

Sensitivity in Polarimetry - An Application Case Study

Significant information can be gained from the use of Polarimetry by properly designed experiments, however. Sensitivity or minimum detectability is an often encountered question.

A modern and accurate Polarimeter like the **DigiPol Nova** can provide such a small detectability. In many cases, its detectability could be much smaller than comparable bulk (non HPLC) methods like refractometry. A recent study for a leading pharmaceutical company proves this

Needing to measure the efficiency of diffusion of a sugar solution across a membrane in their manufacturing process they were not satisfied with the accuracy of the existing method, which called for measuring the refractive index of the diffused fraction, a very dilute solution of sugar or other carbohydrates, it was requested if Polarimetry could do better.

A quick check of a leading Automatic Abbe Refractometer reveals that they have:

- a minimum readability of : **0.01% solids in extended display mode**
- **Precision/ accuracy of: ± 0.1% solids again in extended display mode.**

Against that, the following are the numbers for Polarimeters:

- **Specific rotation of sucrose, $[\alpha]$: 66.6° nominal**
- **Observed rotation, $\alpha = [\alpha] * c * l$, where c is the concentration grams per mil and l is the cell length in 100 mm units**

The following table provides some interesting numbers:

Sucrose Concentration Percentage, g/ 100 ml	Observed rotation in sample cell of length:		Specifications of DigiPol - Automatic Polarimeters
	100 mm	200 mm	
1	0.6666°	1.3320°	Accuracy: better than ± 0.01° Repeatability: better than ± 0.003°, ± 0.002° possible in clear solutions Readability: 0.0005°
0.1	0.0666°	0.1330°	
0.01	0.0066°	0.0133°	
0.0075	0.0050°	0.0100°	
0.0025	0.0017°	0.0033°	
0.0015	0.0010°	0.0020°	
0.0004	0.0003°	0.0005°	

DigiPol - Automatic Polarimeter therefore would provide a clear improvement:

- **An accuracy of: 0.0075% in sucrose (with possible to improvement in small ranges by spot calibration/ linearity checks)**
- **Resolution/ Readability of: 0.0004% sucrose**
- **Repeatability (Precision essentially) of: ± 0.0025% sucrose at least, and possibly even 0.0015%**

To confirm our predictions, some very dilute sugar solutions were prepared and proved that it was possible to estimate the low concentrations, and distinguish between two solutions with slightly different concentrations in the range in which the customer was interested. A Digital Polarimeter would further enable a host of other USP tests with much greater accuracy.

The comparative data are presented in the following table for easier comparison

%sugar	Refractometer performance			DigiPol obs. rotation °		Performance comments
	ref. index	change		100 mm	200 mm	
0	1.33302		Data Brown & Zerban	0°	0°	Spec. Rotation., nominal
5	1.34037	0.007350	page 101	3.33°	6.66°	66.6
0.0004	1.333021	0.000001		0.000266°	0.0005°	Resolution/ Readability
0.0015	1.333022	0.000002		0.000999°	0.002°	Repeatability in clear samples
0.0023	1.333023	0.000003		0.001532°	0.003°	Repeatability specified
0.0075	1.333031	0.000011		0.004995°	0.01°	Accuracy specified
0.02	1.333049	0.000029	Precision/ Accuracy limit	0.01332°	0.0266°	
.01	1.333035	0.000015	Readability limit	0.00666°	0.01332°	
0.1	1.333167	0.000147		0.0666°	0.1332°	
1	1.33449	0.001470		0.666°	1.332°	