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U.S. DEPARTMENT OF
ENERGY



Best of the Betters: 2020 Better Project and Better Practice Presentations

Wednesday, June 10
11:00 am-12:30 pm ET



Daniel Downen and John Keller

ThyssenKrupp Elevator



Submit Questions
www.slido.com event code **#bbsummit**
then go to room “**Best of the Betters**”



Better Project Presentation: Structural Oven Energy Reductions

DANIEL DOWNEN AND
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THYSSENKRUPP ELEVATOR
MIDDLETON, TENNESSEE

BETTER BUILDINGS SUMMIT 2020
JUNE 10, 2020

ThyssenKrupp Elevator Middleton Plant

- Middleton TN plant, only plant in U.S. for TKE
- Established in 1969
 - 700,000 sq ft (about 70% manufacturing, rest is offices)
 - Approximately 1,100 employees
- Production of new elevators, elevator modernization, and parts (cabs, doors, safeties, governors, controllers, etc.)
- Energy management practices encouraged by parent company
- Accreditations
 - ISO 50001 in 2019
 - Also LEED Gold in 2015, and ISO 9001 and 14001



One World Trade Center, New York

TKE Structural Oven



Parts entering structural oven

Two ovens used to cure coatings on elevator parts

- Older oven for structural elevator parts
- Newer oven for architectural parts

Structural oven identified as an SEU

- Part of ISO 50001 process
- May use 35% of plant natural gas

Structural oven designed decades ago

- Limited data on oven specifications
- Heavily used 20+ hours continuous use each day
- Quality of powder coat finish is critical
- Concern over making changes, conservative approach

Opportunities for Reduction in Oven Heat Losses

In 2018, we requested an assessment from the University of Memphis Industrial Assessment Center

- Looked at all areas of plant, but did spend time on oven
- Verified that oven insulation was a project opportunity
- We later confirmed the savings and arranged insulation to be installed

After IAC, still had sense that further reductions were available, and worked with TAM during visit in 2019 to focus on oven

- Logged key data and developed oven energy balance using MEASUR
- Refined energy use data, oven using 25 percent of plant gas use, lower but still significant
- Indicated high share of exhaust heat, pointed to potential heat recovery opportunity

After reviewing analysis, and minimum exhaust flow rates, we shut down one exhaust to reduce heat loss

Also built enclosure in rear of oven to further reduce losses



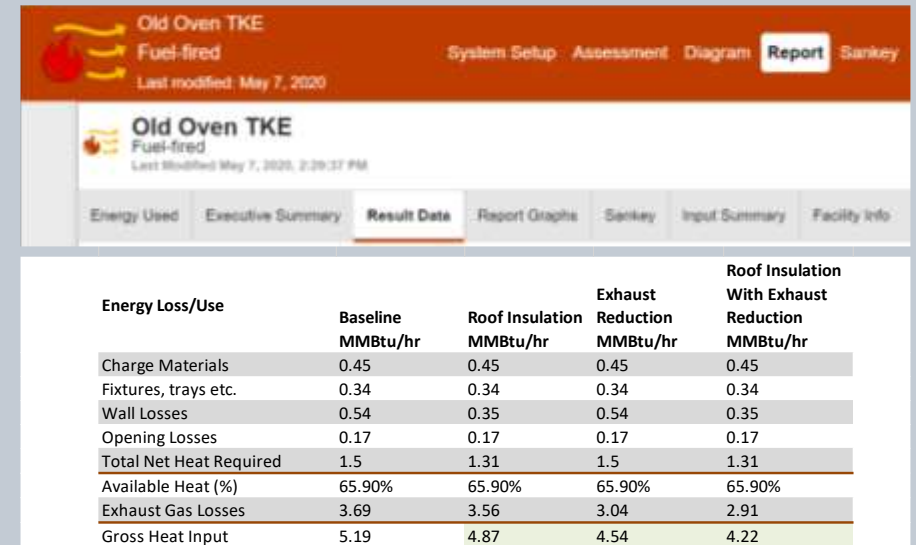
Developing Oven Energy Balance

- During the TAM visit, we observed the 4am oven startup to log initial firing rates, and kept recording these throughout the day to baseline the full production cycle fuel rate.
- We also documented data on oven dimensions, temperatures, exhaust rates, and other important parameters, to construct a baseline model of mass and energy balances, using the DOE MEASUR tool.
- We then documented the impact of the improvements, after insulation was installed and exhaust gas flow rate reduced
- The data was input into the MEASUR tool and compared with the baseline data collected earlier.
- These operating values also will serve as a revised baseline, for Phase 2 improvements.

Impact of Improvements

- Firing rate dropped from 5.2 MMBTU/hr to 4.2 MMBTU/hr, a 19 percent reduction.
- Startup procedure was reduced from 2 hours to 60 minutes, and production time also cut by an hour
- This reduced the oven shift hours from 20 hours per day to 17 hours, a decrease of 15 percent.
- Collectively, this represents a 34 percent reduction in fuel use.

MEASUR analysis of structural oven

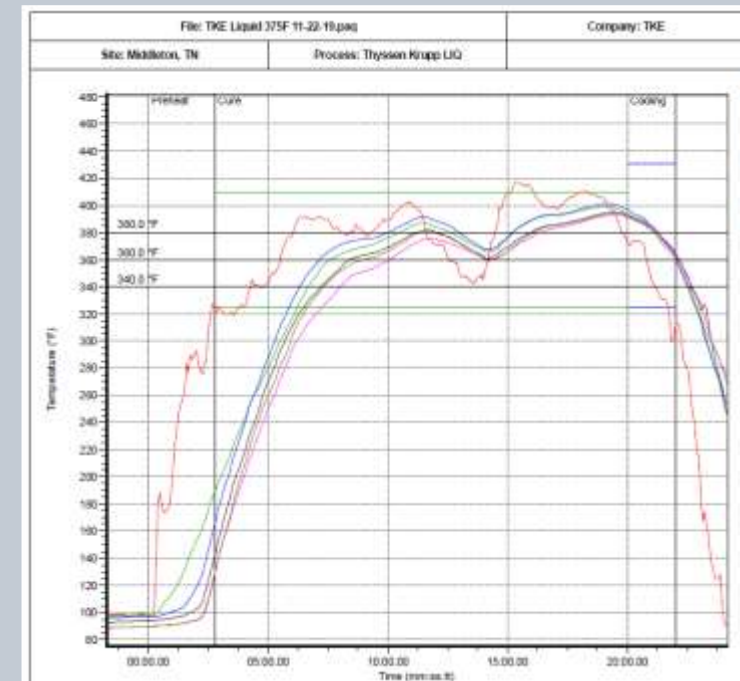


The screenshot displays the MEASUR software interface for an analysis of a structural oven. The title bar indicates 'Old Oven TKE Fuel-fired' and 'Last modified: May 7, 2020'. The main content area shows a table of energy loss and use data, comparing baseline conditions with improvements in roof insulation and exhaust reduction.

Energy Loss/Use	Baseline MMBtu/hr	Roof Insulation MMBtu/hr	Exhaust Reduction MMBtu/hr	Roof Insulation With Exhaust Reduction MMBtu/hr
Charge Materials	0.45	0.45	0.45	0.45
Fixtures, trays etc.	0.34	0.34	0.34	0.34
Wall Losses	0.54	0.35	0.54	0.35
Opening Losses	0.17	0.17	0.17	0.17
Total Net Heat Required	1.5	1.31	1.5	1.31
Available Heat (%)	65.90%	65.90%	65.90%	65.90%
Exhaust Gas Losses	3.69	3.56	3.04	2.91
Gross Heat Input	5.19	4.87	4.54	4.22

Confirming Oven Curing Time

- Powder coating requires 25-30 minutes, maintained at approximately 350 F
- Developed an approach to testing the oven, to ensure that the energy reductions did not adversely impact production or product quality.
 - Part assembly that has imbedded thermocouples
 - Employ the parts handling system to route the assembly through the oven, while held at production firing rates, and record the temperature profile as it passed throughout the oven zones
 - Test results (see figure on right) can be compared with prior results to ensure that the cure time and temperature requirements are maintained.
 - Energy Team conducted this test after each improvement was implemented, to confirm that the oven controls were able to maintain oven parameters



Thermal profile of parts moving through structural oven

Sustained Impact

- Monthly reporting metric indicates project-specific natural gas savings, based on production rates and change in oven firing rates
- Results indicate a 35% reduction in oven gas consumption, corresponding to the 34 percent reduction in firing rate and oven hours, yielding a six month bill reduction of \$15,694
- Full year savings of \$31,000, a payback period of 3 months

	19-Oct	19-Nov	19-Dec	20-Jan	20-Feb	20-Mar	Total, Half Year
Natural Gas, North MMBTU							
FY2020	2,990	3,569	2,971	4,346	4,336	2,943	21,155
FY2019	2,327	4,133	4,339	5,388	4,125	3,407	23,718
YOY Savings %	-28%	14%	32%	19%	-5%	14%	11%
2019-2020 Reduction MMBTU	(663)	564	1,367	1,042	(211)	464	2,563
Bill Savings (\$)	(3,983)	3,489	8,229	6,491	(1,291)	2,850	15,694
Compare Metered Reductions with Project Savings							
Metered Use, North MMBTU	2,990	3,569	2,971	4,346	4,336	2,943	21,155
Metered Reduction MMBTU	(663)	564	1,367	1,042	(211)	464	2,563
Percent Reduction	-22%	16%	46%	24%	-5%	16%	12%
Total Oven Use Est. MMBTU	2,000	1,579	1,444	2,005	1,765	1,845	10,638
Project Savings Est. MMBTU	585	800	935	374	615	534	3,843
Percent Savings	29%	51%	65%	19%	35%	29%	36%
HDD55							
2020FY	24	272	270	307	298	59	59
2019FY	18	265	312	407	200	211	211
YOY Increase %	33%	3%	-13%	-25%	49%	-72%	-72%

Project level results, comparing with metered reductions and also weather patterns