

**DOWEX OPTIPORE L493 and V493**

Polymeric Adsorbents

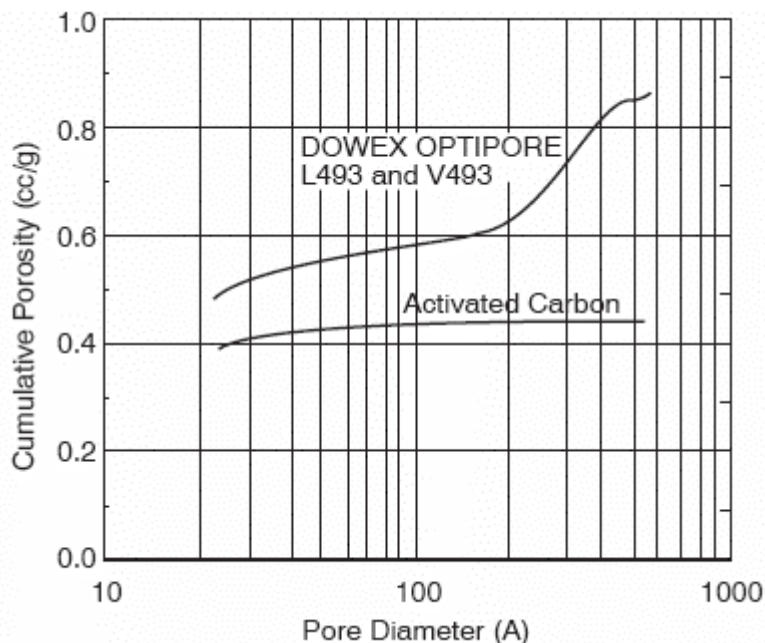
Dow has developed a new polymeric adsorbent type for the concentration of organics from air and water. Key features of these adsorbents are:

- Highly cross-linked polymer matrix
- Unique pore size distribution
- High surface area
- Improved capacity for organic compounds
- Hydrophobic adsorbent surface
- Non-catalytic activity
- Spherical beads with good physical strength

Material Properties

DOWEX™ OPTIPORE™ L493 and V493 are a highly cross-linked styrenic polymer that is insoluble in strong acid, strong base or organic solvents. It has a high surface area and a unique pore size distribution. Its total pore volume is 1.16 cc/g, and its BET surface area is 1100 m²/g. The pore size distribution is shown in Figure 1 with a comparison to a typical activated carbon.

Figure 1. Pore size distribution



L493 and V493 is supplied as 20 to 50 mesh spherical beads with very good physical strength. Its average crush strength is 500 g/bead. These adsorbents can be produced in both a wet and dry form. The wet material, L493, is intended for liquid applications, whereas the dry material, V493, is intended for vapor applications. Typical properties of the two forms are shown in Table 1. The wet adsorbent is easily dried in a flowing stream of ambient temperature air.

Material Properties (cont.)

Table 1. Typical physical and chemical properties of DOWEX OPTIPORE L493 and V493⁽¹⁾

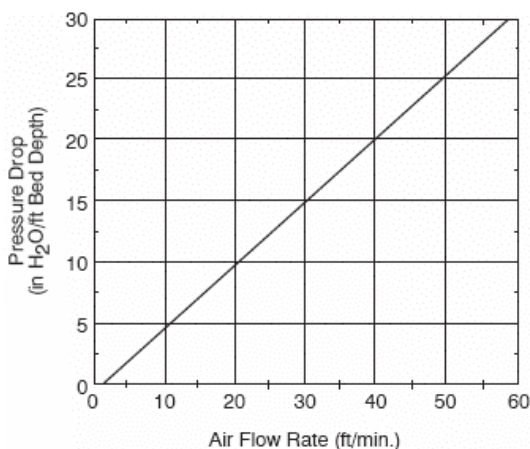
	DOWEX OPTIPORE L493	DOWEX OPTIPORE V493
Matrix structure	Macroporous styrenic polymer	Macroporous styrenic polymer
Physical form	Orange to brown spheres	Orange to brown spheres
Particle size	20 - 50 mesh	20 - 50 mesh
Moisture content	50 - 65%	< 5%
BET surface area (m ² /g)	1,100	1,100
Total porosity (cc/g)	1.16	1.16
Average pore diameter (Å)	46	46
Apparent density (g/cc)	0.62	0.34
(lbs/cf)	42	21.3
Ash content (%)	< 0.01	< 0.01
Crush strength (g/bead)	> 500	> 500
Heat capacity (cal/g°C)	0.75	0.30
Thermal conductivity (cal/s cm°C)	0.00033	0.00016

⁽¹⁾ These properties are typical of the product and should not be confused with or regarded as specifications.

Pressure drop due to fluid flow through an adsorbent bed is an important design consideration. The pressure drop for water flowing through a bed of DOWEX OPTIPORE L493 is given by the equation $\Delta P \text{ (psi)} / L \text{ (ft)} = k y F \text{ (GPM/ft}^2\text{)}$, where k is 0.15 and y is the viscosity of water in cps.

For air flow through a packed bed of DOWEX OPTIPORE V493, pressure drop is shown graphically in Figure 2. In fluidized bed applications, DOWEX OPTIPORE V493 will begin to fluidize at an air velocity of about 10 ft/min.

Figure 2. Pressure drop due to air flow through a bed of DOWEX OPTIPORE V493



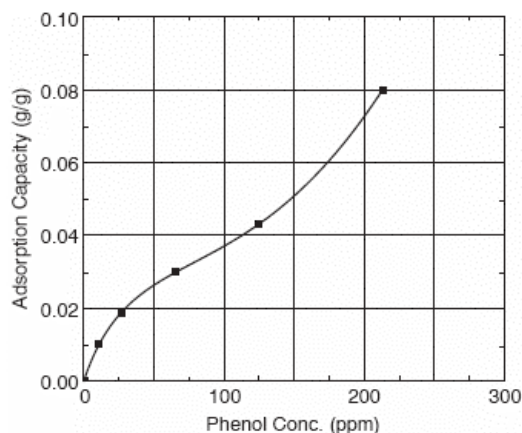
DOWEX OPTIPORE L493 for Liquid Applications

DOWEX OPTIPORE L493 is an excellent choice for removal of certain organics from water. Because of its unique pore size distribution, it has high capacity for organics and good desorption characteristics.

Adsorption forces are generally weak and heavily influenced by the properties of the matrix (pH, temperature, ionic strength, etc.). Equilibrium isotherm testing is a convenient, time saving way to screen adsorption media for specific applications. An easy to follow guide for generating isotherms is available on request (see "Equilibrium Isotherm Testing for Liquid Phase Applications" Form No. 177-01721). As an example, results of an equilibrium adsorption isotherm study are shown in Figure 3 for removal of phenol from a pH 6.0 solution with DOWEX OPTIPORE L493.

DOWEX OPTIPORE L493 for Liquid Applications (cont.)

Figure 3. Equilibrium adsorption isotherm for phenol in water @ pH = 6.0

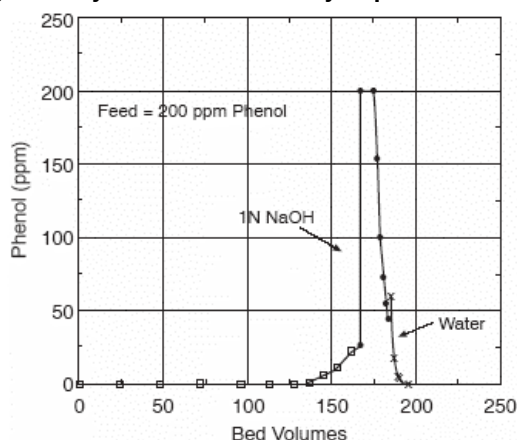


The isotherm data confirmed the feasibility of this separation and this led to the dynamic column study shown in Figure 4. A 200 ppm phenol solution at pH 6.0 was introduced into a column of L493 at 8 bed volumes/hr. At 10% breakthrough the column had treated 160 bed volumes of feed.

The adsorbent was regenerated with 1N NaOH followed by a water rinse.

The L493 can be desorbed or regenerated by a number of methods depending on the nature of the compound and the process. Possible desorbents are aqueous acids or bases, organic solvents, or steam.

Figure 4. Dynamic column study of phenol adsorption with DOWEX OPTIPORE L493



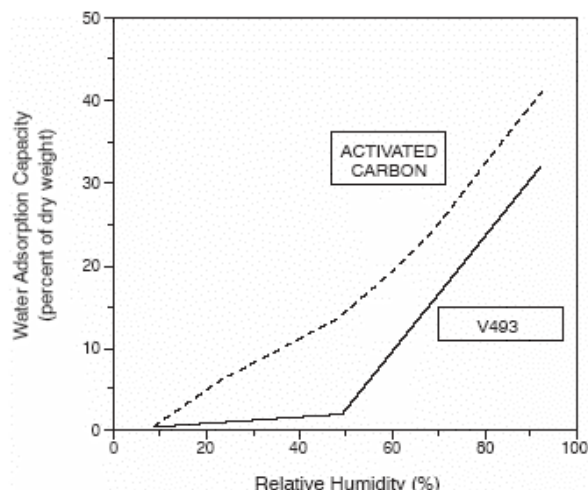
DOWEX OPTIPORE V493 for Gas Applications

DOWEX OPTIPORE V493 exhibits high capacities for a variety of volatile organic compounds (VOC) and hazardous air pollutants (HAP). Some representative equilibrium adsorption isotherms obtained at ambient temperature are included on page 5.

Compared to activated carbon, V493 is more hydrophobic, and for this reason it will be better suited than carbon for applications in high humidity air streams. The equilibrium adsorption isotherms for both activated carbon and V493 are shown in Figure 5.

**DOWEX OPTIPORE
V493 for Gas
Applications (cont.)**

Figure 5. Water vapor adsorption isotherms for DOWEX OPTIPORE V493 and activated carbon

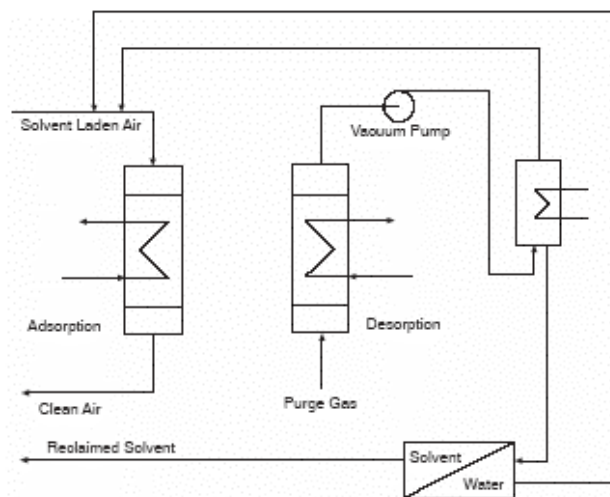


The V493 can be desorbed or regenerated in a variety of ways, such as with steam, hot air or inert gas, vacuum, or combinations thereof. For solvents that are immiscible with water, steam desorption may be the method of choice. Condensate can be collected and the organic and water phases separated by decantation. The resulting water phase can be air stripped to remove residual organics, and the stripper vapor recycled to the adsorbent bed.

Hot gas desorption may be effectively used to regenerate V493. Desorption temperatures as high as 120°C may be safely used as long as some small quantity of cooling gas, presumably either air or nitrogen, is allowed to flow through the adsorbent bed. In most cases, a desorption temperature <100°C will be adequate. The choice of air or nitrogen purge and the specific desorption temperature will depend on the particular solvents being desorbed, their concentrations and their oxidative stability.

Vacuum desorption in a pressure swing adsorption process may also be practiced. In some cases, a combination of moderate vacuum and elevated temperature may be beneficially used to regenerate DOWEX OPTIPORE V493 adsorbent. Vacuum desorption is commercially practiced using indirect thermal and microwave heating as shown in Figure 6.

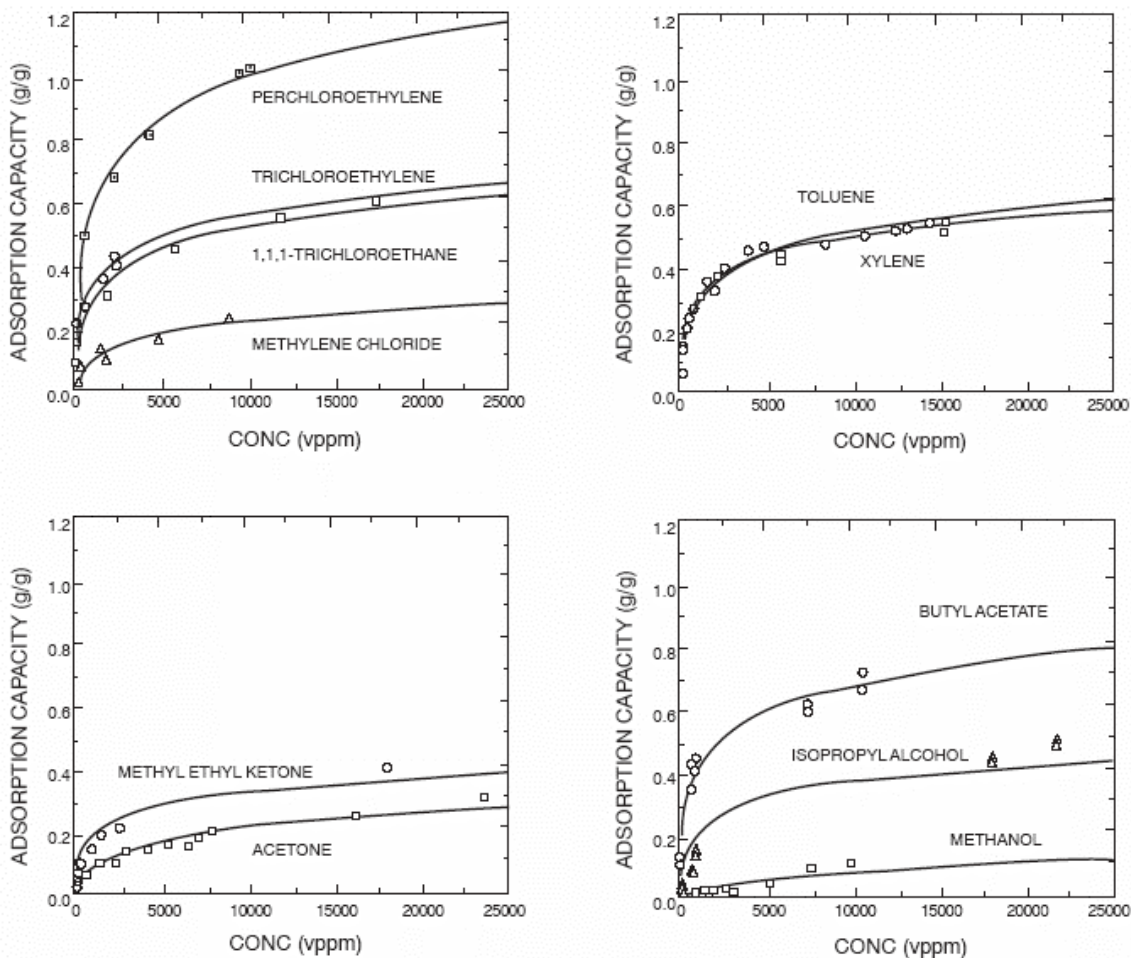
Figure 6. Equipment layout for vacuum swing regeneration of DOWEX OPTIPORE V493 polymeric adsorbent



Catalytic Activity

In contrast to activated carbon, V493 can be used to adsorb reactive solvents without catalyzing their decomposition. Reactive solvents such as acetone, methyl ethyl ketone, cyclohexanone and styrene have been adsorbed and desorbed from V493 without measurable change in composition. With most activated carbons, however, measurable solvent degradation occurs. In extreme cases, solvent degradation on carbon beds can lead to an uncontrollable exotherm and a subsequent bed fire. The lack of catalytic decomposition when using V493 may be attributed to its extremely low mineral ash content.

Vapor Phase Adsorption Isotherms for DOWEX OPTIPORE V493 Polymeric Adsorbent



DOWEX Ion Exchange Resins

Warning: Oxidizing agents such as nitric acid attack organic ion exchange resins under certain conditions. This could lead to anything from slight resin degradation to a violent exothermic reaction (explosion). Before using strong oxidizing agents, consult sources knowledgeable in handling such materials.

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