IS LITERATURE ON THE PRESSURE ON FARM TRENCH SILOS WALLS STILL ACCURATE?

VAN NUFFEL\textsuperscript{1} Annelies, VANGEYTE\textsuperscript{a\textdagger} Jürgen, BAERT\textsuperscript{4} Jeroen, MAERTENS\textsuperscript{4} Willem, SONCK\textsuperscript{4} Bart

\textsuperscript{1}Agricultural Engineering, Technology and Food, Institute for Agricultural and Fisheries Research (ILVO),
Burg. Van Gansberghelaan 115 bus 1, 9820 Merelbeke, Belgium
jurgen.vangeyte@ilvo.vlaanderen.be
T: +32 9 272 27 65 / F: +32 9 272 28 01

Introduction
Farm trench silos are mainly used for the storage of grass and maize silage. The tractor-pulled wagons filled with silage are unloaded over the whole length of the silo while driving over the forage. Subsequently a tractor with or without loaded wagon compacts the forage. During filling the vehicles exert high loads that are transferred by the forage onto the walls. A literature review (Gruyaert et al., 2007) showed considerable differences in measured wall pressures between authors. Therefore, more experimental measurements are required to enable constructors to design well dimensioned silos.

Methods
A panel (Figure 1) to measure wall pressures was developed by the Agricultural Engineering Section of ILVO. Ten pressure plates with a height of 0.25 m and a width of 0.75 m are crosswise divided over the front surface of a 2 m high by 2.5 m wide measurement panel. In this way, the panel consists of eight measuring plates on the vertical middle axis (nrs. 1 to 8, Figure 1) and three measuring plates on the horizontal axis at ± 0.625 m height (nrs. 3, 3R and 3L, Figure 1). The two lowest pressure plates were equipped with four S-beam load cells, each with a measuring range up to 100 kg with 0.5 kg precision. All the remaining pressure plates were equipped with four S-beam load cells of 50 kg range and 0.5 kg precision. Each measurement plate was calibrated by exerting known loads with a pneumatic piston.

Figure 1: Measuring panel with crosswise divided pressure plates

The experiment was carried out in October 2006 during and after filling a 2 m high trench silo with chopped maize at the experimental farm of Ghent University. During the measurements, the pressure plates detected short peak values, corresponding with the moment when a tractor or wagon passed.

Results and Conclusion
Figure 2 visualises the pressure (N/m\textsuperscript{2}) on every pressure plate during the filling process of the trench silo with chopped maize. Pressure peaks of more than 50 000 kN/m\textsuperscript{2} were detected between 0.25 m and 0.5 m height with a maximum peak value of 54 050 kN/m\textsuperscript{2}. The lowest peak pressure was found on the upper two pressure plates and they measured between 15 000 N/m\textsuperscript{2} and 19 000 N/m\textsuperscript{2}.
These results show that the silage produces a horizontal pressure on the silo walls that is much higher. Consequently the literature (Gruyaert et al., 2007) on the determination of existing loads could be out of date. To avoid cracking of even failure of the walls due to underestimation of the reinforcement and the dimensions of silo walls, more research is needed under current practical conditions. Other experiments will be carried out during September/October 2007 to calculate the repeatability of our measurements and to elaborate a simplified load scheme for these experiments. These results will be presented at the AgEng conference.

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References