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TECH TALK 0077
ETHANOL / WATER BLENDS
TESTED IN DIPTRONIC
19/7/2007

Background

A drink manufacturer wished to measure the contents of storage tanks using the Diptronic. Each tank could contain at any one time the following products:

- Wine
- Bottling scotch (inc. Bourbon, rum etc) at 35% concentration.
- Concentrated Scotch (incl. Bourbon, rum etc) at 70% concentration.
- Essentially pure spirit at 96% concentration of ethanol.

Diptronic reading varies with the liquid dielectric. Water has a dielectric of approximately 70 for tap water with wide variation for degrees of demineralization. Ethanol has a dielectric of 24.3. Therefore a change in blend ratio will affect the dielectric of the blend and thus the accuracy of the reading versus other ratios.

Summary

The manufacturer supplied samples of 96% pure ethanol and 70% concentrate Scotch.
These samples were tested as-supplied and then by dilution in several steps by adding Smithfield tap-water.
Readings were taken at two different stick depths of 150mm and 300mm to provide a good range of readings.

Results showed a steady change in readings from pure water to (almost) pure ethanol such that a single calibration on any particular concentration would **NOT** meet accuracy requirements through the whole range.

Limited range change may be possible. Water calibration and then reading wine provides excellent correlation.
Bottling scotch (35%) reads fairly accurately compared with concentrated scotch (70%) and **MAY** allow a calibration on bottling Scotch to fall within accuracy requirements for concentrated Scotch. However pure ethanol (96%) falls outside all other calibration blends.

It is not possible to use one calibration for all liquids.

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Test Detail

Test DIP 100 stick 1 metre long

Sensor DIP-120 set to Dielectric 1.4-1.7
Software 1.00.16 Dated 2-04-07

Compartment setting

Step 1117.0 +0000.0L
Step 0000.0 +1000.0L

No thermal drift correction data entered.

Set up to read 1mm = 1 litre.
Use 1000ml plastic measuring tube.

Procedure

These samples were supplied in small bottles of 675ml each and so readings were possible only at 150mm up from the stick tip and 300mm up from the tip. (Two readings of each were taken simply to increase the average accuracy).

All dilutions used Smithfield factory tap-water.
Points on the graph for “70%” and “35%” were for the supplied Scotch concentrate.
All others were diluted from the supplied 96% ethanol.
All readings shown on the consolidated graph of the data are to a Diptronic accuracy of +/-1mm (+/- 1litre).

Table 1a

Sample	Conc.	500ml	1000ml
Water	0.00	162.7	255.00
Spirit	0.19	162.4	254.87
Spirit	0.32	162.0	253.96
Scotch	0.35	162.2	253.83
Spirit	0.48	161.8	253.83
Spirit	0.64	161.4	253.12
Scotch	0.70	162.2	253.57
Spirit	0.96	159.5	250.85

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Discussion

In this particular case there are two further items to note:

a) The customer requires NMI approval. This can only be done by firstly carrying out a calibration and then having NMI attend and supervise a verification of the results.
b) The standard Autocal rig would have to be replaced with a food grade system (pumps, meter, air eliminator, valves in stainless steel with white rubber or Teflon seals) as the calibration must use bottling scotch as the liquid.

After this, should the approval process succeed, the system will be certified only for concentrates at 70% and bottling strength at 35%. Pure spirits will not be approvable but the customer requires it for customs and excise. (Wine is ok, it need not be approvable as it is not bonded and nor is it as valuable).

The water used in the dilution process is imported in drums. Its dielectric is unknown. It may be of benefit to the accuracy or detrimental. If the project continues this information should be obtained at a very early stage.

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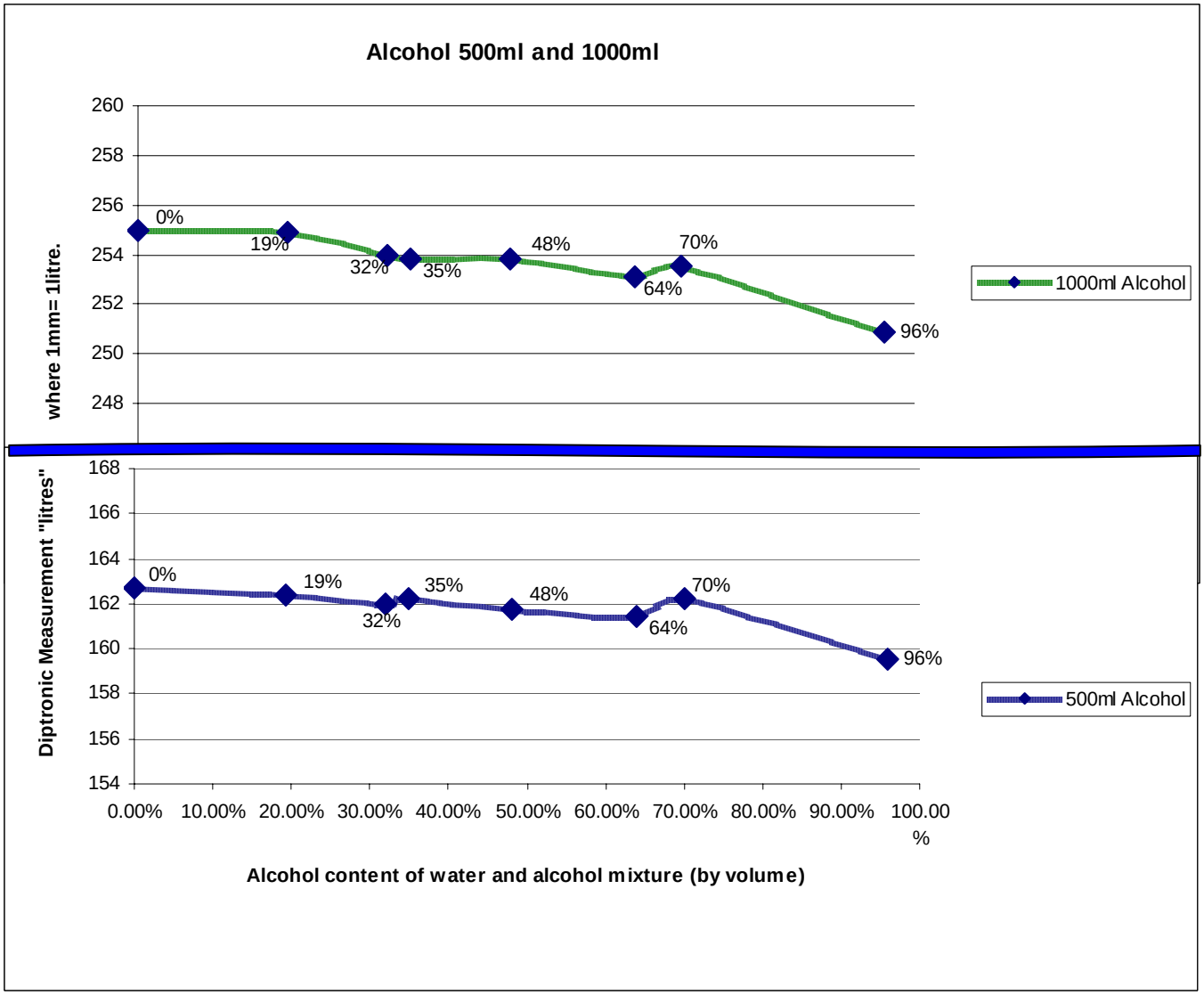

David Gregory
19 July 2007