



Food & Beverage Series

ETHANOL DETERMINATION IN BEER

Application Note 201LS
YSI Life Sciences



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Ethanol Determination in Beer



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INTRODUCTION

Ethanol concentrations in complex matrices such as beer can be measured directly and quickly using any YSI 2900 Series Biochemistry Analyzer. YSI's unique biosensor technology provides for rapid ethanol measurement. Measurements are virtually unaffected by color, turbidity, density, or pH.

When a sample is injected into the sample chamber, the ethanol diffuses into the membrane containing alcohol oxidase. The ethanol is immediately oxidized to hydrogen peroxide and acetaldehyde. The hydrogen peroxide is detected amperometrically at the platinum electrode surface. The current flow at the electrode is directly proportional to the hydrogen peroxide concentration, and hence to ethanol concentration.

Other alcohols can interfere with ethanol measurement by also oxidizing and producing a signal. Fortunately, most alcohols have much lower responses to alcohol oxidase than ethanol. One notable exception is methanol, which is over three times as sensitive to the enzyme as ethanol. Therefore, samples must be methanol-free.

This application note demonstrates how simply and quickly ethanol concentrations can be determined using the following method. Precision of replicate samples was determined from selected samples; and percent recovery was determined for samples spiked with ethanol. The results section demonstrates typical precision and accuracy when using a YSI Biochemistry Analyzer in process applications.



I. MATERIALS & INSTRUMENT SETTINGS

- YSI 2900 Series Biochemistry Analyzer - equipped with a 2786 Ethanol Membrane and 1579 Ethanol Buffer.
- 2790 Ethanol standards (2.00 g/L, 3.20 g/L). Place the 2.00 g/L calibrator solution in Station 2.
- Connect the 2900 Series Biochemistry Analyzer to a suitable power source.
- Perform the instrument and membrane check described in the Operations Manual.
- Volumetric glassware (Class A recommended).
- The following instrument setup is recommended:

Probe A Parameters

Chemistry	Ethanol
Unit	g/L
Calibrator	2.00 g/L
Sample size	15 μ L
End Point	45 Sec
Cal Station	2 ¹

Probe B Parameters

B Chemistry	None
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Autocal Parameters

Time (min)	30
Sample	5
T Shift (°C)	1
Cal Shift (%)	2

¹ Calibrator should be used in small quantities and refreshed frequently due to evaporation. Calibration should be performed from a test tube.

II. METHOD

- A. Dilute sample to bring ethanol concentration into the linear range of the instrument, which is 0.04 to 3.20 g/L. Samples with 1.5 to 2.5 g/L ethanol will give the best results.
- B. Calibrate the 2900 Series Biochemistry Analyzer with a 2.00 g/L ethanol standard solution.
- C. Check the linearity of the membrane at least once a day with an ethanol linearity check solution (3.20 g/L). Refer to the User's Manual for specifications.
- D. Assay the sample prepared in A by aspiration into the 2900 Series Biochemistry Analyzer. The linear range of the system is 0.04 to 3.20 g/L ethanol. If the value reported exceeds this, further dilution is required.
- E. Calibrate frequently as described in the User's Manual.

III. CALCULATIONS

To calculate % ethanol, multiply the reported value by the appropriate dilution factor.

Example: 5.00 mL of beer was diluted to 100 mL in a Class A volumetric flask. When assayed, the value reported was 1.56 g/L ethanol.

% Ethanol: 1.56 g/L x 0.100L/5mL	= 0.03120g ethanol/mL beer = 3.12% (w/v)
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For a v/v result, divide the mass by the density of ethanol (0.789 g/mL at 20°C).

0.03120 g/mL / 0.789 g/mL	= 0.0395mL ethanol/mL beer = 3.95% (v/v)
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IV. RESULTS / DISCUSSION

Several beers were analyzed for their ethanol concentrations (w/v) using the YSI biochemistry analyzer and Sigma Test Kit 332-BT. The YSI analyzer results and Sigma Test Kit results are compared in the following table:

	YSI	Sigma
Beer A	4.40%	4.39%
Beer B	3.75	3.76
Beer C	3.89	3.87
Beer D	3.74	3.79

YSI's proprietary immobilized enzyme membrane technology provided accurate ethanol results within one minute of sampling. The YSI 2900 Biochemistry Analyzer's ability to provide rapid, precise analyses makes it ideal for brewing process monitoring and control and QC analysis of beer harvest samples.



ORDERING INFORMATION

YSI Part Numbers:

2900 Series	Biochemistry Analyzer
2786	Ethanol Membrane Kit
2790	Ethanol Standards Kit
1579	Carbonate Buffer Concentrate
2363	Potassium Ferrocyanide Test Solution
2392	NaCl Solution (for membrane installation)

For further information, please contact:

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YSI 2900 Biochemistry Analyzer



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YSI Life Sciences develops and manufactures scientific instruments, sensors and systems that serve a variety of scientific and industrial markets worldwide. YSI has a long history in the life sciences and bioanalytical markets, most notably with our introduction of the world's first commercial whole blood glucose analyzer in 1975. Today there are over 10,000 YSI instruments installed around the world, trusted in critical situations to provide the most accurate data in the shortest time.

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