



# Moisture Analysis of Coffee

APPLICATION NOTE

Coffee is consumed and enjoyed by billions of people across the globe every day. Coffee is available in a variety of diverse blends and flavors.

Coffee is a brewed drink prepared from roasted coffee beans, which are the seeds of berries from the coffee plant. Moisture content indicates the maturity of the beans, the amount of drying the beans require, and the weight loss of the green beans during the storage and roasting, all of which decide the quality of the finished coffee product. Measuring the amount of moisture in coffee is important because coffee that is too high or too low in moisture will not maintain high cupping quality. It is also important to ensure consistent roasting protocols.

## SUMMARY OF THE PROCESS



**Endothermic Stage:** The green beans are slowly dried at 200 to 250°F (93 to 121°C) to drive moisture out of the coffee resulting in a humid grassy smell and yellowish color

**First Crack Stage:** As the coffee beans heat up to 300°F (149°C) they continue to absorb thermal energy and begin to brown. The “First Crack” stage begins at about 400°F (204°C) in which the bean doubles in size, becomes a light brown color, and experiences a weight loss of approximately 5% and is a result of the internal moisture and CO<sub>2</sub> gas pressures cracking the coffee bean releasing the gas and heat in an exothermic reaction. Once the beans crack, they again begin to absorb heat and if the roaster does not increase thermal energy, the beans will bake and not continue to roast. The roast taste is preferred to the baked taste. With the increase of temperature the bean color changes to medium brown and the bean experiences a weight loss of 13%.

**Second Crack Stage:** The second step is followed by a short endothermic period which is followed by another exothermic step called the second crack. This second pyrolysis occurs between 435 - 450°F (223 - 232°C), and the roast color is defined as medium-dark brown. The second pop is much quicker sounding and the beans take on an oily sheen.

**Caramelization:** Caramelization of the reducing sugars begins during the increase of temperature from 340 - 400°F (116 - 204°C) when the long chain polymerization of the sugars is disrupted. Sucrose melting point of 370°F (188°C) typifies this process. The first crack stage ends around 415°F (213°C) with the total release of moisture and CO<sub>2</sub> and the caramelization of half of the sugars.

Different roasters seeking different flavor, odor, and other characteristics modify the individual processes. Caramelized sugars are bitter when compared to sweet non-caramelized sugars, and the roasting temperature of 400 - 425°F (204 - 218°C) approaches the point to differentiate the impact of these sugars on flavor. The beans can be roasted to smooth out the surface features and complete with an end point at about 435 - 450°F (223 - 232°C), or the roaster may continue roasting to the “Second Crack” with more of a bitter taste.

## QUALITY PARAMETERS AND MEASURING POINTS

**Moisture Measurements:** Moisture in Roasted coffee is usually less than 5%. A **QuikCheck Benchtop NIR Analyzer** benchtop analyzer can be used in the laboratory or at-line for both quality and process control. Moisture can also be measured in the incoming green beans, roasted beans and instant coffee.

For monitoring moisture of ground coffee before packaging, the **MCT460 Online NIR Sensors** are especially useful instruments. These moisture sensors can be positioned at critical stages of the production process (after grinding, for example) to provide accurate moisture readings and ensure the best possible coffee quality.

## VALUE AND QUALITY

Moisture content will impact the quality and the shelf life of the finished product. Under-drying may cause mold. In severe cases, under-dried coffees may develop fungi and molds. Over-drying is as significant as under-drying especially that it costs money. Not only weight, and therefore money, lost unnecessarily, but the accompanying loss of color also translates directly into lower quality.

Green bean moisture varies from 8–12.5%. Producers try to keep moisture high, as they are sold based on weight. Moisture above 12.5% lends itself to mold and being rejected. Moisture below 9% is likely past peak crop and will shrink, distorting the beans. There is great value to measuring the green bean moisture going into the roaster. Moisture content of green beans can vary from batch to batch and the roasting protocol must be adjusted to compensate for these changes.

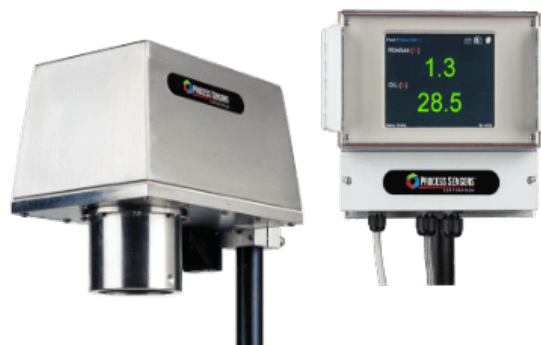
Roasted coffee moisture is usually less than 5%. The moisture content will impact the quality of the roasted coffee and will reflect on the drinking experience of coffee consumers.



*The QuikCheck Moisture Analyzer is a benchtop NIR instrument ideally suited for analyzing product samples at-line.*

## QUIKCHECK MOISTURE NIR ANALYZER

- Easy setup, calibration, and operation.
- Results are returned to the operator in 5-to-10 seconds.
- Space-saving, ruggedized design fits smoothly into most at-line or lab settings.
- Little-to-no sample preparation required.



*The MCT460 Series Online NIR Sensor (MCT466-SF shown here) helps operators control moisture within one-tenth of a percent to meet product specifications.*

## MCT460 SERIES ONLINE NIR SENSORS

- Monitor raw ingredients and in-line processes to maintain consistent product quality, increase yield, and minimize waste.
- Simple to operate, integrate, and standardize across multiple lines or locations.
- Rugged enclosure withstands harsh conditions. Washdown unit is also available.
- Proprietary temperature-controlled detector ensures measurement stability.

### KPM Analytics

8 Technology Drive | Westborough, MA 01581 USA

Phone: +1 774.399.0500

www.kpmanalytics.com | sales@kpmanalytics.com

©Copyright 2023. All rights reserved. 04.001.291.EN.v1.1

