

Applications Note



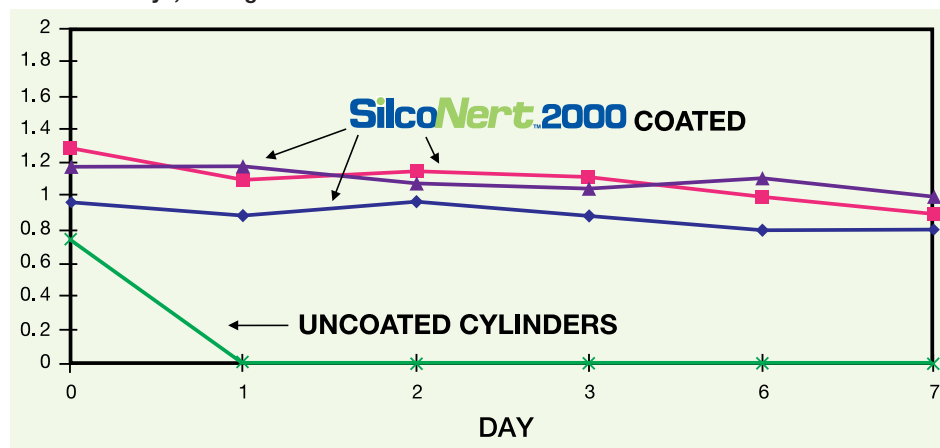
Sulfur and Mercury Sampling in Refineries Using SilcoNert™2000

SilcoNert™2000 is inert to sulfur and mercury compounds to part per billion (PPB) levels.

Refinery and natural gas samples often contain trace amounts of sulfur containing compounds like hydrogen sulfide (H₂S) and mercury containing compounds. Sulfur, hydrogen sulfide and mercury compounds can interfere with reactions, poison catalysts in petrochemical processes, and damage equipment.

Because sulfur and mercury compounds quickly react with stainless steel surfaces, accurate determination of these compounds is impossible when samples are collected and stored in untreated sample cylinders. (see figure 1)

Figure 1 shows complete loss of Sulfur compounds in as little as 1 day¹ with uncoated cylinders while SilcoNert™2000 treated cylinders maintain sulfur stability for 7 days, or longer.



- Reliable sulfur and mercury sampling to ppb levels
- Accurate sampling the first time, every time
- Reduce lab costs
- Accurately grade feedstock
- Detect costly process upsets
- Improve product yield

SilcoTek's innovative coating, SilcoNert™2000, bonds an inert silicon layer into the surface of stainless steel, preventing active compounds, like sulfur or mercury, from reacting with or adsorbing to the steel.

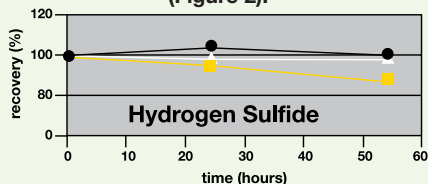
The high temperature, durable coating will conform to most intricate surfaces while maintaining high dimensional tolerances. SilcoNert™2000 will deform with tubing surfaces allowing for radius bends and will not interfere with threaded or compression joints; making SilcoNert™2000 the ideal coating for refinery gas sampling, flare gas sampling, and process sampling.



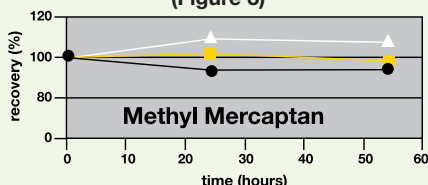
112 Benner Circle | Bellefonte, PA 16823
814-353-1778 | Fax 814-353-1697
www.SilcoTek.com

Lit Cat # SN-011

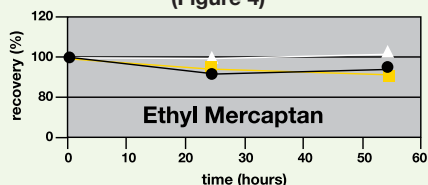
Hydrogen sulfide (H₂S) exhibited greater than 85% recovery ².
(Figure 2).



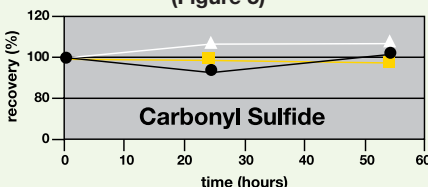
Methyl mercaptan exhibited greater than 90% recovery
(Figure 3)



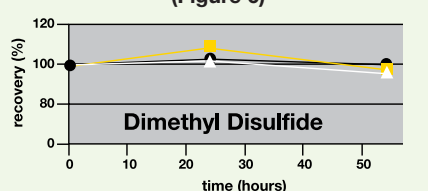
Ethyl mercaptan demonstrated greater than 90% recovery
(Figure 4)



Carbonyl sulfide, greater than 90% recovery
(Figure 5)



And dimethyl disulfide exhibited greater than 90% recovery
(Figure 6)



▲ SilcoNert™2000 cylinder 1
● SilcoNert™2000 cylinder 2
■ SilcoNert™2000 cylinder 3

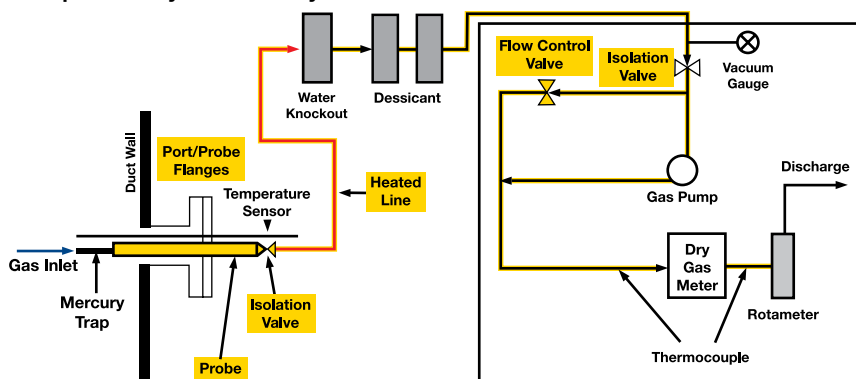
SilcoNert™2000 treated gas sampling equipment is ideal for collecting and storing samples containing ppb levels of sulfur compounds, such as those found in natural gas or beverage-grade carbon dioxide. SilcoNert™ 2000 treatment ensures that sulfur compounds, like hydrogen sulfide (H₂S) or other highly active compounds remain stable during transport from the field to the laboratory, resulting in accurate, reliable sampling the first time, every time.

Figures 2 through 6 show significant stability of the SilcoNert™ 2000 surface when exposed to common sulfur containing compounds like hydrogen sulfide (H₂S), mercaptans, and other sulfur containing species. Typical sulfur compound recovery rates exceeded 90%, even when sampling low ppb concentrations.²

Stable Mercury Results

SilcoNert™2000 is utilized in a wide variety of mercury sample containment and transport applications such as stack and flare gas sampling, CMMS sampling, down-hole sampling, and natural gas pipeline sampling.

A typical sampling train schematic (below)³; application of SilcoNert™2000 to all components of a stack or continuous emission monitoring system will greatly improve analytical reliability.



To measure the impact of SilcoNert™2000 treatment on adsorption of mercury during storage, we compared the performances of 304 grade stainless steel gas sampling cylinders (Swagelok®, Solon OH) with and without SilcoNert™2000 treatment. We filled each cylinder with 8µg/m³ of elemental mercury (approximately 1 part per billion) (Spectra Gases, Alpha NJ) and assessed the mercury concentration in each cylinder over time to determine changes in mercury concentration.

SilcoTek™ treatments are available worldwide!

SilcoTek™ offers treatments on a custom basis direct from our facility. Just follow 2 easy steps to maximize the performance of your product!

Step 1 - Get a quote!

We make it easy with quote options to fit your needs. Visit our website at www.SilcoTek.com and complete our on-line quote request form or fax your quote request to Quotes at 814.353.1697 or e-mail it to Silcod@SilcoTek.com. We'll get a quote out to you within 24 hours!

Step 2 - Send in your parts!

Mailing instructions, shipping labels and a service number will be forwarded to you along with your quotation. Box up your parts and send them to us. Your order will be processed in 10 working days or less.

Our 2 touch system means zero disappointments. We'll notify you when we receive your parts and when your order is ready to ship.



SilcoTek™ treats manufacturers, and visit our website



Australian Distributors
Importers & Manufacturers
www.chromtech.net.au

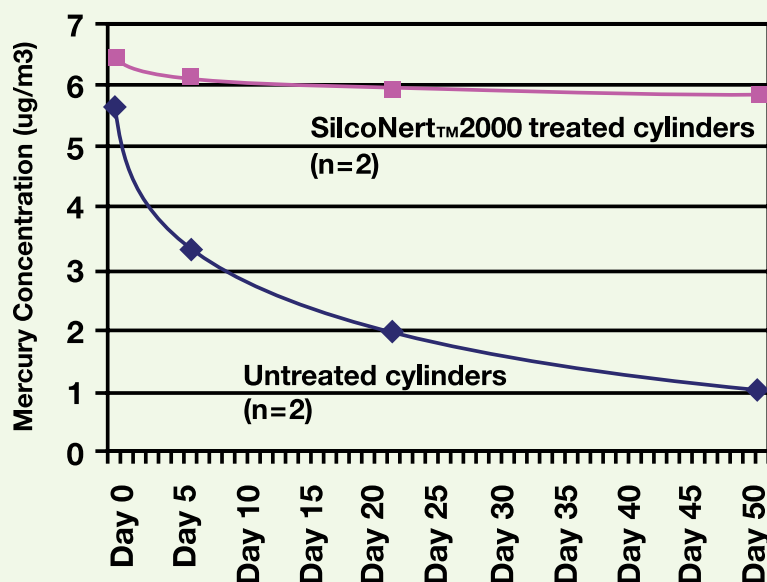
013/+

specialists, fitting products,

Website NEW : www.chromalytic.com.au E-mail : info@chromtech.net.au Tel: 03 9762 2034 . . . in AUSTRALIA

Detection was achieved by direct interface gas sampling to an atomic absorption detector. The sample pathway regulator and tubing were SilcoNert™2000 treated to ensure accurate transfer. The data in Figure 7 demonstrates that SilcoNert™2000 treatment provides a stable surface for elemental mercury, untreated stainless steel does not. Based on these results, SilcoNert™2000 treated steel or stainless steel components and tubing in CMMS and sorbent tube mercury sampling systems will dramatically improve analytical reliability in refining applications.

Figure 7: SilcoNert™ 2000 treated cylinders and sampling components provide an inert sample path, which prevents adsorption of active compounds like hydrogen sulfide and mercury and ensures accurate sampling.⁴



Fittings

Tube fittings can be a source of sulfur and mercury adsorption and sample loss. Exposed fitting surfaces will react with active compounds at ppb and ppm levels like sulfur, H₂S, NO_x and mercury resulting in sample loss, inaccurate readings, delayed response and false positive readings due to memory effects in tubing and fittings.

Purchase SilcoNert™ or Silcolloy™ treated parts directly from the manufacturer.

The following list of partners and OEM's supply **SilcoTek™** coated products.

Swagelok Company

www.swagelok.com

Go to Swagelok's website to find a distributor near you. For SilcoNert™2000 (Siltek®/ Sulfinert®) treated fittings, ask your local Swagelok distributor to add the following suffix to your part number: Fittings: add -JA

Parker

www.parker.com

Ask your Parker distributor for SilcoNert™ 2000 (Siltek®/ Sulfinert®) treated fittings and valves.

Hy-Lok

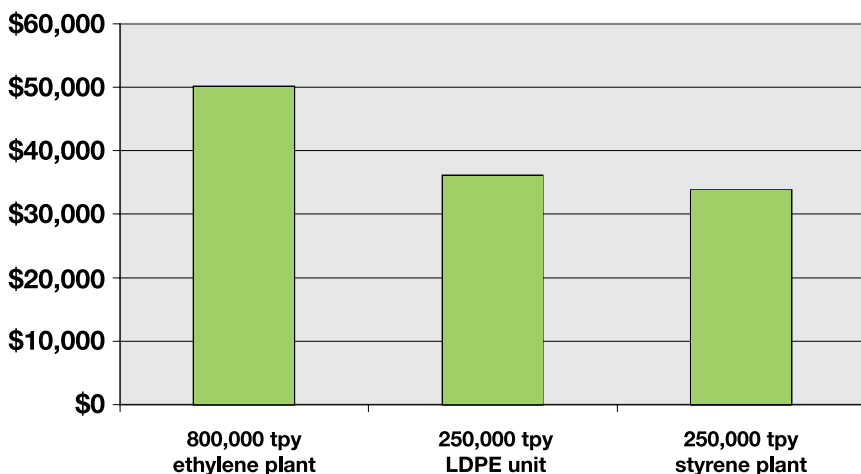
www.hylokusa.com

Offering SilcoNert™2000 treated fittings, valves, and tubing. Ask your Hy-Lok USA representative for SilcoNert™2000 coating where inert sampling is critical.

Value of an Inert Pathway

SilcoNert™ 2000 treated sampling and transfer equipment results in more accurate sampling and faster cycle times. SilcoNert™ 2000 treated sample pathways improve accuracy and reliability of data for sulfur, mercury, H₂S and methyl mercaptan sampling. Downstream processes can be more precisely controlled, resulting in a significant cost savings. Shorter sampling cycles translate directly into more samples collected and analyzed in a given period of time. Process upsets can be detected faster while false readings can be eliminated. Typical savings can be calculated by looking at average per-hour cost of operating a process that relies on accurate quantification of sulfur compounds. A 1 hour delay in operations can cost an 800,000 tpy ethylene plant \$50,000. A 250,000 tpy LDPE unit will cost operations \$36,000 for a 1 hour upset while an EBSM styrene plant will cost \$33,000 (See Figure 8).

Figure 8: Estimated Losses Resulting from 1 Hour Delay in Operations Due to Sulfur Adsorption in Sample and Transfer Systems



Tubing

SilcoTek™ partners offer the finest in treated tubing. SilcoNert™ and Silcolloy™ treated tubing is available in 304 and 316 grades.

O'Brien Corporation

www.obrien-analytical.com

Contact your O'Brien representative and ask for EPS tubing.

Restek Corporation

www.restek.com

Restek offers Siltek®/Sulfinert® and Silcosteel®-CR coated tubing.

Thermon... The Heat Tracing Specialists®

www.thermon.com

Contact your Thermon representative and ask for Silcosteel® or Sulfinert® coating.

To learn more about our direct line partners Visit our website
www.SilcoTek.com

Summary

SilcoNert™ 2000 treated sampling and transfer systems allow refineries to obtain accurate sulfur and mercury data the first time, every time with no delay, sample errors, or false readings down to ppb levels. Analysts charged with monitoring sulfur and mercury levels in process streams can save thousands in improved yields, better test cycle times and improved system reliability. To learn more, visit our web site at www.SilcoTek.com or call us at 814-353-1778.

References

1. Barone, G., Higgins, M., Smith, D.; Restek Corporation; Rowan, S., Gross, W.J.; O'Brien Corporation; Harris, P., "The Surface for Sulfurs" Hydrocarbon Engineering, Dec. 2004 (pages 47-50)
2. Barone, G., DeGraff, I., Restek Corporation, "Stable Sulfur & Mercury Sampling in Refineries" Restek Advantage, 2008, Vol 1.
3. Proposed Method 324. Determination of Vapor Phase Flue Gas Mercury Emissions from Stationary Sources Using Dry Sorbent Trap Sampling. United States Environmental Protection Agency. Washington, D.C. P. 5.
4. Higgins, Martin; Barone, Gary; Smith, David; Restek Corporation; Neeme, Ted; Spectra Gases Inc., "A Comparison of Surface Adsorption Effects in Mercury and Sulfur Analyzer Systems" ISA Symposium, 2007.



112 Benner Circle | Bellefonte, PA 16823
814-353-1778 | Fax 814-353-1697
www.SilcoTek.com



Australian Distributors
Importers & Manufacturers
www.chromtech.net.au

013/+

Lit Cat # SN-011

Website NEW : www.chromalytic.com.au E-mail : info@chromtech.net.au Tel: 03 9762 2034 . . . in AUSTRALIA