Evolution of friction coefficient in the tribological test

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Materials and their applications

FUNCTIONAL NANOCOMPOSITE COATINGS
   Nanocomposite TiC/a-C(:H) coatings
   MoS2-based coatings
   Oxide coatings –V2O5,

Aircraft gear drives, conventional steel gear systems, and …numerous elements in motor-sport engines and a great number of other applications.

Macroscopic scale

Thermo-mechanical analysis of coupled wear –oxidation and temperature field at transient and steady state

disk braking system

rotating disk ω
convection
pressure
heat generation due to frictional contact

- disk temperature distribution
(steady state)

V_r
F
N
S_C
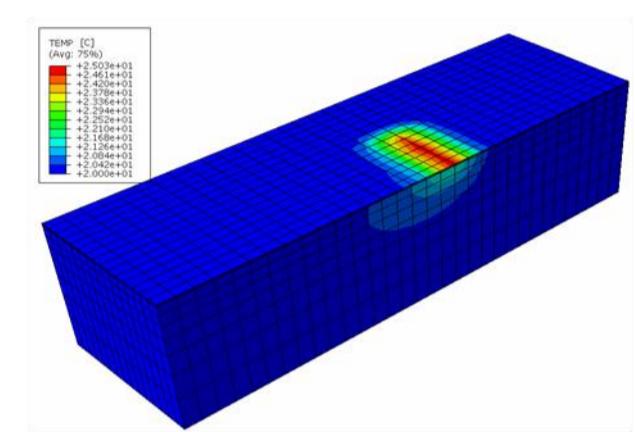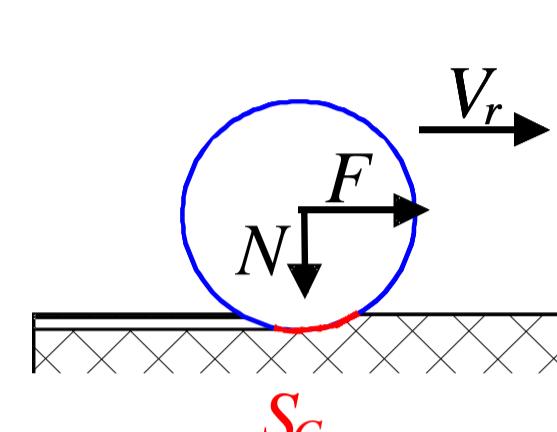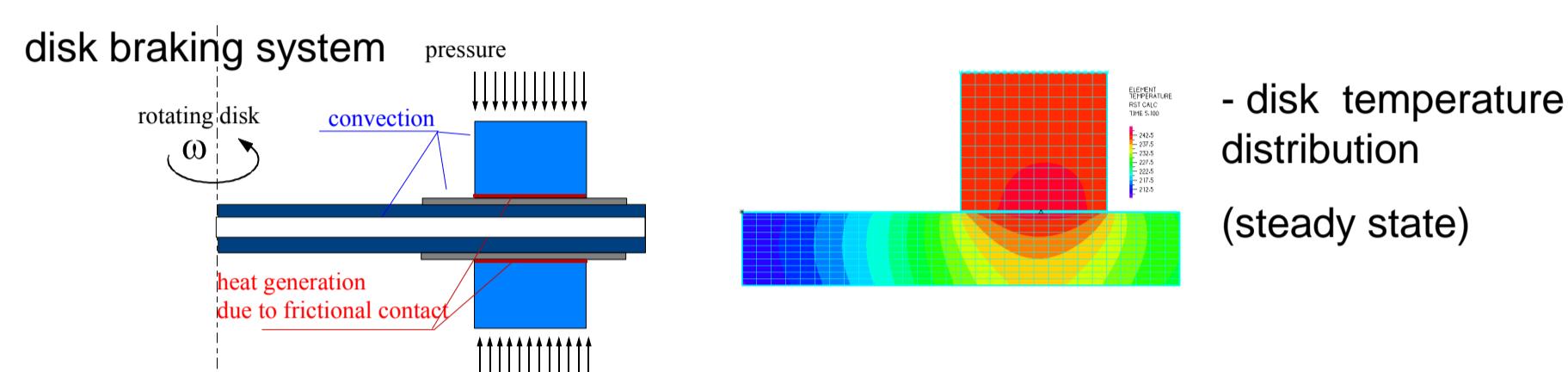
Wear-friction in tribological test (ball on disk , reciprocating test) MoS2-Ti

R=0.5 mm, Fn=1N

R=4mm, Fn=1N

Shape evolution – wear effect

R=3mm, Fn=1N

| mos2_2-1_12h |
| mos2_2-1_3h |
| mos2_2-1_3h a |
| mos2_2-1 12h a |

Length = 1.5 mm Pt = 3.17 µm Scale = 3.89 µm

MoS1b(15)_Ti6Al4V(O2)   MoS1b(15)_ASP2023
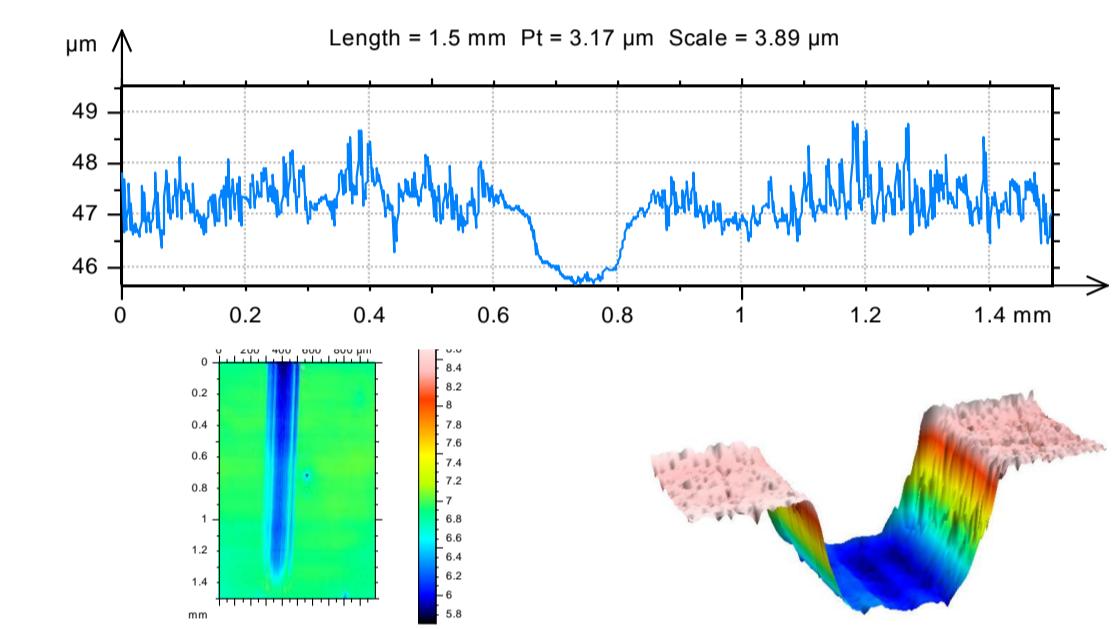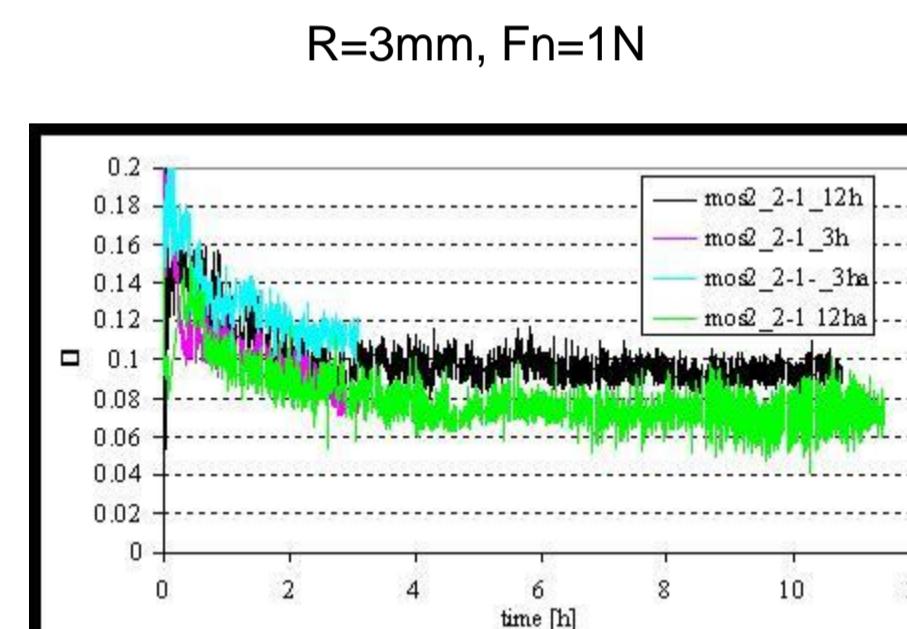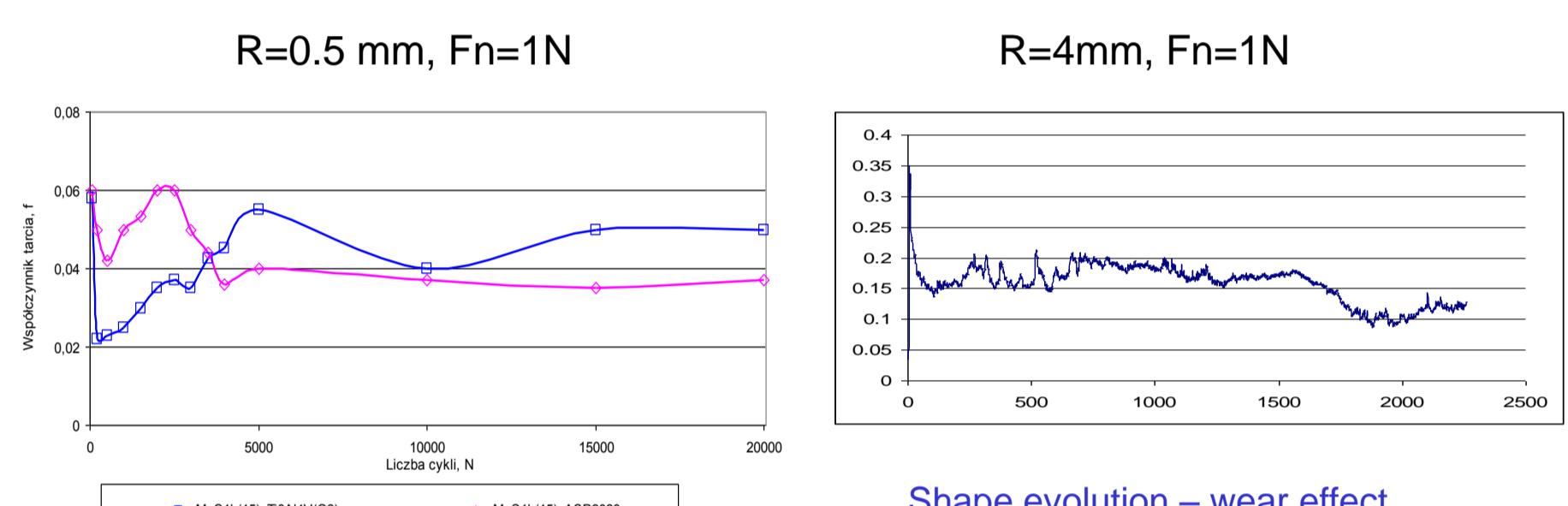
Influence of Load on the friction coefficient in reciprocating test –Al2O3 ball, R=3 mm

× WC2-3 (wear scar) I
● WC2-3 (wear scar) II

■ MoS2 2-1a
▲ MoS2 2-1b
□ MoS2 2-1c

nc-TiC/a-C, worn g=1.5µm   µ=Ft/Fn   friction coefficient   µ=Ft/Fn

HSS steel ,(SW18)   µ=Ft/Fn   Friction coefficient   µ=Ft/Fn

■ MoS2 2-1a
▲ MoS2 2-1b
□ MoS2 2-1c
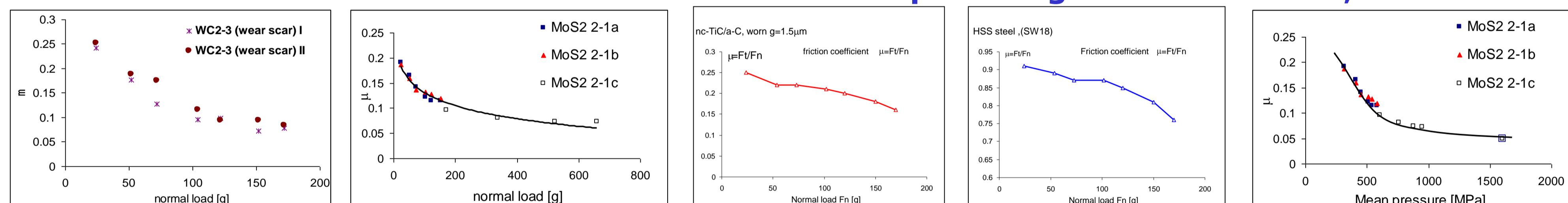
Wear and friction model- FEM analysis

Wear process: modified Archard law

$$\dot{w}_i = \frac{\beta}{H}(\tau_n)\|v_t\|$$

$$\tau_n = (A_2 - (A_1 - A_2)e^{-A_3\sigma_n})\sigma_n$$

nonlinear friction law

R=4mm, Fn=1N

R=0.5 mm, Fn=1N

Shear force evolution Ft, Fn=1N

Ft [N], µ [-]

♦ r=0.5 mm
■ r=4 mm

laps*10³

τn MPa   µ=Ft/Fn

τn
µ

naprężenie normalne σn MPa

wear profile

a) Wear profile(R=0.5mm, niel.,F=1N)
non-linear friction law

5 000
25 000
50 000
100 000
200 000

a) Wear profile (R=4mm, F=1N)
non-linear friction law

1 000
10 000
20 000
30 000
50 000
60 000

normal stress distribution

b) Normal stress distribution

0
100000
200000

b) Normal stress distribution

0
10000
60000
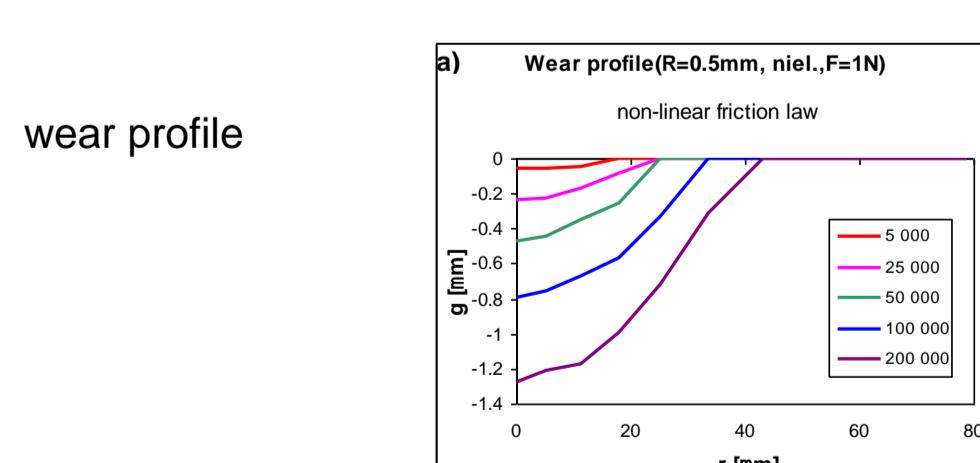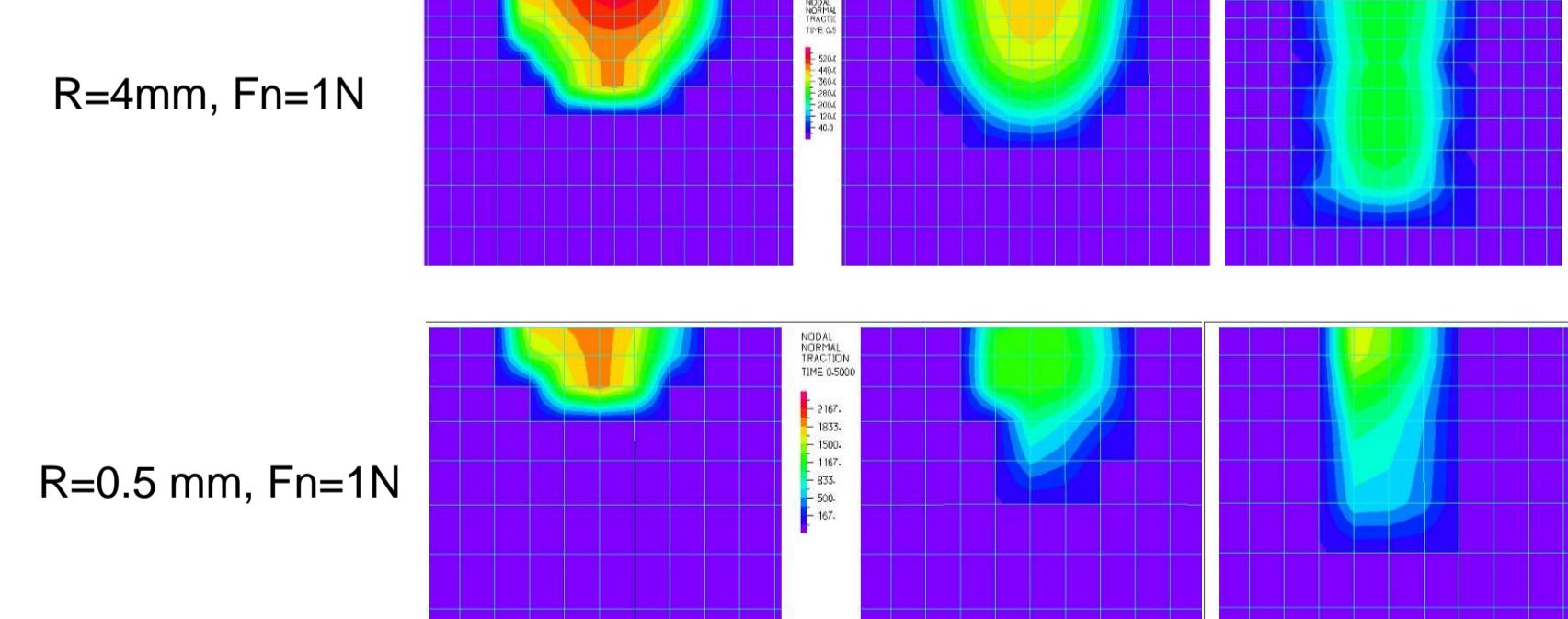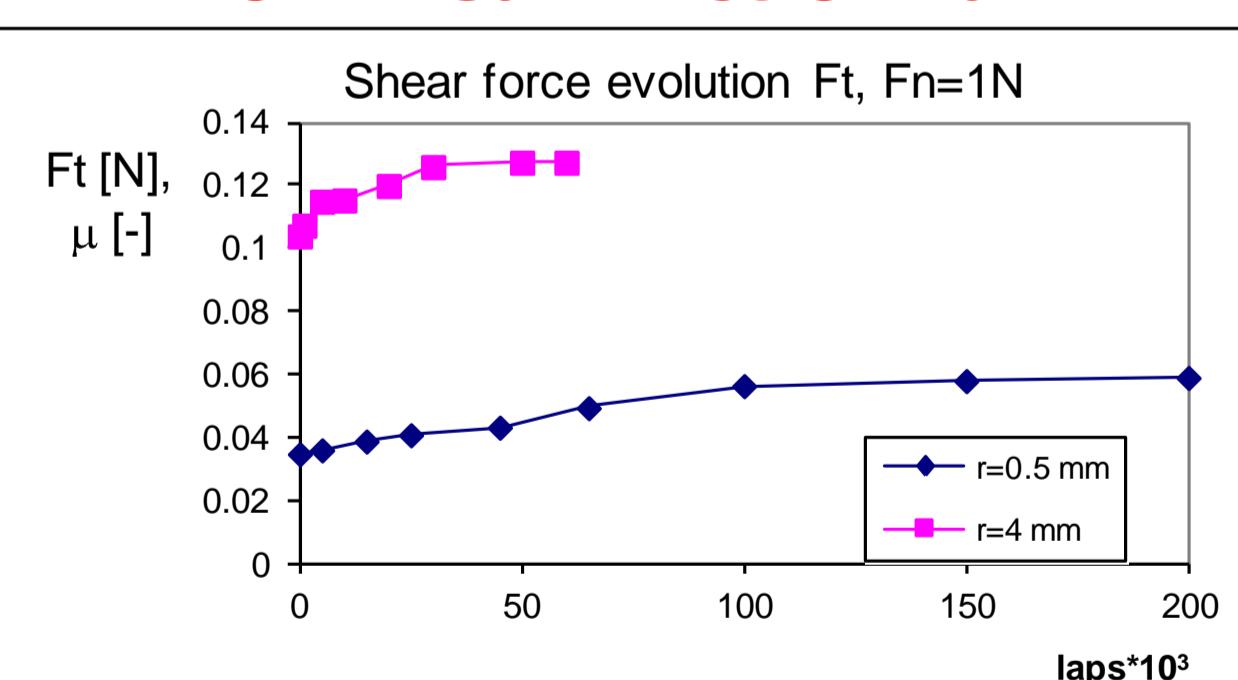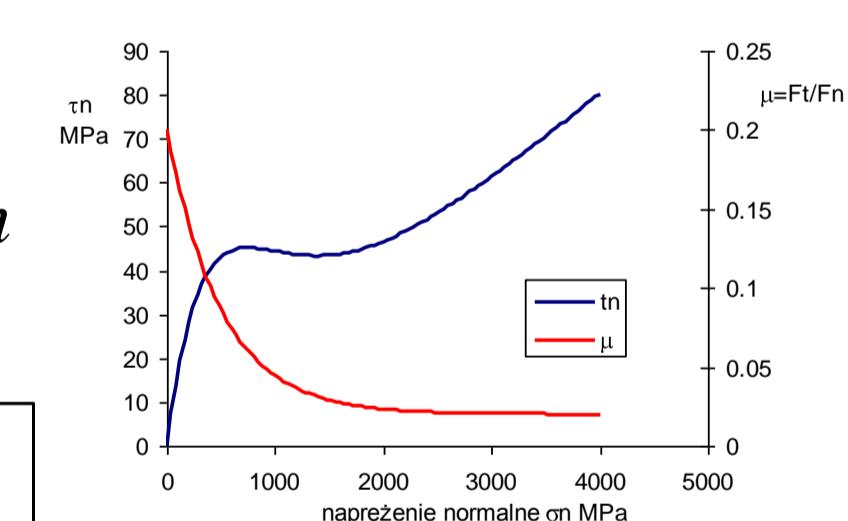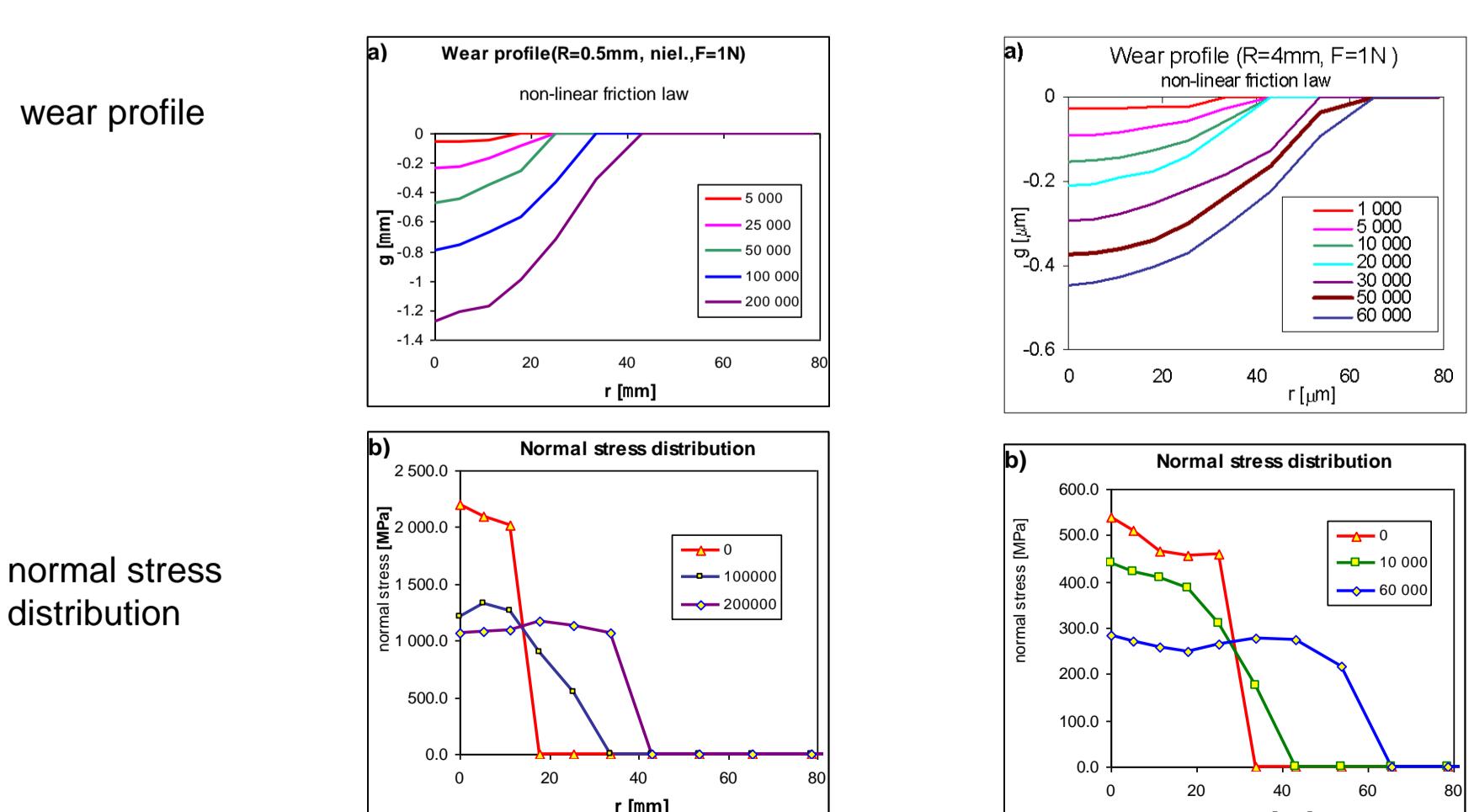
Conclusion

- experiments show corellation between friction cefficient µ and normal stress σn
- experimental results of wear process depend on ball radius R and normal force
- friction coeffcient µ evolves during wear process

INNOWACYJNA GOSPODARKA NARODOWA STRATEGIA SPÓJNOŚCI

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UNIA EUROPEJSKA EUROPEJSKI FUNDUSZ ROZWOJU REGIONALNEGO

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SEVENTH FRAMEWORK PROGRAMME