



ANHUI LINQUAN CHEMICAL INDUSTRY CO LTD

Replacement of glue sphere with screw cordonnier system in steam turbine condenser

SUMMARY OF THE OPTION

Anhui Linquan Chemical Industrial Company Ltd. is a joint stock company established in 1970, a middle size chemicals producer located in Anhui province, Middle China. It produces over 1 million tons of chemicals, mainly urea and ammonia.

The key equipments in the Heat and Power department include the steam turbine and electricity generator. A condenser recycles excess water from the steam turbine but gets contaminated with scaling after several cycles. In order to decrease the scaling build up in the condenser and improve the power efficiency of the turbine, the screw cordonnier system was installed in the condenser to replace the original glue sphere.

This system focuses on process control and is able to discharge pollutants in accordance with legal standards, and able to meet higher requirements of environmental protection and cleaner production, at the same time making more reasonable use of natural resources; it can also reduce pollutants in the recycled water and then reduce the on/off frequency of the steam turbine. Therefore, this system may generate good environmental benefits and economic benefits.

The initial investment was US\$ 62,000 (511,500 RMB), the net savings were US\$ 101,032, with only about 7-months payback period. Annual energy savings included 2,420 tons coal and 42,000 kWh, which is equal to CO₂ emission reductions of up to 3,710 tons per year. Other benefits are reduced chemical consumption to recycle water, and reduced atmospheric pollution with SO₂, NO_x, CO and particulate matter, resulting in improved compliance with legislation.

KEY WORDS

Chemicals, China, Heat and Power department, Steam Turbine, Condenser, screw cordonnier system

OBSERVATIONS

The key equipment in the Heat and Power Department are the steam turbine and electricity generator. The excess water vapor produced by the steam turbine goes to the condenser, which cools the vapor and recovers water for reuse. After several recycling cycles, the water contains various kinds of impurities like salt, sand, algae and microbes. This results in scaling on the inner surface of the condenser, which decreases the efficiency of cooling and the steam turbine. The condenser had to be cleaned regularly and to do this the turbine and generator had to be shut down each time the condenser was cleaned.



There are different ways to clean the condenser: (1) chemical cleaning using chemicals and (2) mechanical cleaning using a brush, hydraulic giant method, or glue sphere. This company used the glue sphere method, which consists of a rubber ball that is pushed through the condenser's copper pipes to remove contaminants. Chemicals are used to treat and recycle the contaminated water. However, all these methods focus on cleaning condensers, but it would be better to try and prevent the condensers from getting contaminated so that cleaning is not needed at all.

OPTIONS

In order to decrease scaling of the condenser and increase the power efficiency of the turbine, the screw cordonnier system was installed in the condenser to replace the glue sphere method. The system focuses on process control. Atmospheric pollutants emission will meet the national requirement and the company will advance in cleaner production.

The system consists of three parts:

- Fixed part, which is fixed tightly to one end of the copper pipe
- Junction suspension link, which is made of stainless steel
- Spiral tie (or screw), which is made of polymer materials, and therefore easy to install and replace, with high heat-resistance ($t=100^{\circ}\text{C}$) and rot-proof (can be used for more than three years).

The new system avoids contaminant formation, which is the basic requirement of Cleaner Production. The principle of the system is to stir the water inside the copper pipes using a spiral so that the laminar water flow turns into turbulent water flow. This flow will prevent sand and other impurities from depositing, thus avoiding contaminant formation. Another effect is enhanced cooling because the heat transfer coefficient of the turbulent flow is bigger than the laminar flow. The number of start ups of the turbine generator is also reduced.

The system can be used for various kinds of tube heat exchangers and is widely used in electrical and chemical companies.

RESULTS

The new method will reduce chemical consumption for water recycling, pollutants, electricity consumption from reduced number of start ups of the turbine generator and more efficient cooling in the condenser, and coal consumption.

Financial benefits

- Investment: US\$ 62,000
- Annual net cost savings: US\$ 101,032 (= cost savings – operating costs)
- Payback period: 7 months

Environmental benefits

- Annual coal savings: 2,240 tons (= 13,440 tons steam / 6 tons coal to produce 1 ton of steam)
- Annual electricity savings: 42,000 kWh
- Annual GHG emission reduction: 3,710 tons CO_2
- Annual other emission reductions:
 - SO_2 : 107 kg
 - NO_x : 5.2 tons
 - CO: 220 kg
 - Particulate matter (PM_{10}): 5.8 tons
- Reduced chemicals consumption (not quantified)

FOR MORE INFORMATION

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