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Measurement of Moisture in Tobacco Using Near Infrared (NIR) Sensor

Key Words

- Near Infrared
- NIR
- Spectra-Quad
- Tobacco
- Moisture

Thermo Industrial Solutions Note

Introduction

In the tobacco industry, moisture measurements are critical throughout most stages in the production of cigarettes, cigars and chewing tobacco. Tobacco processors are constantly adjusting moisture and heat during the conditioning process to maintain the quality of their product. If conditioned tobacco has too much moisture it will rot and mold. If the conditioned tobacco is too dry, the tobacco will not bind together or pack well in each cigarette. Process efficiency depends on continuous, accurate and reliable moisture measurements. Depending on the stage of the manufacturing process, if the product is too dry, dust and crumbling occurs and if too wet inconsistent flow results. Moisture can be measured at several points in the process including before or after the conditioning cylinder, dryer, cooling zone, and after blending and cutting (*figure 1*).

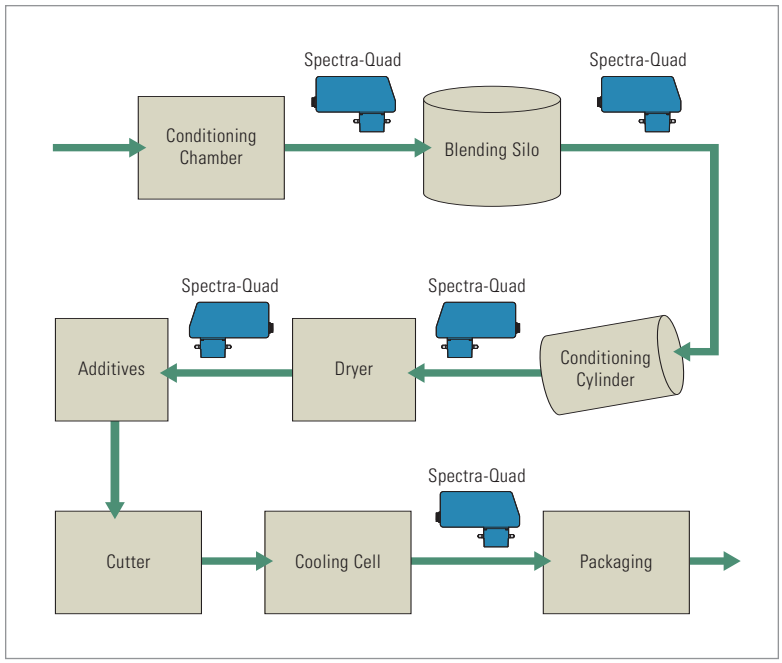

figure 1 – Typical tobacco conditioning process

figure 2 – Spectra-Quad NIR sensor

Moisture can be continuously measured on-line in real-time using the Spectra-Quad™ Online Moisture and Constituent Analyzer from Thermo Electron (*figure 2*). The Spectra-Quad uses a measurement technique, based on Near Infrared (NIR) light absorption. It is a non-contact, non-destructive and non-hazardous method. The sensor illuminates the sample with NIR light at a wavelength which water absorbs. The light is very low intensity and does not heat or damage the sample. The sensor measures the reflected light. The more moisture present the more light that is absorbed and the less reflected. The reflected light is inversely proportional to the amount of the moisture in the tobacco. The typical measurement range for moisture in tobacco is 10-25%.

Sensor Location

In the example presented, the Spectra-Quad was configured to monitor moisture after the conditioning cylinder, which uses steam to increase the moisture content of the leaves. The Spectra-Quad is mounted over the conveyer carrying the leaves. It is configured with the wavelengths best suited to measure moisture in tobacco. Using a 4-20 mA output, the moisture of the leaves exiting the conditioning cylinder is used to control the residence time in the cylinder. The Spectra-Quad NIR sensor could also be placed at other points in the process including after the dryer and cooling cell.

Sample	Type	Laboratory Value (% Moisture)	Spectra-Quad Value (% Moisture)
1	Generic	13.8	14.7
2	Generic	15.2	15.3
3	Generic	19.7	19.9
4	Generic	22.3	22.7
5	Generic	23.5	23.2
6	Regular	13.7	13.5
7	Regular	14.5	14.9
8	Regular	16.1	15.9
9	Regular	19.5	20.0
10	Regular	21.3	21.1
11	Light	13.9	14.3
12	Light	15.9	16.1
13	Light	17.4	17.3
14	Light	19.5	19.7
15	Light	22.3	22.2
16	Light	24.6	25.0

table 1 – Moisture in tobacco - correlation coefficient 0.996.

Calibration

The Spectra-Quad NIR sensors were calibrated using five or more samples of three types of tobacco blends. The samples are analyzed by a laboratory reference method and by the Spectra-Quad. The laboratory reference method for moisture is loss on drying.

The sensor was configured with filters specifically selected for tobacco blend applications. The calibration algorithm reduces bias to color and blend type to a minimum allowing a single calibration to be used for multiple tobacco blends. A linear regression is performed using the laboratory and Spectra-Quad values. The result is a calibration equation that can be used to predict the moisture content of the process. The data used to generate the calibration for moisture in tobacco is presented in *table 1*.

The goodness of the calibration or its ability to accurately predict the constituent concentration is described by the correlation coefficient, which is a decimal value between 0 and 1. A perfect calibration is described by a correlation coefficient of 1. Therefore, the closer the correlation coefficient is to the value of one the better the calibration. The correlation coefficient for the application presented is 0.996.

The calibration results can also be represented graphically by plotting the laboratory results against the Spectra-Quad readings. The straight line on the graph represents the result of the linear regression. The calibration plot for the moisture in ground tobacco analysis is presented in *figure 3*.

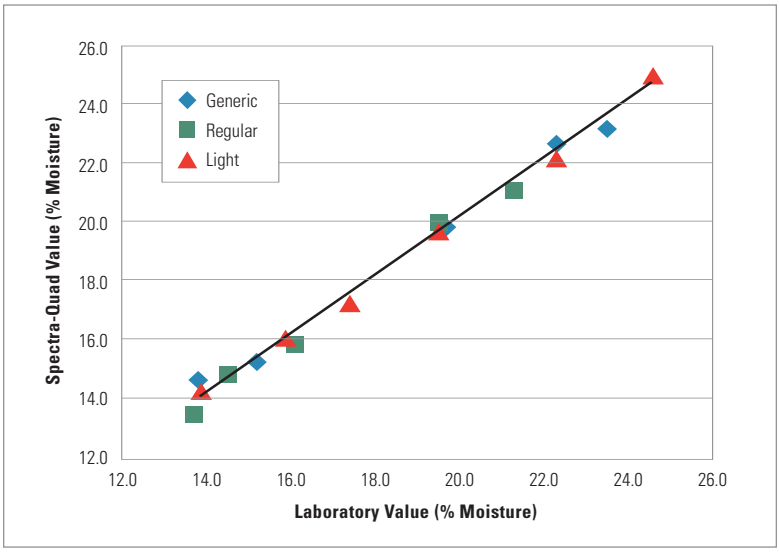

figure 3 – Calibration plot for moisture in tobacco

Conclusions

With the Spectra-Quad Online Moisture and Constituent Analyzer, tobacco producers are able to monitor moisture at multiple locations in their process. The Spectra-Quad provides the flexibility needed to analyze different blends. The moisture concentration is used to control the process resulting in improved efficiency, reduced costs and a better quality product.

Other Applications in the Tobacco Industry

The Spectra-Quad can also be used for the measurement of sugar and nicotine in ground tobacco.

For More Information

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