Question 29: What technologies do you use for treating or recovering VOCs from small-scale truck loading terminals? Discuss the merits associated with each?

Alec Klinghoffer (Coffeyville Resources)

The three main VOC treating systems for small scale truck loading are vapor combustion system, flare gas recovery unit, and an adsorption/absorption vapor recovery system.

The simplest system is the vapor combustion system. In this system, the vapors flow through a vapor shutdown valve and detonation arrestor and enter a combustor. The vapors are ignited by a pilot and the assist air blower provides some combustion air and mixing energy to ensure smokeless combustion. This system is very robust and provides very efficient combustion of the hydrocarbon vapors. It is also a very simple system mechanically so there is very little maintenance involved and is used in a lot of additional applications (such as wastewater installations).

The second type is the flare gas recovery unit. This unit consists of a knockout vessel, a liquid seal vessel and the flare itself. A flare header collects gases from various sources and as the flare header pressure reaches a set point, a liquid seal compressor starts up and begins to compress the gases. A heat exchanger is used to control the compressor discharge temperature. The compressor discharge is sent to a 3-phase separator that separates the liquid from the flare gas. This liquid is recovered and can be sold as product or used elsewhere in the refinery. The recovered fuel gas can be sent back to the refinery fuel gas system or processed as a chemical feedstock. The advantage of this system is the recovery of the gas and liquid to be re-used in the refinery. Also, there is a minimum amount of flaring since a portion of the gas can be used elsewhere in the refinery. The liquid recovery directly affects profits and minimal flaring is viewed as a better option from the point of environmental stewardship.

The third type of vapor recovery system is the adsorption/absorption vapor recovery system with a “dry” vacuum pump. This system is the most complex but probably also the most environmentally friendly system of the three presented here. The unit is equipped with 2 identical activated carbon filled adsorbers. One adsorber is always on steam while the other is being regenerated. When loading is occurring, the VRU automatically starts and sends hydrocarbon rich air to the activated carbon bed. The bed removes the hydrocarbon through adsorption and vents air with a minimal amount of hydrocarbon. During regeneration, the carbon bed is stripped of hydrocarbon using purge air and high vacuum. The purge air is discharge directly into an absorption column where the hydrocarbons are stripped from the air. The stripping medium in the absorber column is usually a material similar to what is being loaded at the rack (i.e., gasoline). In the absorber, the vapor is liquefied and returned back to the storage tank. A small stream of air and residual vapor is recycled back through the carbon bed for re-adsorption. The major benefit of this system is that most if not all of the hydrocarbons are recovered in this system. There is also an elimination of a flare in this system and there is reduced energy consumption because of the dry vacuum pump system. There is no compressor in this system so maintenance cost decrease and reliability increase for this configuration.

John Clower (Chevron)

Technologies used for VOC recovery are simple adsorption technologies or incineration. The technology used depends on design vapor load and emissions monitoring requirements. The Richmond Refinery employs a carbon adsorption/absorption vapor recovery system at its truck terminal. This system employs two carbon drums, one in adsorption mode and a second in regeneration or standby.

The “adsorption” flow path passes through a carbon vessel and past continuous emissions monitoring and to a vent.

The “regeneration” flow path uses high vacuum and air purge to remove adsorbed hydrocarbons from the carbon bed. The extracted hydrocarbons accumulate in a separator and are processed through an absorber for recovery of heavier hydrocarbons back to the storage tank.

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