Rohm and Haas:

Furnace Replacement Project Saves Energy and Improves Production at a Chemical Plant

Benefits

- Saves $7 million annually
- Reduces annual energy consumption by 210,000 MMBtu
- Improves throughput by 8%
- Achieves a 2.6-year simple payback

Applications

Chemical plants can often reclaim feedstocks by heating or melting waste streams or residues. Ensuring the efficiency of such process heating applications can achieve significant energy savings and better productivity.

Project Summary

To improve the efficiency of a sulfuric acid recovery process, staff at Rohm and Haas's Deer Park, Texas, plant replaced a natural gas-fired furnace and preheater with new equipment. Using DOE's Process Heating Assessment and Survey Tool (PHAST) software, plant personnel were able to accurately determine the energy savings and productivity improvements that would result from replacing the equipment. This retrofit project has yielded higher than anticipated energy savings and productivity gains. Annual energy and energy cost savings total 210,000 MMBtu and approximately $2 million, respectively. Also, the recovery process now has a higher acid reclamation rate, which provides annual cost savings of $5 million per year. With total project costs of $18 million, the project achieved a 2.6-year simple payback.

Plant/Project Background

Covering more than 800 acres and employing more than 750 people, the Deer Park facility is Rohm and Haas's largest production plant, producing more than 5 billion pounds of chemical products annually. The plant's sulfuric acid recovery process, which was installed in 1970, reclaims approximately 3,600 tons of sulfuric acid per day by decomposing sulfuric acid residue.

In 2002, a pinch analysis identified structural inefficiencies in the process that resulted in energy losses. The preheater's efficiency was found to be 62%, down from its design rating of 76%, largely because of leaks in the heat exchangers. Plant personnel realized that the furnace and preheater were near the end of their design lives and planned to replace them. In 2004, they used the PHAST tool to estimate how much energy the retrofit would save. The PHAST analysis showed that, in addition to the retrofit, more energy savings and higher capacity could be obtained by increasing the temperature of the preheated air by 25%. These savings estimates validated the decision to replace the unit.

The project included replacing both the preheater and the furnace as well as upgrading certain sensors and insulation. The newly installed preheater solved the leaking heat exchanger problem associated with the previous preheater. Previously, the type of furnace exhaust oxygen analyzer used resulted in delayed readings and made it more difficult to accurately monitor combustion conditions. Three new analyzers were situated within the furnace ducts to provide real-time readings of exhaust oxygen levels. Finally, plant personnel installed 9 inches of insulating refractory, rather than the 4.5-inch refractory used in the previous furnace.

Results

The retrofit project is yielding substantial performance improvements and energy savings. The preheater's efficiency has risen to 83%, reducing process energy use by about 8.5%. The exhaust oxygen analyzers allow staff to operate the furnace consistently at the lower end of the desired oxygen range, so the furnace uses even less fuel. Also, the new furnace's configuration allows for more efficient burning and faster residue decomposition, so plant personnel were able to lower the furnace temperature by 40°F.

Preliminary data show that the process uses about 11% less natural gas than it did previously. This translates into annual energy savings of 210,000 MMBtu and energy cost savings of $2 million. The new furnace's capacity utilization is better than expected and throughput is 8% higher; consequently, $5 million worth of additional sulfuric acid is reclaimed. With total project costs of $18 million and total savings of $7 million, the simple payback is 2.6 years.

Lesson Learned

Ensuring the efficiency of an industrial process heating system requires reducing energy losses and maximizing the amount of energy transferred to the load. At the Rohm and Haas Deer Park plant, some structural conditions accrued over time that reduced efficiency and caused energy losses in the plant's sulfuric acid recovery process. To improve the efficiency of the process, staff decided to implement a system-level project to replace an aging furnace and preheater and upgrade the furnace's sensor technology and insulation. An assessment performed using DOE's PHAST software was instrumental in determining the project's energy savings and production benefits, which turned out to be higher than anticipated. PHAST and other DOE software tools—such as AIRMaster+, PSAT, SSAT, MotorMaster+, and FSAT—can help plant personnel determine how to optimize their industrial motor systems and processes.

Claudia O'Rourke

Project Partners

Rohm and Haas Company
Deer Park, TX

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Partner Profile

Claudia O'Rourke, a chemical engineer with Rohm and Haas, is the process steward in the Deer Park plant's sulfuric acid recovery unit. She routinely evaluates the efficiency of the recovery process and uses DOE's PHAST software tool to gauge the efficiency of the preheater and furnace. The Deer Park facility has been using DOE techniques and tools to evaluate energy efficiency opportunities since 1999.

Industrial Use of DOE System Assessment Software

Industry professionals involved in system or plant operations, engineering, and management often use DOE software to evaluate their plants' motor and industrial systems. DOE offers one-day training workshops in compressed air, electric motor, fan, process heating, pump, and steam systems that teach the DOE assessment software tools (AIRMaster+, FSAT, MotorMaster+, PSAT, PHAST, SSAT, SSST and 3E Plus). These workshops assist attendees in identifying cost-cutting and efficiency opportunities in their plants.

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BestPractices emphasizes plant systems, where significant efficiency improvements and savings can be achieved. Industry gains easy access to near-term and long-term solutions for improving the performance of motor, steam, compressed air, and process heating systems. In addition, the Industrial Assessment Centers provide comprehensive industrial energy evaluations to small- and medium-size manufacturers.

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