Molecular Sieve Desiccant Dehydrator For Natural Gas

Effective Water & H₂S Adsorption

Regenerable Desiccant Bed

Conformance to NACE MR-01-75

Reduces Fluid Contamination

Increases Equipment Life

Reduces Risk of Hydrate Formation

Reduces Gas Supply Freeze Off Risk

Bettis Model DD
(Standard Service)

Bettis Model DD-S
(Sour Service)
Molecular sieve characteristics

Molecular sieves are synthetically produced zeolites, a crystalline form of alkali metal (calcium, sodium, potassium) aluminosilicates, very similar to natural clays. They are highly porous, with a very narrow range of pore sizes and very high surface area per package volume. Manufactured by ion-exchange, molecular sieves possess highly localized polar charges on their surfaces that act as extremely effective adsorption sites for polar compounds such as water and hydrogen sulfide. Unlike other desiccants, molecular sieves exhibit a fairly constant rate of adsorption and equilibrium water capacity over a wide range of relative humidities. Molecular sieves are alkaline, so special acid resistant sieves are available for very sour gases.

Since the pore size range is narrow, molecular sieves exhibit selectively towards adsorbates on the basis of their molecular size, and tend not to adsorb bigger molecules such as the heavy hydrocarbons. The pore diameter of a molecular sieve is measured in angstroms, Å (1 micron = 10,000 angstroms). Molecular sieves offer a means of simultaneous dehydration and desulfurization and are therefore the best choice for sour gases.

Natural gas, whether at the well head or in the sales gas pipeline, almost always contains water vapor. Water content can range from extremely high at the well head and gathering system to the typical 4-5 lb. H₂O/MMscf in the sales gas line. Dehydration of supply gas, whether power, signal, or burner, can reduce the risk of contaminating hydraulic fluid, freeze offs and hydrate formation.

Hydrogen sulfide (H₂S), when present in natural gas, may generate corrosive by-products at concentrations as low as 50 ppm. Natural gas containing H₂S may also contain carbon dioxide (CO₂) which is corrosive at concentrations as low as 0.7 wt %.

Molecular sieve 4A desiccant will adsorb H₂S and CO₂, thus reducing corrosion, increasing equipment life and reducing the foul odor associated with H₂S in vented gas.

Bettis Desiccant Dehydrators can be used to remove adsorbates from flows such as fuel, power, and signal gas streams and can also remove of water vapor from the power and/or signal gas of gas/hydraulic valve operators.

**Features**
- Effective adsorption of water and hydrogen sulfide
- Conformance to NACE MR-01-75 (optional)
- Molecular sieve desiccant bed can be regenerated
- Reduces the risk of hydrate formation
- Reduces the risk of power gas supply freeze off
- Reduces the risk of contaminating hydraulic fluid (in gas/hydraulic operators)
- Adsorption of hydrogen sulfide and carbon dioxide increases equipment life and reduces foul odors
- Can be used to remove adsorbates from flows such as fuel, power and signal gas streams
- Various sizes and desiccant types available
- Available in both standard and low temperature configurations

## Typical Physical Characteristics

### General

<table>
<thead>
<tr>
<th>Available Pellet Diameters</th>
<th>1/16&quot;, 1/8&quot;</th>
<th>Theoretical H₂O Adsorption Capacity by Weight at 60°F and 40% R.H.</th>
<th>22%</th>
</tr>
</thead>
<tbody>
<tr>
<td>Heat of Adsorption</td>
<td>1800 max. BTU / lb. H₂O</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

### By Type

<table>
<thead>
<tr>
<th>Desiccant Type</th>
<th>3A</th>
<th>4A</th>
<th>5A</th>
<th>13X</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pore Diameter (Å)</td>
<td>3</td>
<td>4</td>
<td>5</td>
<td>10</td>
</tr>
<tr>
<td>Zeolite</td>
<td>Potassium</td>
<td>Sodium</td>
<td>Calcium</td>
<td>Sodium</td>
</tr>
<tr>
<td>Bulk Density (lb./cu. ft.)</td>
<td>44</td>
<td>44</td>
<td>44</td>
<td>40</td>
</tr>
<tr>
<td>Typical Molecules Adsorbed (each type adsorbs listed compounds plus those of all types to the left)</td>
<td>H₂O, NH₃</td>
<td>Ethanol, H₂S, CO₂, SO₂, C₂H₄, C₂H₆, C₃H₆</td>
<td>n-C₄H₁₀, C₃H₈, to C₂₂H₄₆, R-12</td>
<td>Molecules with effective diameters &lt; 10Å</td>
</tr>
</tbody>
</table>
Typical Schematic of Power Gas Application

Models

<table>
<thead>
<tr>
<th>Model</th>
<th>DD-1</th>
<th>DD-2</th>
<th>DD-3</th>
</tr>
</thead>
<tbody>
<tr>
<td>Overall Size</td>
<td>NPS 3 X 24”</td>
<td>NPS 4 X 30”</td>
<td>NPS 6 X 36”</td>
</tr>
<tr>
<td>Capacity MS</td>
<td>2.05</td>
<td>4.05</td>
<td>12.98</td>
</tr>
<tr>
<td>Desiccant Weight (lbs.)</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Refer to Product Manual for sizing information.

Specifications (All Models)

<table>
<thead>
<tr>
<th>Specification</th>
<th>DD-1</th>
<th>DD-2</th>
<th>DD-3</th>
</tr>
</thead>
<tbody>
<tr>
<td>Maximum Allowable Working Pressure (Std. Service)</td>
<td>2220 psig</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Maximum Allowable Working Pressure (Sour Service)</td>
<td>2220 psig</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Temperature Rating (Standard Materials)</td>
<td>–20 to 150° F (–29 to 65° C)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Temperature Rating (Low Temp. Materials)</td>
<td>–50 to 150° F (–46 to 65° C)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Inlet Connection</td>
<td>1/2 NPT</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Outlet Connection</td>
<td>1/2 NPT</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Mounting</td>
<td></td>
<td></td>
<td>U-Bolt or free standing as required.</td>
</tr>
</tbody>
</table>

**Testing/Registration**

Flanged body Desiccant Dehydrator pressure vessels are designed, constructed and tested in accordance with ASME Section VIII Div. 1 requirements. Local regulatory approval, if required, is available. CRN Number OH3118.12
**Cutaway Assembly Model DD-1F**

![Cutaway Assembly Model DD-1F Diagram]

### Item Description Material Qty. Note
1. NPS 3 SMLS PIPE SA-333-6 1
2. NPS 3 FLAT HEAD SA-350-LF2 1
3. NPS 3 WELD NECK FLANGE SA-350-LF2 1
4. NPS 3 THD. RED. CAP SA-350-LF2 1
5. O-RING, FITTING H-T Fluoro 70A 1 (Y)
6. O-RING, CAP H-T Fluoro 70A 1 (Y)
7. STUD SA-320-L7M 4
8. NUT SA-194-7M 4
9. DESICCANT CARTRIDGE SS 304 1 (Y)
10. DECAL (DE-PRESSURIZE BEFORE ...) VINYL 1
11. SHIPPING PLUG (LOOSENED) A105 2 (H)
12. TEST PLUG (SEALED DRAIN) A105 1 (H)
13. ASME NAMEPLATE (OPTIONAL) AL/SS 1

**NOTE:** (Y) RECOMMENDED SPARE PARTS, PART NO. SPRK-DD-1F

(H) NOT SHOWN

**SPECIFICATIONS:**
- PORTS: 1/2 NPT x 1/2 NPT x 1/2 NPT
- SERVICE: AIR, SWEET GAS, H2S SOUR GAS
- TEMP. RATING: -46°C THRU 65°C
- MASS: 50.8 lbm [23.0 kg]
- OPTION: DRAIN VALVE
- MAWP: 1500 OR 2220 PSIG, AS SPEC'D
- STD CARTRIDGE: 4A
- EFFECTIVE Cv: 3.5 at 1000 PSIG INLET
- COMPLIANCE WITH NACE MR-01-75, AND APPLICABLE PARTS OF ASME VIII-1

### H₂O Content of Natural Gas (lb. H₂O/MMscf)

<table>
<thead>
<tr>
<th>Dewpoint (°F)</th>
<th>0</th>
<th>10</th>
<th>20</th>
<th>30</th>
<th>40</th>
<th>50</th>
<th>60</th>
<th>70</th>
</tr>
</thead>
<tbody>
<tr>
<td>115 psia</td>
<td>4.75</td>
<td>7.25</td>
<td>11.50</td>
<td>18.00</td>
<td>29.00</td>
<td>40.00</td>
<td>62.00</td>
<td>90.00</td>
</tr>
<tr>
<td>515 psia</td>
<td>1.25</td>
<td>2.00</td>
<td>3.25</td>
<td>5.00</td>
<td>7.25</td>
<td>10.50</td>
<td>15.50</td>
<td>21.50</td>
</tr>
<tr>
<td>1015 psia</td>
<td>0.75</td>
<td>1.25</td>
<td>1.75</td>
<td>3.00</td>
<td>4.25</td>
<td>6.00</td>
<td>9.00</td>
<td>13.00</td>
</tr>
</tbody>
</table>

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