

# Analysis of Alcohol Levels in Hand Sanitizer

Answers in the lab or in the field with Agilent FTIR instrumentation



# Pass or Fail Results in Less Than a Minute

Alcohol quantification is a common FTIR measurement. Measuring calibration standards and creating a method for routine analysis takes little expertise and approximately 15 minutes with Agilent instrumentation. Measuring samples and generating accurate color-coded pass/fail results takes less than a minute per sample and can be done in the lab or at site.

## Recommended formulations for alcohol-based sanitizer

Alcohol-based hand sanitizer is recommended in the protection from viruses like SARS-CoV-2, the cause of the coronavirus disease (COVID-19) pandemic. With increased demand due to the pandemic, the US FDA issued temporary policies to allow certain entities to prepare alcohol-based hand sanitizer (1). The US Centers for Disease Control and Prevention (CDC) has advised effective alcohol-based hand sanitizer should contain at least 60% alcohol (2). The World Health Organization (WHO) has also recommended two formulations (3), as summarized in Table 1.

**Table 1.** Formulations for alcohol-based hand sanitizer recommended by the WHO. Sterile distilled or boiled cold-water makes up remainder of the volume.

Formulation 1 – Ethanol based	Formulation 2 – Isopropyl alcohol based
Ethanol 80% (v/v)	Isopropyl alcohol 75% (v/v)
Hydrogen peroxide 0.125% (v/v)	Hydrogen peroxide 0.125% (v/v)
Glycerol 1.45% (v/v)	Glycerol 1.45% (v/v)

Ensuring that sanitizer alcohol concentration meets the requirements is critical for manufacturers. Fraudulent dilution or tampering has also compelled retesting at delivery.

FTIR spectroscopy provides a quick and reliable way to measure and identify the alcohol concentrations in hand sanitizer products. Here we provide an overview of a fast and accurate method to quantify ethanol and isopropyl alcohol in hand sanitizer using the Agilent Cary 630 FTIR spectrometer.

The compact Cary 630 FTIR provides a fast, reliable, and accurate quantification of alcohol in hand sanitizer and is able to differentiate between alcohol types in unknown samples.

For at-site QC of hand sanitizer product at point of delivery, the Agilent 4500 Portable FTIR provides a flexible, transportable solution based on the same methodology.

## References

1. *Temporary Policy for Preparation of Certain Alcohol-Based Hand Sanitizer Products During the Public Health Emergency (COVID-19)*, U.S. Department of Health and Human Services, Food and Drug Administration, Center for Drug Evaluation and Research, Washington D.C. June 1, 2020.
2. Centers for Disease Control and Prevention, <https://www.cdc.gov/handwashing/show-me-the-science-hand-sanitizer.html> (accessed Jun 15, 2020).
3. *Guide to Local Production: WHO-recommended Handrub Formulations*, World Health Organization, April 2010.



**Figure 1.** The Agilent Cary 630 FTIR is a multipurpose high-performance, and compact instrument..



**Figure 2.** The Agilent 4500 FTIR is a rugged battery-powered portable analyzer, ideal for analysis in the field.

## Measurement example

Ethanol and isopropyl alcohol calibration standards were prepared by mixing the desired concentration of alcohol with glycerol and hydrogen peroxide. The standards were made up with Milli-Q filtered water. A commercial alcohol-based hand sanitizer was used as a reference sample. Two samples were also prepared with 55 and 75 % ethanol and isopropyl alcohol, respectively. FTIR spectra were collected using a Cary 630 FTIR equipped with an ATR sampling accessory as shown in Figure 3.

### Identifying alcohol species

As shown in Figure 4, ethanol and isopropyl alcohol show distinct spectral differences in the IR fingerprint region. The peaks around 880  $\text{cm}^{-1}$  for ethanol and 950  $\text{cm}^{-1}$  for isopropyl alcohol are well separated and were used to identify the type of alcohol in unknown samples.

The characteristic C-O stretch band found in primary and secondary alcohols between 1000–1120  $\text{cm}^{-1}$  were used to develop a quantitative model based on Beer's law for both types of alcohol. Two calibration curves were generated using band area. For each alcohol type, measuring the standards, developing the model, and creating the method for routine analysis took less than 12 minutes. Running this method, the final concentration is directly reported after data acquisition. The method could be modified to suit commercial products with more ingredients such as antibacteriocides, perfumes, and moisturizing agents.

The Cary 630 FTIR method was highly accurate in determining the alcohol concentration. Data summarized in Table 2 shows that the results are well within the WHO guidelines of  $\pm 5\%$  of the target alcohol content (3).

**Table 2.** Ethanol and isopropyl alcohol-based hand sanitizer concentration measured using the Cary 630 FTIR spectrometer.

Sample	Calculated Concentration	Measured Concentration
Sample 1 (ethanol)	55%	55.7%
Sample 2 (ethanol)	75%	76.0%
Sample 1 (isopropyl alcohol)	55%	54.1%
Sample 2 (isopropyl alcohol)	75%	75.4%
Commercial sample (isopropyl alcohol)	70%*	71.8%

\*as indicated on the label

The Agilent MicroLab software allows minimum and maximum thresholds to be set for quantitative results. A minimum threshold of 60% alcohol concentration was set for this example. The color-coded results in Figure 5, show Sample 1. It contained ethanol, but at 55%, it was less than the 60% threshold.

### Fast, accurate alcohol measurement

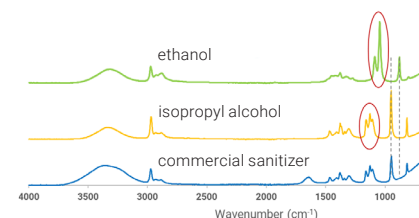
The Cary 630 FTIR instrument with MicroLab software provides a quick and easy workflow for qualification of alcohol-based hand sanitizer. The system can:

- Identify the types of alcohol in the sample
- Flag samples with too little alcohol, using color-coded results
- Be modified to suit sanitizer products with more ingredients, with method development being quick and easy

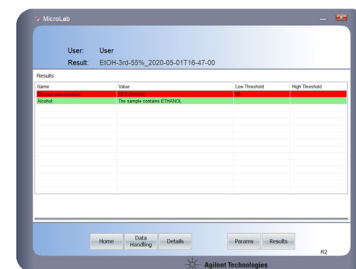
While the Cary 630 FTIR spectrometer is the ideal solution for lab-based analysis of hand sensitizers, the method can also be applied to the Agilent 4500 Portable FTIR spectrometer. This mobile instrument can be used in-situ in the field, or in warehouses or receiving docks.



**Figure 3.** The neat hand sanitizer sample is placed onto the ATR accessory, fitted to the Cary 630 FTIR. The Agilent MicroLab software uses picture-guided workflows to help users to follow each step of the measurement including cleaning and sampling.



**Figure 4.** FTIR spectra pure ethanol (green), isopropyl alcohol (yellow), and a commercial sanitizer sample (blue). Dashed lines show the peaks used to differentiate between ethanol and isopropyl alcohol samples. The red circles indicate the C-O stretch band used for quantification.



**Figure 5.** Pass/fail results are displayed in less than a minute. A routine QC method can automatically identify the type of alcohol and present the correct result. This sample does contain ethanol, but not enough to reach the nominated pass threshold of 60%. The 55.8% results are flagged in red.

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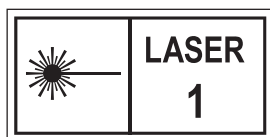
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