

Moisture & Degree of Roast: Coffee



Applications Note: 10200-01-2018

Rapid Quality Assurance

It's common practice for Coffee roastmasters to measure the moisture and "color" (which ranges from light to dark) of roasted coffee beans to monitor the quality of the roasting process, and ensure the product is within target specification prior to further processing. The color value, often referred to as degree of roast (DOR), is normally measured in the ground state as the beans are generally not uniform in color.

To date, these measurements require the use of multiple analytical technologies (instruments) with different sample handling and operating requirements.

NDC Technologies has recently upgraded its proven and trustworthy InfraLab at-line moisture analyzer to provide a **simultaneous** measurement of Moisture and Degree of Roast in five seconds. See Figure 1. With no special skill required to operate, the InfraLab provides process vision far beyond that of conventional testing. This provides unprecedented feedback to the process controller for improved control of Moisture and DOR which offers financial benefits such as:

- Performing both measurements in a single instrument for reduced maintenance
- Improving batch-to-batch consistency through rapid feedback of moisture and DOR, enabling roasters to confirm and refine processing operations
- Improving operating efficiency



Figure 1. InfraLab at-line moisture analyzer

Applications and Measurement Performance

The InfraLab analyzer incorporates a patented opto-electronic design that not only enables it to withstand the processing environmental conditions but also provide robust, linear and consistent measurements over long periods of operation without requiring constant re-adjustment after commissioning.

Achieving this capability has required significant applications engineering to deliver off-the-shelf, linear measurement algorithms that are fit-for-purpose and do not drift over time.

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Applications Note: 10200-01-2018



Moisture:

Table 1 includes a list of NDC developed moisture measurements and the charts in Figure 2 demonstrate the InfraLab's performance against an oven primary measurement method.

Product	Component	Accuracy
Ground Roast Coffee	Moisture 1-10%	± 0.1
Roast Coffee	Moisture 5-10%	± 0.3
Green Beans	Moisture 9-14%	± 0.3
Freeze Dried, Spray Dried & Agglomerated Coffee	Moisture 1-6%	± 0.1

Table 1: Examples NDC moisture measurements in Coffee products

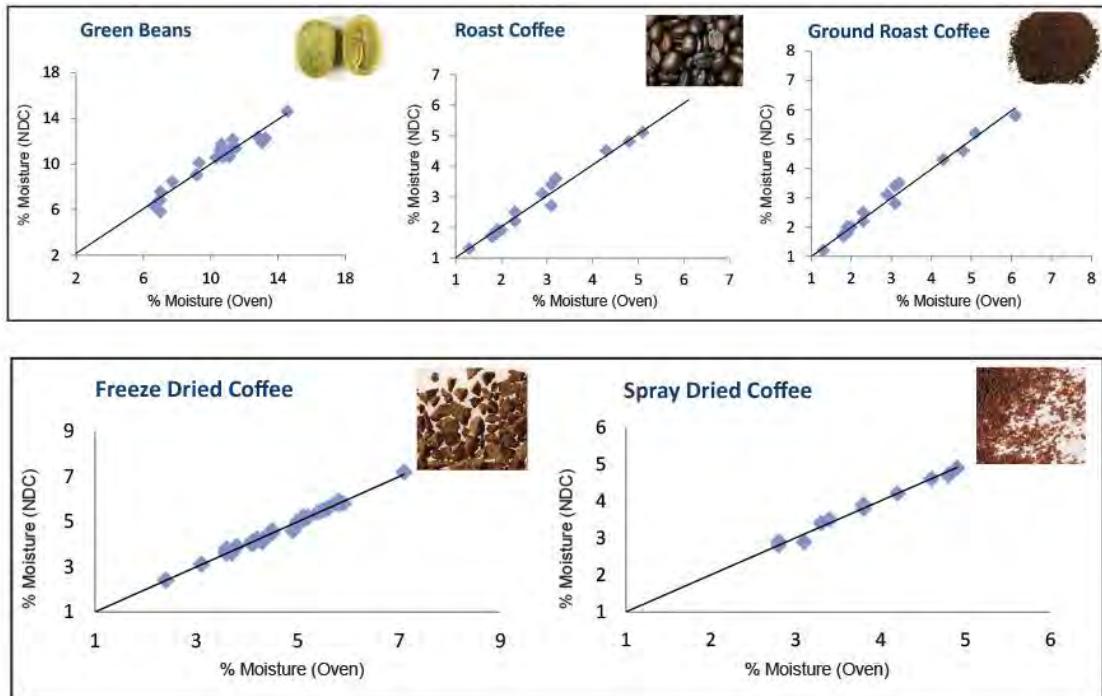


Figure 2: InfraLab Moisture measurement performance against primary reference methods

Degree of Roast:

Historically, to differentiate between different degrees of roast, a narrow band of visible light reflected from a ground sample of the roasted bean is measured. The InfraLab now incorporates this capability to provide a simultaneous measurement of Moisture (using NIR light) and DOR from a single sample of coffee.

For consistency, samples should be analyzed close to room temperature and as DOR is an absolute reflectivity measurement, the sample bowl filled to form a flat surface that is level with the edge of the dish. To simplify this

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for ground and

soluble coffee, a sample levelling device is provided. The operator simply overfills the sample dish which is then pushed under the leveling bar to create a flat surface as shown in Figure 3.



Figure 3: Sample levelling device

Figure 4 shows Moisture and DOR values obtained from 4 different samples of ground coffee ranging from light to dark roast.



DOR:	113	82	65	35
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Moisture:	3.1	2.5	2.5	2.0
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Figure 4: DOR and Moisture results from a range of ground coffee samples

Moisture & Degree of Roast: Coffee

Applications Note: 10200-01-2018



Long term, the InfraLab has excellent stability and reproducibility as shown above in Figure 5 & Table 2. Figure 5 plots the observed variation of the DOR reading from a reflectivity tile over a period of several months.

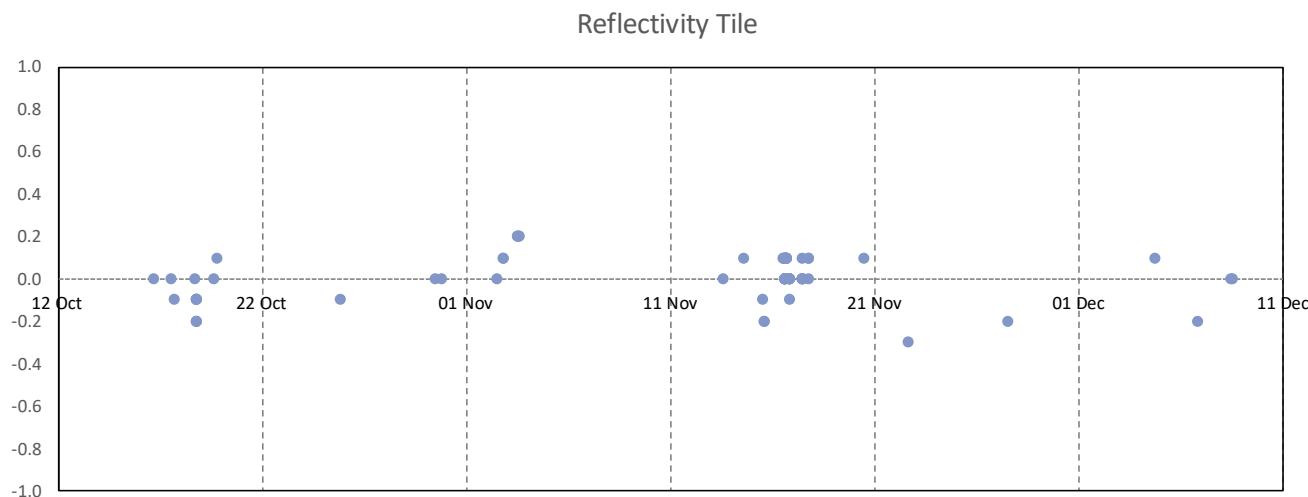


Figure 5: Observed variation in DOR from a reflectivity tile over several months

Table 2 shows DOR readings from three equilibrated samples of ground coffee measured over a period of several months. Six individual measurements were made from each pot of sample and the DOR readings averaged.

Date	1		2		3	
	DOR-Avg	SD	DOR-Avg	SD	DOR-Avg	SD
17/10/2017	113	0.4	82	0.4	35	0.3
15/11/2017	113	0.2	82	0.6	35	0.3
04/01/2018	113	0.4	82	0.5	36	0.3

Table 2: DOR readings from equilibrated ground coffee samples

Moisture & Degree of Roast: Coffee



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Summary

NDC's applications-engineered measurement solutions bring measurable process benefits to the coffee processor:

- ▶ Improved product consistency and quality
- ▶ Linear measurement algorithms engineered for the product, parameter and operation range
- ▶ Robust, state-of-the-art optics and electronics design
- ▶ Long-lasting stability: no need for re-calibration
- ▶ Highly dependable operation: unaffected by ambient conditions
- ▶ Best performance: accuracy, precision, speed and signal-to-noise
- ▶ Fastest ROI and lowest cost of ownership
- ▶ Lifetime partnership philosophy with customers to cooperatively develop solutions and improve competitiveness
- ▶ Peace of mind knowing that you are working with a stable, reliable organization for the long term
- ▶ NDC Technologies is part of Spectris PLC (www.Spectris.com), a leading global provider of productivity enhancing instrumentation and controls

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