



# The benefits of a membrane unit retrofit to existing carbon VRU

**NISTM**  
National Institute For Storage Tank Management

At many bulk terminal loading racks, the emphasis is on increasing the number of bays, loading arms and the associated instantaneous loading rate of products such as gasoline. During the initial design and construction of these terminals, the designers of the vapor recovery or combustion system try to anticipate a certain volume growth to allow flexibility for accommodating increased rack rates. As a practical matter however, the design capacity of the vapor control device is quickly reached and then exceeded. The use of the undersized vapor control device results in increased emissions, and therefore the loading rack rate must be scaled back.

The options facing the terminal operator using an undersized carbon adsorption system involve using a booster pump on the existing vacuum pump to aid in more quickly regenerating the adsorbed carbon bed, or scrapping the old unit and installing an entirely new vapor recovery unit (VRU). The booster pump option is very capital and energy intensive and does not allow higher instantaneous loading rates per se, only a faster regeneration time of

the bed. Thus, the bed cycling will require higher frequency and therefore even more energy will be expended. The retiring of the existing unit and building a larger capacity model can also be an expensive and time-consuming process, especially if the present unit has significant years of useful life remaining.

A creative option involves the retrofitting of the existing carbon adsorption VRU with a membrane stage upstream of the VRU. The membrane stage separates the vapor stream from the loading racks into two streams:

- The stream passing through or permeating the membrane is highly enriched with hydrocarbons and is passed directly into the existing scrubber (absorber) where the hydrocarbons are entrained back into liquid phase.
- The stream exhausting from the membrane is depleted of hydrocarbons, water vapor and oxygenates (such as ethanol) and is directed to the carbon beds.

By removing a large fraction of the mass loading, the existing adsorber beds function as vapor “polishers” and are able to operate at a much higher efficiency.

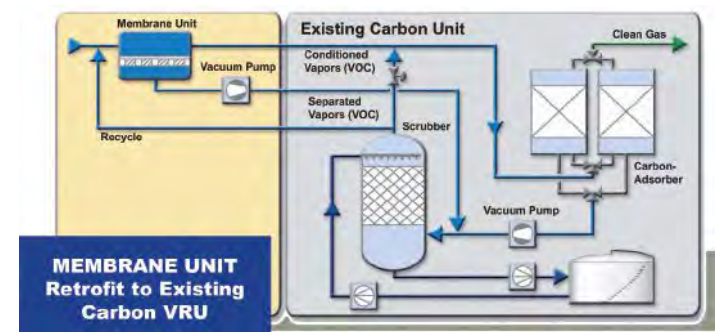
Petro-Diamond Inc. (PDI) has retrofitted

a membrane stage at its Long Beach, Calif., terminal. Its existing carbon bed system had become too small to accommodate the increased throughput desired. After the existing carbon adsorption system was augmented by the membrane stage, PDI was able to go from four loading arms to nine loading arms operating simultaneously. South Coast Air Quality Management District’s emissions standard for this terminal was set at 0.08 pounds of high carbon vapors per 1,000 gallons of fuel loaded. A recent California Air Resources Board test measured an emissions level of 0.0011 pounds of hydrocarbon vapors per 1,000 gallons loaded; this emission level was only 1.4 percent of the allowable level. Of particular note, benzene and aromatics emissions were reduced by more than 75 percent and 95 percent, respectively.

“The older carbon adsorption unit

would require a large capital investment for replacement plus a newly purchased carbon-based system would still struggle with processing oxygenates added to our gasoline such as ethanol,” said PDI General Manager Mike Dougherty. “With the membrane retrofit option, our carbon bed is usable as is, and the new unit removes the highly polar, hard-to-treat components before they reach the carbon beds.”

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March 13-15, 2013

## 15th ANNUAL

Orlando, Florida

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#### CONFERENCE SCHEDULE OF EVENTS:

**Welcome Reception:**  
**Tuesday**

March 12, 2013  
8:30pm – 10:00pm

**Cocktail Mixer:**  
**Wednesday**

March 13, 2013  
5:30pm

**Conference Hours:**  
**Wednesday**

March 13, 2013  
8:15am – 5:30pm

**Thursday**

March 14, 2013  
8:30am – 5:00pm

**Friday**

March 15, 2013  
8:30am – 12:15pm

**FREE Trade Show:**  
**Wednesday**

March 13, 2013  
8:00am – 5:30pm

**Thursday**

March 14, 2013  
8:00am – 3:00pm

**Conference & Trade Show Location:**

Rosen Shingle Creek Hotel | Gatlin Ballroom  
9939 Universal Blvd, Orlando, FL 32819

Phone: 866.996.9939 • Booking ID #29262 • [www.rosenshinglecreek.com](http://www.rosenshinglecreek.com)

#### CO-LOCATED EVENTS:

**FREE EPA SPCC & FRP**

March 12, 2013

8:00am – 5:00pm

**Tank Fundamentals & Integrity Seminar**

March 12, 2013

8:30am – 4:30pm

**Shop Fabricated Tank Systems**

March 11, 2013

12:00pm – 6:00pm

March 12, 2013

8:00am – 5:00pm



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