Focus on Energy Conservation, Minimize Your Energy Consumption by Reusing Your Waste Heat— You Have Already Paid for It!

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As gas prices continue to rise the need for companies to reduce their level of energy consumption and to reduce the cost of operations is a critical consideration. Coupled with the current economic downturn the ability to save money in production is every bit as important as the need to increase sales**.**

Recovering Waste Energy through a Heat Pipe Heat Exchange Technology Leads to Higher Profits

MANTRA Innovative Systems has recently introduced into the United States an innovative approach to reducing energy consumption by designing integrated energy recovery systems for industrial facilities. These systems utilize the most advanced heat exchangers available featuring a patented heat pipe technology but the emphasis is not just on the heat exchanger but the collection, conveyance and redistribution of the heat energy available within the system.

Finding the right energy recovery solution for your production process should be focused on how to maximize the recovery of the heat energy available in the process exhaust. The objective is to return the most energy from an exhaust stream and to transfer the maximum amount of energy possible back into the process stream.

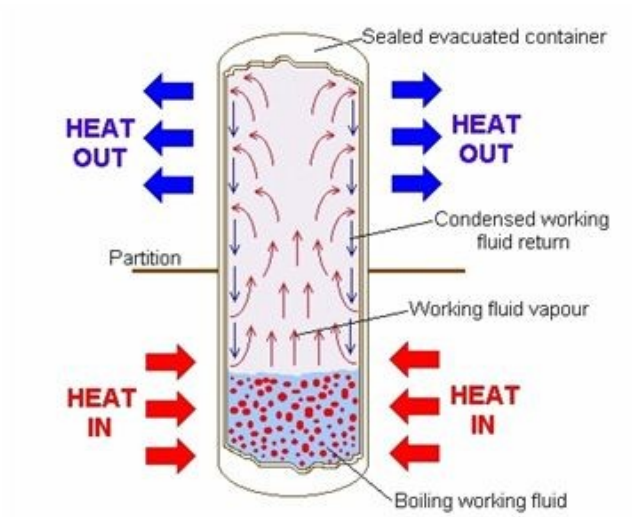
Advancements in the efficiency of heat exchangers and in particular heat pipe heat exchangers offers industry the opportunity to recoup some of the money being spent on energy that is literally going up the stack.

What Are Heat Pipes?

Heat pipes are hermetically sealed evacuated tubes normally containing a mesh or sintered powder wick and a working fluid in both liquid and vapor phase.

When one end of the heat tube is heated the liquid turns to vapor absorbing the latent heat of vaporization. The hot vapor flows to the colder end of the tube where it condenses and gives out the latent heat. The condensed liquid then flows back through the wick to the hot end of the tube. Since the latent heat of evaporation is usually very large, considerable quantities of heat can be transported with a very small temperature difference from one end to the other.

The heat pipes used are filled with a variety of working fluids to maximize the heat transfer potential in each situation. The selection of the correct pipe material and the proper working fluids allows the heat pipe to transfer up to 1000 times more thermal energy than a normal copper pipe.



Schematic Representation of the Heat Pipe

As part of an evaluation process company's should take critical measurements within the production process to identify the amount of energy that can be recaptured from the heat in the exhaust air stream. The available heat coupled with the mass air flow determines the amount of energy that can be returned to the facility.

This information will also determine the number of heat pipes to be used, the material used for the pipe and the fluid to be used for the heat transfer. The efficiency of the system is relational to the exposed surface area of the pipes to the gas stream and as such allows for a variety of configurations in the make-up of the heat exchanger. The heat exchanger can be designed to suit the production area where it is to be located whether the exchanger needs to be tall and slim or short and wide as long as there is sufficient surface area the heat exchanger will perform to its design specifications.

One of the unique features of the heat pipe heat exchanger is that there are no moving parts and therefore they require a minimal amount of maintenance. The operation of a heat pipe heat exchanger requires no external energy other than the thermal energy to be transferred.

The operation of the heat exchanger is far more reliable since the failure of a single heat pipe does not affect the performance of the other heat pipes within the exchanger. Should a heat pipe fail the partition between the exhaust air side and the incoming combustion air eliminates the risk of contamination of the incoming air.

Once the heat exchanger has been designed for the heat and air flow available a systematic approach to the design of the total energy recovery system has to be initiated. As with most technologies the heat exchangers ability to perform is limited to a set design criteria. Concentrating on creating an efficient collection and return system that maximizes the potential of the heat exchanger is as critical a step as the design of the heat exchanger itself.

Details such as maximum temperatures possible, maximum mass flow rates, air stream pollutants, system pressure drops, should all be taken into account in the overall system design.

Advancements in Heat Pipe Technology

Heat pipe heat exchange technology has improved greatly over the last few years. Advancements in the selection of the appropriate heat tube materials and the fluids used to convey the heat have improved their efficiency and their durability in most settings. The proper engineering and installation of the collection and the return system are an integral part to enabling the energy recovery system to perform to its optimum design criteria.

Adopting a total systematic approach to the installation of a heat pipe heat exchanger will ensure the maximum results are achieved and that the expected savings will be realized in the shortest period of time.

Case Study

- *The problem*: to find a viable means to counter rising fuel costs.
- *The solution*: an energy recovery system utilizing heat pipes as the core technology.

In December 2007 MANTRA installed a heat pipe energy recovery system in an aluminum foundry in Kentucky. This facility operates 24 hours a day, 7 days a week and 50 weeks a year.

This particular facility had 2 furnaces into which we fitted an energy recovery system. The systems were 1 x 7,000lb and 1 x 7500lb gas fired smelting furnaces consuming 13 MBTU per furnace. The furnaces had an exhaust stack temperature of 816°C and a mass flow rate of 3,470 Kg/hr.

The clients objective was to preheat the incoming combustion air from ambient (0°C-30°C) to 385^{0}C before injection into the furnace.

Both systems required the heat exchangers to be located outside of the production area. The exhaust gas was taken from the stack using a specially designed banjo fitting located 18′ above the cowl to collect the hottest gas available. The hot air exhaust was then ducted about 60′ to the heat exchanger where it was able to preheat the incoming combustion air to the required 385^{0}C.

The energy recovery system was able to give the client significant savings on their energy bills and provided the client with a 20 month ROI.