

EFFECTS OF BIONIC NON-SMOOTH UNITS ON REDUCING SOIL RESISTANCE TO DISC PLOUGHING

Abstract

The concept of bionic non-smooth units was applied to disc ploughs and an experiment was conducted in an indoor soil bin to find out the effects of different non-smooth units on reducing soil resistance to disc ploughing. Convex bionic units with bigger bionic units and higher density gave the highest soil resistance reduction reaching a maximum of 19% reduction compared to most shallow concave bionic units with lowest density.

Methods

10 plough discs made from 65Mn steel were used for the experiment. The plough disc had the following dimensions: diameter = 440 mm, concavity = 60 mm and thickness = 5.5 mm. 2 of the 10 discs were just left plain, 4 were carved on the concave side to form the bionic concave units and the other 4 had convex bionic units made of UHMPE material. A milling machine and a drilling machine were used in combination for making the concave and convex units. All the bionic units had a base radius of 10mm. Depths of 1mm and 3mm were used for the concave units (Fig. 1) whilst for convex units (Fig. 2) the heights were also 1mm and 3mm. The density of bionic units was either 10% or 30% .



Fig. 1 Concave Units



Fig. 2: Convex units

Results

In general, a higher bionic density results in less horizontal force. Therefore, all the bionic units with 30 % density were more effective in reducing soil resistance. Sample 9 which had convex units of height 3 mm provided the highest soil resistance reduction of 15 %. The UHMPE material contributed in making the convex units anti-adhesive because of its hydrophobicity.

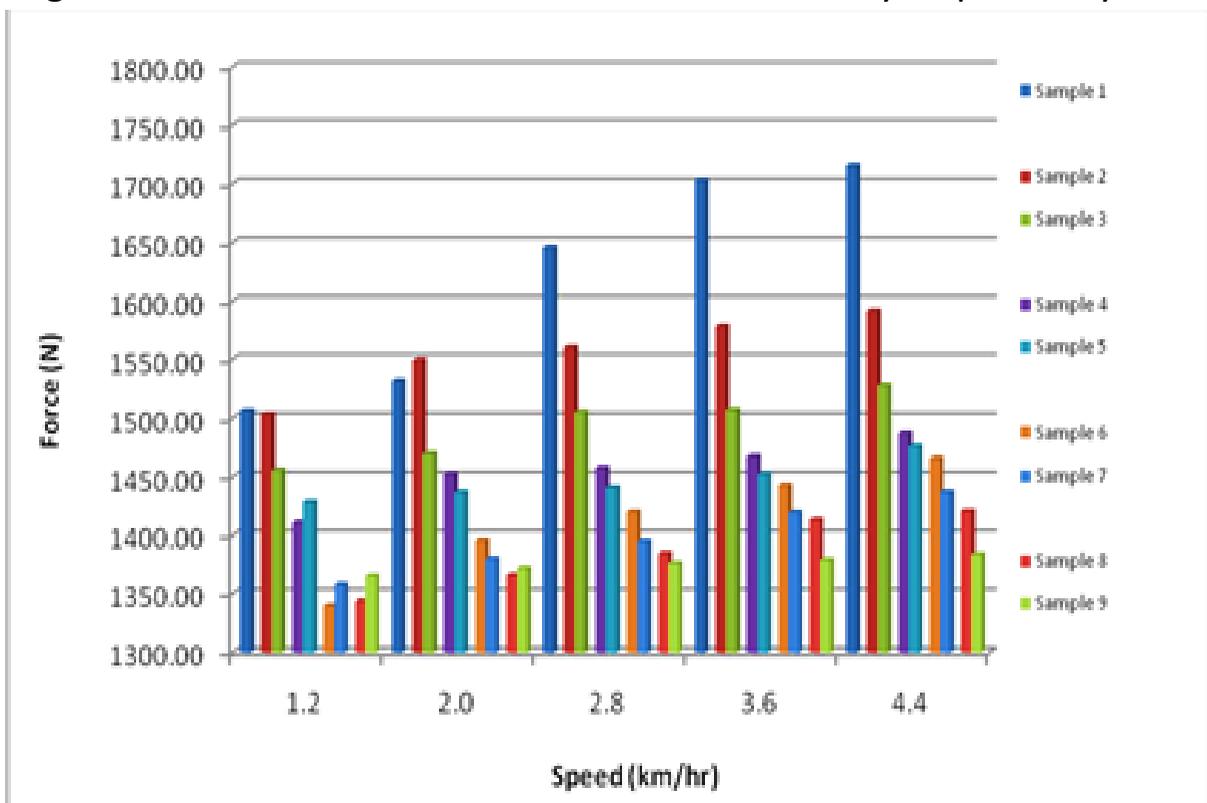


Fig. 3 : Effects of Bionic Density on Soil Resistance

Conclusion

Compared to the plain disc, non smooth units gave better soil resistance reduction. Convex units gave highest reduction, even reaching a maximum of 19% reduction for sample 9. It can therefore be concluded that non-smooth units can indeed reduce soil resistance in disc ploughs.

Publications

1. Effects of bionic non-smooth surface on reducing soil resistance to disc ploughing, Science China Technological Series Journal, Vol. 53 No 1, pp1-6, 2010.
2. Analysis of critical factors affecting the performance of bionic tillage discs, International Conference of Bionic Engineering, Nanjing, China, pp 37, August 2013.