

Gasoline Analysis

RTA Application Note # 02

The **Industrial Raman Analyzer** has been designed specifically for operation in demanding production facilities and is ideal for numerous gasoline applications, such as characterization of gasoline additives.

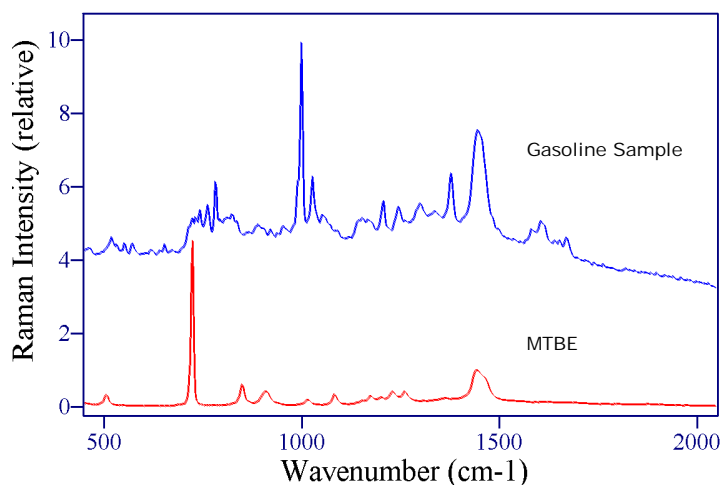
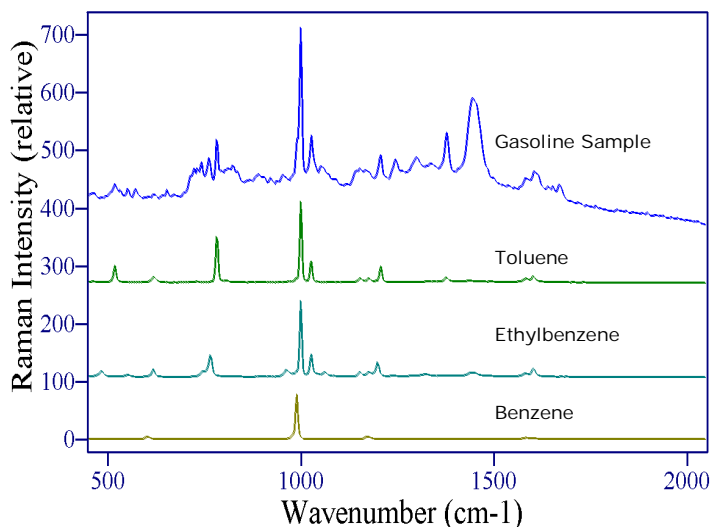
Quality Control of Aromatics used as Octane Improvers

In simplest terms, gasoline is separated from crude oil by distillation. However, the collected fractions are not pure, each consisting of aromatic, heterocyclic, saturated and unsaturated, branched- and straight-chained hydrocarbons that boil at similar temperatures. Consequently, gasoline is characterized in terms of various chemical and performance parameters, and then modified as needed to meet specifications. For example, the octane number can be raised by adding aromatics or branched alkanes, or simply blending with a higher rated fraction. However, there is a limit to the amount of aromatics, benzene, toluene, ethylbenzene, and the xylenes (BTEX), that can be added, since they can cause increased particulate emissions. The **Industrial Raman Analyzer** can determine BTEX concentrations in unfinished fuels, as well as to verify that modified fuels do not exceed regulatory concentrations.

Here a gasoline sample was obtained from a local station and analyzed. A fiber optic probe was placed in the sample and a 5 minute spectrum recorded. A spectrum was constructed from pure spectra for each of the BTEX components to match the measured gasoline spectrum. The amount of each component was varied and a match was obtained. This was accomplished in less than 1 second, and yielded $1.6 \pm 0.1\%$ by volume benzene, the limit set by the Environmental Protection Agency. The same sample contained considerably more toluene and ethylbenzene, 4.8, 3.9%, respectively, but less than 0.5% of the xylenes.

Quality Control of Oxygenates

In an effort to protect the ozone layer, the EPA requires ~ 25% of the US by region to add oxygenates to gasoline to reduce carbon monoxide emissions. Depending on the state and time of year 2.0 or 2.7 weight percent oxygenate must be added. In most cases methyl *tert*-butyl ether (MTBE) is added. Through the use of a fiber optic probe, the **Industrial Raman Analyzer** measured 2.2 ± 0.1 wt % MTBE in the same gasoline sample. A series of MTBE concentration standards yielded a linear response of the 725 cm^{-1} Raman band intensity to concentration, which confirmed the 1-minute measurement.



Toluene is often added to raise the octane number to 89, while iso-octane is required to achieve an octane rating of 93 or higher.

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