

Water evaporation from cellulose based materials with different pore sizes



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The water evaporation from the surface of porous materials is the process significantly depending on the material spatial structure and the pores geometric parameters distribution. This fact is caused by the mass and heat transfer processes within the volume depend on such type parameters and can differ significantly for materials with different pores types [1,2]. The work represents data of experimental investigation of water evaporation from different materials surfaces in the air for atmospheric pressure and different values of ambient temperature (50, 60, 70 and 80 C). For pore size influence investigation cellulose-based materials with various pore sizes were chosen: filter paper, fabric, and bandage.

Method and samples

cellulose based materials

MX-50
moisture analyzer



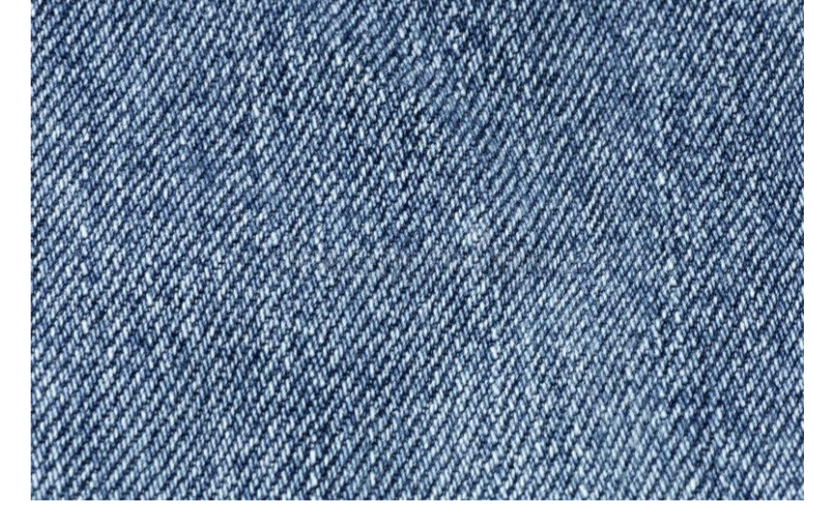
bandage



filter paper

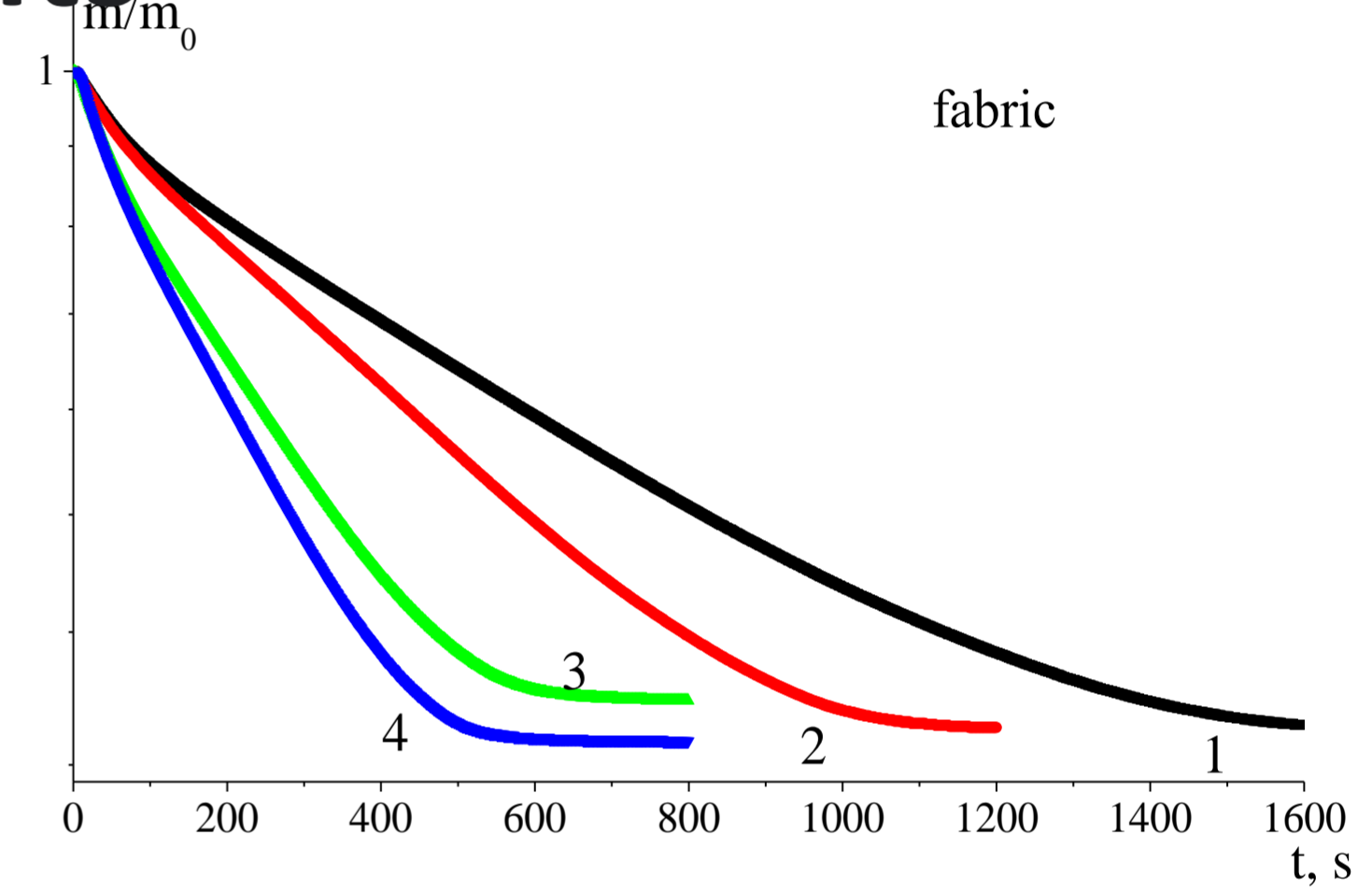
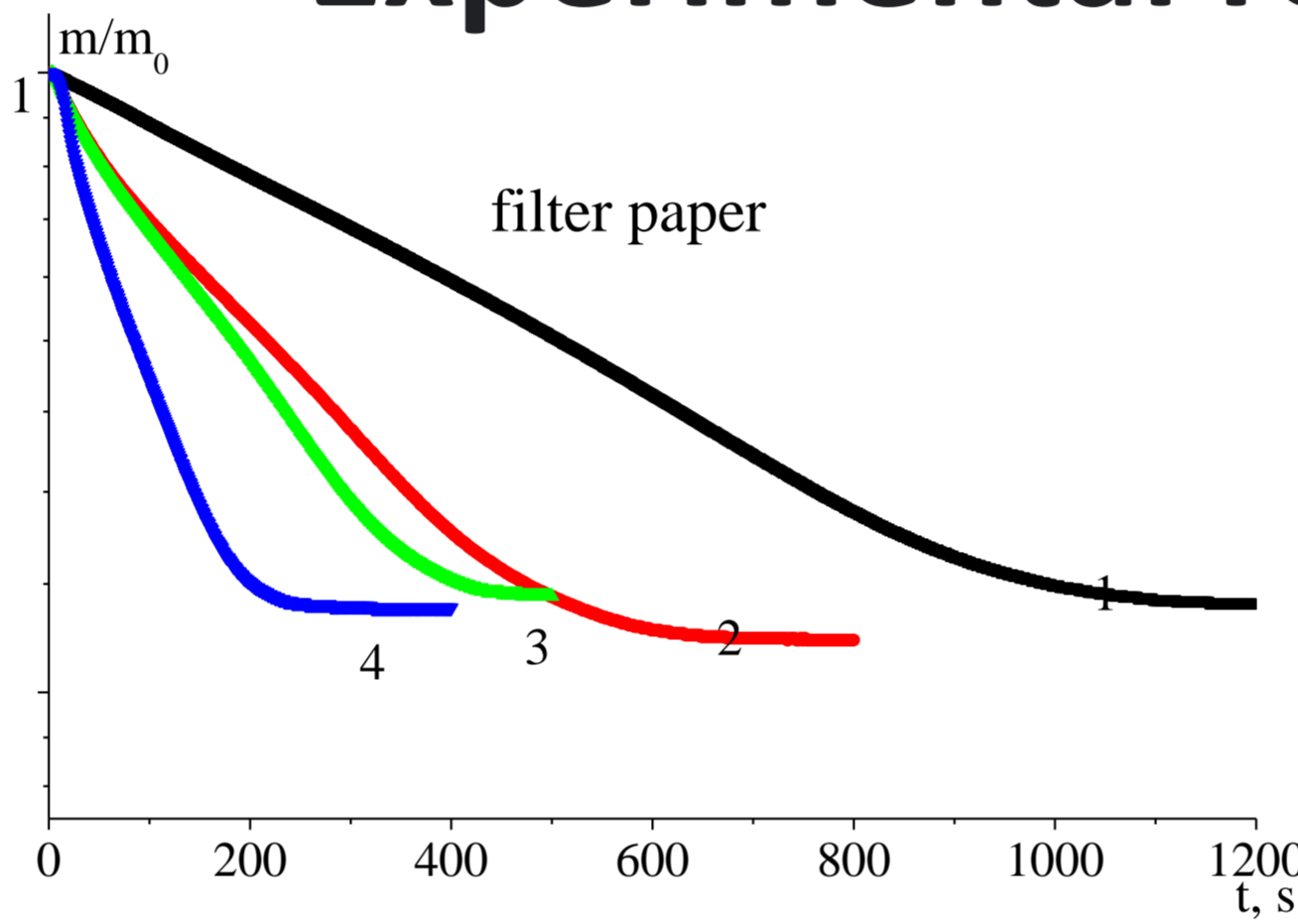
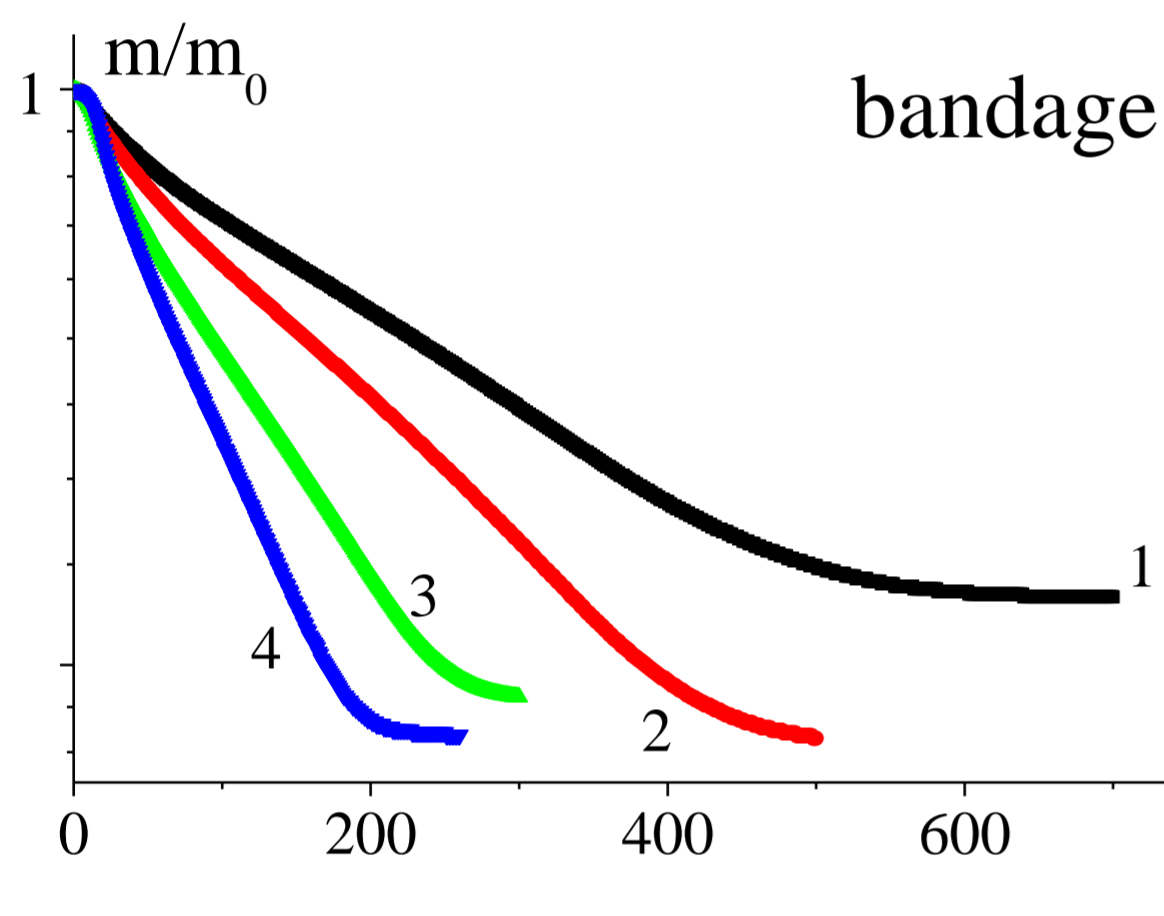


fabric



In the experiments sample mass dependences on time were measured at the time during water was evaporating from its surface. Experimental dependences for investigated materials are represented in the next section

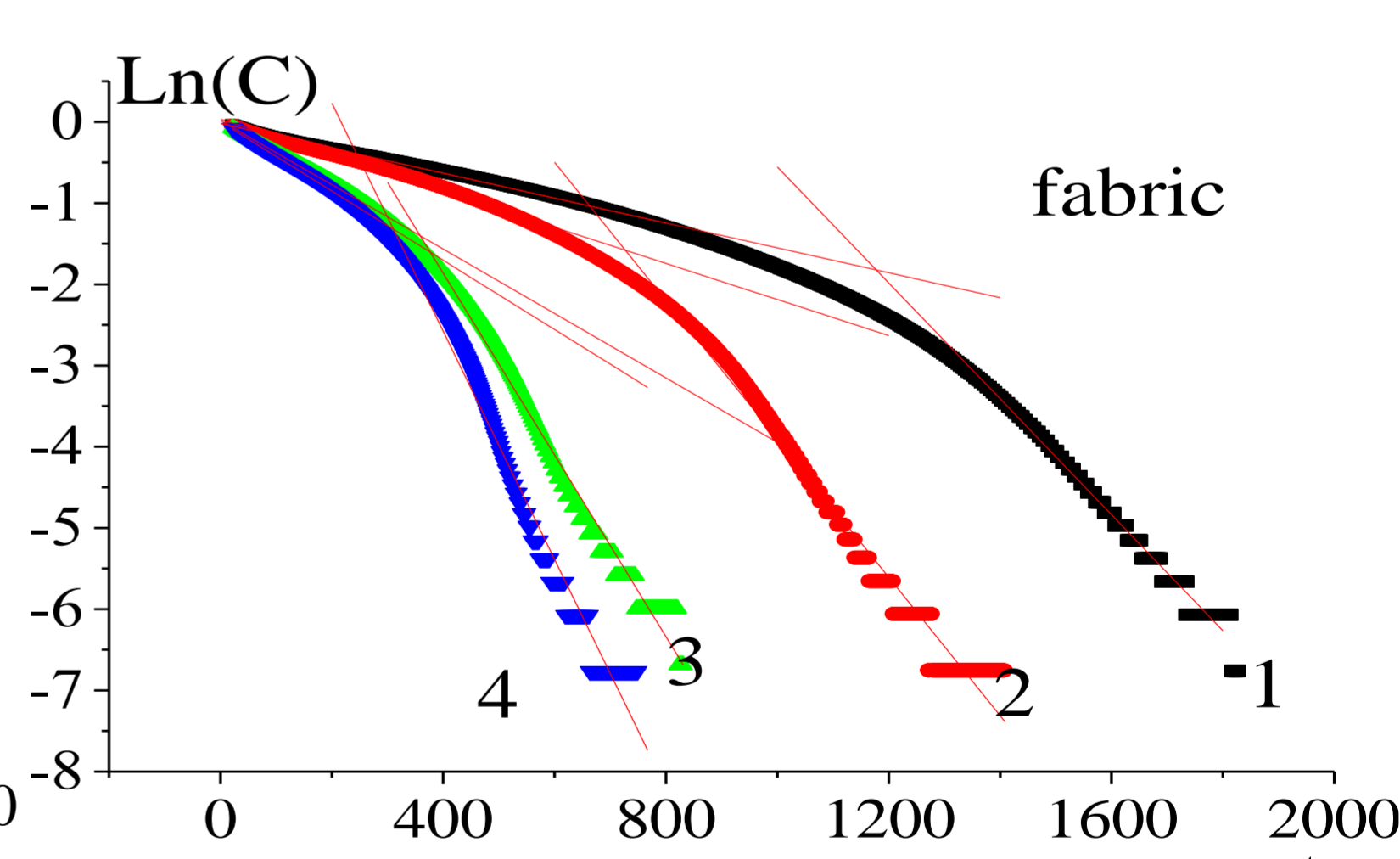
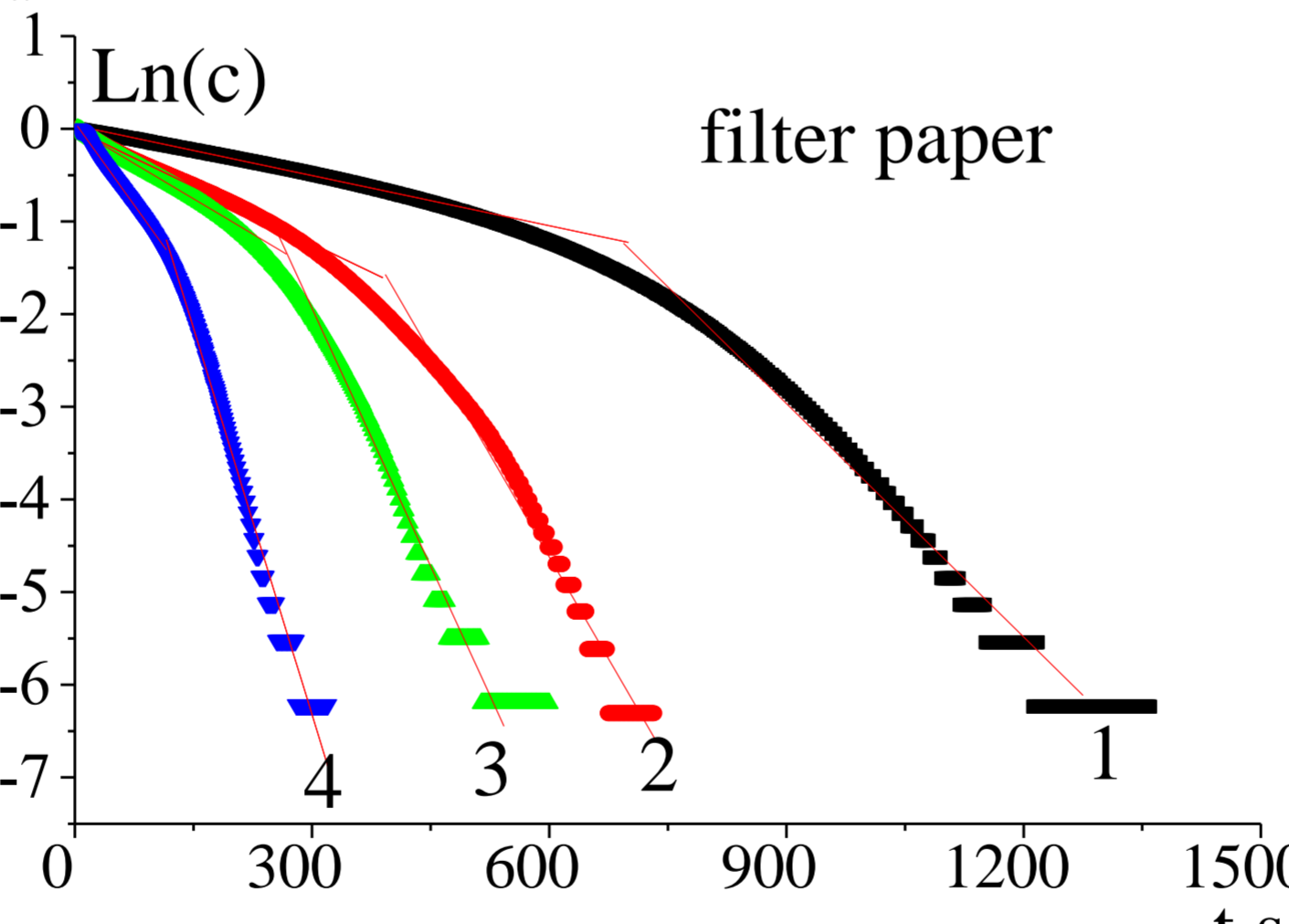
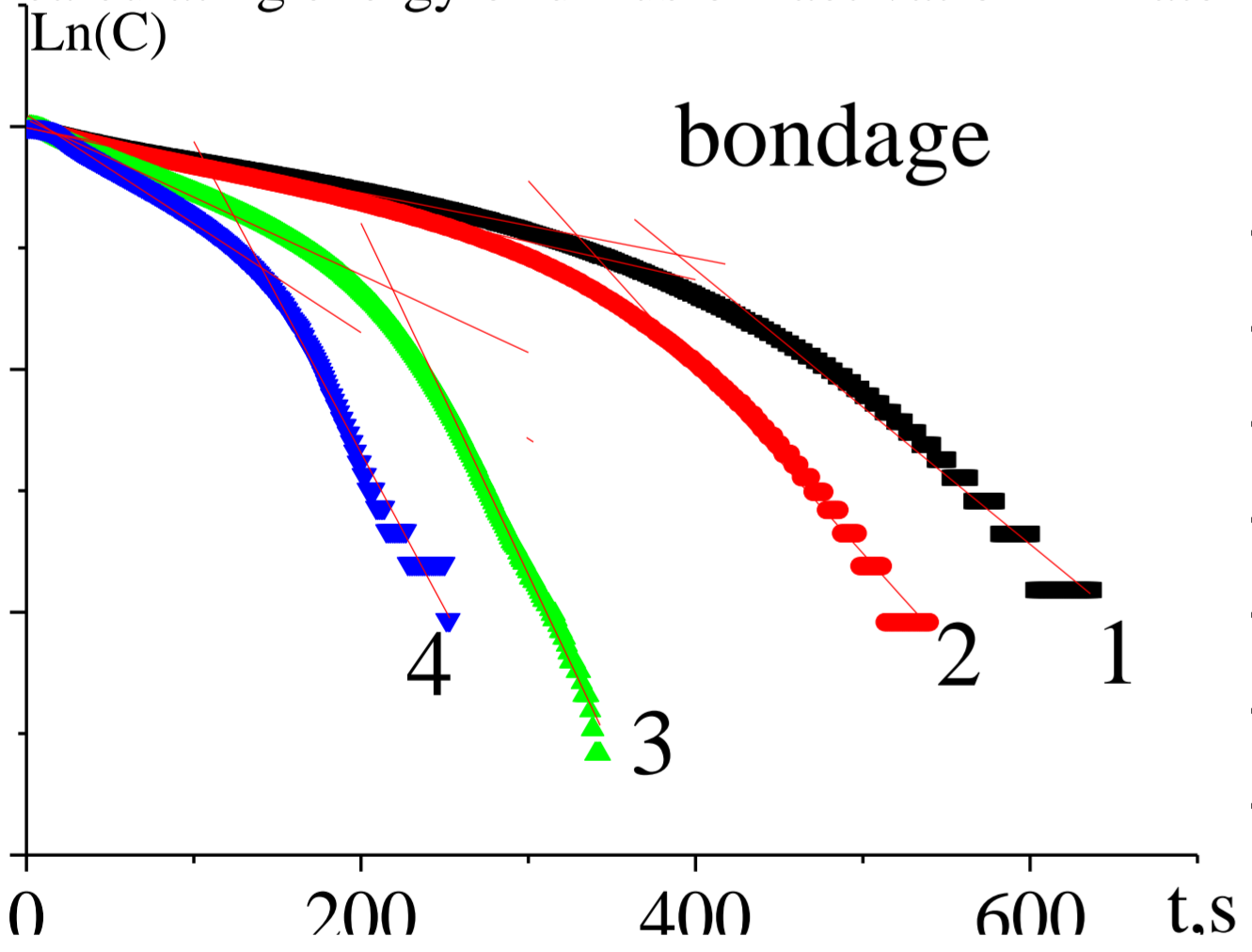
Experimental results



Investigated materials based samples mass dependences on time during water evaporating from its surfaces in the air for atmospheric pressure and different values of ambient temperatures 1-50, 2-60, 3-70 4-80 C.

Model and calculations

By using obtained experimental data water relative concentration in material (moisture content) time dependences were calculated. Obtained dependences were used for calculating energy of diffusion activation in material



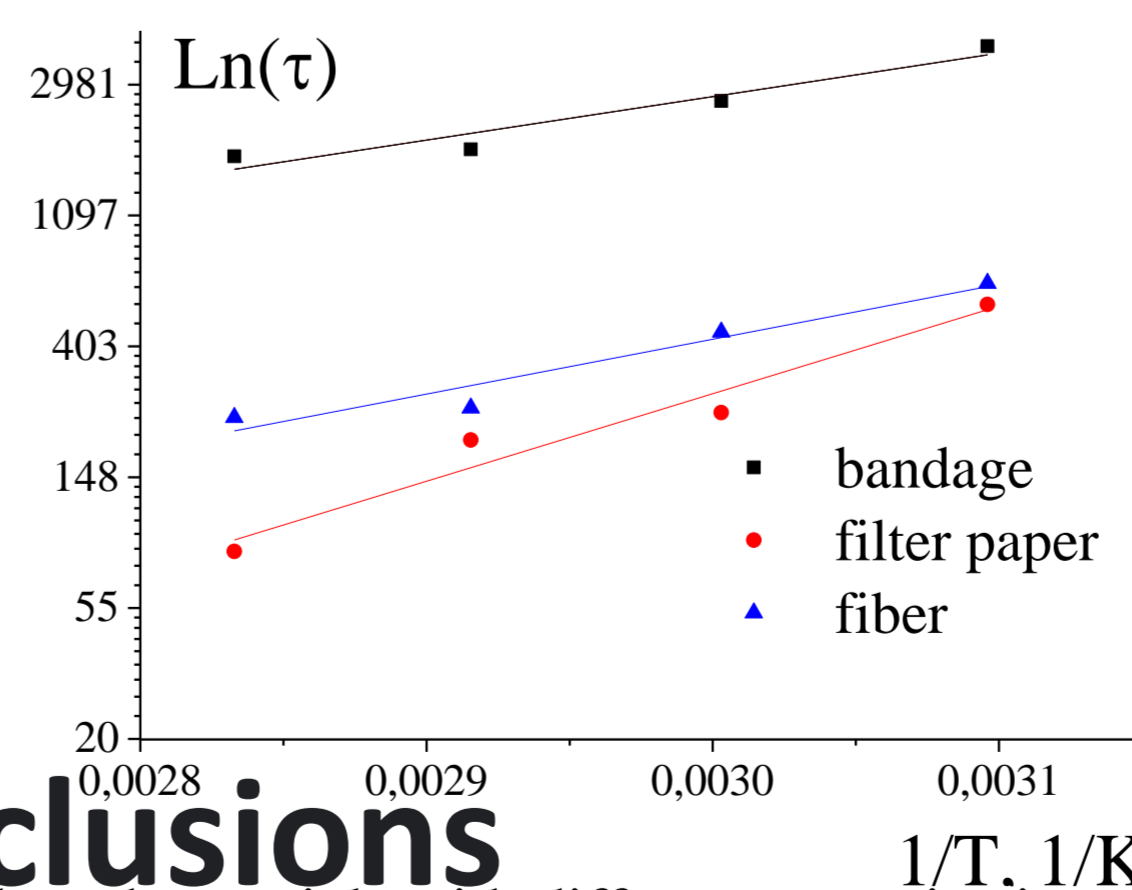
Investigated materials based samples relative water concentrations dependences on time for water evaporating from surfaces in the air for atmospheric pressure and different values of ambient temperatures 1-50, 2-60, 3-70, 4-80 C.

Model assumptions

- rate of diffusion in material is smaller the evaporation rate
- diffusion activation mechanism in material

Relative water concentration time dependence during the first stage of evaporation

$$c = (c_0 - c_\infty) e^{-\frac{t}{\tau}} + c_\infty \text{ where } \tau = \tau_0 e^{\frac{U}{kT}}$$



Material	U, cal/mol
bandage	6600
Filter paper	13300
fabric	8300

Conclusions

1. It was investigated water evaporation from surfaces of cellulose based materials with different pore size in case for different values of ambient temperature.
2. A simplified model of the water diffusion process inside the samples was proposed. The activation energies of water molecules diffusion in these materials were determined. It was shown that the greatest value of activation energy is equal 13300 cal/mol for filter paper and the smallest value is equal 6600 for bandage. For fabric activation energy value is equal 8300 cal/mol.