Prof. d-r. Dragi Danev, Faculty of Mechanical Engineering, Skopje, Republic of Macedonia,
Prof. d-r. Milan]osevski, Faculty of Mechanical Engineering, Skopje, Republic of Macedonia,
D-r. Simeon Simeonov, AD “RUEN” Kocani, Republic of Macedonia

UTICAJ ODNOSA KONAC/IMPREGNAT U STRUKTURI MATERIJALA OBLOGA NA TRIBOLO[KE KARAKTERISTIKE SPOJNICA MOTORNIH VOZILA

IMPACT OF STRING/IMPREGNANT RATIO OF THE COMPOSITION OF THE LININGS MATERIAL ON THE TRIBOLOGICAL CHARACTERISTICS OF THE MOTOR VEHICLES CLUTCHES

REZIME:

Kompozicija materjala za oblo{ke frikcionih spojnica iskazuja zna~ajan uticaj na tribolo{ke karakteristike spojnica. Spojnica treba imati stabilne radne karakteristiki uz {to je mugu}e du`i vek rada, a da pri tome ispunjava i ekolo{ke zahteve. Da bi se to postiglo, posebna se pa`nja mora posvetiti kompoziciji materjala za frikcione obloska. Iskustva su pokazala da poseban uticaj ima odnos konca i impregnanta. Ovaj rad prikazuje rezultate koja su u tom smislu proizasla iz obimnih eksperimentalnih istrazivanja sprovedenih u AD "RUEN" – Ko~ani.

KLJU^NE RE^I: spojnice, oblo{ke, kanap, impregnant, tribolo{ke karakteristike

ABSTRACT

Material composition of the friction clutch lining appears to have a significant influence upon the tribological characteristics of the clutch. The clutch should have stabile working characteristics, working life which is as long as possible, fulfilling in the same time environmental requirements. In order to obtain this, particular care should be given on the material composition of friction clutch lining. Experience has shown that string/impregnant ratio has significant influence. This paper shows the results of extensive experimental testing, which has been performed in AD "RUEN" – Ko~ani.

KEY WORDS: clutch, lining, string, impregnant, tribological characteristics

1. General approach

Sliding in the process of plugging in and releasing of the clutch is the main cause of insufficient life of the friction element. The possible overload of the clutch is another important factor that may shorten its life. In order to enlarge the life time of the clutch, the biggest efforts are directed towards increasing the quality of the friction linings. They should fulfill an array of conditions.

The friction material is one of the important carriers of the qualities of the clutch.
The composition of the material, and particularly the technology of production should be considered, since different qualities of the friction material in certain working conditions may be achieved by the use of different technology, even though the composition of the material is the same.

The friction material should fulfill the following basic requirements:

- stabile friction
- resistance to wear
- satisfactory thermoconduction
- good physical qualities
- workability
- high value of the friction coefficient at increased pressures and temperatures
- satisfactory adhesion with the metal parts

The friction materials may generally be divided into two groups:

- asbestos and
- non-asbestos materials

Both of them have basically same structure, determined by four main components:

- string (mesh)
- charger
- adhesion means and

- friction modifiers.

These components have special functions in the mixture of the friction material.

The factors that have an impact on the tribological parameters, depending on the composition of the lining are the following:

- change of the string/impregnant ratio
- change of the diameter of the string
- percentage of metal in the string
- change of the ratio of modifiers
- way of spining of the string
- way of knitting of the lining

The tribological parameters of the lining depend on the quality of the lining and the conditions of testing:
- temperature between friction surfaces
- specific pressure between friction surfaces
- sliding speed of friction linings

It should be mentioned that the technological procedures of production of linings used by famous producers, according to the adhesive means, may be divided into two groups:
- group “A” - adhesive means on the basis of caoutchouc and resins;
- group "B" - adhesive means on the basis of water dispersion (synthetical latex)

In the production worldwide, adhesive means from group "A" are predominant, while the adhesive means in group "B" are less frequently used.

2. Testing

In order to get the information about the impact of the string/impregnant ratio in the composition of the lining material on the tribological parameters of the motor vehicle clutches, the following testing, based on the following approach, is done:

2.1. The tested linings are made of material produced by the adhesive means from the group "B"

2.2. The structure of the lining includes:
- non-asbestos string (mesh)
- tar, carbon, some poly-dispersions (charger)
- synthetical latex (means of adhesion)
- sulfur, phenol resins etc. (modifiers)

2.3 In order to estimate the impact of the string/impregnant ratio in percentages (adhesive means-latex, chargers and modifiers) on the tribological parameters, the following activities are established and implemented:

a) Linings with dimensions $\phi 350/\phi 195/3.5$ with different string/impregnant ratio were produced:

- 40% string with 60% impregnant
- 45% string with 55% impregnant
- 52.5% string with 47.5% impregnant
- 56% string with 44% impregnant
- 60% string with 40% impregnant

b) The testing was made on a testing stand for friction clutches with the following way of work:
- number of rounds: 1600 [rpm];
- inertial momentum: 10.22 [kgm^2];
- specific workload: 107 [J/cm^2];
- frequency of plugging in : 1.5 [pl/min];
- total number of plugging-in: 1000 [pl.].

c) The linings are hammered to a disc and are placed on the testing stand. The lining is worked up by a minimum of 500 plugging-ins, in order to get a contact surface of the lining with 75% of its total surface .

3. Results

Results of the testing are presented in table nr.1

Table nr.1

Composition (%)		Coefficient of friction μ	Coefficient of specific wear υ [$cm^3/10MJ$]
String	Impregnant		
40	60	0,29	0,96
45	55	0,31	0,78
52,5	47,5	0,35	0,62
56	44	0,40	0.46
60	40	0,46	0,44

The inter-relation of the coefficient of friction and the specific wear with the string/other substances (impregnant) ratio, is presented on Fig. 1.

4. Analysis and conclusion

The diagram shows that the higher the percentage of the string is, the larger the coefficient of friction is, and the specific wear is smaller. The string with

a defined composition may absorb more impregnant depending on the percentage of organic matter. The higher the percentage of organic matters is, the more does the string absorb impregnant. The organic matters determine the percentage of loss in soft stoking of the string.

The shown diagrams are a curve of second order:

$$\mathbf{A \cdot x^2 + B \cdot x + C = y}$$

Determination of coefficients A, B and C is made with the software package GRAPHER by interpolation. The coefficients for the curves are shown on table nr. 2:

Table nr.2.

		A	B	C
μ	% of string	0,001019	-0,08203	2,15458
υ	% of string	0,000463	-0,07283	3,1307

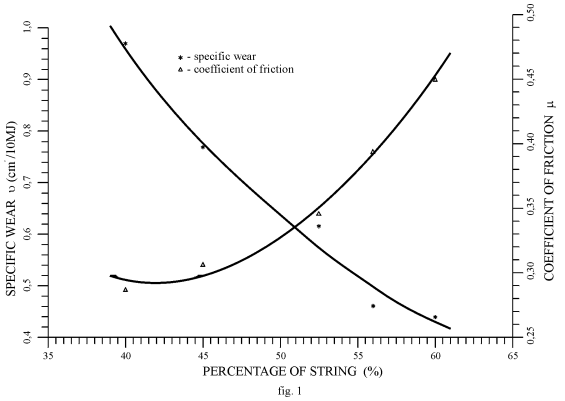

Fig.1

5. References:

5.1 J. Todorovi}: Ko~enje motornih vozila , Zavod za udzbenike i nastavna sredstva, Beograd, 1988

5.2 Friction materials for engineers, Ferodo/Ltd, 1961

5.3 FIAZ – Tehni~ki i propagandni materjal

5.4 Zamena azbestnih vlakna sa ugljeni~nim i drugim materjalima u frikcionim i zaptivnim proizvodima, Jugoslovenski srtru~ni skup , Prokuplje , 23.11.1995.

5.5 AD "RUEN" – Ko~ani, tehni~ki materjali, iskustva, izve{tai od ispituvawa, tehnologija na izrabotka na frikcioni oblo{ki i spojki za motorni vozila.