Calibration and accuracy determination of a microwave type sensor for measuring grain flow

ABSTRACT

Impact type grain flow sensor for crop yield monitoring is known to have problem of some thrown grain by the elevator conveyor in a combine not hitting the sensing impact plate. New technology of microwave solid flow sensor was used to solve the problem of impact-type sensor. A calibration stand with its instrumentation systems to stimulate the actual operation of the clean grain auger in a rice combine had been designed and constructed in this study for the purpose of conducting the calibration and evaluation study of the sensor. Two different solid flow sensor orientations and three different solid flow sensor extrusions were investigated in order to find the best positioning of the sensor on the chute for the measurement. Results from the conducted tests indicates that the best sensor positioning is on totally flat ground at 180o orientation and 8 cm extrusion of the chute cross section (R2=0.9400). Then, the solid flow sensor was tested at seven chute pitch angle positions (i.e-4.5o, -3.0o, -1.5o, 0o, +1.5o, + 3.0o, and +4.5 o), seven chute roll angle positions (i.e-4.5o,-3.0o, -1.5 o, 0o, +1.5o, +3.0 o, and +4.5o). Finally, accuracy tests undertaken to compare the real time measurements against the average flow measurements. ANOVA test shows that both pitch angle and roll angle positions have significant effects on the measurement accuracy of the sensor. The measurement errors increased with increasing roll angles and increasing pitch angle. Conclusively, this conducted laboratory study was able to quantify the measurement accuracy of the SWR Solid Flow sensor for real-time measurement of grain flow under a simulated laboratory rice combine test set-up.

Keyword: Flow measurement; Measurement accuracy; Microwave sensor; Sensor calibration