Application Note
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Measuring moisture and color of roasted coffee

BUCHI NIR-Online® process analyzer:
Moisture and Color with NIR

1. Introduction

Coffee is one of the most famous drinks worldwide. Beyond variety and geographical origin of the coffee beans, the key factor for its taste is the roasting strategy of the beans themselves. Roasting not only extends the shelf life by reducing the moisture of the coffee beans, but it is also crucial for developing and highlighting typical colors and flavors of specific coffee varieties.

Hence real-time control of the roasting process is very critical not only to ensure a consistent and repeatable high-quality of the final product, but also to reduce the operating costs, avoiding faulty batches and increasing the margin by optimized roasting results and moisture content.

2. Equipment

- BUCHI NIR-Online® process analyzer: X-Three (NIR + VIS)
- Wavelength range: 400 – 1700 nm
- Measurement principle: Diffuse Reflection
- Interface to process: Weld-in Flange

3. Application

The diversity of coffee drinks, their related sensorial appearance, and available technical roaster equipment cause a wide range of roasting strategies. Such strategies vary in coffee bean temperature (160 – 300 °C) and roasting duration (2 – 20 min). This makes coffee roasting very complex and challenging in terms of product consistency and reproducibility from batch to batch, presenting the overall product quality to meet the customer's expectations.

Conventional quality methods are tedious, time consuming, destructive, and off-line [1 – 3]. The implementation of a BUCHI NIR-Online® process analyzer after the roasting step (Fig. 1) provides full characterization of the coffee beans. Within seconds, several parameters are accurately, simultaneously, and continuously measured (see Table 1).

Real-time information about the current coffee roasting batch, mainly in terms of moisture and color, enables proceeding with in-process adjustments, running a production closer to specified targets, and preventing over-roasting. This helps to reduce discards, increases energy efficiency, and leads to economical growth.

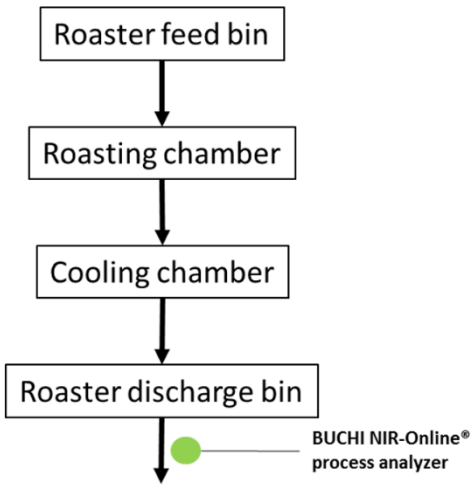

Figure 1: Coffee bean roasting process

4. Result

The BUCHI NIR-Online® process analyzer was found to be suitable for accurate measurements of the parameters relevant to coffee roasting (Table 1).

Table 1: Calibration performance.

Parameter	Range	SEC
Arabica		
Moisture	3.8 – 5.7	0.02
Color*	55 – 88	0.22
Robusta		
Moisture	2.8 – 5.2	0.12
Color*	52 – 86	1.5
Coffee Powder		
Moisture	1.6 – 6	0.03
Color*	46 – 86	0.29

*SEC. Standard error of calibration (absolute)
*Color was measured by colorimeter in transmittance (linear scale from 0 – 100).

Other parameters successfully monitored with NIR-Online are, for example, sucrose or impurities due to barley grain. The configuration is also applicable for related processes and products, such as drying tea leaves, aromatic herbs, or their extracts, spray dried powders, or freeze-dried granules.

5. Conclusion

Results clearly show that a NIR-Online process analyzer is able to simultaneously measure multiple properties of roasted coffee beans and ground coffee powder. The measurements provide real-time determination of product composition, thus allowing immediate in-process adjustments in the coffee roasting process, leading to improved product consistency, quality, and maximized efficiency.

6. References

[1] ISO 11294: 1994. Roasted ground coffee – Determination of moisture content – Method by determination of loss in mass at 103 degrees C (Routine method).
[2] ISO 11817: 1994. Roasted ground coffee – Determination of moisture content – Karl Fischer method (Reference method).
[3] ISO 11664-4: 2008 (CIE S 014-4 / E: 2007) Colorimetry – Part 4: CIE 1976 L*a*b* Colour space.