CHROMATOGRAPHIC SPECIALTIES INC.

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SilcoTek™ Driving Innovation

A Comparison of Surface Inertness in Process Analytical Systems



Introduction

Recent innovations in coating technologies have dramatically improved the analytical sensitivity and test precision of process sample transfer and analytical systems. Poor surface inertness can result in performance issues ranging from poor sensitivity and resolution, to adsorption/ desorption and catalytic effects. The overall impact to the customer includes regulatory compliance issues, lost product, poor process yields, and ultimately lost customers.

This study compares the surface inertness of 2 coatings on the inner walls of 1/8" stainless steel tubing: SilcoNert™2000 (SilcoTek™Corporation) and Silonite (Entech Instruments Inc.). The data show significant differences in surface inertness of the two coatings.

Experimental

SilcoNert™2000 and Silonite coated tubing sections (1.0m long x 1/8" OD x 0.85" ID) were tested for various active compounds (see appendix A for test compounds and test results). The test tubing was connected to the end of an MXT-5 analytical column (Restek Corp.), and tested on an Agilent gas chromatograph model 6890 (Figure 1) See appendix B for test conditions.

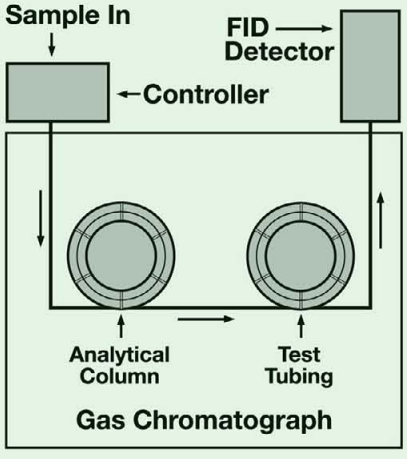


Figure 1 - Experimental setup comparing the inertness of SilcoTek™2000 and Silonite tubing.



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A test mix containing active and non-active compounds was first injected into a control analytical column without any connected 1/8” tubing. Test results show superior results with all compounds resolved (Figure 2).

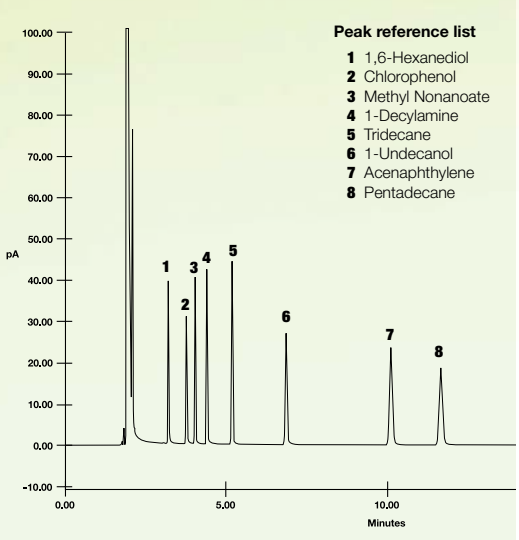
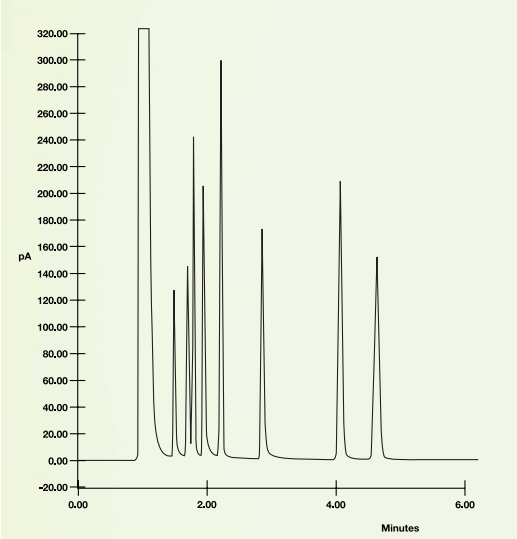


Figure 2 - Control analytical column shows superior results, with all compounds resolved.



A SilcoNert™2000 coated tube was then installed in series after the analytical column. The test compounds were then injected into the column combination under similar conditions as the control run. Results show nearly identical peak resolution and response with the SilcoNert™2000 tubing with little to no loss of active compounds (Figure 3).

Figure 3 - SilcoNert™2000 coated tubing provides exceptional inertness with nearly exceptional transfer of compounds.

The SilcoNert™ 2000 tubing was then removed and replaced with the Silonite tubing. Test compounds were then injected into the column combination under similar conditions as the previous run. Results show significant loss of active compounds with a high distortion of signal (peak tailing and broadening) and loss of peak area (Figure 4).

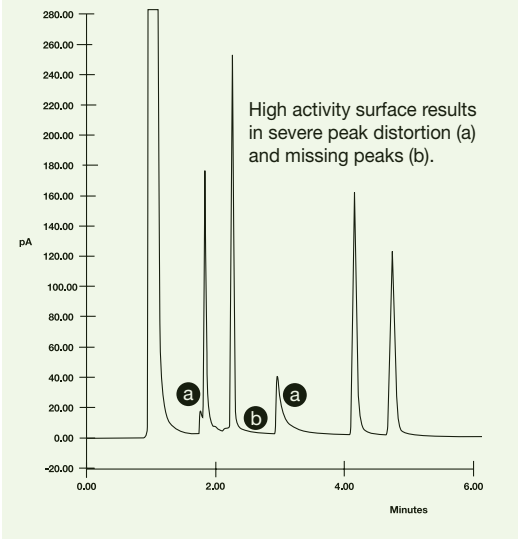
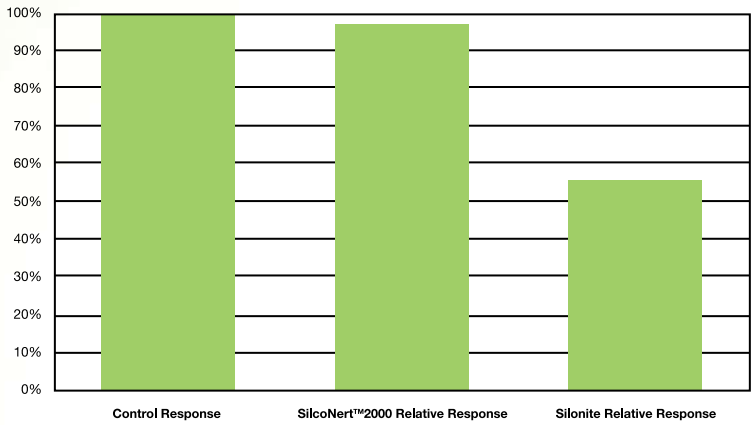


Figure 4 - Silonite coated tube shows significant loss of compounds with high peak tailing.

Results

Tests show the SilcoNert™2000 treated tube is the least active surface for analytical and process sampling. The Silonite surface is drastically more active. Exhibiting significant surface activity with very poor resolution of active compounds. Figure 5 shows the relative activity of each coating based on test results of the 8 active compounds. For a mildly active compound such as 4-chlorophenol, the SilcoNert™2000 surface showed nearly 6.7 times better response than the Silonite surface. For a more active compound such as 1,6-hexanediol, the SilcoNert™ 2000 column surface showed a response nearly equal to the response seen on the analytical column alone. With high activity compounds the Silonite column system showed total adsorption of 1,6-hexanediol. See Appendix A for comparative analytical data.

Figure 5: SilcoNert™2000 demonstrates superior inertness compared to Silonite.



Conclusion

SilcoNert™2000 surface is demonstratively the most inert surface for sampling, transporting, or analyzing active compounds containing active functional groups such as diols, nitrophenols, sulfurs, and mercury compounds.

Appendix A: Comparative analytical test results of SilcoNert™2000 vs, Silonite coated tubes,

Test Compound	Analytical Column (Control)	Peak area ratio	Control Response	SilcoNert™2000 Coated Tube	Peak area ratio	SilcoNert™2000 Relative Response	Silonite Coated Tube	Peak area ratio	Silonite Relative Response
1,6-Hexanediol	154650	0.61		277855	0.55	90%		0	0%
4-Chlorophenol	150581	0.59		291236	0.58	98%	57631	0.07	12%
Methyl Nonanoate	177997	0.7		358693	0.7	100%	582963	0.69	99%
1-Decylamine	206534	0.81		394075	0.78	96%	34138	0.04	5%
Tridecane	255610	1		504389	1	100%	844897	1	100%
Undecanol	213964	0.84		414297	0.82	98%	454764	0.54	64%
Acenaphthylene	283097	1.11		558834	1.11	100%	782758	0.93	84%
Pentadecane	270241	1.06		516370	1.02	96%	715064	0.85	80%
	1712674		100%	3315750		97%	3472215		55%

Appendix B: Analytical Test Conditions Comparing SilcoNert™ 2000 Coated Tubing with Silonite Coated Tubing

Analytical Column: Mxt-5, 30m x 0.53mm x 0.50µm (Restek Corporation)
Inj.: 1.0µl split injection of Rxi-500 Isothermal Test Mix (Restek Coporation)
Oven Temp: 135°C isothermal
Inj./Det. Temp.: 250°C/330°C
Linear Velocity: 55cm/sec hydrogen
Detector: FID
Split Flow: 100ml/min



Silco'd Technologies

SilcoTek specializes in innovative surface coating technologies for stainless steel, steel, alloys, glass, and other materials. SilcoTek coatings are chemically inert, ultra pure, non-stick and corrosion resistant; making them ideal for process, sampling, and analytical applications including:

- **Sulfur and H_2S sampling in petrochemical, refining, oil and gas exploration.**
- **Anti-Coking or anti-fouling in refining and petrochemical plants.**
- **Corrosion resistance in industrial, refining and chemical plants.**
- **Moisture control and high purity in semiconductor operations.**

SilcoTek's patented coating technologies include:

SilcoNert™

The ultimate in inert coating technology.

SilcoNert™1000: A general passivation coating for steel and stainless steel.

SilcoNert™ 2000: A required coating when analyzing low levels of organo-sulfur compounds (such as H2S).

Silcolloy™

A corrosion resistant coating that increases the lifetime of system components.

Silcolloy™: Improves corrosion resistance of stainless steel by an order of magnitude in chlorides & acidic environments.

SilcoKlean™

A non-stick coating designed to reduce the onset of carbon coking and fouling on stainless steel.

SilcoKlean™: Reduces carbon coking or fouling by up to 8X on stainless steel.

SilcoGuard™

A low outgassing, rapid pump down, high purity coating designed to improve ultra high vacuum system performance.

SilcoGuard™: Reduces outgassing by 14 fold and significantly improves vacuum pump down in semiconductor and research systems. Our patented processes reduce interactions between pathway surfaces and active compounds to enhance surface performance in a broad variety of applications.



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