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RESULTS OF VERIFICATION OF THE FORMULA FOR CALCULATION OF FRICTION COEFFICIENT OF THREADS, CORDS AND ROPES ON A TRACTION DRUM OF THE FRICTIONAL MECHANISM

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The purpose of our work

The purpose of our work was ***verification of the formula*** for calculation of friction coefficient μ of threads, cords and ropes on a traction drum of the frictional mechanism (Nedostup et al., 2010)

$$\mu = 0{,}6\sqrt{\frac{\frac{S_{1\max}}{S_2}-1}{\alpha}} \tag{1}$$

where S_{1max} - tension in threads, cords and ropes before frictional trade mechanisms; S_2 - tension in threads, cords and ropes after frictional trade mechanisms; α - an angle of an arch of a grasp of a drum of the frictional mechanism.

Process of extension of fishing gears with the help of mechanisms of frictional type (MFT)

Frictional interaction between the fishing gear and a surface of traction drum of MFT

Between the **fishing gear** and a surface of traction drum of **MFT** there is a force of friction of rest F . During rotation on a surface of a drum district force F_c which is shifting force in friction-gear «**Fishing gear** - drum of **MFT**» operates and is directed to the opposite side from force of friction F. Joint movement of the instrument of fishery and drum of **MFT** will pass without sliding at performance of a condition (Chichinadze et al., 2003)

$$F > F_c \qquad (2)$$

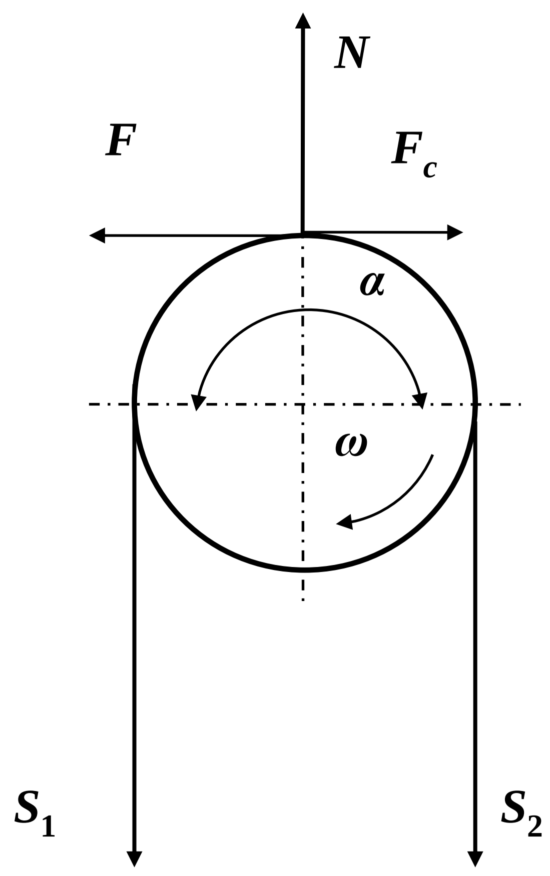


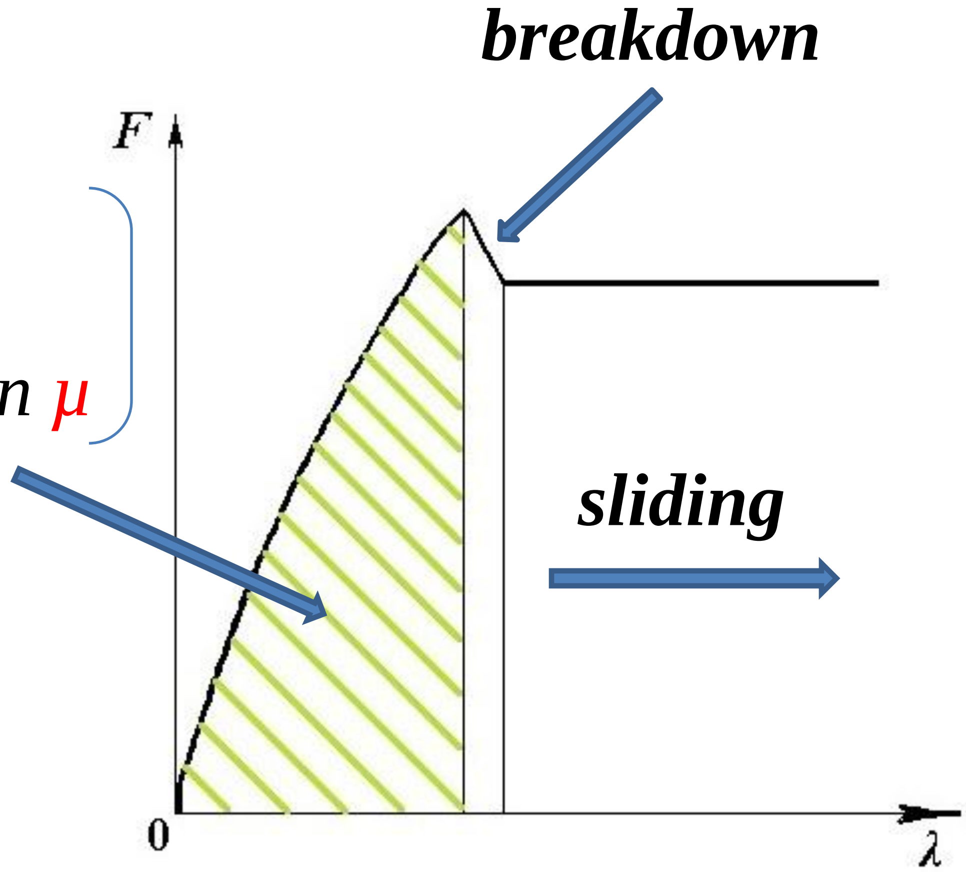
Fig. 1 The settlement circuit of normal loading N

Preliminary displacement

preliminary displacement

a friction of rest F

static factor of friction μ



Amonton

Force of friction of rest F is defined by static factor of friction μ which according to formula by **Amonton** (Chichinadze et al., 2003) can be expressed

$$\mu_A = \frac{F}{N} \ , \tag{3}$$

where N - pressure or normal loading from the fishing gear on drum **MFT**.
At α=180^0 force of friction of rest F we shall present

$$F = S_{1\max} - S_2 \quad , \tag{4}$$

where $S_{1\max}$ - tension in threads, cords and ropes or fishing gear before frictional trade mechanisms; S_2 - tension in threads, cords and ropes or fishing gear after frictional trade mechanisms.
Pressure or normal loading we shall present

$$N = S_{1\max} + S_2 \tag{5}$$

With the account (4) and (5) formula (3) will become

$$\mu_A = F / N = \left(S_{1\max}^{\cdot} - S_2\right) / \left(S_{1\max} + S_2\right) \tag{6}$$

Amonton: two restrictions

Application of the formula (6) has **two restrictions**:

- *restriction* 1. The formula (6) is fair at $\alpha \leq 180^0$;

-*restriction* 2. Calculation under the formula (6) will always give result $\mu_A < 1$.

In practice, an angle of an arch of a grasp of a drum of the frictional mechanism α can exceed 180^0. For example, 3 coils of a rope on friction drum of winch make $\alpha = 1080^0$.

Coefficients of friction can be $\mu \geq 1$ since a surface traction drum of MFT cover with rubber

Fig. 2 TRIPLEX: traction drums cover with rubber

No restrictions

In 2009 we have offered the formula (1) for calculation of static coefficient of friction (Nedostup et al., 2009, 2010).

This formula has **no restrictions** about which it was spoken above.

$$\mu = 0,6\sqrt{\frac{\frac{S_{1\max}}{S_2} - 1}{\alpha}}$$

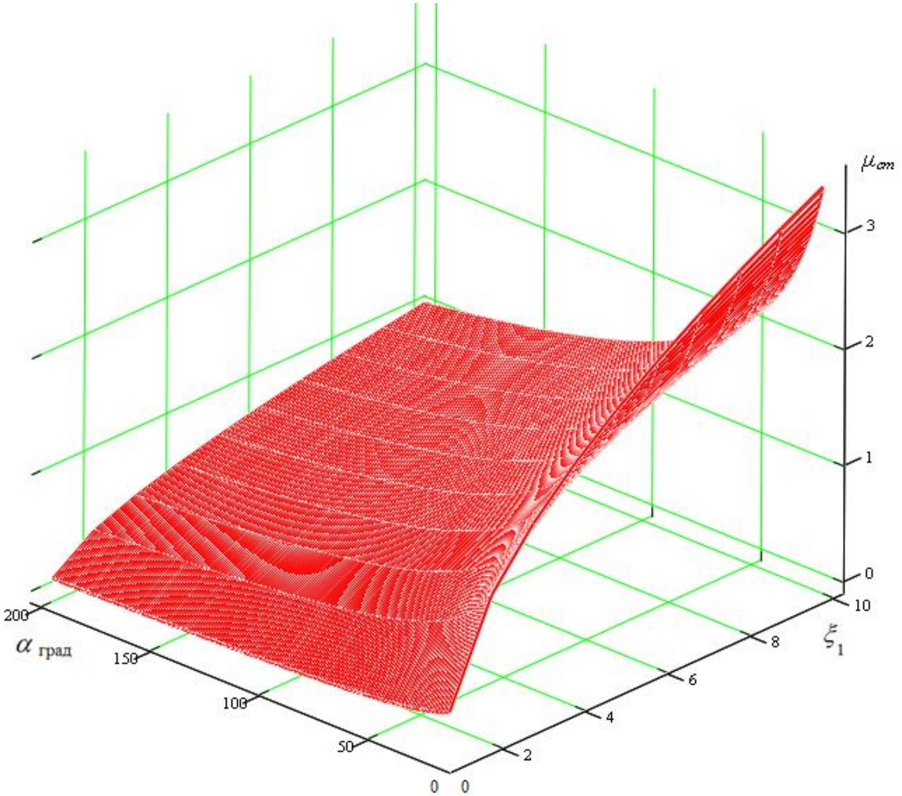


Fig.3. The dependence μ=f(S_{1max}/S_2,α)

Material and methodic

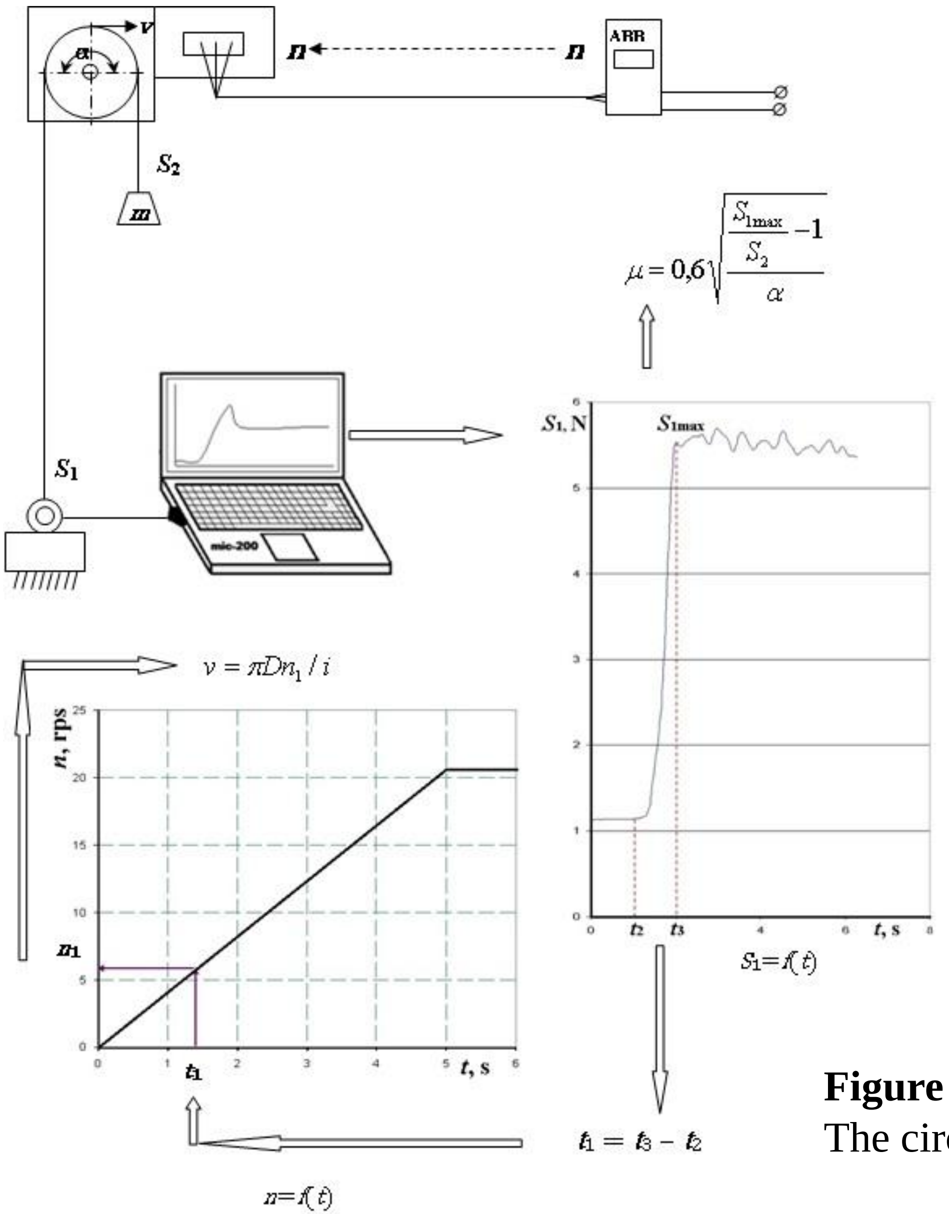


Figure 2
The circuit of experimental installation and experiment

Material and methodic

Table 1
Samples threads, cords, ropes (W_f=1,72% actual humidity of samples TCR).

Material	Kind	№ sample	Diameter, *d* mm	Explosive loading, *T* N	Length, *L* m	Mass, *m* gm
Polyamide PA	Twirled thread	1	1	212,1	10,06	4,1
		2	2,5	1257	4,6	11,8
	Twirled cord	3	3,1	2258,6	4,3	24
		4	5	4222,6	5,44	67
	Twirled rope	5	10	15712	4,08	230,3
		6	18	54010÷66776	1,9	292,5

$$v = \pi D n_d = \pi D n / i \qquad (7)$$

where *D* - diameter of a drum; n_d - frequency of revolutions of a drum; *n* - frequency of revolutions of a shaft of the engine; *i* - transfer number of a reducer.

Methodic of experiment

Consistently four values of frequency of revolutions of a shaft *n* have been set to the electric motor: 5,57rps; 12,37rps; 15,90rps and 20,58rps. Samples TCR were stacked on a drum so, that an angle of an arch of a grasp of a drum of the frictional mechanism α=180°. The accumulating branch fastened to the strain gauge connected with the measuring device MIC-200. The loading S_2 was set by the measured cargo. Mass of a measured cargo *m* changed four times for each value *n*. Numerical values *m* have been taken from the previous experiments to reproduce intervals of pressure ($0 \leq p_1 \leq 3470 N/m^2$; $3471 \leq p_2 \leq 6650 N/m^2$; $6651 \leq p_3 \leq 16000 N/m^2$; $16001 \leq p_4 \leq 25500 N/m^2$) at which the formula (1) (Nedostup et al., 2009,2010) has been received. The electric motor of experimental installation was included, resulting in rotation a drum. The strain gauge registered tension S_1 which entered the name MIC-200 during time *t* rotations of a drum in accumulating branch TCR.

Methodic of experiment

Figure 3
TRIPLEX

Figure 4
Power Blok

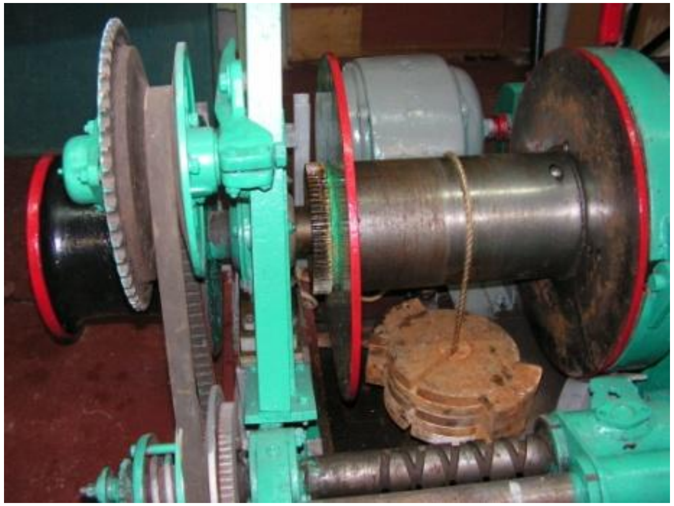


Figure 5
Trawl winch

Results of experiments

For dry cords from the polyamide, investigated on a steel drum trawling winch, pressure $180000 \leq p \leq 460000 N/m^2$ has been received. For dry ropes from the polyamide, investigated on a steel drum trawling winch, pressure $230000 \leq p \leq 650000 N/m^2$ has been received. For cords and ropes from the polythene, investigated on a steel drum trawling winch, pressure $160000 \leq p \leq 390000 N/m^2$ is received. For a rope from PP/PE, investigated on a steel drum trawling winch, pressure $230000 \leq p \leq 590000 N/m^2$ is received. For damp cords and ropes from the polyamide, investigated on a steel drum trawling winch, pressure $240000 \leq p \leq 710000 N/m^2$ is received. For cords and ropes from the polyamide, investigated on Power Blok with rubber a drum, pressure $115000 \leq p \leq 241000 N/m^2$ has been received. For working pressure static coefficients of friction under formulas (1) and (6) have been determined. The relative error of calculations δ has not exceeded 5%. Exception was made with results of one experiment with Power Blok in which the relative error has made 7,6%.

For a dry cord from polyamide d=5mm, the experimental installation investigated on a steel drum, nominal pressure p=52,68N/m² is received. For a dry cord from polyamide d=4mm, the experimental installation investigated on a rubber drum, pressure p=173,31N/m² is received. For small pressure static coefficients of friction under formulas (1) and (6) have been determined. The relative error of calculations δ has not exceeded 5%.

Acknowledgements

Results of verification of the formula (1) show, that the formula (1) can be applied to calculation of static coefficients of friction under following conditions:

- in an interval of district speeds on a surface of a drum $0{,}005 \leq v \leq 0{,}067$ m/s;
- at interaction TCR from PA, PE and PP/PE with steel and rubber drums MFT;
- at dry and wet conditions TCR;
- in an interval of pressure: on a steel drum $52{,}68 \leq p \leq 710000$ N/m²; on rubber a drum 173,31 N/m² $\leq p \leq 241000$ N/m².

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Thank you for attention!