STUDIES AS CONCERNS THE STRATIFIED COMPOSITE MATERIALS UTILIZATION IN ENGINEERING OF THE MOULDBOARDS OF MODERN MECHANIC PLOUGHS

STUDII CU PRIVIRE LA UTILIZAREA MATERILELOR COMPOZITE STRATIFICATE PENTRU CONSTRUCȚIA CORMANELOR PLUGURILOR MECANICE MODERNE

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Abstract: *The paper presents the results of the author's researches on the line of pointing out the differences of behaviour at the requirements of the stratified composite materials used in the moldboard's engineering of mechanic ploughs and pointing out the advantages in using the stratified composite materials in comparison with the traditional materials.*

Rezumat: *În lucrare se prezintă rezultatele cercetărilor autorului pe linia evidenţierii diferenţelor de comportament la solicitări a materialelor compozite stratificate folosite în construcţia cormanelor plugurilor mecanice şi evidenţierea avantajelor acestora în comparaţie cu materialele tradiţionale.*

Key words**:** *stratified composite materials, moldboard*
Cuvinte cheie: *materiale compozite stratificate, cormană*

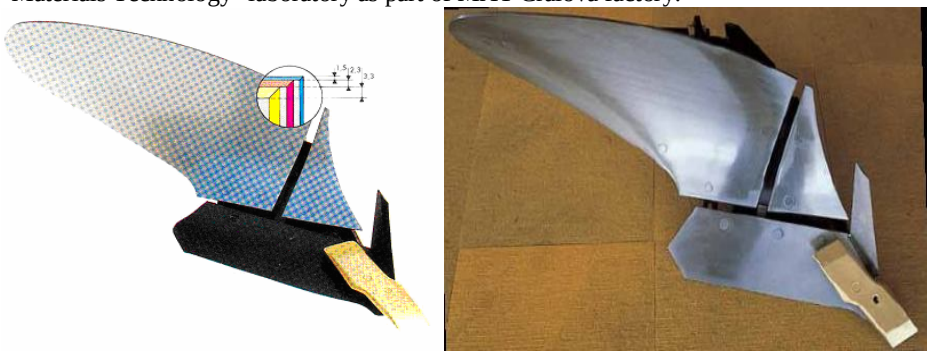
INTODUCTION

During work the plough must be a very stable mobile technical system. The stability of the plough in work is the result of the effectuation of some accurate adjustments about the afferent mechanisms which define the parameters which estimate the achievement of the stability in work (by maintaining of a depth and breadth of work at constant values). At the insurance of this stability it contribute both the correct attaching of the plough at the tractor and the measure in which the materials the working mechanisms are manufactured from, it attenuate the negative influence of some disturbed factors which appear directly during the work such as: impacts, vibrations, lend's variations of level, the appearance of some rigid obstacles.

The contribution of these negative factors it is also amplified by the modification tendency of the change of place surface's geometry of the furrow as a result of the abrasive and chemical wear of this surface. The abrasive wear has a decisive contribution in modification of the initial geometry of the working surface. As a result, the mechanical ploughs designers are concerned in finding some materials that satisfy maximum the counteracting possibility of the destructive and unbalance combined effect of all these factors. Therefore, both in the current stage and in the prospect the researchers' attention is pointed towards finding of some materials that, on one side, to answer more efficient to these requirements, and on the other side, to situate the cost at an acceptable level on the international market.

MATERIALS AND METHOD

Two laminated stratified composite materials realised by the companies from C.S.I. and the TRIPLEX material realised by the French company Huard used at mouldboards of mechanical ploughs were studied by the author as part of the Polyvac laboratory of U.M. Timişoara, "Materials' Science and Thermic Treatments" Department from U.P. Timişoara and "Materials Technology" laboratory as part of MAT Craiova factory.



a) b)

c) d)

Figure 1. The TRIPLEX material used at the classical and lamellar mouldboards manufacturing (Kuhn French Company): a)-the Triplex material; b)-the classical mouldboard manufactured of this material (Kuhn – French); c)-the lamellar mouldboard manufactured the stratified composite material (Massey Ferguson – USA); d)-the plough with mouldboards manufactured of TRIPLEX material (Kuhn – French)

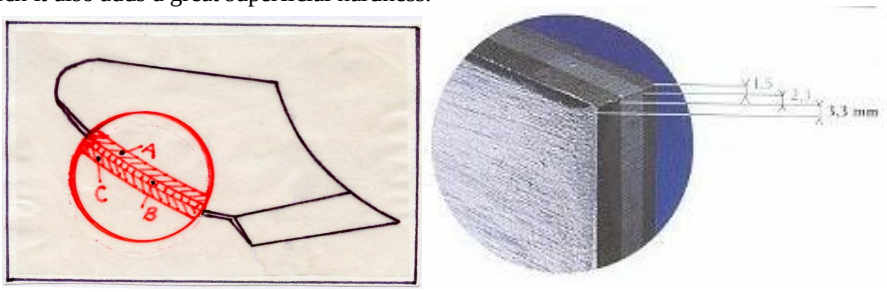
RESULTS AND DISCUSSION

From functional, economic or aesthetic reasons exist today the tendency of replacement of the traditional materials (OLC45, OLC60, Si-Cr-V steel) with those obtained through mechanical mixture, at macroscopic scale, of two or more materials.

The integral utilization of the strength capacity of the used materials is an important way of reduction of the planned product's cost. From this point of view, the projection of any strength structures made up of composite materials has a supplementary component part given the projection of these from traditional material's microstructure in concordance with the most propitious behaviour requirements in exploitation of the product. Today, the composite materials are specially created in order to respond to some exquisite exigencies as concerns the mechanical strength, rigidity, reduced specific weight, dimensional thermic and chemical steadiness, strength at tiredness, impact, wear and tear of the insulating properties, aesthetics, and last but not least the economic imperatives.

Today, on international plane, were achieved different laminated stratified composite materials for moldboards, resisting at wear, with great stability at abrasive wear and alternative requirements, which consist of at least two stuck materials (bound together) [1]. Thus it can combine the best properties of the constitutive materials, obtaining a superior material as to strength, rigidity, density, aesthetics, strength at corrosion, humidity and so on.

The great majority of the foreign companies achieve the mechanical plough's' mouldboards from a laminated stratified compose material achieved from three stratums of steel (figure 2) [1]. This is constituted from a middle stratum, supple, achieved from a steel with content in carbon of 0,055 . . . 0,1%, that by its persistence reduces at minimum the risk of breaking through impact and from two external stratums achieved from steel with high carbon content, of about 0,7%, that is allied with chromium and elaborate in electrical furnace. These peripherical stratums are resisting at wear and have a great hardness. This laminated stratified composite material, after tempering, obtains a high strength, a good strength at impacts at which it also adds a great superficial hardness.



a) *b)*

Figure 2. - Detail regarding the laminated composite material used at mouldboards:a)-original reprezentation; b)-Kuhn French Company's reprezentation

In steeled state, the very fine grain of those two external stratums permits a gentle polishing and ensures a surface with a high degree of smoothing, which appreciably reduces the sticking possibility of the soil during the ploughing. These qualities ensure the mouldboards a long duration in exploitation, superior to those with homogeneous hardness.

The composite materials in laminated state have a maximum hardness of 305 HB in accordance with the French technical standards NF 36361 and 269 HB in accordance with GOST 6765. These bounds are however over fulfilled in case of the steels with 1% C, fact that requires an annealing of the belts. After tempering in water, the hardness of these materials is of 60 Rc (608 HB) in accordance with French standards and 55 Rc in accordance with GOST standards.

In the tables 1 and 2 it presents the chemical composition for each stratum partly of the laminated composite materials achieved by different foreign and Romanian companies.

Table 1.

The chemical composition of the material, mark KAP 85D, achieved by the Japanese company KAWASAKI

Stratum	C [%]	Si [%]	Mn [%]	$P_{max.}$ [%]	$S_{max.}$ [%]	$Cr_{max.}$ [%]	$Ni_{max.}$ [%]
A	0.80...0.90	0.15...0.35	0.30...0.90	0.035	0.035	0.25	0.25
B	0.15	0.30	0.25...0.50	0.035	0.035	0.057	0.057
C	0.80...0.90	0.15...0.35	0.30...0.90	0.035	0.035	0.25	0.25

Table 2.

The chemichal composition of the material achieved by the Romanian Company SIDEX S.A. GALAŢI

Stratum	C [%]	Si [%]	Mn [%]	P [%]	S [%]	Cr [%]	Ni [%]	Steel's mark
A	0.65...0.75	0.15...0.35	0.15...0.35	0.03	0.025	0.20	0.25	OSC7
B	0.07...0.14	-	0.35...0.65	max.0.040	0.020...0.045	-	-	OLC10
C	0.65...0.75	0.15...0.35	0.15...0.35	0.03	0.025	0.20	0.25	OSC7

Two laminated stratified composite materials realised by the companies from C.S.I. and the TRIPLEX material realised by the French company Huard used at mouldboards of mechanical ploughs were studied by the author as part of the Polyvac laboratory of U.M. Timişoara, "Materials' Science and Thermic Treatments" Department from U.P. Timişoara and "Materials Technology" laboratory as part of MAT Craiova factory.

In the table 3 and 4 it presents the chemical composition for each stratum partly, of two laminated composite materials, determined by the author.

Table 3.

The chemical composition of the laminated composite material, number 1, studied by the author[1]

Stratum	Fe [%]	C [%]	Si [%]	Mn [%]	P [%]	S [%]	Cr [%]	Mo [%]	Ni [%]	Al [%]	B [%]	Co [%]	C u[%]	Pb [%]
A	98.0	0.676	0.208	0.649	0.009	0.0233	0.067	0.004	0.075	0.034	0.0001	0.002	0.131	0.0002
B	99.1	0.077	0.023	0.261	0.010	0.0300	0.070	0.008	0.009	0.011	0.000	0.003	0.160	0.0002
C	98.0	0.619	0.210	0.656	0.009	0.0257	0.067	0.005	0.075	0.035	0.0001	0.002	0.134	0.0002

Table 4.

The chemical composition of the material achieved by the French company HUARD (TRIPLEX material)[1].

Stratum	C [%]	Mn [%]	Si [%]	P [%]	S [%]	Cr [%]
A	0.75	0.70	0.20	0.035	0.025	0.20
B	0.10	0.40	0.15	0.035	0.035	0.000
C	0.75	0.70	0.20	0.035	0.025	0.20

The variation of the hardness on section at the laminated stratified composite material achieved by the French company (tempering + low return), determinate by the author, in accordance with the quality standards "CITROEN" is presented in the table 5 and figure 4,a and that of those two materials realised by the companies from C.S.I., determined by the author, is presented in the tables 6 and figure 3,a,b.

In order to compare the stratified composite materials with traditional materials, as part of the MAT Craiova Company were performed and studied samples of tin of 7 mm from OLC60 and OLC45, at which were applied the following technology of thermic treatment: tempering followed by the return to 450^{o} C. The results that we obtained for the sample from OLC60 are presented in the table 7. The variation of the hardness on section for OLC60 is presented in figure 4,b.

Table 5.

The values of hardness on section for the TRIPLEX material achieved by French companies

The distance from the surface of the sample [mm]	0	0.5	1	1.5	1.6	1.7	1.8	1.9	2	Core
Hardness HV	851	851	872	831	831	841	748	629	223	223
Hardness HRC	65.5	65.5	66	65	65	65.3	62	60	22	22

Table 6.

The values of hardness on section and the tearing strength for the RED sample

RED sample								
The distance from the surface of the sample [mm]	0.2	0.8	1.2	2 (Core)	3.5 (Core)	4.2	5	5.8
Hardness HV [N/mm^2]	304	304	305	113	114	297	302	302
Hardness HB [N/mm^2]	289	289	290	108	109	284	287	286
Tearing strength [N/mm^2]	979	979	982	362	366	965	973	970

Table 7.

The values of hardness on section for that OLC60 material, determined by the author.

The distance from the surface of the sample [mm]	0	0.5	1	1.5	2	Core
Hardness HRC	46	46	46	45	45	44

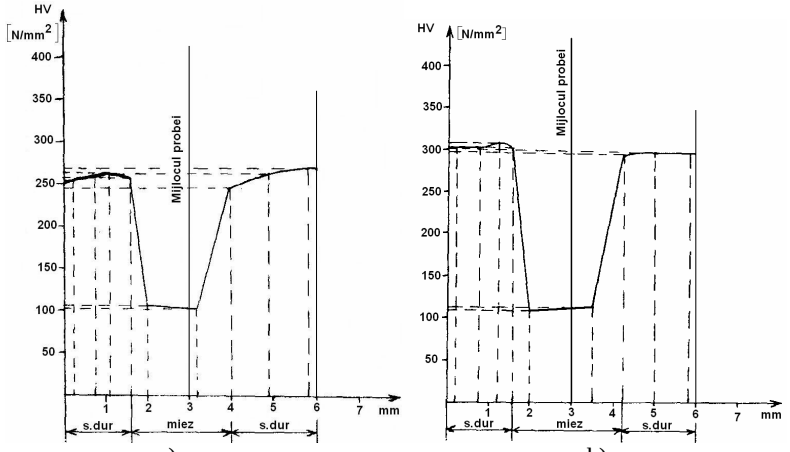


Figure 3. The variation of the hardness on section for the two materials, realised by the companies from C.S.I, determined by the author [1][2]: a) - Yellow sample; b) – Red sample

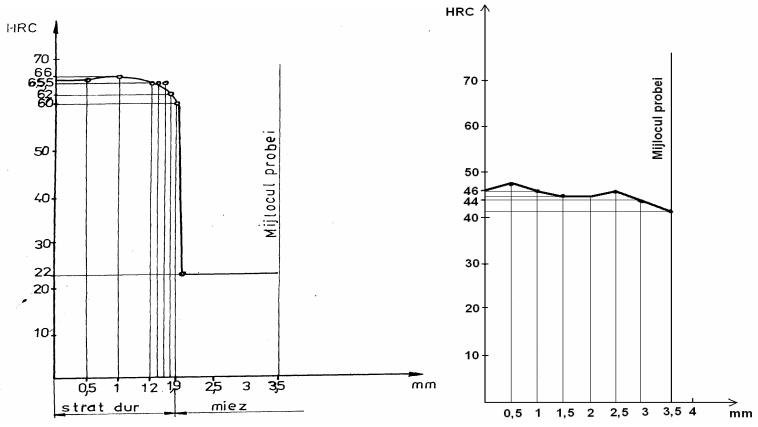


Figure 4. The variation of the hardness on section for TRIPLEX tin (tempering + low return) and the variation of the hardness on section for the tin from OLC60 steel(tempering + return),determinate by the author[1][2]: a) – TRIPLEX material;; d) – OLC60 steel

CONCLUSIONS

1. The duration of good efficient working in exploitation of the stratified composite materials is superior to the traditional materials.

2. The consumption of combustible decreases with about 9% in case of utilization the stratified composite materials.

3. The strength at wear is 2-3 time bigger in case of utilization of the stratified composite materials than in case of utilization of the traditional materials.

4. The existence of intermediary stratum with low hardness considerably improves the impact strength of these materials.

5. In the utilisation's conditions of the traditional materials OLC45 or OLC60 is obtained a hardness almost constant on the whole piece's section. This fact is caused by the great capacity of the respective steel to harden and the small thickness of the piece (7 mm) that leads to a tempering in depth. As a result of this fact appear a series of difficulties in the manufacturing process (fissures during the stamping of the hole, thermic treatment and breaking in fitting), assuring at the percent about 10% losses. Also, the hardness of the mouldboards performed from OLC45 and OLC60 is much smaller, because of the low values of densities, which diminish the strength at wear during working.

6. The study performed praises that, with a view to avoiding the fissuring of the mechanical plough's mouldboards, is rather to be used laminated stratified composite materials.

BIBLIOGRAFY

1. BUNGESCU, S. - "Studies and researches regarding the stresses distribution on mouldboard's surface of lamellar type with a view to construction's modelling and optimisation", Doctor's degree thesis, Timişoara, 2001;

2. BUNGESCU, S. – "The researches on using the composite order in engineering of the mouldboards of mechanic ploughs", Scientific Bulletin of the ,,POLITEHNICA" University of Timişoara, Transactions on MECHANICS, Romania, 46 (60) Tome, 2 Fascicle, 2001, pag. 91 – 98.