

LOW COST MOISTURE SENSING FOR SEED COTTON AND LINT

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Abstract

Commonly available moisture sensors use resistive interface upon which the sample is pressed. The readings are greatly dependant on the amount of pressure applied against the sensor. The greater the pressure the higher is the indicated moisture level. While in a hand held device one has some control over the amount of pressure applied, in line units suffer great variation of pressure thus the provide varied readings for same samples. The sensor introduced at this event by Advanced Sensing and Controls is designed to overcome that deficiency and provide readings that are invariable to the amount of the pressure applied upon the sensor. This is achieved by the inclusion of a secondary optical (IR) sensor which estimated the pressure applied against the resistive sensor. With the inclusion of the optical sensor, the moisture system compensates for the pressure applied and provides more stable readings while used with a desk unit or a in process operation.

Introduction

Resistive moisture sensing is the most common and in-expensive method for measuring lint moisture. To measure the moisture of a sample one has to place the sample against a resistive plate - part of the sensor instrument - and the electronic circuits measures the conductivity of the sample which is correlated to the moisture level. The higher the moisture content - the greater will be the conductivity, the ability to conduct electrical current. The sensing plate is normally design to contain two terminals containing a static potential between them. Current will flow from terminal to the other upon the introduction of a current conducting material between them. Cotton fibers alone do not conduct electricity well. However moist cotton, containing water molecules, when placed between the electrodes, will conduct current between them. The conductivity of the moisturized lint is proportional to the amount of water molecules it contains, i.e. to its moisture level. It can be logically explained the conductivity is also dependant on the amount of pressure, or the density, of the sample. The greater the pressure or the density, of the sample the higher will the measured conductivity. That is due to the fact that there is denser and greater area through which the current can be conducted from one conductor of the sensing plate to the other. The theory is simple but no commercial product which considers the density or the pressure of the sample against the sensing plate to measure true moisture content which is independent of the applied pressure or its density.

Twin Sensing

The new ASCI sensor is comprised of two sensors: the commonly known resistive plate and an IR sensor in its center to measure the density of the tested sample. Figure 1 presents the sensor plate with its density sensor behind the glass window at its center. As the resistive sensor produces analog signal proportional to the moisture level, the IR sensor produces another analog signal proportional to the density of the cotton pressing against the sensor plate. These two signals are then sent to the unit processor for the final calculation of the moisture. The processor uses both signal to calculate the moisture level.

Test Results

Table 1 compares the measurements with and without the density contribution for three levels of moisture. Three samples were prepared for the test with moisture levels of 3.3%, 6.2% and 10.1% . Each sample was measured with varying amount of pressure applied against the plate: 0gr, 100gr, 200gr, 300gr and 400gr. The graphs at figure 3 present the results showing rather flat readings when measurement is pressure compensated, as detected by the density sensor, while the uncompensated signal is proportionally increasing as function of the applied pressure.



Figure 1. ASCI new moisture sensor containing a density sensor on board.



Figure 2. ASCI desk top moisture sensor containing a density sensor on board.

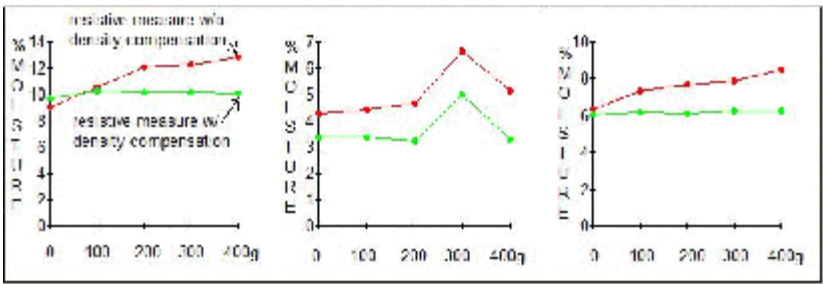


Figure 3. Graphs comparing the moisture readings with varying pressure levels.

		0 gr	100 gr	200 gr	300 gr	400 gr
3.30%	with comp.	4.2687	4.4511	4.6863	6.6463	5.1503
	w/o comp.	3.4012	3.3697	3.2323	4.9945	3.3053

6.20%	with comp.	6.3167	7.3343	7.6703	7.8895	8.4863
	w/o comp.	6.0666	6.1665	6.1253	6.2295	6.2858
10.10%	with comp.	9.0303	10.5503	12.1247	12.3199	12.8319
	w/o comp.	9.7393	10.3094	10.2094	10.1516	10.1139

Table 1. Moisture test result; comparing the calculated moisture levels with and without density compensation

Summary

A low cost of a cotton resistive moisture sensor which includes a density sensing for higher accuracy and measurement independent of the pressure applied against the plate. This product complements ASCI product line of sensor and controller including flow control, feed control, moisture restoration and final bale moisture sensor measured with the use of microwave signals.