

Sludge Incinerators -Waste Water Treatment Plant
FALCONEER Technologies LLC-Natural Gas Cost Savings Evaluation Report

SUMMARY

Many operations that incinerate sludge using multiple hearth or fluid-bed incinerators are interested in understanding how to optimize their use of natural gas therefore reducing the cost of using natural gas to supplement their operational requirements. The following case study shows an analysis of natural gas cost savings based on last year's historical data (2008 Dec to 2009 Nov) provided by a typical multiple hearth incinerator customer for all tags which could be used to analyze the natural gas cost savings opportunities. The total annual cost of natural gas usage in 2009 on incinerators and auxiliary boilers is estimated at \$1M based on this information. It cost approximately \$400K of natural gas to operate incinerators per year in 2009. Significant savings opportunities based on improved monitoring and control were identified based on 2009 usage conditions, even before optimization efforts are considered.

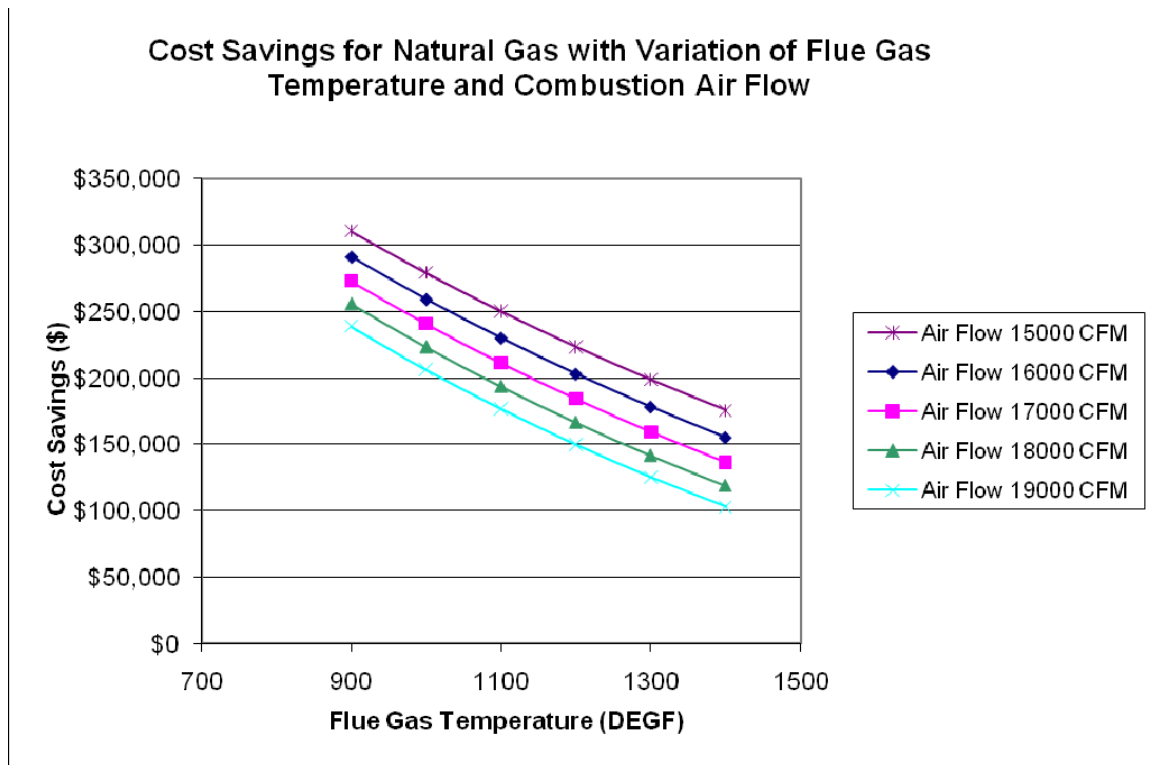


FIGURE 1: Natural Gas Cost Savings Opportunities

For the analysis, it was determined on a daily basis how much heat was required for incinerator operation and how much heat was actually provided by the combination of digester gas, digester sludge and natural gas. The cost savings were the difference between the natural gas fed and the natural gas actually required to make-up the heat requirement. The heat requirement was to evaporate the water, burn the sludge and maintain temperature in incinerators drying and burning hearth level and afterburner.

The total cost savings per year by reducing unnecessary natural gas use to incinerators is summarized in the Figure 1 above. The analysis investigated variations of flue gas temperature and combustion air/flue gas flow. The cost savings opportunities identified can be achieved by identifying and notifying operations in a timely manner for proper control actions. Based on some conservative estimates, the likely cost savings opportunities will range from \$150K to \$200K per year on incinerator process area alone with good control of combustion air flow and flue gas temperature. To this end, FALCONEER™ IV performance solution can provide real-time forecasting and calculations using the relationship between flue gas temperature, combustion air flow, THC, and natural gas feed as alarms and real time trending for operators in order to have better control over the natural gas usage without overfeeding it.

Discussion

The analysis of natural gas cost savings is based on last year's historical data (2008 Dec to 2009 Nov) provided for all tags which could be used to analyze the natural gas cost savings opportunities. From this one year of historical data, we obtained the data every 6 minutes for most tags. However, several tags are daily measurements only, but we also included this information in our analysis. Some of the months of natural gas price / MCF are available and others are getting from the EIA website. The total annual cost of natural gas usage in 2009 on incinerators and auxiliary boilers is estimated at \$1M based on this information. It cost approximately \$400K of natural gas to operate incinerators per year in 2009.

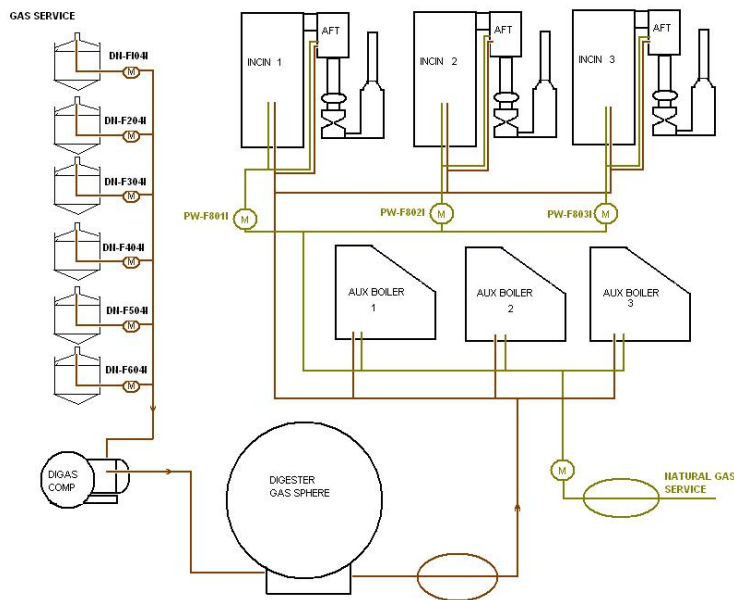


Figure 2: Gas Flow Diagram for Sludge Incinerator Facility

In order to determine both the actual heating requirement and the actual heat provided to the incinerator operation, key information was collected from actual plant operations data.

1. First we need to know the total of digester and natural gas being fed into areas like auxiliary boiler, incinerators, afterburners, etc. We have 6 digester gas flow rate tags and 3 natural gas flow rate per Figure 2 above. Per Operations, we assumed all digester gas is fed to the incinerators as normal practice.
2. Total dry ton sludge fed is required to calculate required and excess use of digester and/or natural gas per ton of dry sludge.
3. Flue gas flow is used to calculate the heat within the incinerator and being used downstream to generate steam production on waste heat boiler. Without this information, we investigated the savings over a range of flue gas flows. To be more accurate, we need to know the flue gas flow to the waste heat boiler and we need the performance curve for the cooling and combustion air fan in order to calculate the flue gas flow.
4. We can correlate from THC to the temperatures and other conditions on afterburners and incinerators to save excess natural gas usage from overheating. This analysis was not part of this report but can easily be incorporated into the FALCONEER™ IV system for enhanced performance monitoring & advising and cost savings.
5. We can calculate the total heat required to dry and burn the incoming wet sludge and correlate with the digester and natural gas flow. The combination of the following two factors is the result of total sludge incineration process:
 - Heat input from digester or natural gas required on drying hearths to evaporate the water from incoming sludge
 - Heat input from digester or natural gas required on sludge combustible hearths to completely burn volatile contents.

With the combination of these two factors as part of the real-time analysis, it is possible to control the digester or natural gas feed to the incinerator in real-time for cost savings. Other factors like combustion air and cooling air can be added to the real-time analysis to further control the digester and natural gas feed.

A few conservative assumptions were made for this analysis to estimate the natural gas cost savings per year.

1. The heating value of the digested sludge (dry basis) is 4400 Btu/lb (CH2MHill Design Basis = 6000 Btu/lb)
2. The heating value of digester gas is 650 Btu/scf (CH2MHill Design Basis = 700 Btu/scf)
3. The heating value of natural gas is 1000 Btu/scf

4. The combustion air/flue gas flow through the incinerators is 15,000-18,000 ft³/min (CH2MHill Design Basis = 15,000 – 17,500 cfm)
5. The flue gas heat capacity is 0.25 Btu/lb^oF
6. The density of flue gas is 0.0375lb/ft³
7. The incinerator flue gas average temperature is 900-1400 °F
8. All digester gas is used in incinerators.

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The total cost savings per year by reducing unnecessary natural gas use to incinerators may be significant, perhaps up to half the current natural gas use for incinerator operation. The analysis investigated variations of flue gas temperature and combustion air/flue gas flow. The cost savings opportunities identified can be achieved by identifying and notifying operations in a timely manner for proper control actions. Based on some conservative estimates, the likely cost savings opportunities will range from \$150K to \$200K per year on incinerator process area alone with good control of combustion air flow and flue gas temperature. To this end, FALCONEER™ IV performance solution can provide real-time forecasting and calculations using the relationship between flue gas temperature, combustion air flow, THC, and natural gas feed as alarms and real time trending for operators in order to have better control over the natural gas usage without overfeeding it.