Pure Water. Clean Air. Better World. CalgonCarbon®

HGR® for Mercury Removal in Natural Gas

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About HGR

Calgon Carbon's HGR granular activated carbon is sulfur impregnated and made from select grades of bituminous coal and suitable binders to create a unique pore structure and superior hardness necessary for the intended service. After activation, the sulfur is distributed in a thin layer over the extensive internal surface area of the carbon. This process creates the special properties required for the removal of elemental and organic mercury from natural gas, air, and other gas mixture streams.

In the 1980s, when mercury was identified as a catastrophic corrosion instigator for aluminum cold box heat exchangers, HGR provided a viable solution for the Liquid Natural Gas (LNG) industry. Since then, no other mercury removal technology has matched Calgon Carbon's decades of successful installations of HGR, or treated more cubic meters of natural gas successfully.

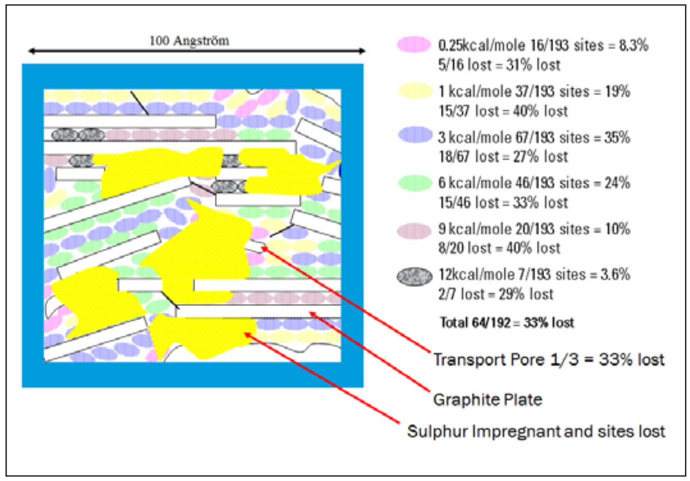
Why is Mercury a Problem?

The presence of elemental mercury in wellhead natural gas has been well documented. Mercury-induced corrosion of LNG aluminum alloy cryogenic exchangers has led to documented instances of equipment failure, and mercury present in a syngas, or hydrocarbon gas stream shortens the useful lives of many precious metal catalysts. From both worker safety and environmental perspectives, mercury removal may be necessary. The U.S. Occupational Safety and Health Administration (OSHA) has set exposure regulations for inorganic mercury compounds, which are also regulated as an air toxin under the Clean Air Act Amendments. In many cases, it is important to remove mercury from the source to minimize process emissions.

HGR – The Activated Carbon Solution

Activated carbon is highly adsorbent and attracts mercury to its interior surfaces, as demonstrated by its use in emission control at coal fired power plants. A process called chemisorption, however, produces a significantly higher capacity and associated longer bed life. During chemsorption, mercury is captured by the strong London Dispersion Forces of activated carbon and drawn deep in to the internal pore structure of the carbon granule or pellet. Once adsorbed, the mercury comes into contact with the element sulfur impregnant and reacts chemically to form a mercury sulfide compound. The process results in a very stable, very low pressure metal sulfide from a relatively volatile mercury vapor species.

Adsorption Sites on HGR Impregnated Carbon-15%S



Vessel Sizing

Because compressed natural gas is denser than atmospheric air, more time is required for comparable diffusion and this also results in higher pressure drop through the bed. Typical superficial velocities for HGR beds in LNG trains are between 20 and 40 ft/min (0.1 – 0.2 m/sec). Calgon Carbon typically recommends the use of graded size ceramic balls as a bed support and bed hold-down/ flow distribution material to encourage proper flow distribution and maintain bed horizontal integrity. A floating screen above the HGR bed and underneath the top layer of ceramic balls also helps to maintain separation between the balls and the HGR.

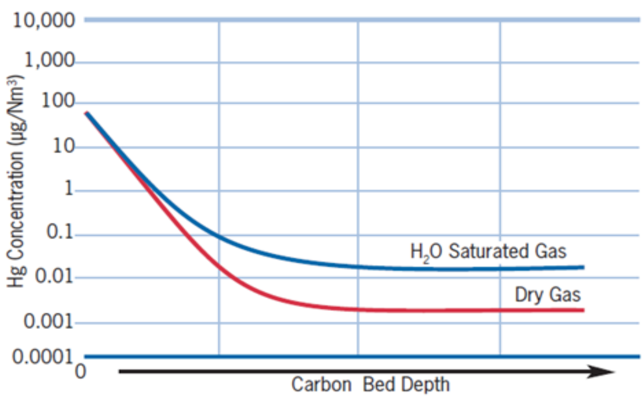
Bed Life

Research has shown that there is a minimum time and distance required to contain the Mass Transfer Zone (MTZ) for mercury removal and chemisorptions. Calgon Carbon maintains a proprietary predictive model to determine the optimal size for HGR beds as a reflection of all of the process conditions including pressure, temperature, density, moisture content and Hg influent concentration. The basis for the model is an extensive research program conducted at the Company's Pittsburgh, Pennsylvania laboratories to accurately characterize the influence of various factors. For typical expected bed life of 3 years, only the highest influent Hg concentrations will affect the bed size and minimum EBCT. As longer bed lives are desired and Hg influent concentrations increase, the minimum EBCT will track upwards.

Influence of Moisture

Moisture in the form of relative humidity (RH) has been shown to directly affect the attainable effluent mercury concentration. Gas streams with lower RH can achieve demonstrated Hg effluent concentrations less than 0.01 micrograms/Normal cubic meter.

Impact of Moisture



Testing

Mercury capacity on HGR activated carbon can be as high as 30% by weight. Testing shows that HGR performs well at both low and high mercury contamination levels, and its performance is not affected by H_2S, SO_2, CO_2, COS, and other acid gases. Additionally, virgin (or new) HGR does not generate heat when exposed to air or oxygen.

Treatment of Waste

Once the useful life of an HGR bed has expired, the unit is swept with nitrogen and depressurized. The spent (or used) HGR is then removed by vacuum and sent to a retort furnace facility to recover the mercury.

Global Solution

HGR has been employed on five continents and continues to represent Calgon Carbon's practical and trusted solution for mercury removal from natural gas streams. From the first installations in Asia to Europe and the Middle East, to Northern Africa and the Southern U.S., HGR consistently proves to be a trusted and reliable solution for mercury removal.

Most recently, Calgon Carbon has been awarded orders for projects in the U.S. LNG market in Louisiana and Texas and globally in Northeastern Australia.

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