Title Friction of Wheat on Corrugated and Smooth Galvanized Steel Surfaces
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Abstract

A new modified direct shear device was constructed and experiments performed to estimate the coefficient of friction of soft red winter wheat on corrugated and smooth galvanized steel surfaces. The modified direct shear test device is slightly different from most conventional direct shear testers in that the metal test specimen is pulled to create a shear plane as it is moved within stagnant granular material. In most conventional direct shear test devices, the granular material is sheared across the metal test specimen by a force applied laterally to the grain compartment. The effects of steel sample size, sliding speed and normal pressure on the coefficient of friction were studied for the corrugated sample using the modified direct shear device. Four speeds of 0·05, 0·5, 5, and 50 mm/min were tested. Tests were conducted at three different normal pressures of 6·9, 27·6, and 48 kPa. Using the modified shear tester the coefficient of friction of wheat on the corrugated surface increased with an increase in speed and decreased with an increase in normal pressure. 'Slip-stick' behaviour was observed for tests with sliding speeds lower than 2 mm/min. Coefficients of friction determined with the shortest and/or the narrowest steel sample were significantly higher (α=0·05) than the values obtained with larger steel samples.

The test device was also adapted to enable measurements of the friction force of wheat on smooth galvanised steel. Friction was measured for two sliding speeds (0·5 and 5 mm/min) and three normal pressures (6·9, 27·6 and 48 kPa) At low speeds, slip-stick was observed that ceased after the speed increased to a critical value of 0·2 mm/min. Coefficients of friction were found to decrease with an increase in vertical pressure.

Friction was measured using a tilting table test method on the same steel samples which had been used for the tests with the modified shearing device. The coefficient of friction had a tendency to decrease with an increase in normal pressure. Values of the coefficient of friction determined using the tilting table test method were in the same range as those determined for test conditions using the modified shearing device at the lowest normal pressures and sliding speeds.

Results from either the tilting table method or the modified shearing method can be applied to design conditions at low pressures and low sliding speeds. For higher normal pressures and greater sliding speeds, the modified shearing method should be applied. For practical applications the modified shearing method should be used because it most closely smulates the actual conditions at the frictional interface in a grain bin when grain slides down the wall.