Savings ($C_{D,S}$)

$$C_{D,C} - C_{D,P}$$

Eq. 14) Waste Cost Savings ($C_{S,W}$)

$$C_{W,C} - C_{W,P}$$

Eq. 15) Annual Cost Savings (S)

$$C_{S,W} + C_{E,S} + C_{D,S} + C_{NG,S}$$

Eq. 16) Implementation Cost (C_I)

$$C_D + C_{IN} + C_{SP} + C_{MIS}$$

Eq. 17) Simple Payback (t_{PB})

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

3 - AR No. 6 - Incentive Analysis

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Incentive Data

Annual Gas Savings	(E_{GS})	***-55,188***	Therms	**(Rf. 1)**
Annual Gas Savings	(E_{GS})	***-5,519***	MMBtu	**(Rf. 1)**
Annual Electrical Savings	(E_{ES})	***-235,164***	kWh	**(Rf. 1)**
Annual Cost Savings	(S)	***$229,046***	/yr	**(Rf. 1)**
Implementation Cost	(C_I)	***$405,000***		**(Rf. 1)**
Simple Payback	(t_{PB})	***1.8***	years	**(Rf. 1)**

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.

References

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