Design of Heat Reclaim System from CNH Industrial's Cure Oven

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Background

During the winter months the receiving bay loses some of its heat when the doors are opened during deliveries. The loss of heat can cause the workers in the receiving bay to become uncomfortable. To solve this issue, CNH has installed a number of heaters that will turn on if the temperature drops. This current solution comes at a cost of thousands of dollars per year and increases carbon emissions. On the other hand, a nearby cure oven currently has unused heat above it that could be utilized to heat nearby rooms.

Project Goals and Objectives

The objectives of this project is to design a heating system in the receiving bay that utilizes the wasted heat above the cure oven and reduce the time the existing heaters are active. This will have the benefits of reducing the carbon emission created and the cost of natural gas required to heat the room.

Tubular Inline Fan

Design iterations have been conducted to determine the most cost-effective fan that will both deliver the required heat and fit the area below the ceiling. A tubular centrifugal inline fan from Twin City Fans is selected to transfer the exhaust heat to the receiving bay. The TSL-270 will transfer 15,000 CFM, and have an operating power of 15 HP at 1800 RPM. The 1029 lbs. fan will be placed in between ductworks and supported from the ceiling by spring hangers that will isolate vibrations caused by the motor.

Figure 1. TSL fan manufactured by TCF.

Heat Available

The amount of heat that can be supplied to the receiving bay is proportional to the temperature of the air above the oven. The optimal temperature of the air above the oven is determined to be 50 °C.

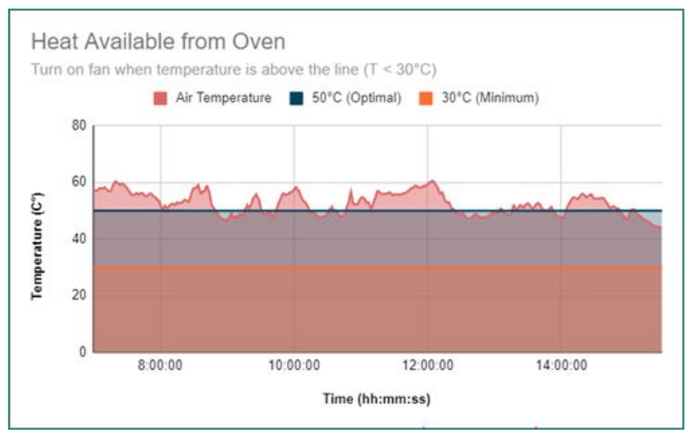
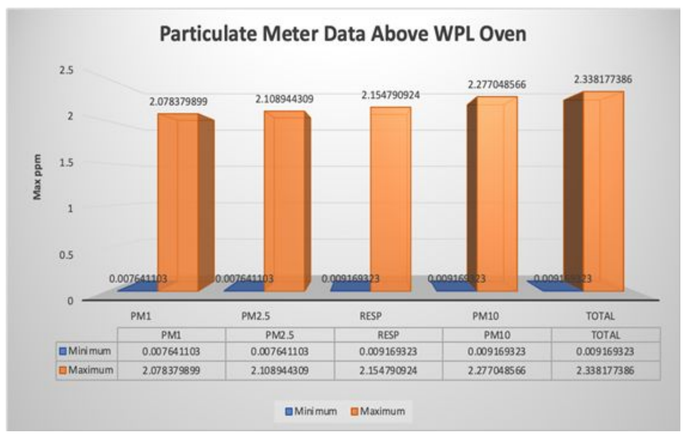


Figure 2. Heat available from oven.

Filtration

Particulate recordings on the exhaust air above the oven:



	PM1	PM2.5	RESP	PM10	TOTAL
Minimum	0.007641103	0.007641103	0.009169323	0.009169323	0.009169323
Maximum	2.078379899	2.108944309	2.154790924	2.277048566	2.338177386

Figure 3. Particulate data from DUSTrack.

Using an aerosol monitor, it is found that the minimum and maximum total volume of the particles is 0.006 mg/m^3 and 1.53 mg/m^3 respectively. Based on economic and performance calculations, eight MERV 14 filters would be needed for this application. A custom filter bank would be fabricated to contain all the filters.

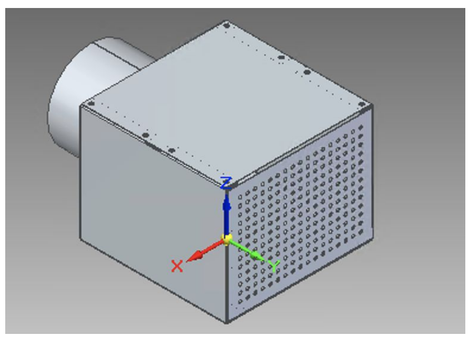


Figure 4. Fabricated filter bank.

Results and Outcomes

1. $3600 worth of natural gas saved (8 month period)
2. 35 tons of carbon emissions reduced annually.

   Capital Investment - $24,205
   Yearly Net Savings - $3,024
   Expected Payoff Period - 8 years

Final Design

The final design utilizes a tubular centrifugal inline fan that is able to transfer 15,000 CFM of air through a 36” ducting system from above the cure oven to the receiving bay. The inline fan is selected as it could be mounted to the roof and it would be able to send enough air to the receiving bay to accommodate the required 810,000 BTU/hr of hot air required to replace 5 out of the 11 existing heaters. Air quality is a large concern as the air above the cure oven contained a small amount of particulate that could be damaging to ingest. To transfer safe air to the receiving bay, the supply fan pulls air from through a filter bank containing eight MERV 14 filters.

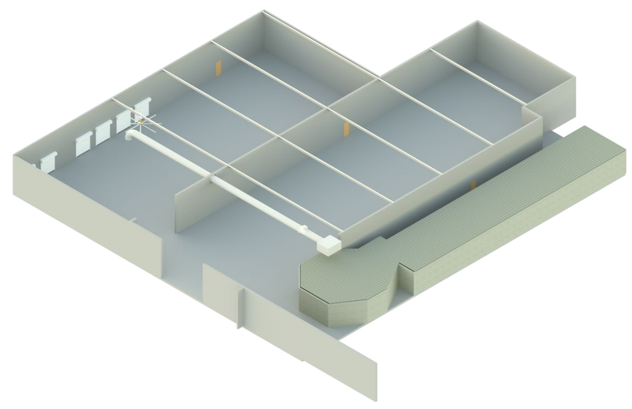


Figure 5. Layout of the facility including the ductwork and the tubular fan.

Conclusions and Recommendations

Within the scope of this heat reclaim system, two major conclusions can be drawn. Firstly, the potential to replace the existing heating system with a system that utilizes the heat above the oven is possible. Secondly, though there is enough energy to heat the receiving bay, this system does not seem feasible without initial investments to cover the capital costs.

Acknowledgments

This project would not have been possible without the assistance and expertise of Celine Bierman, Robert Thomas, Reg Povey, Larry Mao, Jim Ball, Brad Lulik, and Dr. Idem.

References

ASHRAE Handbooks, SMACNA Manuals, NAFA Guide to Air Filtration Third Edition