Vapour recovery in marine ethanol loading service

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With the onset of minimum oxygenate content regulations in gasoline in various worldwide locations, the production and distribution of ethanol to meet increased demand have introduced new and unique challenges. One such challenge is with regard to ethanol vapour control in marine loading operations. John Zink Company is actively addressing the needs of marine terminals around the world in this area by providing safe, reliable, and cost-effective vapour control solutions. Both Vapour Recovery Units (VRU) and Vapour Combustion Units (VCU) have special design considerations for marine ethanol loading applications; this article will address those considerations, specifically for terminals utilising Carbon Adsorption Vapour Recovery technology.

Employing a Carbon Adsorption VRU in marine ethanol loading service presents some specific issues that must be taken into account in the system's design. As an example, the air/hydrocarbon vapour mixture transferred to the VRU via liquid displacement from a barge will often contain gasoline light end vapours in addition to ethanol vapours. This effect can be attributed to the fact that ethanol product, when stored or transferred in bulk for the petroleum industry, is often denatured with another higher vapour pressure petroleum product such as gasoline. As a result, near the end of a barge load, the inlet hydrocarbon concentration to the VRU can potentially exceed the maximum theoretical concentration of ethanol alone in atmospheric air. The amount of activated carbon and the capacity of the regeneration system must take into account the above effects in the VRU's design.

Figure 1. VRU Based on DVP Technology.

Figure 2. Dock Safety Unit.

The specification of the vacuum system in marine ethanol loading service is of critical importance for operational success. The liquid ring vacuum pump, while robust and proven in the vapour control industry, requires a circulating ethylene glycol-based seal fluid, which can be a substantial disadvantage in ethanol vapour recovery. Ethanol is miscible in ethylene glycol and can cause seal fluid dilution in the separator vessel. Ethanol has a higher vapour pressure than ethylene glycol, so when diluted seal fluid is circulated to the suction of the vacuum pump, the ethanol has the tendency to flash into vapour form at normal operating temperatures and high vacuum levels. Vacuum pump capacity that would otherwise be used for activated carbon regeneration is spent by the flashing ethanol, resulting in lower regeneration system efficiency and ultimately high emissions. Seal fluid dilution due to ethanol loading can also lead to ethylene glycol losses. As the seal fluid becomes diluted, its level in the separator rises. If the level becomes high enough, the seal fluid will spill over into the absorber's liquid reservoir and ultimately be pumped back to a product storage tank. If left unchecked, the ethylene glycol content of the seal fluid will decrease and the ethanol content will increase, further hindering performance. To mitigate these effects, John Zink utilises a rotary screw Dry Vacuum Pump (DVP) as the mode of activated carbon regeneration for marine ethanol loading applications. The DVP requires no seal fluid, eliminating not only the potential for dilution but also ancillary equipment associated with the seal fluid such as the separator vessel, the seal fluid pump, and the seal fluid cooler.

One final design issue that must be taken into account is the liquid product into which the ethanol vapours are to be recovered. Ethanol, gasoline, or certain petroleum feedstocks can all be used for this purpose, depending upon site logistics, desired product loading flexibility, rate of storage tank turnover, and a number of other factors. For example, using a gasoline absorbent typically allows for a wider range of alternative products to be loaded to the same system, while using ethanol reduces the required circulation rate. John Zink has offered solutions to both scenarios on recent applications.

Customised marine ethanol loading VRU solutions are often required to meet varying site conditions. John Zink has a considerable amount of experience and expertise in this area, including the dry vacuum pump retrofit of an existing liquid ring system and the design of a new DVP system, each to accommodate ethanol barge loading. John Zink also has the capability to provide USCG-approved marine vapour collection and safety equipment, including Dock Safety Units and Vapour Blower Units. Look to John Zink Company to be your total marine vapour control solution.

ABOUT THE COMPANY

John Zink® advanced products and technologies provide industry with environmentally sensitive solutions that enhance air and water quality. From research and development through manufacturing to field installation, John Zink's team of engineering experts ensures that advanced, clean-burning solutions serve a host of global industries.

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