PTL APPLICATION REPORT

ON-LINE CHECK-WEIGHING AND BULK MEASUREMENT OF CONVEYED OBJECTS USING ELECTRICAL CAPACITANCE TOMOGRAPHY

In many manufacturing processes, nominally identical products are transported through the production process on moving conveyor belts. Each item produced by the same manufacturing plant should be similar and, in an ideal world, the plant would operate within a closed feedback loop to ensure that the products remain within an acceptable normal range. A typical example of this occurs in processed food manufacturing, where products are usually required to have similar shapes and identical masses. For these manufacturing process to operate under closed loop control, a sensor which can measure the bulk or mass of the product is required, so that the sensor output can be used to correct the process continuously. In some applications, a conventional on-line check-weigher can be used as the sensor. However, for many processes, check-weighers cannot be used because of speed or contact problems.

Where the materials used in the products products are predominantly electrical insulators (or dielectrics) Electrical Capacitance Tomography (ECT) can be used as a form of high-speed non-invasive check weigher and can also provide an output to monitor and control the manufacturing process. Some examples of food products which can be measured in this way include chocolate, butter, and most fat or oil-based products where the water content is low. Other suitable non-food products are plastics, glass, many minerals and hydrocarbons.

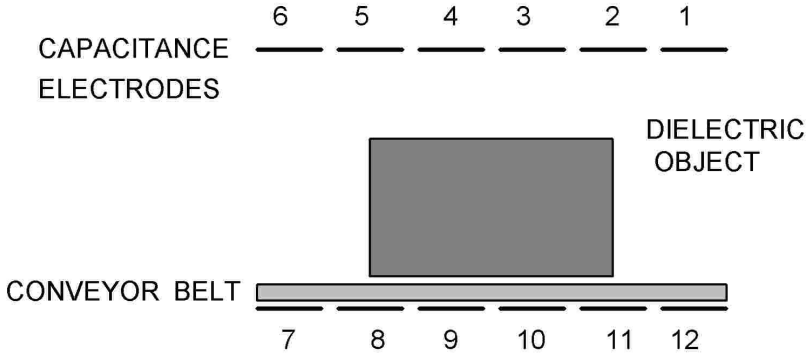


Figure 1 Capacitance sensor electrode configuration (cross-section)

A typical ECT bulk measurement electrode configuration for conveyed products is illustrated in figure 1, which shows a view of the cross-section of the conveyor belt, the sensor electrodes and the dielectric test object, which is moving along an axis orthogonal to the page. A photograph of an experimental sensor is shown in figure 2. If the conveyor belt is made from an insulating material such as plastic, it is possible to locate the lower array of electrodes below the conveyor belt and there will therefore be no need for the measurement electrodes to be in contact with the product. Hence in this application, the bulk sensor can be completely non-invasive, which minimises the risk of product contamination.

The width of each bar sensor is constrained by the widths of individual bars and the spacing between the lines of bars. Moreover, as there is little point in making the sensors much longer than the lengths of the bars, (as this simply increases the standing sensor capacitances), the axial length of the sensor is also defined approximately by the bar dimensions.

The number of electrodes which can be used above and below the bars depends on the sensitivity of the capacitance measurement circuitry. In the example shown above 12 electrodes have been used with six located above and six below the conveyor belt.

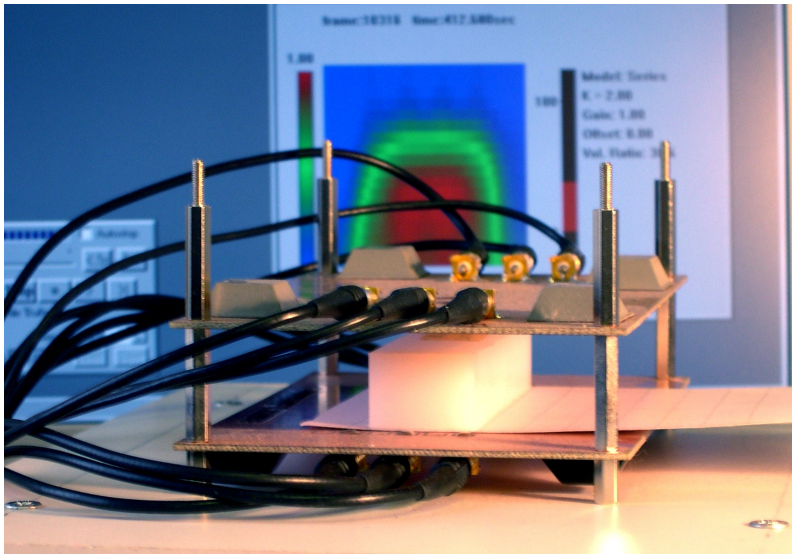
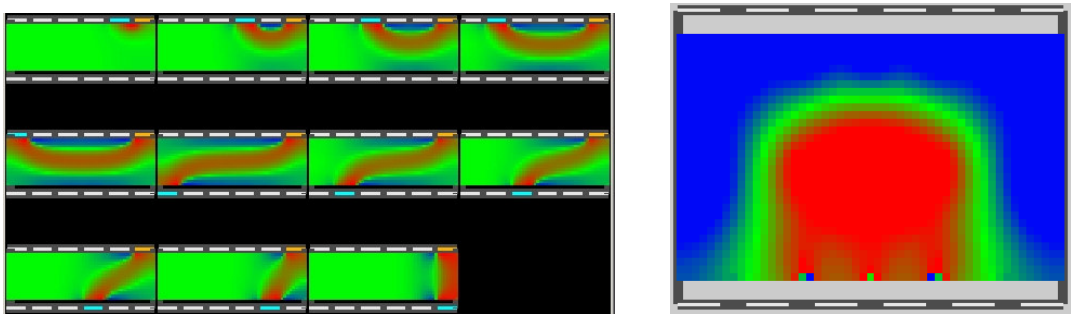


Figure 2. Test bar inside 12-electrode ECT sensor

Figure 2 above shows a test bar located inside a 12-electrode ECT sensor and figure 3 below shows a set of sensitivity maps for the sensor and a typical ECT image (permittivity profile) obtained using this sensor. The object bulk or volume can be calculated from the permittivity profiles.



(a) Sensor sensitivity maps (b) ECT image of test bar

Figure 3 Sensor sensitivity maps and reconstructed image of bar

Tests carried out on a set of accurately machined plastic bars showed that it was possible to obtain measured values for the bar volumes within a range of 2% of the actual bar volumes using a standard PTL300E ECT system and the 12-electrode sensor shown in figures 1 and 2.

FURTHER INFORMATION

For further information, please contact our sales department at the address below or email us at enquiries@tomography.com

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