



# DOWEX OPTIPORE Adsorbents

## Styrene Emissions Control

Styrene is a basic component of a wide variety of plastics used today. During manufacture of these plastics, emissions of styrene commonly occur causing concerns for worker exposure and release to the environment. Styrene is classified as a Hazardous Air Pollutant (HAP); emissions exceeding 10 tons per year must be reported. OSHA has established worker exposure limits (PEL) of 100 ppmv.

In order to assure low exposure levels for workers, high ventilation levels are used in the workplace. Consequently, styrene emissions are contained in high volumes of air. Emissions often contain other components and are not desirable for reuse so thermal oxidation is the method of choice for disposal. The option of directly burning a very large volume of air is very expensive due to the cost of natural gas required to reach destruction temperatures.

### Another Option

Styrene emissions can be effectively removed from an air stream by adsorption onto polymeric adsorbents, effectively cleaning the air and concentrating the emissions on the adsorbent. The adsorbents can then be thermally regenerated on site, producing a concentrated emission stream that can be autothermally oxidized. Important considerations are the capacity of the adsorbent for the styrene and the rate of desorption of the styrene.

### Polymeric Adsorbents

Dow manufactures two adsorbents that can be used for styrene vapor emissions control. They are DOWEX\* OPTIPORE\* V323 and DOWEX OPTIPORE V493 polymeric adsorbents.

DOWEX OPTIPORE V323 is a divinyl benzene adsorbent that is characterized by a more open pore structure, resulting in very fast desorption kinetics and a good adsorption capacity. For more information on the physical and chemical properties of DOWEX OPTIPORE V323, please consult the technical bulletin (Form No. 177-01700/CH 171-412-E).

DOWEX OPTIPORE V493 is a methylene bridged type of adsorbent developed for its high surface area and high adsorption capacity. For more information on the physical and chemical properties of DOWEX OPTIPORE V493, please consult the technical bulletin (Form No. 177-01505).

### Adsorption Capacity

The adsorption capacities of DOWEX OPTIPORE V323 and V493 are shown in Figure 1. The figure plots

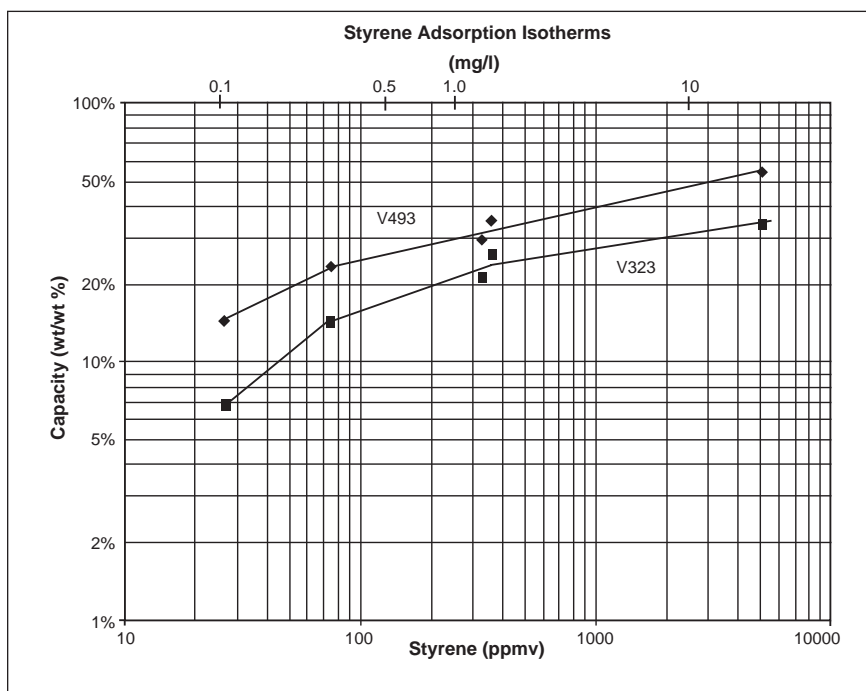
the capacity of the respective adsorbents against the vapor concentration of styrene. V493 has a slightly higher capacity at lower styrene concentrations. Adsorption isotherm data for other solvents of interest can be found in the technical literature for the respective adsorbents.

### Adsorbent Regeneration

DOWEX OPTIPORE V323 and V493 polymeric adsorbents have been designed for their ease of desorption under conditions available in on-site regeneration systems. Polymeric adsorbents contain macro and meso pores that facilitate the rapid transport of compounds in and out of the adsorbents.

Desorption is performed by adding heat to overcome the forces of adsorption. Desorption can be done with steam, hot air or microwave energy. The most widely used

**Figure 1. Equilibrium adsorption isotherm of styrene with DOWEX OPTIPORE V323 and V493 adsorbents.**



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## DOWEX OPTIPORE Adsorbents

For more information about DOWEX OPTIPORE

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desorption method is with hot air. Figure 2 shows the desorption of styrene from DOWEX OPTIPORE V323 and Calgon BPL activated carbon. The data was generated by fully loading the respective adsorbents with styrene, then regenerating with 124° C air at a linear flow rate of 103 ft/min (174 m<sup>3</sup>/hr). Both adsorbents were regenerated under identical conditions.

### Equipment Configurations

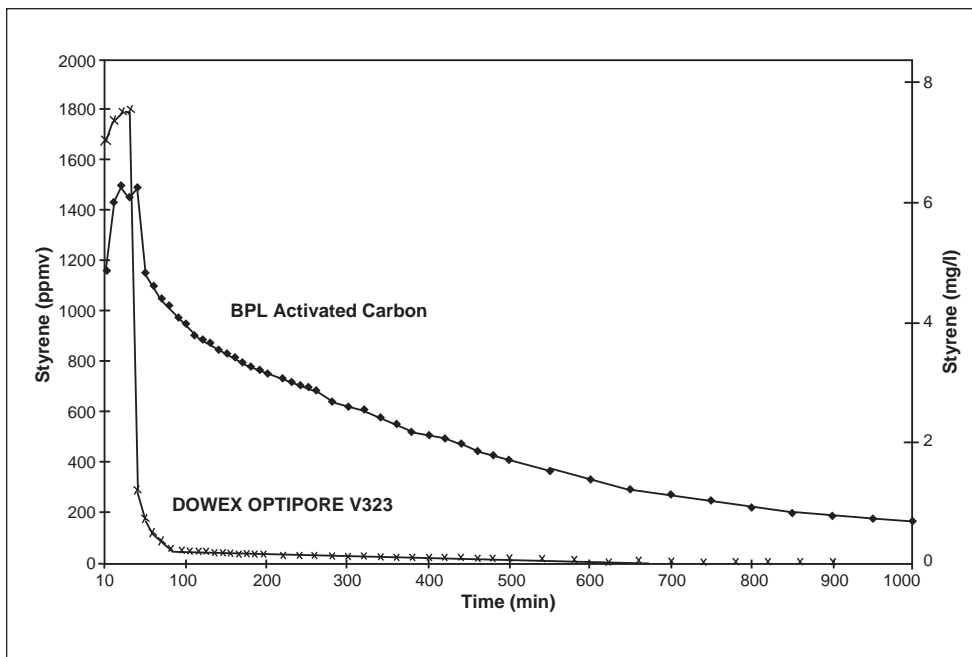
DOWEX OPTIPORE polymeric adsorbents are versatile materials that can be used in a number of equipment configurations. Fixed bed adsorption systems are typically used for low air flow applications.

Applications with high air flows and low emission concentrations are best treated with fluidized bed systems. The Polyad™ Concentration Process has been successful since 1989 for control of styrene vapor emissions with polymeric adsorbents.

### Low Chemical Reactivity

Activated carbons are historically known for their tendency to cause the degradation or polymerization of reactive compounds. This reactivity has been attributed to reactive sites represented by the ash content of activated carbons; often as high as 10%. DOWEX OPTIPORE polymeric adsorbents are synthetic polymers with inherently low levels of minerals. Their typical ash content is less than 0.01%. The advantages of the low chemical reactivity of polymeric adsorbents are described in a pending U.S. patent application.

Figure 2. Styrene Desorption Comparison



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