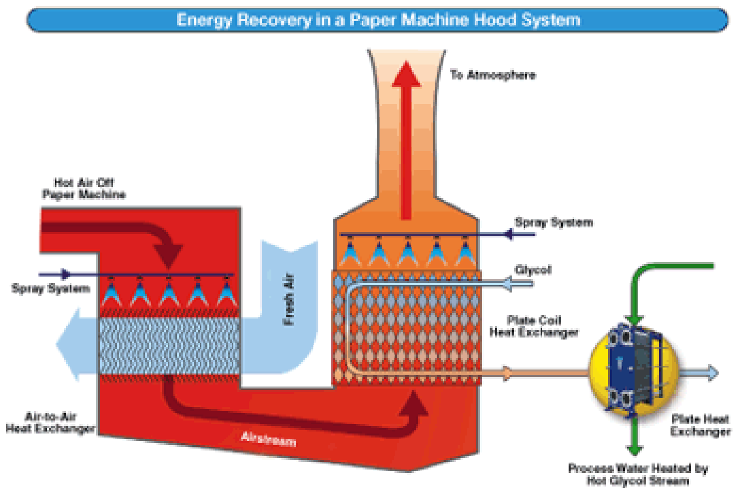
How to Recover Heat with Plate Coil Heat Exchangers

Two case histories demonstrate how a plate coil heat exchanger allows processors to save money by recovering heat from their processes.

As a result of rising energy costs, process industries are saving money by recovering heat energy from waste gas streams using plate coil heat exchangers. Application of this dimpled plate technology has led to these exchangers being nicknamed "energy banks." Two examples of where using plate coil heat exchangers have benefited plant processes with fast payback, low maintenance and reduced operating costs are examined.



In this example, 550 gal/min of 30% glycol can be heated from 70 to 130°F (21.1 to 54°C) using 45,000 acfm saturated air 155°F db/wb. This represents heat recovery of 15 million BTU/hr. Depending upon energy rates, this represents savings to the mill between $45 and $60 per hour.

Pulp and Paper. Hood exhaust systems efficiently evacuate hot air containing water vapor from processes such as the wet end of paper machines and thermal mechanical pulping (TMP) processes. Directing the waste stream through a plate coil heat exchanger recovers significant amounts of heat to water/glycol streams. The recovered heat then can be used to preheat hood supply air as well as heat process water or circulating water for machine room ventilation. Energy recovery eliminates ventilation heating costs for mills located in northern colder climates.

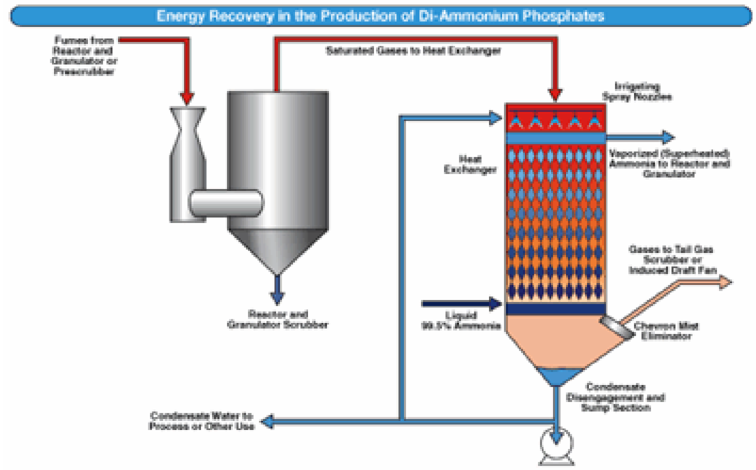
Inside the plate coil heat exchangers, hot air flows in a counter-current direction to the water/glycol stream. Water vapor entrained in the air condenses on the cold surface of the dimpled plate. The presence of water vapor in the airstream increases the condensing coefficient, and the latent heat of this condensation provides high heat recovery rates. The plate design provides a large heat transfer area in a compact space. Low fouling characteristics and ease of cleaning ensure the unit is able to handle cellulose and resins that often become entrained in the waste steam and airstreams from the process.

To guarantee the inlet air is saturated and to enhance efficiency, many mills use spray nozzles ahead of the plate coil heat exchanger.

Phosphate Fertilizer. During the production of di-ammonium phosphate (DAP), ammonia is vaporized and fed to a reactor (preneutralizer) and granulator. One conventional approach has been to use steam to vaporize the ammonia, placing the ammonia on the shell-side of a kettle-type shell-and-tube heat exchanger. But, significant savings can be achieved using a plate coil heat exchanger to eliminate the steam requirement.

The plate coil heat exchangers are placed strategically in the saturated airstream at the outlet from the scrubber that scrubs reactor and granulator fumes with recirculated scrubber liquor solution. This airstream contains traces of ammoniated phosphoric acid and also is saturated with water vapor. By condensing the water, the latent heat of condensation enables the ammonia required for the reactor and granulator to be vaporized while attaining a high condensing heat transfer coefficient.

The condensed water from the scrubber airstream can be recovered for other uses with a bleed stream. A bleed stream recirculated to sprays above the plate coil heat exchanger reduces fouling and enhances heat transfer at the unit's entrance.



In this example, the 100 ton/hr DAP plant requires 50,000 lb/hr ammonia vapor. By using an airstream at 165°F (74°C), the necessary 26,400,000 BTU/hr is provided. This represents savings of between $80 to $105 per hour in steam costs.

Using a plate coil heat exchanger instead of a shell-and-tube heat exchanger in this application offers several advantages.

- Unlike the shell-and-tube, where a shell must be designed for the high pressures of vaporized ammonia, only the plate coils have to be designed for high ammonia pressure.
- Higher heat transfer coefficients and compact construction result in a smaller, less costly heat exchanger.
- The air side of a plate coil heat exchanger is lower fouling and easier to clean than the tubes in a shell-and-tube.
- Hold-up volume of ammonia is much lower, so process control of the ammonia temperature and pressure is easier and safer to maintain.

Process engineers benefit with simpler, less costly and safer designs. Also, if an ammonia leak occurs in the plate coil, there is no threat of fugitive ammonia vapors escaping because the gas side is under vacuum. Finally, the low pressure drop of the air side and the reduction in air volume to be handled due to the condensation of the water vapor make the plate coil heat exchanger suitable for retrofitting applications.