7th INTERNATIONAL MULTIDISCIPLINARY CONFERENCE
Baia Mare, Romania, May 17-18, 2007
ISSN-1224-3264

INFLUENCE OF SPRING SUPPORTED FRONT BRIDGE FOR THE PULLING FORCE OF JD6920S TRACTOR

Zoltán Kovács
Lecturer, College of Nyíregyháza,Department of Agricultural and Food Machinery
4400 Nyíregyháza, Kótaji u. 9-11., HUNGARY

Abstract:
To judge and classify the performance of tractors, to study the pulling force of the tractors in operation, and to compare different brands of tractors have been carried out based on traction test. With these tests it is possible to measure the tractive pull performance of tractors, their economy and efficiency comparing them with other brands of tractors. A number of tractor manufacturing companies adapted the spring supported front bridge on their tractors of mass production. We examined, that how the application of a spring supported front bridge affects the pull force of the JD6920S tractor on arable land, and how various static axle loads modify it.

Keywords: *spring supported front bridge, pulling force, tractor, slip.*

1. INTRODUCTION

The great tractor manufacturing companies have introduced a lot of technical novelties including spring supported front bridges, which are applied in the agricultural practices. According to the manufacturers by using a spring supported front bridge not only becomes driving convenient, but also there is an increase in the pull force of the tractor, and the tractor are more stabile on the road. Due to a greater pull force the efficiency of the aggregate will be greater [4, 5, 6].

Studying and designing of running gears from the aspect of vibration go back to the times, when automobiles were not invented yet. Spring supported railway carriages and coaches were used before vehicles appeared on the roads. Universal power machines in agriculture mean a special load on the running gear, because they have to possess a big pull force under the extreme climatic conditions. What is more, ergonomical requirements are becoming stricter.

2. BACKGROUND

To judge and classify the performance of tractors, to study the pulling force of the tractors in operation, and to compare different brands of tractors have been carried out based on traction test. With these tests it is possible to measure the tractive pull performance of tractors, their economy and efficiency comparing them with other brands of tractors. However we have to keep in mind, that the data we received during the tests, are relevant only to identical soil conditions. Therefore, when examining a certain type of tractor, only by large-scale repeated tests, varying the different measurements can the data be obtained for various soil types. So, traction tests need great case and proper design [3].

The tests were started on concreted roads, followed by measurements on various soil types and soil conditions including plant covered soils. In the case of examinations for special purpose the smoothness of the soil has to be considered too. Therefore, soil profile measurements have to be done before and after the tractor crossed the soil. Data obtained during the tests are relevant only to tractors of a certain mechanical state, brand and setting, and identical soil condition [3].

Pull force is mostly obtained not by power machines, but by a braked carriage or braked tractor. It makes possible load of various rates and variable gear. The braking tractor normally is a power machine, bigger in volume and engine performance than the tractor to be tested, with built in hydraulic or mechanical braking device, called sometimes retarder. The various data from different measuring spots are brought to the measurement system as electrical signs, whose pre-evaluation can be completed immediately after the measurements [4].

It is advisable to carry out the pull force tests on a horizontal and long plots of the area. The revolution number of the driving wheels had to be counted, including the pull force (usually with dynamometer), fuel consumption, velocity, the actual length of the road, and other suitable parameters. The measurements were done in no load (without exercising pull force) and loaded with pull force. The necessary characteristics can be calculated. E.g. the velocity can be calculated from time and distance, the tractive performance from average pull force and velocity, the slip from the actual revolutions of the wheels, etc. [1]

3. MATERIAL AND METHODS

The measurements were taken on land by the John Deere 6920S power machine with spring supported front bridge. It was possible to switch off the front axle cushioning, which is impossible to do with mass produced tractors. During our tests on the arable land according to a shedule, made before the tests, the following data were measured:

- measurement time (sec),
- number of motor revolutions (n^{-1}),
- the revolutions of the back wheel (n^{-1}),

- torque of the left back wheel (kNm),
- torque of right back wheel (kNm),
- torque of the front driving shaft (kNm),
- velocity (m/s),
- left front wheel revolutions (n^{-1}),
- right front wheel revolutions (n^{-1}),
- pull force (kN),
- tractor frame acceleration (m/s^2),
- left front bridge acceleration (m/s^2),
- right front bridge acceleration (m/s^2).

The arable land tests were completed on a humus corn stubble field. We chosed this soil type, because 25-30 % of Hungary's arable land area is made up of it. To measure the back wheel shaft torque, an auxiliary wheel body with a gauge measuring pin was fitted to the back wheel body, then it was fixed to the back wheel of the tractor. Extensometers were fixed on the gauge measuring pins calibrated to the torque.

The tests were completed in July, 2003 on the land of Dél-Pest County Agricultural Share Company, near Cegléd. The various loads were set by a braking tractor – a New Holland power machine.

The signs from the sensors were received by a HOTTINGER SPIDER MOBIL 16 channels measuring and data collecting system, which enabled us to evaluate the data previously. The measurements could be checked, and in the case of mistakes, they could be repeated.

The differential locking device of the tractor was switched on during the tests and throughout the total length of the measurement sections, ensuring the identical revolution number of the wheels on one axle of the tractor. According to Hungarian standard the rolling of the wheels is considered slip proof, if the tractor is operating without pulling force. To achieve it, measurements were started with zero pulling force (without pulling force) for each gear.

4. RESULTS AND CONCLUSIONS

The received data were analysed by Microsoft Excel computer program. Due to frequent data collection (200 Hz), the measured pulling force data were converted into average data every second, then the average values of a 10 seconds measuring section were calculated. Therefore an average pulling force value belonged to each measuring section. In the function of the average pulling force values the slip was determined, than described in a diagram.

The measurements were started in three gears (B1, B3, C2) with setting of 3 various static axle load-distribution. They were as follows: 1) 30 % of the total volume on the front, 70 % on the back axle; 2) 40 % of the total volume on the front, 60 % on the back axle; 3) 45 % of the total volume on the front, 55 % on the back axle.

In each case the parameters were separately measured switching off and switching on the front bridge shock absorption. For example the wheels slip is described in Fig. 1 and Fig. 2 in the function of the pull force in case of switched off and switched on cushioned front bridge.

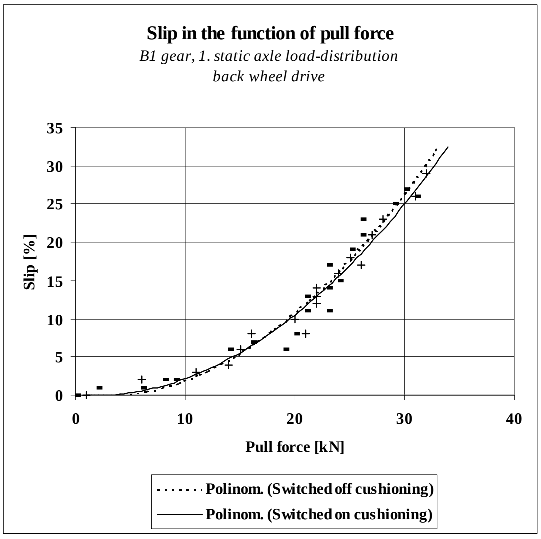

Fig. 1. Slip in the function of pull force

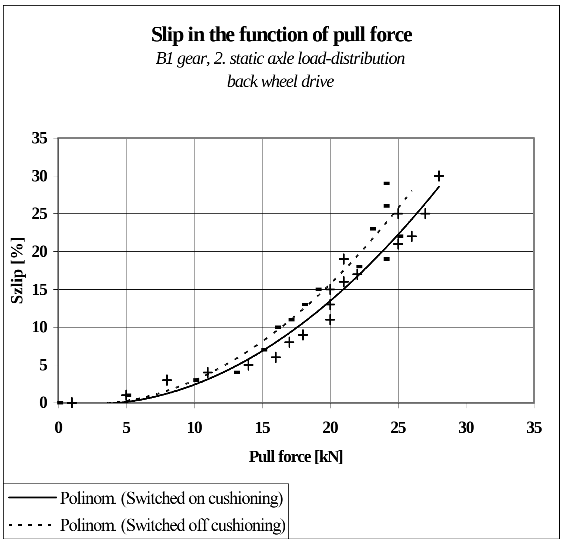

Fig. 2. Slip in the function of pull force

Figure 3 shows the velocity in the function of pulling force.

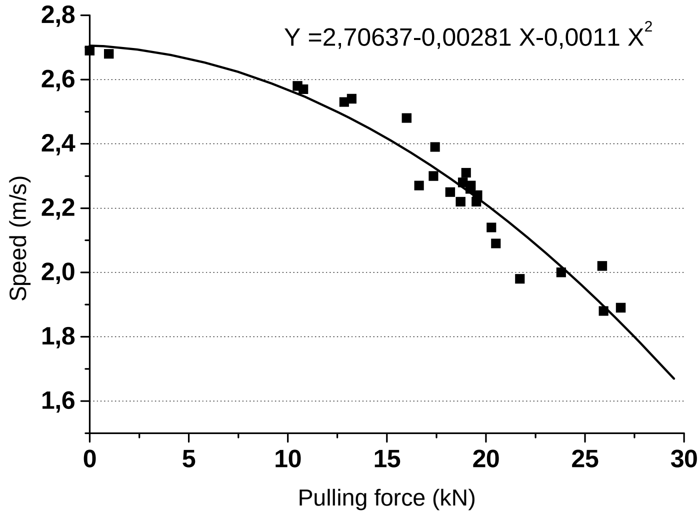

Fig. 3. Velocity in the function of pull force

The slip at switched on front bridge cushioning is marked by a continuous line, while at switched off position by a dashed line on the diagrams.

Figures 1 and 2 describe the slip in the function of pull force at B1 gear, in the case of 2 various axle load-distribution. Both of the 2 diagrams demonstrate, that when the front bridge cushioning is switched on less wheel slip belongs to the same pull force values. Significant differences can be observed for pull force above 10 kN in all cases, as there is no significant wheel slip less than 10 kN pull force. Above this range there are significant differences, partly caused by spring-supported front bridge.

In rear wheel drive various axle load-distributions do not change slip the values. The rate of differences varied between 1-4 %.

The same differences were received for measurements in the other gears. E.g. in Figure 3 shows the velocity is in the function of the pull force in B3 gear. The diagram demonstrates, if pulling force is increasing the velocity is falling down. The tendency is the same as in the case of other gears. The reason: with increasing of pulling force the slip is increasing too, proportionatly decreasing the velocity of the tractor.

Used the spring supported front bridge the slip values will be less, due to it the velocity of the tractor and the pulling performance will be greater.

REFERENCES

[1] Kovács, Z. et al. (2004): Vibration response of spring supported front bridge tractors, with special regards to ground profile, XVIII. MTA-AMB Kutatási és fejlesztési tanácskozás, 2004. január 19-20.

[2] Laib, L. – Gedeon, F. (1989): The analysis of the vehicles of the field. Vehicles, Agricultural Machines, 1989. 8. Issue

[3] LAIB L. (1998): A talajon gördülő kerék vizsgálata, vonóerő-kifejtés. 57-88. p. In: LAIB L. – VASS A. (Szerk.): *Traktorok-autók.* Budapest: Mezőgazdasági Szaktudás Kiadó, 393 p.

[4] SCHROTTMAIER J. et al. (2001): A rugózott mellső híddal és vezetőfülkével szerelt traktorok rezgésjellemzőinek vizsgálata és optimalizálása, a rugózott mellső híd hatása a traktor vonóképességére. Mezőgazdasági Technika, 42 (5) 2-5 p.

[5] Szente, M. – Füzesi, M. (2001): The effect of spring supported front bridge on New Holland TM 165 tractor. Agricultural Techniques, Jan. 2001.

[6] Szente, M. (2002): The traction characteristic of tractors, driven by auxiliary front wheel. Agricultural Techniques, Jan. 2002.