Closed final gas cooling systems save energy and eliminate emissions at coke plant

Avdeevskiy coke processing plant, Donetsk, Ukraine **Case Story**

Avdeevskiy coke processing works in Ukraine was the first plant of its type to invest in closed final gas cooling systems.

Avdeevskiy coke processing works is Ukraine's leading coke processing plant. To comply with European emission and process regulations for the coke industry, the plant has replaced two open final gas cooling systems, using scrubbers, with Alfa Laval closed systems utilizing 11.5 metre high spiral heat exchangers (spiral columns). One system was installed in the benzene section of the desulphurization department in 2006 and another one was installed in the subsequent recovery stage in 2008.

According to Chief Engineer Semen Kaufman, the results in terms of energy savings and reduction of harmful emissions were impressive.

Upgrading the desulphurization department

Prior to the installation of the new systems, the coke oven gas (COG) was scrubbed and cooled in an open system using water. This arrangement resulted in considerable emissions of harmful substances to the atmosphere from the cooling towers. After hearing about Alfa Laval's technical solution, Avdeevskiy coke processing works decided to install closed final gas cooling systems in the desulphurization department.

These systems comprised a three-stage spiral heat exchanger (SHE) tower, which would allow the gas to be scrubbed and cooled before the benzene scrubbers. In this arrangement,

Fast Facts

Avdeevskiy coke processing works

Located outside Donetsk in Ukraine and owned by Met Invest Holding, Avdeevskiy coke processing works is the largest coke processing plant in Europe. It is not associated with a steel mill but operates independently and exports coke and byproducts.

Avdeevskiy coke processing works has been operating since 1963, and today, 3.5 million tons of raw coal are processed each year, with the coke output averaging 73%.

Final coke oven gas cooler. An Alfa Laval spiral column installed at Avdeevskiy coke processing works.

Spiral heat exchanger column supplied by Alfa Laval.
The unit is 11.5 metres high and 2.1 metres in diameter.

the COG enters the upper part of the SHE tower, passes through stages I, II and III, and is released through an outlet at the bottom of the vessel. It then continues to the benzene scrubbers.

The cooling water flows in the opposite direction, upwards in the tower in a spiral mode. In order to ensure sustainable operation, each step is equipped with a continous spraying system using an oil/water emulsion as washing agent. In addition, by applying a high enough gas velocity a self-cleaning effect is established.

Final cooling water loop closed

Gas cooling is achieved by circulating technical water from plant systems. Water cooling is carried out in cooling towers and there is no direct contact between the gas and the water. The heat exchange is performed in the heat exchanger sections in the SHE tower.

The final cooling water loop is thus closed.

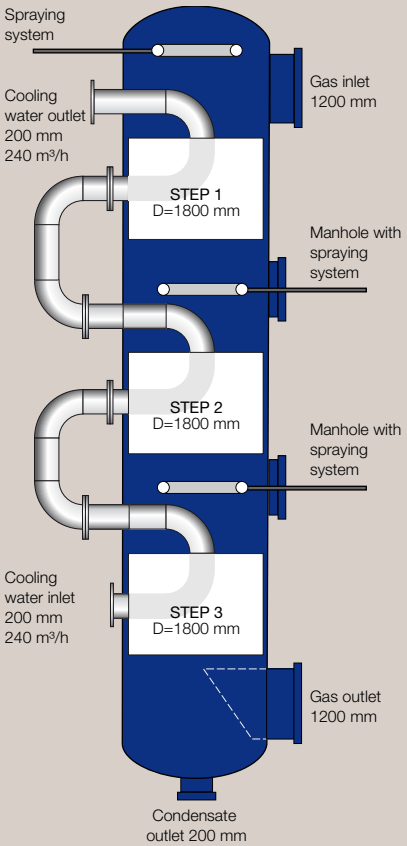
"Avdeevskiy coke processing works was the first coke processing plant in the world to invest in this solution," says Semen Kaufman. "Emissions of ammonia, hydrogen cyanide, hydrogen sulfide, benzene, naphthalene and phenol were reduced to zero. Reduced pumping costs and elimination of water treatment costs provided substantial financial and energy savings."

Many additional benefits

Semen Kaufman: "The source of hazardous discharges, such as ammonia, hydrogen cyanide, benzene and naphthalene, to the environment were eliminated. There were space-saving advantages as well. The height of the old final gas coolers with the naphthalene scrubber was about 40 metres, with a diameter of about 6 metres. This was replaced with a unit 11.5 metres high and 2.1 metres in diameter."

Semen Kaufman relates that the performance of the benzene section was improved by means of a decrease in COG temperature after the final gas cooler. "The recovery of crude benzene was increased by 1.5–2%. The performance of the condensing section was improved. Sedimentation of tarry substances was prevented in the cooling towers of the final cooling cycle and steam and electricity demands were reduced by 15–20%."

Moscow coke system



The environmental efficiency of closed COG final cooling in recovery section №1 is shown in this table.

№ of emission source	Hazardous substance	Amount of emissions, tons/year	
		Before implementation	After implementation
9072	Ammonia	76,2	0
	Hydrogen cyanide	520,5	0
	Hydrogen sulfide	89,6	0
	Benzene	203,8	0
	Naphthalene	641,2	0
	Phenol	0,2	0

How to contact Alfa Laval
Up-to-date Alfa Laval contact details for all countries are always available on our website at www.alfalaval.com.