

September 11, 2020

00000000000
Plant Manager
ABC Company
Somewhere, KY

Phone:
Email:

Optimus Plant Code:
Proposal:

SUBJECT: Heat & Mass Audit of Dryer 1

Dear Mr. XXX:

Thank you for giving **Optimus Solutions** the opportunity to perform our Heat and Mass Audit service on **ABC Company's Dryer #1**. The purpose of this service is to determine the current performance and efficiency of the dryer.

Work Scope – Combustion Performance Audit

- Process Heat and Mass Balance
- Thermal imaging inspection of dryer tubes
- Write-up with findings

Recommendations

- Two of the tubes seem to have blockages. We recommend monitoring the tubes
- We recommend an audit in a year to ensure optimum performance

Executive Summary

Optimus Solutions performed a Heat and Mass balance Audit for **ABC Company's** Dryer #1 to determine the current performance and efficiency.

The analysis looked at the amount of steam required for the process compared to the amount of steam used for the process. Per the data collected the amount of steam used is **24,000 lbs/hr**, and the amount of steam needed for the drying process is **8,826 lbs/hr**. This gives an efficiency of **37%**. This is relatively low compared to the typical design efficiency of 90%.

This unit makes use of recycle product to decrease the inlet moisture content to **20%**. Based on the analysis, **40,000 lbs/hr** of recycled product and 7% is required to decrease the inlet feed moisture content from 60% to 20%. Therefore, the total transient product load in the dryer is 53,000 lbs/hr.

In addition to the analysis, a thermal inspection of the steam tubes was performed. The thermal map showed that the temperatures of the tubes range from 318 °F to 330 °F. However, there were two cold spots with temperatures of 283 °F and 287 °F on the map. These two cold areas could indicate that the two tubes are blocked. This could also contribute to the low efficiency of the unit.

Thank you again for the opportunity to perform this service for **ABC Company**. If you have any questions, please contact us at 844-880-5822, Ext. 1208.

Sincerely,

Sarah Belew
Key Accounts Specialist
Optimus Solutions

Cephas Idan
Mechanical Engineer
Optimus Solutions

Tom Zhang, PhD, PE
Senior Engineer
Optimus Solutions

SB/sd
cc: A.B.F., J.H.

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Heat and Mass Audit

Introduction

A Heat and Mass audit was performed on **ABC Company's** using Dryer #1. The variables provided to us are shown in Table 1.

Table 1. Input Variables

Variable	Data	Units
Inlet Feed Rate	6.5	tons/hr
Inlet Feed Temp	160	°F
Inlet Feed Moisture	60	%
Recycle Moisture	20	%
Outlet Product Temp	196	°F
Outlet Product Moisture	7	%
Steam usage	24,000	Lbs/hr
Steam pressure	120	psi

Mass Balance

Table 2 shows the mass balance for the drying process. The data in Table 3 shows the recycle necessary to achieve a 20% moisture. The analysis shows 40,000 lbs/hr of product at 7% is needed for the mix to achieve a 20% moisture content. Thus, the total load of product passing through the dryer is 53,000 lbs/hr.

Table 2. Mass Balance

Material	Mass (lbs/hr)
Wet Feed Material	13,000
Dry Solids	5,200
Water in Feed	7,800
Evaporated Water	7,409
Water in Product	391
Product	5,591

Input (lbs/hr)	Output (lbs/hr)	
13,000	Dry Solids	5,200
	Water in Product	391
	Evaporated Water	7,409
	Total output	13,000

Table 3. Recycle

Mix required	20	%
Feed	13,000	Lbs/hr
Recycle required	40,000	Lbs/hr
Total Mix	53,000	Lbs/hr

Heat Balance

Table 4 shows the energy breakdown of the hourly heat load of the dryer. It was assumed there was no losses due to radiation. From the analysis, the total energy required is 660,643 BUT/hr.

Table 4. Hourly heat Duty

	BTU/hr
Energy to heat material	19,200
Energy to Water	60,000
Evaporative Load	581,443
Radiation	0
Total Heat Load	660,643

Table 5. Steam Balance

Steam Pressure	120	psi
Latent Heat of Steam	878	BTU/lb
Steam required	6,789	lbs./hr
Actual Steam Used	24,000	lbs./hr
Efficiency	28	%

The steam balance in Table 5 shows that the amount of steam required versus the actual amount of steam used. From the data, the efficiency of the process was calculated to be 28%. This is significantly lower when compared to the design efficiency of 90%.

Steam Tubes Inspection

Figure 2 and Figure 2 show the thermal map of the tubes in the dryer. The imaging in Figure 1 shows that the normal tube temperatures are about 318 °F to 330 °F. In Figure 2 we see two cold spots with temperatures of 283 °F and 287 °F on the map. These give an indication that two of the tubes are not at operating temperatures. One possibility of such a scenario is if the tubes have blockages in them.

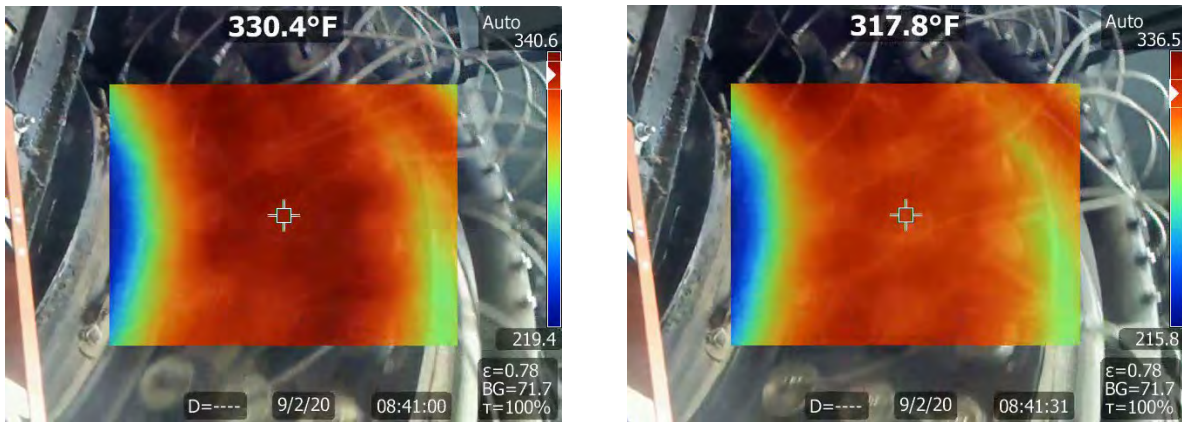


Figure 1

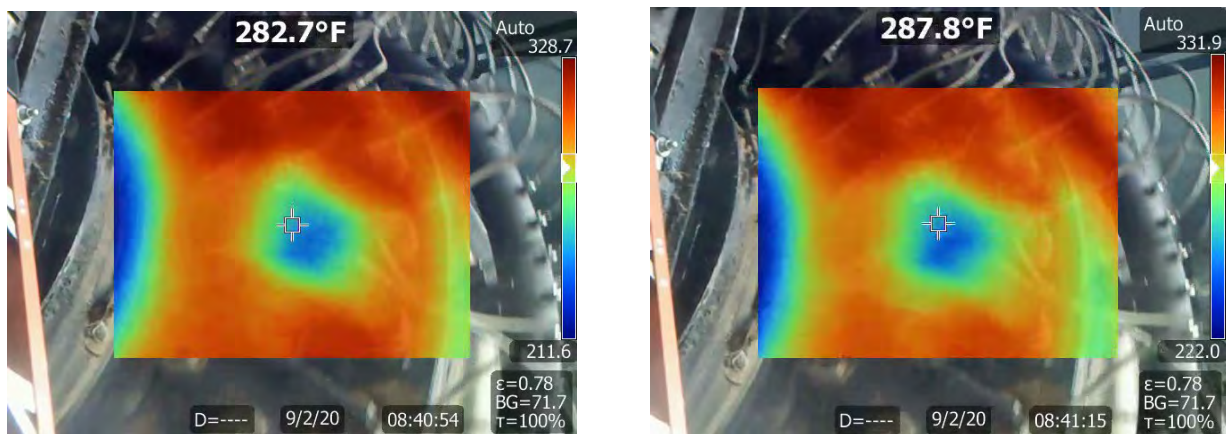


Figure 2