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The Ohio Department of Public Safety is charged with the responsibility of monitoring the sale of alcoholic beverages to minors within the state of Ohio. They currently employ some 80 investigators who routinely scrutinize establishments which serve alcohol to ensure that these businesses are properly dispensing this product. If they determine that the business is indeed selling alcohol to minors, they are required to bring legal charges against the establishment. In such matters, the department must prove that the business did sell an alcoholic beverage to a minor. This entails two components: first, that the purchaser is indeed under the legal drinking age, and second that the beverage does actually contain alcohol.

Recently an AR600 automatic refractometer to the Ohio Department of Public Safety Crime Lab Investigative Unit for the purpose of determining the alcohol content of these beverages for legal action.

Please review the following pages for more information regarding this interesting application.

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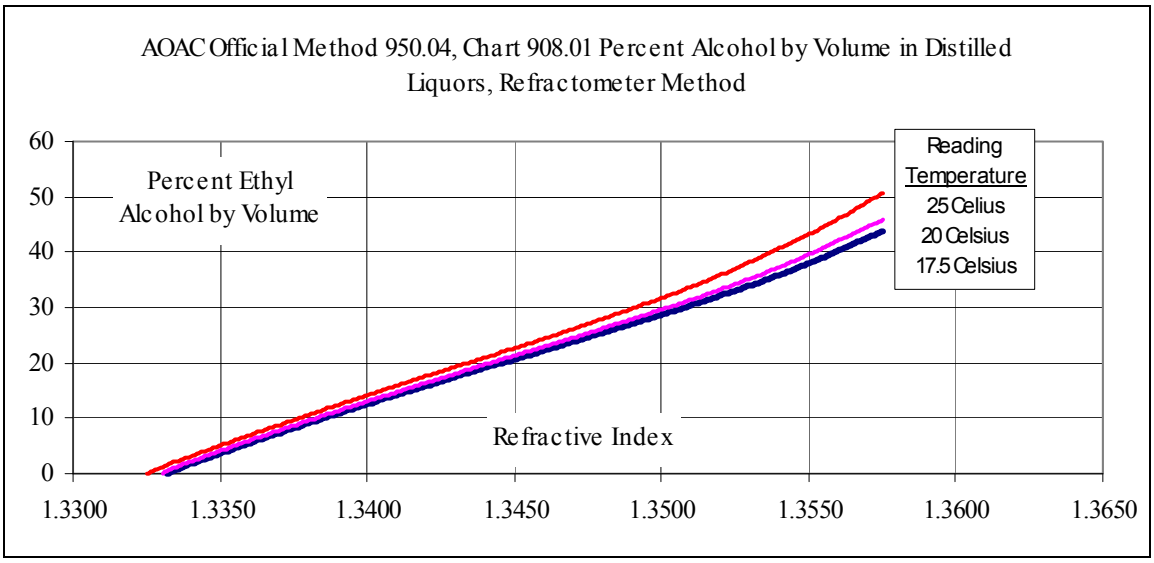
THE AR600 IS ON THE CASE!

The Ohio Department of Public Safety, Investigative Unit Crime Lab uses refractometers to determine alcohol content of field samples obtained for investigations of establishments charged with serving alcohol to minors. As you can see from the following chart, refractive index is an excellent indicator of alcohol content (notice that as with all refractometer methods, reading temperature is a critical factor):



Dr. Mohammed Ali, the Crime Lab Director, had previously been using a Bausch & Lomb immersion refractometer (which is no longer available). This is a precision instrument which has a rather unique and cumbersome mode of operation. Much like a handheld refractometer, the user must manually interpret the shadowline intersect from the refractometer scale once the refractometer is dipped into the sample. This refractometer reading is then converted into an alcohol content value from an AOAC chart. Additionally, the instrument and samples must be maintained at 20°C to obtain a correct reading. The instrument itself is stored in an incubator maintained at 20°C. The samples are temperature controlled by placing them in open faced individual containers in a special tank filled with tap water which has been manually adjusted with hot and cold water using the readings from an analog thermometer to maintain 20°C. Obviously, there are numerous sources for error in this type of system.

Dr. Ali was interested in updating to a more user friendly, automatic system capable of reading alcohol content directly, with automatic temperature compensation. He wanted a system which allowed him to put a sample on the prism, press a button, and get an accurate result directly in percent alcohol by volume. The AR600 was the perfect choice for his application.

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Prior to the purchase of our instrument, Charlie Smith, the Central Region Analytical Sales Manager, had performed a sales call to demonstrate the AR600 for Dr. Ali. This particular unit was preprogrammed with an alcohol content custom channel which read out in percent alcohol by weight based upon an older American Optical table.

Dr. Ali appreciated the direct readout of the alcohol content and the ease of use of the instrument, however, the custom channel he needed would have to be based upon the AOAC method for determining alcohol content by volume. After assuring Dr. Ali that the unit could be programmed with his specific requirements, he agreed to purchase the unit.

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AOAC method 950.04 Alcohol by Volume in Distilled Liquors is used to determine the alcohol content of a sample after it has been distilled and diluted (if necessary). This method uses AOAC reference table 908.01 to convert a refractive index (or immersion refractometer) reading into a percent alcohol content value. Following is an excerpt from that table:

Table 908.01 Percent Alcohol by Volume as Determined by Refractometer

Immersion Reading	Refractive Index	Reading Temperature, Degrees Celsius								
		17.5	18	19	20	21	22	23	24	25
13.20	1.33250									0.00
0.40	1.33257									0.18
0.60	1.33265								0.14	0.35
0.80	1.33273							0.10	0.31	0.53
14.00	1.33281						0.08	0.28	0.49	0.70
0.20	1.33288					0.04	0.24	0.45	0.67	0.88
0.40	1.33296					0.21	0.41	0.63	0.84	1.06
0.60	1.33304				0.16	0.38	0.59	0.80	1.02	1.24
0.80	1.33312			0.14	0.34	0.55	0.77	0.98	1.19	1.40
15.00	1.33319	0.00	0.10	0.31	0.52	0.73	0.94	1.16	1.36	1.55
0.20	1.33327	0.17	0.27	0.48	0.69	0.91	1.12	1.32	1.51	1.71
0.40	1.33335	0.34	0.44	0.65	0.85	1.07	1.29	1.47	1.66	1.86
0.60	1.33343	0.51	0.60	0.82	1.03	1.24	1.44	1.62	1.82	2.01
0.80	1.3335	0.68	0.78	0.99	1.21	1.40	1.60	1.77	1.97	2.17
16.00	1.33358	0.84	0.94	1.17	1.36	1.55	1.75	1.92	2.12	2.33
0.20	1.33366	1.02	1.12	1.32	1.51	1.70	1.90	2.08	2.27	2.48
0.40	1.33374	1.18	1.29	1.47	1.66	1.85	2.05	2.24	2.43	2.62
0.60	1.33381	1.34	1.43	1.62	1.81	2.00	2.20	2.39	2.57	2.77
0.80	1.33389	1.49	1.57	1.77	1.96	2.15	2.35	2.53	2.72	2.92

This table was converted into a custom channel formula to be programmed into the AR600 for Dr. Ali and the Crime Lab.

Reichert personnel visited Dr. Ali on January 25th to install their AR600 and program the AOAC Percent Alcohol by Volume custom channel into the unit. We also assisted him with interfacing the unit with a computer and printer. He wanted hard copy documentation of his results including sample number, result in percent alcohol by volume, date, and time. The AR600 has a unique serial output formatting system which allows the user to automatically transfer any data he wishes, in any order, from the unit whenever a reading is taken. This too proved to be a very favorable selling point. An example of the data which Dr. Ali recorded is as follows:

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***00-005**

% Alcohol by Vol., 4.97, 1/25/2000, 11:35

This documentation is necessary for legal action against liquor establishments. The Ohio Crime Lab reportedly analyzes approximately 5,000 samples per year for alcohol content. Having this analysis (and subsequent documentation) typically eliminates the need for Dr. Ali to travel to court for testimony regarding the alcohol content of these samples.

Once the AR600 was installed and programmed with this unique custom channel and the serial output formatting was established, we verified the performance of the unit with several standard solutions which the doctor had previously created. We analyzed 4 samples each of approximately 5, 6, 15, and 16% alcohol by volume. Each sample had been created individually by Dr. Ali. The AR600 was able to correctly measure the alcohol content of each sample, well within the accuracy specification of ±0.1% asked for by Dr. Ali. In fact, the custom channel formula shows an average error of approximately 0.02% alcohol!

The AR600 proved itself as the only choice for this application thanks to several unique features:

- **Custom Channel Capability** - This features allows the user or Leica to program a conversion formula into the instrument, thus allowing the end user to read out directly in product specific concentration values. In this case, we simply entered the AOAC conversion into the unit to obtain direct readouts in Percent Alcohol by Volume.
- **Definable Measurement Units** - Along with the custom channel formula, end users may define the measurement units which the AR600 will report, such as Percent Alcohol by Volume.
- **Automatic Temperature Compensation** - There is no need to control the temperature of the instrument any longer, the AR600 can read a sample at any temperature and then automatically correct that reading to any desired reference temperature electronically.
- **Calibration History Record** - The AR600 electronically records up to 512 of the latest calibrations performed on the instrument. This information may then be output to a computer or printer for hard copy documentation. This feature ensures compliance with ISO, or more importantly, for legal purposes.
- **Configurable Serial Output** - This feature allows the user to capture data to a computer including all information necessary from the refractometer.

Dr. Ali was thankful for the time we spent preparing the instrument and custom channel for him, letting us know that he would be happy to provide a recommendation for our instrument to anyone that was referred to him.