Paste Plant Self-Cleaning Tar Fumes Ventilation Ducts, Design and Operation

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Abstract

Anodes and cathodes manufacturing generates carcinogenic tar fumes. Capture of tar fumes by ventilation ducts deteriorates when ducts become obstructed by tar and dust accumulation. Modifications to a coke fine tar fumes scrubber were performed to make ducts self-cleaning. Coke fines injection point was added to each tar fume collection point. With clean ducts the capture capacity of the system remains unchanged. History of this development is reported. Working principles are described. Points to check when designing, starting and operating this system are also described, this avoid repetition of mistakes made in the past, when putting into service first versions of this type of scrubber. This description is done from a long-term user of this type of installation.

Keywords: PAH scrubber; self-cleaning ventilation ducts; workplace environment.

1. Introduction

Carbon anode manufacturing processes are based on using coal tar pitch (CTP) binder. During the production of hot green paste and green anodes containing this binder, Volatile Organic Matter (VOM) compounds in the form of fumes are generated. This VOM usually contains carcinogenic, polycyclic aromatic hydrocarbons (PAH's) that workers should be protected from.

To achieve this, green paste plants usually have ventilation systems to convey the gas containing VOM to a scrubber for treatment. These ventilation ducts suffer internal buildup over time by accumulation of condensed VOM, mixed with solid particles which forms a crust that reduces the internal diameter of the ventilation ducts. This causes a reduction of capture capacity of the ventilation system and workers may become exposed to carcinogenic material.

Cleaning of these ventilation ducts is a very unpleasant and hazardous job. Cleaning of ducts is often done manually using metal scrapers or steam lances. Recuperated material is sticky, dirty and highly carcinogenic. Workers doing this job need to be very well protected to avoid any contact with material they remove.

An accidental observation made while reviewing the scrubbing process led to the development of a coke fines injection process for keeping ventilation ducts clean. This in turn, has allowed the capture capacity of VOM to be maintained and eliminated most of the ventilation ducts cleaning.

2. Coke fines scrubber description

The cleaning process that will be described below requires as a prerequisite a coke fines tar scrubber (CFTS).

A CFTS consists of a dust collector, ducting to capture contaminants at their sources and a fine coke supply system.

A CFTS is a variation of an alumina fluoride scrubber. The principle is identical and only the scrubbing medium is different. In both cases, the dust collector is preceded by a vertical duct, often a venturi, where the scrubbing medium is injected. This forms a “cake” on the surface of the dust collector filter. In the case of an alumina fluoride scrubber, hydrofluoric acid is adsorbed on the metallurgical alumina surface and recycled in the electrolysis pot to produce aluminium.

A CFTS uses petroleum coke fines, usually produced by a ball mill, or coming from a dust collector for coke dust. Unlike an alumina scrubber, capture of tar fumes is not done by adsorption on the surface of coke fines, because tar fumes pass through scrubbers without being captured. The mechanism of removal is capture of condensed tar onto coke fines. For this the reason, gas containing tar fumes should be at a temperature of 40C or lower so VOM is condensed when it contacts coke fines. Capture is then done by wetting fine coke with condensed tar. Fine coke loaded with tar is then recycled in anode manufacturing.

3. History

A CFTS was installed at the plant A in 1985. It replaced a water-based lamellar separator scrubber which was not very efficient. The wet scrubber generated contaminated water and tarry mud which were both difficult to get rid of.

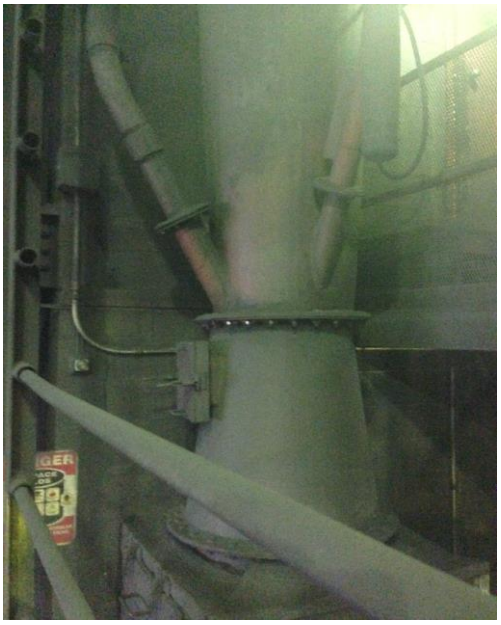

Figure 1. Fresh and loaded coke injection points at venturi throat before dust collector

In 1991, while inspecting the venturi throat where coke was injected (Figure 1), an interesting observation was made. The duct before coke fines injection point was very dirty, whilst the duct downstream coke fines injection point was clean. About half the coke fines injected in venturi throat was delivered to a VOM capture duct connected to a forced-air green paste cooler, which generated a large quantity of tar fumes. This duct stayed clean afterward.

The scrubber manufacturer, Procédair Industries (now Five Solios), started including coke fines local injection points in its scrubber system design [1]. When Eirich mixer coolers were installed at plant A, in 1999 and 2000, local coke fines injection points were added to all VOM capture points of the paste plant. It took time and experimentation to make the local coke fines injection system fully functional.

7. Effect on Ducts Cleaning Cost

Implementation of a self-cleaning ventilation duct system reduces manual cleaning costs. Unfortunately, it was not possible to quantify cleaning costs before and after the implementation for direct comparison in this study. It is widely recognized at both Plant A and Plant B that the effort required to clean ducts has been reduced substantially as a result of a successful implementation of the CFTS systems.

8. Conclusion

Self-cleaning ventilation ducts from a CFTS requires implementation of a number of necessary systems.

The VOM capture ventilation ducts need to have local coke fines injection points installed, with fine coke flow sufficient to capture condensed VOM and convey it to the scrubber dust collector. Tar loaded coke fines requires an air speed sufficient to keep it in suspension up to the dust collector.

Implementation of this type of self-cleaning ventilation ducts improves the paste plant working environment and reduces carcinogenic tar fumes when present and the need for manual and messy removal of coke fines/tar buildup.

9. References

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