New D3606 Column Set Outperforms TCEP Columns for Benzene Analysis

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Demand for finished gasolines containing ethanol continues to increase, as these fuels reduce greenhouse gas emissions and can be used to help control air pollution. Ethanol is a cost-effective additive for production; however, its presence significantly complicates the analysis of benzene, a regulated carcinogen which is added to increase octane levels. Accurate benzene and toluene analysis is critical because incorrect data can result in inaccurate octane levels and out-of-specification product. Toluene analysis is straightforward, but benzene is extremely difficult to separate from ethanol on the 1,2,3-tris(2-cyanoethoxy) propane (TCEP) column listed in ASTM method D3606. A new D3606 column set developed by Restek separates benzene and ethanol completely and more reliably than TCEP columns, resulting in tighter control and more accurate results for refineries and contract laboratories.

Independent Testing Shows New D3606 Column Set Outperforms TCEP

It is widely recognised that TCEP columns often fail to adequately separate ethanol and benzene (*Figure 1*). Additionally, ethanol frequently shows considerable tailing on TCEP columns, further complicating the integration of benzene. Both these effects combine to make accurate benzene quantification on TCEP columns a substantial challenge. In contrast, the new D3606 column set developed by Restek reliably provides excellent separation of benzene and ethanol, allowing accurate benzene quantification (*Figure 2*). Ethanol/benzene resolution values are typically greater than 3.00, allowing easy integration of benzene and more accurate quantification than is typically obtained on TCEP columns.

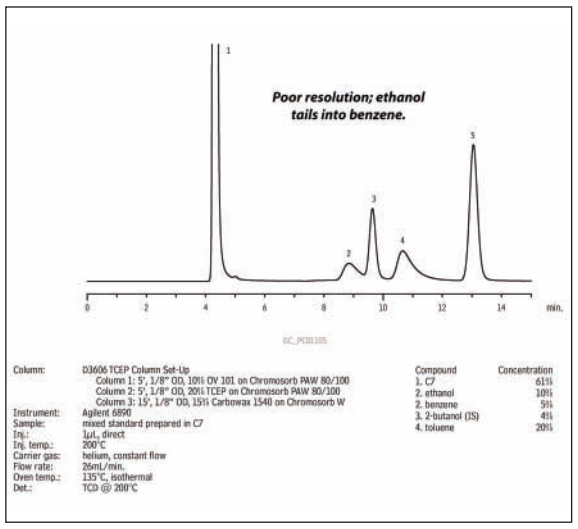

Figure 1 TCEP columns often fail to adequately resolve benzene from ethanol, resulting in poor quantitative results.

Since ethanol and benzene are easily resolved on the D3606 column set, a third column is not needed, resulting in simpler installation than the 3 column configuration described in Appendix X1 of the method (modifications for resolving benzene from ethanol). Each set is composed of 2 columns: column 1 is packed with nonpolar 100% dimethyl polysiloxane Rtx®-1 polymer (6' [1.8m], 1/8" OD, 2mm ID), and column 2 is packed with a new proprietary polymer (16' [4.9], 1/8" OD, 2mm ID). Column 1 separates components by boiling point and is backflushed after the elution of n-octane (C8) to prevent the heavier compounds from entering column 2, the main analytical column. The proprietary polymer used in column 2 allows the complete separation of aromatic compounds and reliably resolves ethanol and benzene.

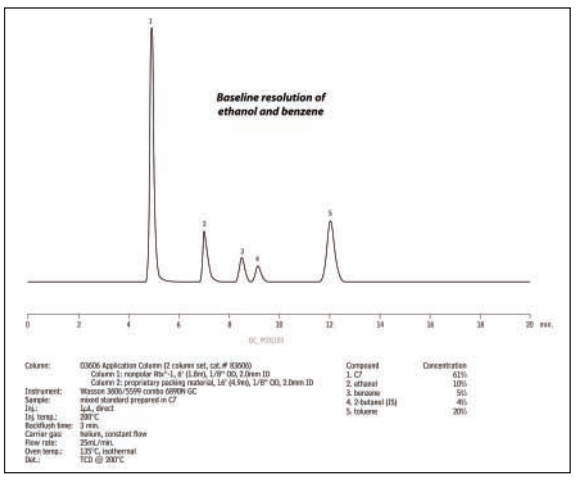

Figure 2 Restek's new D3606 column set accurately and reliably separates benzene from ethanol, improving quantitative accuracy.

Following extensive in-house testing, D3606 column sets were sent to refineries for independent analysis by beta testers and excellent results were obtained from all test sites (*Figures 3 and 4*). Linearity was assessed using calibration curves for benzene and toluene and correlations of 0.99999 and 1.00000, respectively, were obtained. Additionally, beta testers reported that repeatability was excellent and that overall reliability exceeded typical TCEP column performance. Both in-house testing and results from independent testers demonstrate that Restek D3606 column sets substantially outperform TCEP columns and provide more accurate and reliable data for quantifying benzene.

Reliable Performance Guaranteed

In addition to inadequate resolution of ethanol and benzene, TCEP columns show poor thermal stability. This results in short column lifetimes, making TCEP columns a relatively expensive choice in terms of cost-per-injection and downtime required for frequent column changes. In comparison, Restek's D3606 column set is stable to 165°C and exhibits very low bleed, allowing accurate integration and quantification of both benzene and toluene.

Reliable performance is assured, as all D3606 column sets are individually tested for method applicability and a quality test chromatogram is included with each set. D3606 column sets are fully conditioned and ready to use after a short conditioning period (30 minutes at 160°C), resulting in minimal downtime, increased productivity, and lower cost-per-analysis.

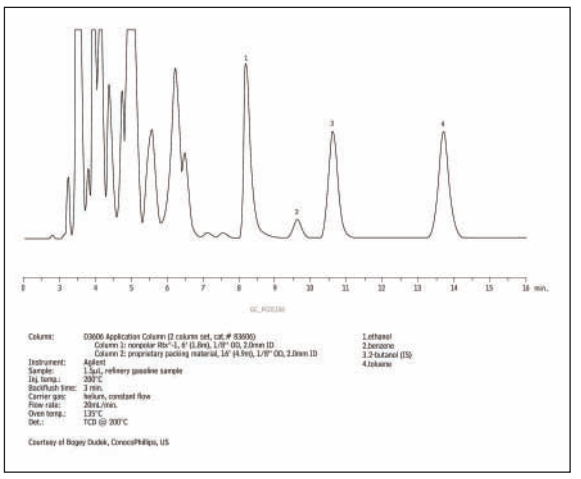

Figure 3 Ethanol and benzene are reliably resolved in refinery gasoline by beta testers using Restek's new D3606 column set.

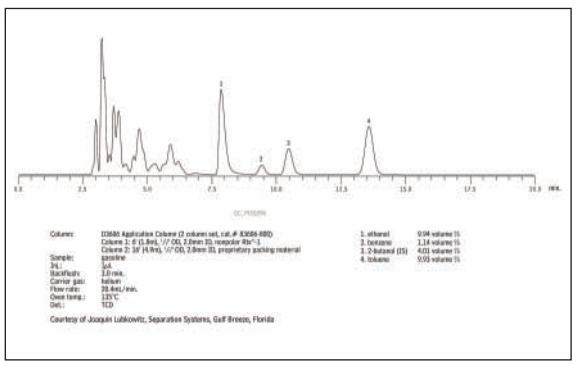

Figure 4 Ethanol and benzene are reliably resolved in commercial gasoline by beta testers using Restek's new D3606 column set.

Conclusion

The new D3606 column set developed by Restek offers substantial performance improvements compared to TCEP columns. New D3606 columns reliably resolve benzene from ethanol, allowing more accurate quantitation.

Additionally, these column sets are individually tested for method applicability and have higher thermal stability than TCEP columns—resulting in a more reliable, cost-effective column option for refineries.