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SOIL DEFORMATION PROCESS ANALYSIS UNDER THE AGRICULTURAL TOOLS TYRES

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Abstract. *The paper present the contact surfaces between tyre and soil, of the pressure on the soil in the contact surface, and of the deformation depth of the soil, depending on wheel load, tyre constructive elements, air pressure in the tyres and traffic intensity..*
Keywords : *diameter, width, wheels, track*

1. INTRODUCTION

Soil compaction can be defined as the reduction of the degree of soil aeration under the influence of external factors. By changing the aeration and moisture regime, compaction strongly influence the activity of soil microorganisms especially those nitrifying where oxygen is one of the limitations of their work. The direct effect of soil compaction on porosity is manifested by reduced ability to retain water and air sustainably.

In general soil compaction due to agricultural traffic, results in damage to the soil surface and deep layers, changing the pore distribution by size, pore continuity and thus the permeability for water and air. These can have negative effects on soil biological activity on soil physical and chemical equilibrium and finally the production.

2. MATERIAL AND METHODS

In the vertical soil application of a rigid body in the form of a plate (Figure 1). Stress distribution in the soil is more complex than for soil application in the horizontal direction (eg tensile or running wheel). Figure 1 shows the situation in which the board is down on the ground and in Figure 1, b is shown the penetration into the soil outside of a plate pressed with a small force N, the soil is subjected to shear stress, the whose value is less than the amount which results in the occurrence and development of breakage. After product overload plaque rupture occurs by shear (Fig. 1, c), and by (slice) located beneath the deformed structure continues to fall and the soil deforms.

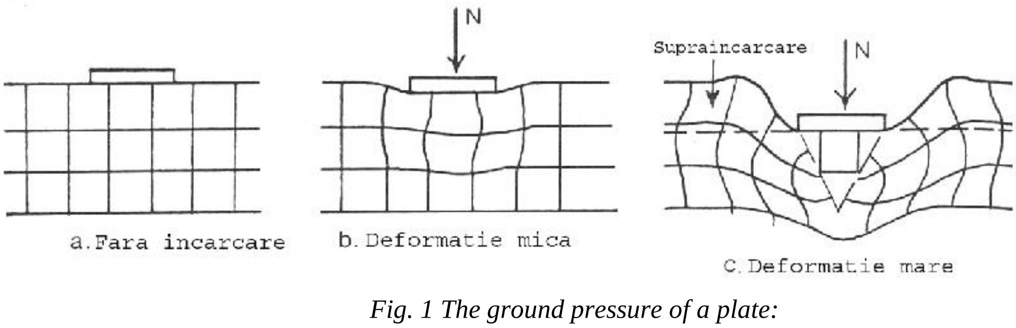

Fig. 1 The ground pressure of a plate:
a- without pressing force; b - small load that produces ground breaking;

c - the local press that produces ground breaking shear.

Natural soils are characterized by a gradual change of the load required for the transition from (b) and (c) of Figure 1, which leads to a gradual change (smooth) the immersion penetration by force.

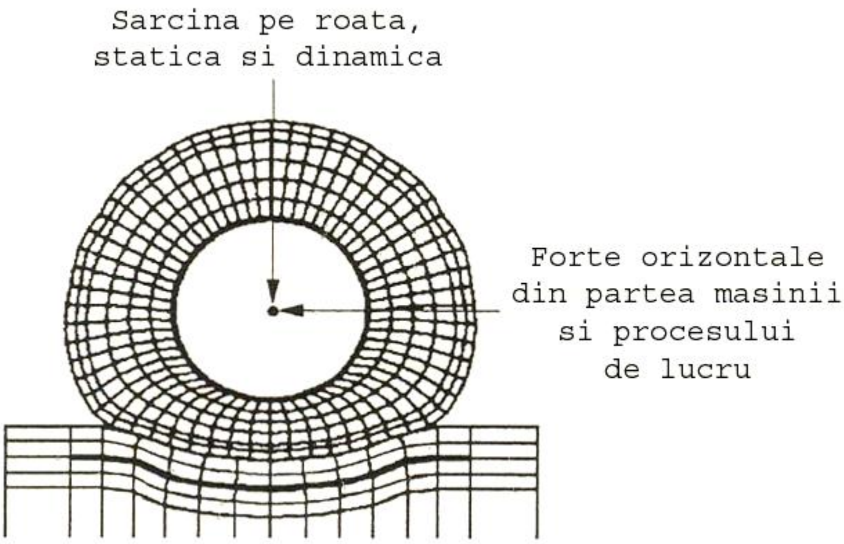

Fig.2. Scheme tire and soil deformation in the contact area between tire and deformable ground

In the process of moving the wheel to the road surface external forces acting on the machine frame on wheels produce elastic deformation of the tire contact area between the wheel and the road (Fig. 2) [3]. When the rolling wheel, the outer surface of the tire produces a strain deformed, and the soil. As the wheel passes over the contact area there is a spring-back to its original tire surface, whose elasticity is determined by the specific construction of the carcass of the tire and the air pressure in the tire. The variation of air pressure in tire size will affect not only the surface, but also a partial modification of the tire stiffness and thus the ability of the tire to take the peak pressure in the forming the contact surface.

By running (passing) wheel tractors and agricultural machinery deformable soils occurring movements of soil particles (Figure 3). Both in the interface between the wheel and the ground and in deep soil layers both horizontally and vertically [4]. As a result of various experimental researches carried out by the researchers it was found that the removal of soil particles horizontal deflection decreases with increasing depth of the vertical movement of the particles is influenced by air pressure in the tire, the geometrical characteristics of the tire, the load of the pneumatic tire load speed travel and spinning tire surface contact area (where the drive wheels).

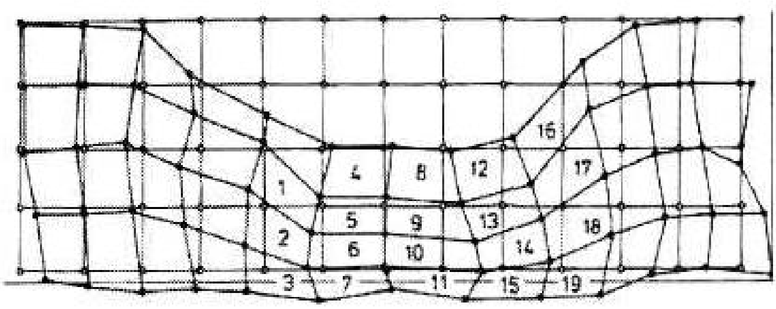

Fig. 3 Scheme Explanatory ground deformations induced by wheel traffic.

After the wheel on the surface of the soil occurs deformable soil residual deformation due to the plastic deformation of the soil, due to the irreversible movement (flow) into the soil particles. Deformations elastic (reversible) soil only appear when moving the wheel on the ground and can only be quantified at this time, by using an appropriate method of measurement

To assess the correlation between the geometry of the tire and wheel geometry trace of ground deformations due to residual soil in Figure 4 is shown the geometric model of the tire-ground interaction. This scheme allows highlighting quantities (parameters) characterizing the elastic deformation of the tire (radial deformation) z, the contour surface soil all at runtime b and residual soil deformation br. Also, the scheme is envisaged and vertical components of strains and wheel geometrical parameters.

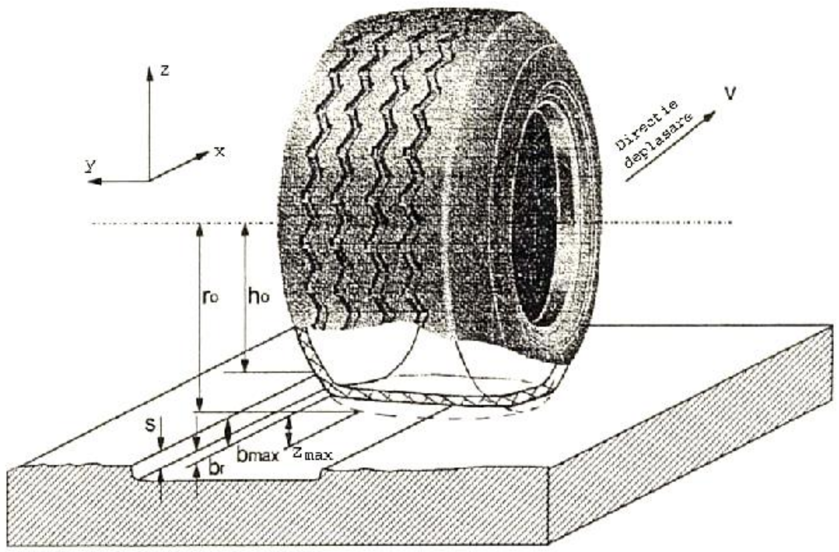

Fig. 4 The geometry of the tire-ground in the running wheel.

The relationship between the maximum sizes that appear in the plan xOz wheel-soil interaction, geometrical model shown in Figure 4 is described by the following relationship:

$$r_0 = h_0 + b_{max} + z_{max}\,, \quad (1)$$

which shows the relationship:

$$b_{max} = r_0 - h_0 - z_{max} \quad (2)$$

in which:

r0 is the radius of the tire undeformed (free range);

h0 - height from the ground to the wheel axis;

bmax - maximum deformation of the soil;

zmax - the maximum deformation of the tire casing;

s - all in soil depth;

br - residual deformation of the soil.

The maximum deformation of the soil can be determined from the relationship:

$$b_{max} = s + b_r\,, \quad (3)$$

For accurate assessment of soil deformation shift (run) wheel is to be determined (measurements) of the maximum vertical deformation of the soil bmax. Because the residual strain of the soil br not be measured directly, the value of the maximum deflection b max of the land can not be determined from equation (3), thus to determine the maximum deformation of the ground zmax is necessary to measure the components of equation (2), i.e., the height h0 wheel axis to the ground and undeformed tire radius r0 (free range). On the basis of the tds used in the method, the elastic deformation of the tire is determined experimentally by methods based on laser technique, and the values of r0 and h0 can be determined through manual measurements. As shown in figure 4.4 the height from the ground to the wheel axis h0 is the only parameter that does not depend on the transverse coordinate y, because the wheel is charged only in the vertical direction and moves only in the horizontal direction.

CONCLUSIONS

• Reduce the area of contact between the wheels and the ground is generally achieved by increasing the contact surface, a process that can be achieved by the following methods: the use of low tire pressure, tire fitting wheel tractors with large width or twin wheels, the use of special low-pressure tires.
• Maximum pressure of the tire and the ground contact surface occurs. The effect of the load weighing on the wheel is the layer of soil under the ground tire pressure application to the three-dimensional spread in vertical direction (producing a compaction process, the compaction of soil) in the longitudinal direction (the shearing process of the soil) and laterally (soil discharge process).
• Assessment of how to apply soil compaction process is generally to the shape of distribution lines equal ground pressure, called isostatic curves, depth distribution in soil layers isostatic curves wheel load depends on the size, size tire (special year balonajului tire width), internal pressure of the tire size wheel spin (an event wheels) ..
• Depth propagation curves isostatic soil layer under wheel increases with increasing duration. Therefore, by increasing the running speed of the wheels on the ground is required shorter, and his request that depth is reduced.

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