Humidity Detection in Sugar Cane Samples Using Microwaves.

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Abstract - In this work are presented some details of the process in sugar cane to obtain sweet; the humidity is fundamental and currently the traditional laboratory test go on with each load in parallel to the process on cane; to conclude that the laboratory results in quality control for each load is known when the process arrive to the end of the chain, because of this there is not possibility to estimate the humidity level in the cane load at the moment when is entering the genius. The microwaves system would work in an alone frequency and would be taken advantage of the technique of signals reflection for in his operation. The microwaves system would be proposed as a complement to the already existing systems of quality control, those which already found in all genius.

Introduction

In most of the industrial processes is convenient to have a control of the own characteristics of the input materials with this, can be estimated which will be the result of manufacture process concerning to quality control; there will be occasions in which in a given process could be modified the conditions in which materials arrive, there will be other in which not, however always it is convenient to maintain a quality control that has several sampling points of supervision, this last can be carried out without having to make use of a sampler or a system that alter the raw material or mutilate it; for that this could be a field for the nondestructive technologies, that by definition, are those that make his review or estimating function of a variable or several variables without altering the composition of the material of interest without breaking it, without mutilating it.

1. State of the art

The characteristic that announces us the quality in sugar cane is the humidity content that presents at the moment of the process. The humidity of the product (sugar cane) is seen reduced with the running of time, once grinding season has been started. This take us to the fact that the production of the sweet is seen reduced due to the fact that is not controlled the court date and, the entry to the genius. It is therefore that the planning and designs of a system that register the humidity in the load to the moment of entering would permit to know the level and the quality of the product. If the system allows an inspection in line (at the moment) of the load, exist a big possibility to accept or to reject the load in the moment of enter to the sugar genius yard, based only in one prediction of the microwave system.

Complementary sampling.

Traditionally, the quality of the sugar cane is first determined through a simple inspection in the accesses of raw material, when go into the genius, in addition with the support information provided by the supplier, information that sometimes is not a very reliable option. It is possible to take samples of each one of the charges delivered at the moment of arrive, when the product is entering courtyards, this implies the necessity to preserve the record, of where was extracted that sample, because this data is used when is gone through the own quality

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controls of the sugar genius (quality control laboratory) which is treated with a certain analysis which need time to realize all the probes in the lab over the product, and then, finally obtain a humidity level of the product.

1.1 About to what is non-destructive

We easily understand the concept of non destructive, however especially for this topic that occupies us, we can define as a non-destructive technologies all the means that permits us to know and understand in what conditions are found the variables of a certain process, without touching or have to approach to close to him[1].

2. Microwave systems.

The measurements that are made on this type of material can be done touching or not, it depends if we has access to one an alone side of the material or to both sides, this carries us to consider the use of techniques based on the reflection or in the transmission signals.
The frequencies that appear attractive do not cover the total of the microwaves spectrum just some bands are useful. Between the useful bands we have, those with the letter asigned: S, L, C, X, and Ku. The technologies development with microwaves takes us to achieve applications in real time. The applications with microwaves in near field those that involve powers that do not overpass miliwatts values; these avoid the interference by EMI.

Humidity estimation using microwaves

The water absorbs strongly the microwave radiations in certain frequency bands. In some applications one or two frequency bands are normally used. -The S band (approximately 1-2 GHz) or the X band (approximately 9-10 GHz). The S band is more penetrable, from there than it will be employed in large scales, X band; it is less penetrable show less sensibility to the material compositions to measure, nevertheless is more deeply used in applications in real time.

The basis sense system is simple, consists basically of a generator of microwaves power, a waves guide and a simple cell; as a detector, a power meter with special connections at the exit for a control system. The horns (transmitting - receiving antenna) are putted between the wave guides and the cell to reduce the reflection of the union of the wall of the cell and the sample. The measurement techniques in line for bands due to attenuations can be employed in places more appropriate for sample chains. Modern generating and detectors are all in solid state and they are capable of showing a high reliability level.

The humidity measurements by microwaves come being more popular for applications in line, due in part by the capacity of response that solids have with sources of microwaves and detectors, and in the other hand to the employ of the spectral regions surroundings the 10 GHz, the one which is less dependent in the composition effects, and also to the used microprocessors that carry out such functions as the power of monitoring, linearity and for the compensation of the density concentration. These have been used in process in line for the determination of the humidity in some kind of paper, fine powder, flour, grains, clays, slimes, coal and cement [2]. Generally the technique would have to be considered for materials that do not vary considerably their composition and they can be trusty manipulated, such as powders or grains that are free of currents or flows. The technique is less used to estimate humidity in reactors or in other plants where the chemistry composition can vary independently of the humidity content.

3. Methods to obtain humidity levels

Dry Oven

The older and very common analytical method to determine the humidity content is to heat the sample to be assured than it is thoroughly dries; the humidity is calculated on a base of less weight between the original and the dried sample. A practical form to determine the humidity used in the field is the following:
Take a handful of silo and to squeeze it so strong as could be attempting to form a ball, if the juice runs freely between the fingers, the dampness is between el75-85%, if the ball maintains the form and the hand is humidity, the interval is between 70-75%, if the ball is expanded slowly in the hand and does not remain humidity in this, the interval is between 60-75%, if the ball is opened quickly in the hand the humidity is smaller than 60%.

4. Electronics Instrumentation

Application method of the proposed microwave signals
The block diagram of a microwaves instrument for the humidity measurement is shown in the figure 1.

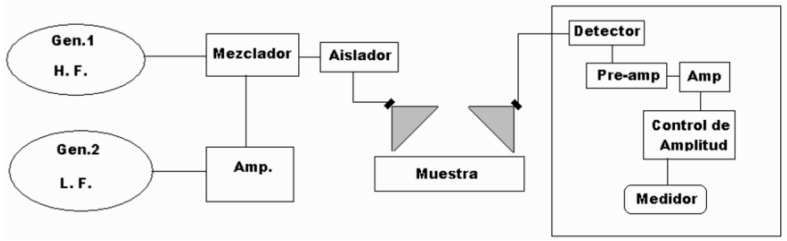

Figure 1. Simplified block diagram of a system for samples characteristics detection. Makes use of the microwaves energy through the sample to estimate the level humidity contained.

For this type of arrangements the penetrated factor (penetration depth of the signal) plays an important role for that, it is necessary to know which one is the adequate frequency that is going to permit either, a pass over the all sample and its respective return, or simply send energy over the entire surface of the sample; much of this has to do with the condition in which the sample is found that means, for this example the sensors only have access to a one face of the sample, energy must travel two times trough the sample to be detected in the opposite extreme where finally is collected to determine their conditions of arrival.

What corresponds to the electronics in the transmitting side of the instrumentation presented through the block diagram showed in the figure 1, has a pair of generators of signals one of them, generating a sine signal of 10 GHz (Gen.1) with a maximum power of 50mW; the second generator (Gen. 2) supply a square signal of 10 KHz with a maximum amplitude of 1 Volt. The amplifier showed is a low noise amplifying arrangement that permits not to load the oscillator and that presents a low exit impedance, with an open loop gain of at least 25 V/mV.

For the system that corresponds to the signals detection it is presented in an enclosed block in the microwaves figure; presents the following characteristic of operation.

The entry impedance is in: $10^{12}\Omega$ provided by arrangements J-FET enough to prevent an overcharge of the sensor and with this the distortion of the signal.

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All the integrated amplifiers used in our design present similar characteristics in *slew rate*, a low profile concerning to current of polarization and offset currents. For operation frequency, advantage is taken that each integrated amplifier has frequency compensation.

Slew Rate: 8 V/us
BW: 3 MHz
Gain in O.L.: 88 dB

The temperature has been considered stable in 25ºC. to avoid compensation circuits

These operation characteristics are very similar to the electronic equipment designated as a reflectometer the one which fulfils the detection and presentation functions of the signal levels received.

CONCLUSIONS

In concept tests it is possible to obtain agreement readings at humidity levels that presents a group of sugar canes, the humidity levels obtained in laboratory tests following the known method of dried - heavy - dried, were compared with the voltage levels obtained with the microwaves equipment to get an effective correlation.

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