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STUDIES ON THE POSSIBILITIES OF NANOMATERIALS TREATMENT OF VERTICAL CUTTERS FOR WEAR REDUCTION

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ABSTRACT

In the paper are presented the studies performed for reduction of the wear, of the vertical milling cutters during the soil working process, by coating them with nanomaterials. The nanomaterials consist of structurally definable components with dimensions from 1 to 100 nanometers (1nm = 10 $^{-9}$m). The coatings which could be applied on vertical milling cutters may contain the following nanomaterials: iron oxide, silicon dioxide, carbon black, titanium dioxide, zinc oxide and silver. Conclusions have been drawn and proposals have been made regarding other technical improvement solutions.

INTRODUCTION

In the paper we studied the possibility of reducing the wear on the vertical milling cutters caused by the contact between the soil and these during the work. During the work between the milling cutters and the ground there is a friction process leading to their wear. Depending on the type of soil, its physical and mechanical properties and the operating parameters of the vertical milling rotor and working depth, the rotor speed and the number of rotor blades, the ground claw can vary in size and the knife wear can be faster or slower. Wearing can increase the thickness of the knife cut, which leads to increased energy consumption, but also to wear on the whole body of the knife on its outer side (i.Saracin and colab 2010.) To reduce energy consumption and reduce knife wear (i. Saracin et al., 2010), or nanomaterials applied on their surface that reduce their corrosion and friction wear (I Saracin et al. 214) can be used in different materials such as sintered steels and thermal treatments.

. Nanomaterials (J.Leuninger et al., 2004) have micropatholes in their composition with specific properties due to reduced particle size. The application of nanomaterials can result in greater capacity and better interaction between the coating layer and the superior hardness of the coating layer. After coating with nanomaterials, the material will have improved properties, such as: high strength, elasticity, hardness.

The main cause of wear, friction between surfaces in relative motion, has been the subject of many research, which has led to the development of various theories and calculation of wear (G. Florea and colab 2010). RGBayer, WCClenton, in 1962 writing the wear calculation equation

$$N= (y_R\ \sigma_y)2.10^3/\sigma_{max}^{-9}\ \ [KN/cm^2] \qquad (1)$$

In which σ_{max} -size of unitary shear stress admissible

$y_R\ \sigma_y$ - the unit wear effort is zero and is achieved in 2x103 final cuts[KN/cm^2]

MATERIAL AND METHODS

The knife proposed for the study can be made of OLC 45 steel with the following characteristics: Chemical composition according to STAS 880-80

-carbon: 0.43 ... 0.48%
-Mangan: 0.5 ... 0.80%
-Silicon: 0.17 ... 0.370%

-rom: max ... 0.03%
-Nichel: max ... 0.030%
Mechanical characteristics
- Flow limit Rp0,2 = 480 N / mm
- Traction resistance Rm = 700 ... 840 N / mm
- Elongation at break A5 = 14% - KCU Resistance 30/2 = 40 J / cm
- Elastic modulus E = 21000 N / mm
- Poisson coefficient = 0.3
- Brinell hardness in an anchor state = max.207

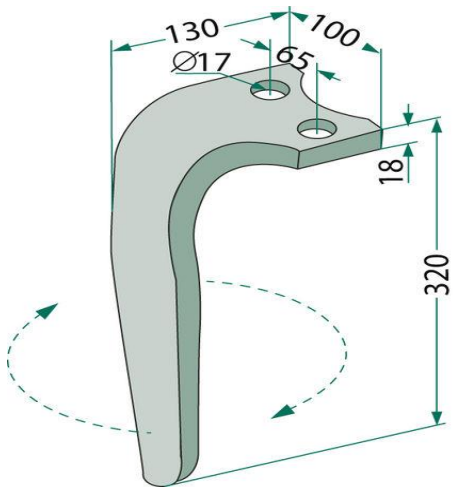

Fig.1 Cutit freza verticala (http://www.utilajetractor.ro)

The method of work used is that presented by Deutsches Lackinstitut 2011.

. The coating is achieved by applying a cohesive layer, from a single or multiple application of a coating material to a substrate. A coating may be in the form of paste, powder or liquid and, when applied, forms a protective layer.

A coating (Pandia Olimpia et al. 2016) is a layer formed by a single or multiple application of a coating material on a substrate, in liquid, paste or powder form.

The term "coatings" includes "lakes", "paints" and similar products. In general, coatings consist of the following four types of ingredients:

- binders (film forming agents) based on organic and intermediary polymers and which provide a coherent film during drying and curing of the lacquer.

- Pigments and thinners. Pigments have insoluble color particles used as dyes and extenders are used to create or modify different physical properties.

- Solvents are single liquids or liquid mixtures that dissolve other substances to form solutions without reacting with these substances.

- Additives are added to a coating in small quantities and can alter a variety of properties (eg weather resistance, surface tension, gloss, structure, UV).

The mass fraction of a nanomaterial in a coating system depends on the desired function. When the goal is to add nanomaterials to a lacquer to improve wear resistance, their constraint is 3-7% (Deutsches Lackinstitut 2011).

Taking into account the desired function, functional nanotechnology coatings can contain the following nanomaterials: titanium dioxide, silicon dioxide, carbon black, iron oxide, zinc oxide and silver.

Applying nanomaterial-coated coating layers to the surface of the vertical grapple knives can have multiple advantages: increasing the life of vertical cutters, increasing mechanical strength, shock resistance, reducing wear during the soil process

RESULTS AND DISCUSION

Research has shown that nanomaterials applied on vertical grapple knives can reduce wear, can prolong their exploitation.

Hardness, mechanical strength, ductility, superplasticity, chemical affinity, thermal insulation capacity, dirt and paint dirt rejection and self-cleaning ability, self-repairability are just a few of the properties for modern constructions based on these new technologies

Nanomaterials are defined as new materials, whose elementary structure has been brought to nanoscale. In other words, by using - embedding, manipulating - very small particles of material, new materials are created on a large scale.

The Secret "is the following: brought to dimensions of the order of 100 nanometers, materials begin to show radically improved properties, controllable, and even completely new properties

CONCLUSIONS

Taking into account the desired function, nanotechnology-based functional coatings may typically have multiple advantages over vertical grater blades, such as increasing the life of vertical milling cutters, increasing mechanical strength.

Coatings may contain the following nanomaterials: titanium dioxide, silicon dioxide, carbon black, iron oxide, zinc oxide and silver.

Coatings can be made by applying directly to the outer surface or by inserting the element to be treated in the prepared material and immersing it.

BIBLIOGRPHY

1.**Deutsches Lackinstitut** (2011): Nanolack-Studie – *Entweichen Nanoteilchen aus dem Lack?* Lack im Gespräch, Informationsdienst Deutsches Lackinstitut Nr. 110, Seite 9-11. http://www.lacke-undfarben.de/fileadmin/templates/img/pdf/LIG_110.pdf

2.**Gh.Florea si colab** *Aliaje antifrictiune pentru sisteme tehnice*, Aius 2010

3.**I.Saracin si colab** *Appaatus for determination soil pentration resistance for elstablishing work index parameters agricultural machines* ,Metalurgia international vol xv,nr 11,2010, pag 91-93 ISSN 1582-2214. http://www.metalurgia.ro

4.**I.Saracin si colab** *Thermal treatment of gear sintering by powder metal steels*,Metalurgia international vol xv,nr 11,2010, pag 94-96 ISSN 1582-2214. http://www.metalurgia.ro

5.**I.Saracin si colab** *Researches on corossion cracking phenomenon that occurs on welded of agricultural equipment*,Metalurgia journal Croatia ,vol 54/2,2014, pag 395-398 ISSN 0543-5846. http://public.carnet.hr/metalurg/index.html

6.**Leuninger, J., Tiarks, F., Wiese, H., Schuler, B.** (2004*): Wässrige Nanokomposite. Farbe & Lack* 10/2004 S. 30. http://www.europeancoatings.com.

7.**Pandia Olimpia** *,Management coordination on steel industry in the context of durable development*, Metalurgia journal Croatia, vol 53/3,2016, pag 519-522 ISSN 0543-5843 http://www.metalurgia.ro