Constantine the Philosopher University
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Department of Chemistry

THE UPTAKE AND RELEASE OF HUMIDITY BY WOOL IRRADIATED WITH ELECTRON BEAM

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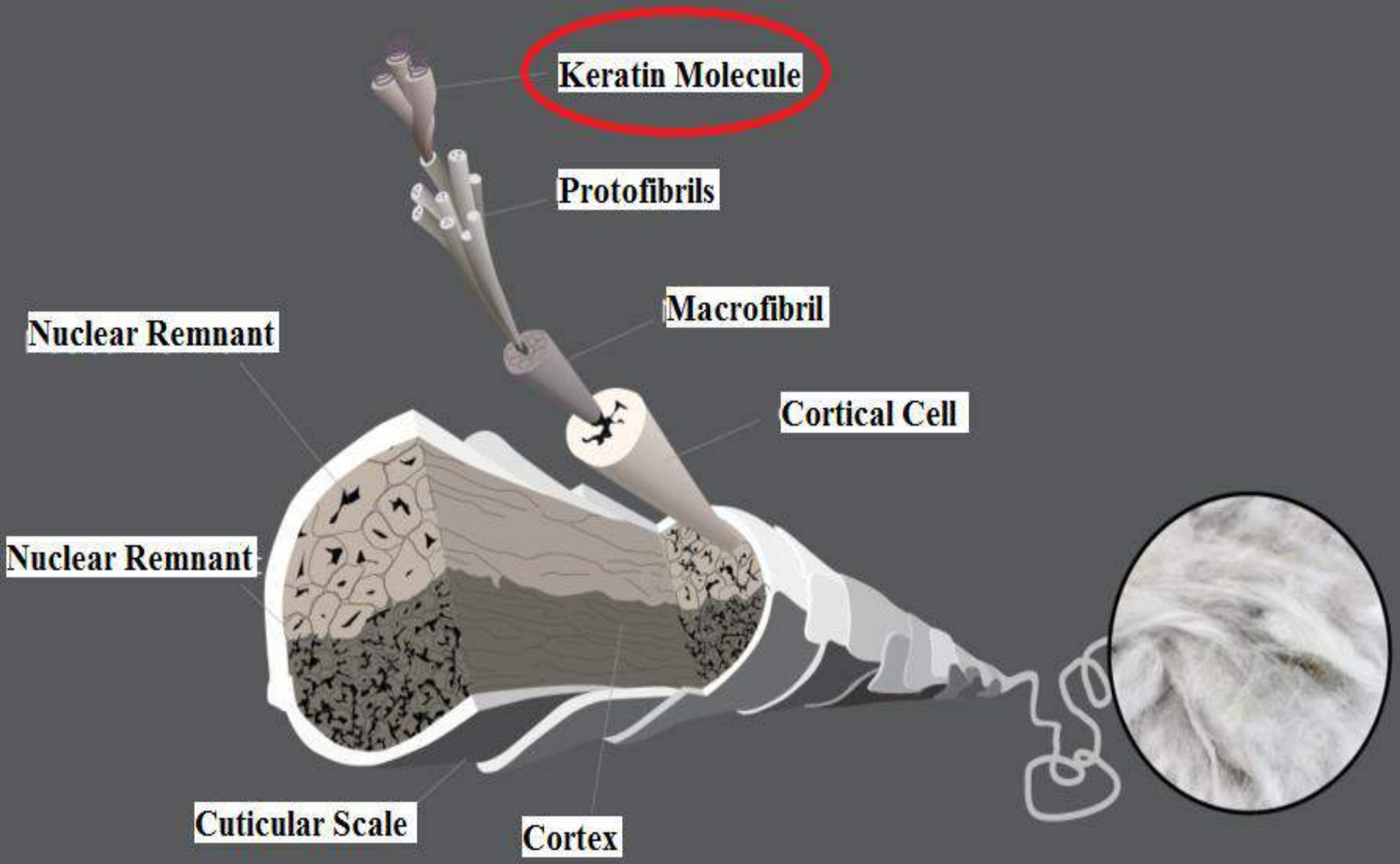
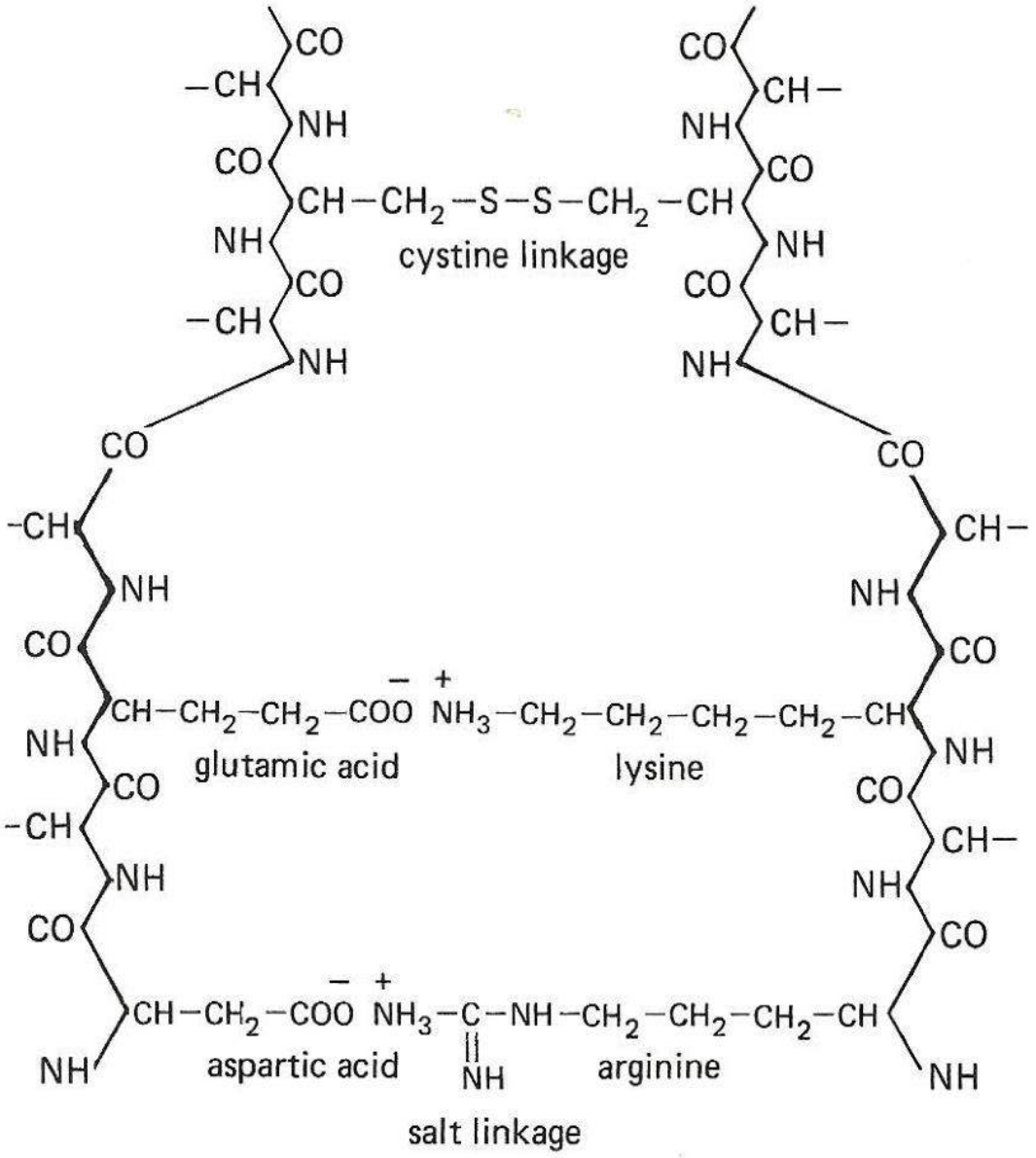
The Science of Wool Fibre



Adsorption technologies



Sheep wool

Keratin

chemisorption

or

physisorption

Wool samples

a) degreased
and **stored in desiccator** (**WD**)
b) **degreased**
and **stored freely** (**WF**)
c) **cleaned in water**
and **stored freely** (**WW**)

irradiated
by **accelerated electron beam**,
doses **0 – 400 kGy**,
in air.

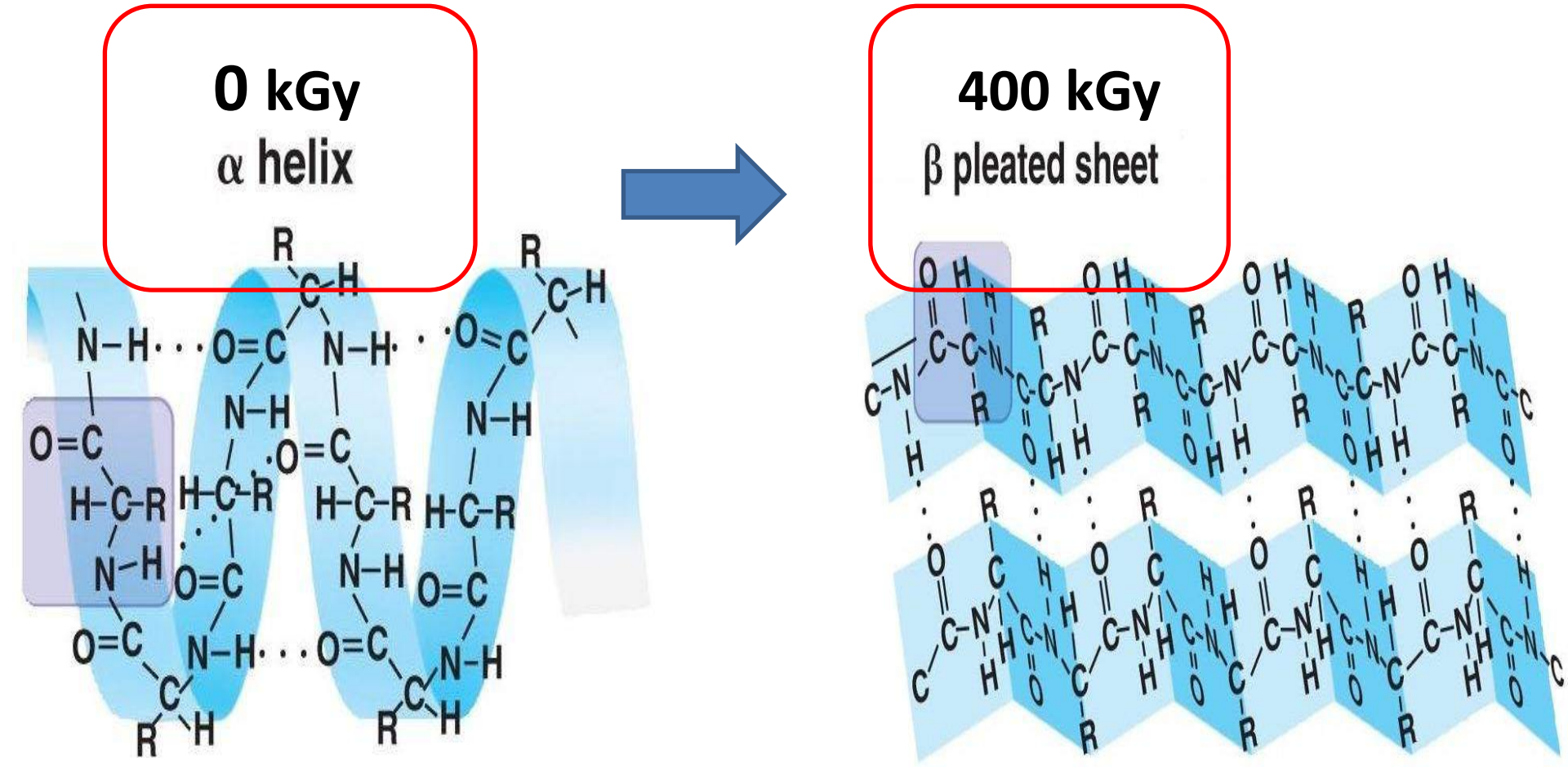
<u>The exposure in:</u>

University Centre of Electron Accelerators

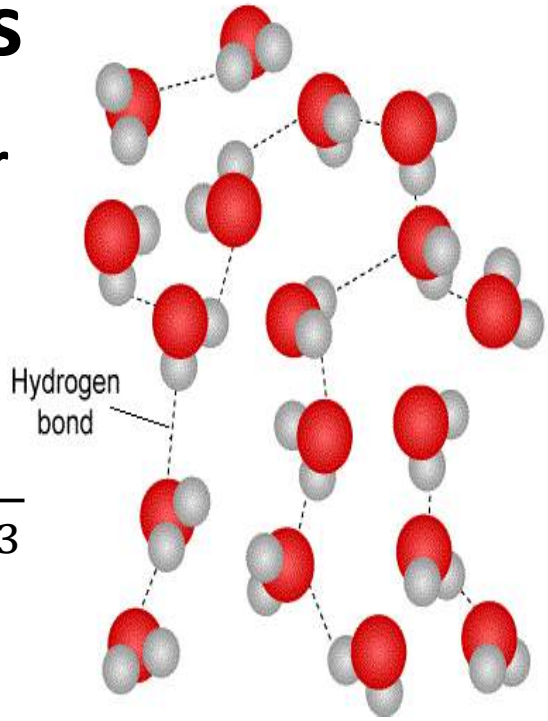
- in Trenčín
- linear electron accelerator

Irradiating electron accelerators

- Increasing absorbed dose: 0 kGy ➡ 400 kGy
  - increasing of **β-sheet** over **α-helix**



FTIR spectral analysis



- **the irradiation of wool with electron beam in air**
  - leads to the splitting disulphide bridges in keratin molecule
  - following oxidation gave S-sulphonate:

$$- \mathrm{R-S-S-R} \xrightarrow{e^-} \mathrm{R-S-S^{\cdot}} - \xrightarrow{O_2} \mathrm{R-S-SO_3^-}$$

- **more polar oxygenic groups**
  - modified properties of wool
  - wool altered affinity for other polar substances

<u>Higher content of S-sulphonate</u>

↓

better conditions to create H-bonds

↓

between molecules H_2O and polar S-sulphonate groups

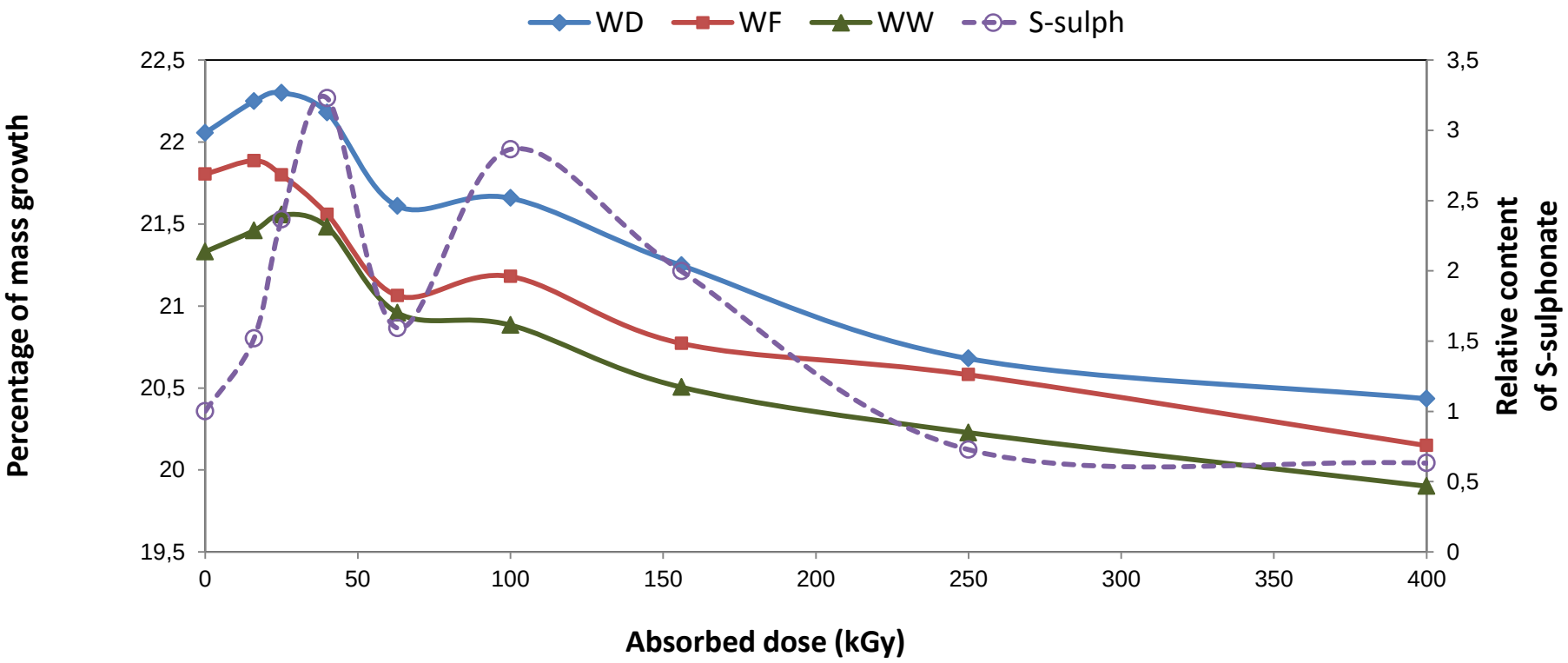
The uptake of humidity by sheep wool

- room temperature
- 97 % relative humidity

examined **gravimetrically**

- Wool irradiated **16-40 kGy** – the best results

S-sulphonate is high, α-helical conformation prevails



Comparison of humidity uptake for all wool samples depending on absorbed dose and related to content of S-sulphonate in the degreased dry wool (WD)

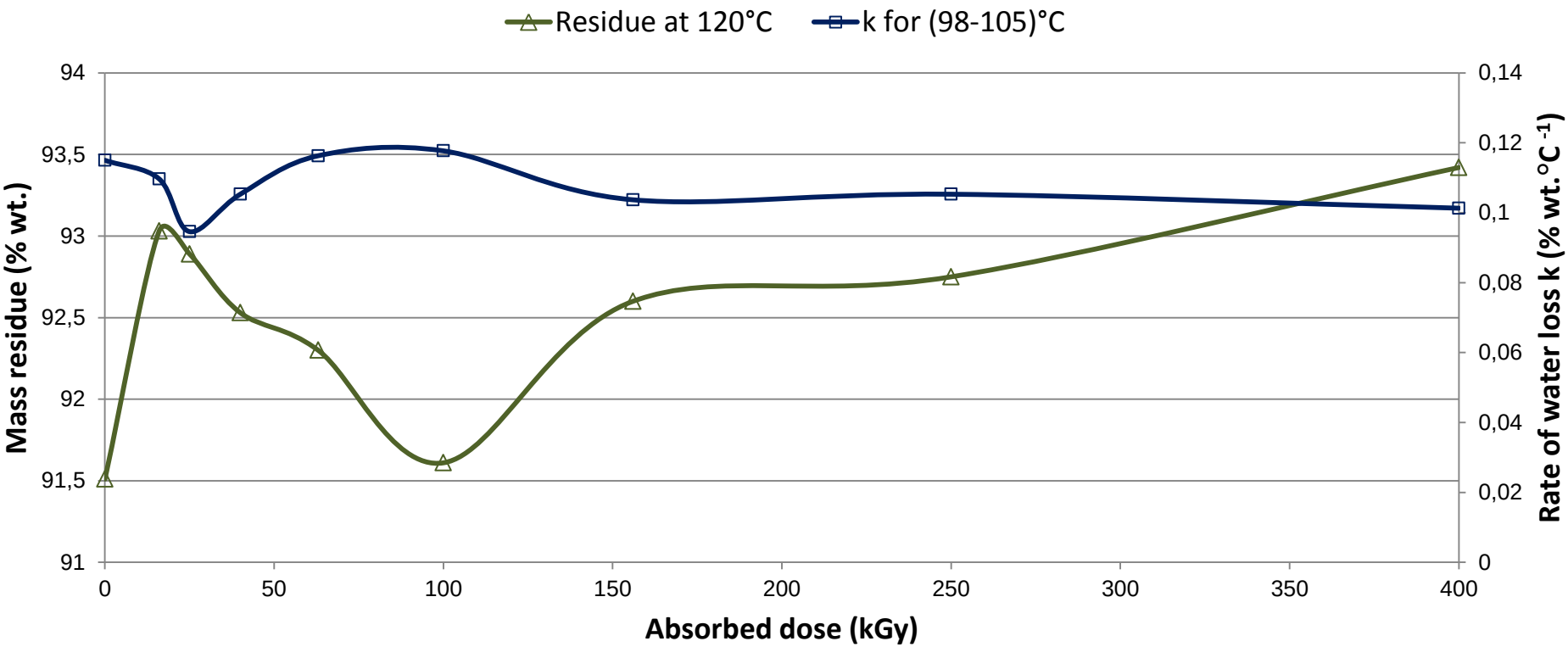
The humidity release and rate of mass loss

- measured using **thermogravimetry**

0 and >100 kGy - the weakest retention of water – β sheet

16 – 25 kGy - the smallest loss of the humidity,

- humidity uptake, S-sulphonate content attain the maximum - α-helices
- surface tension increases.

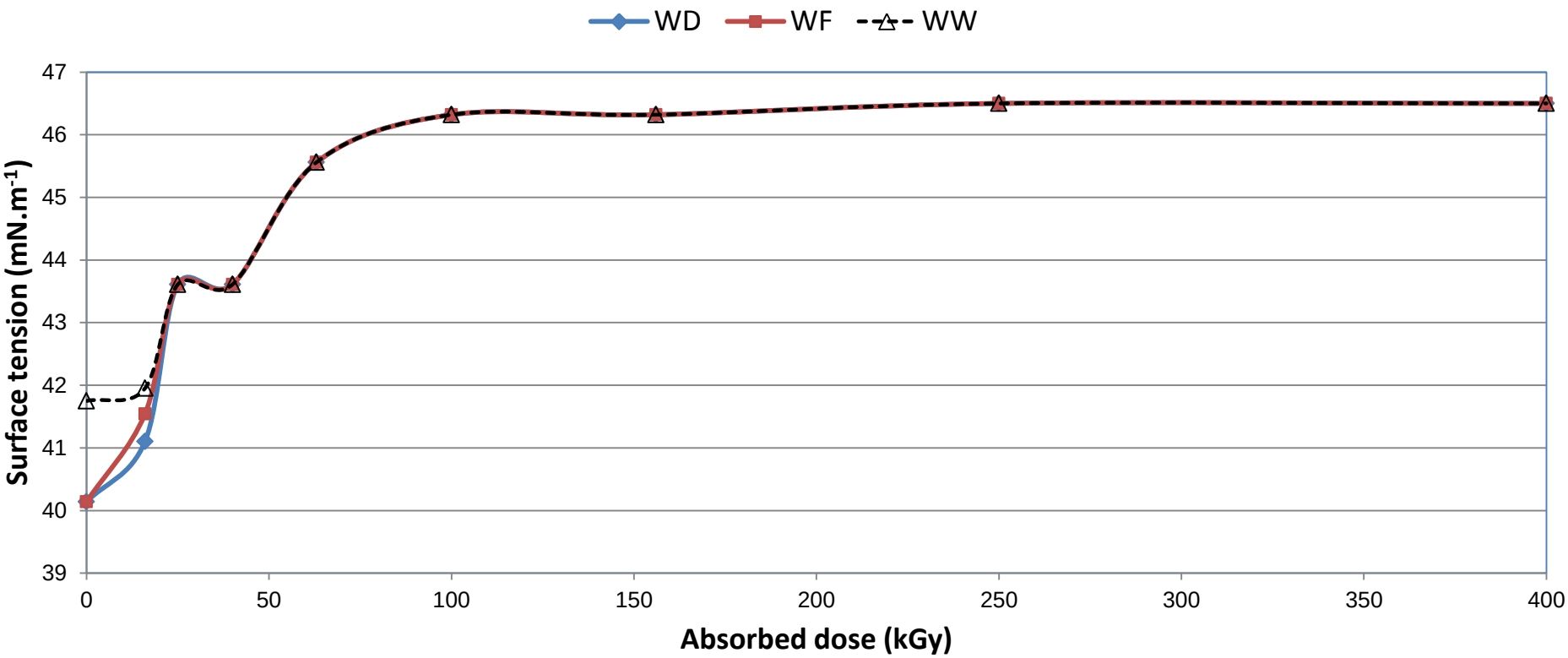


Dependence of residual mass at 120°C and rate of water loss in degreased dry wool (WD) on absorbed dose within range of (98-105)°C on absorbed dose

Surface tension fibres of sheep wool

- determined using **flotation method**
- measured by **stalagmometer**
- **increasing from starting doses to 100 kGy**

63 kGy dose and higher - the keratin denaturation



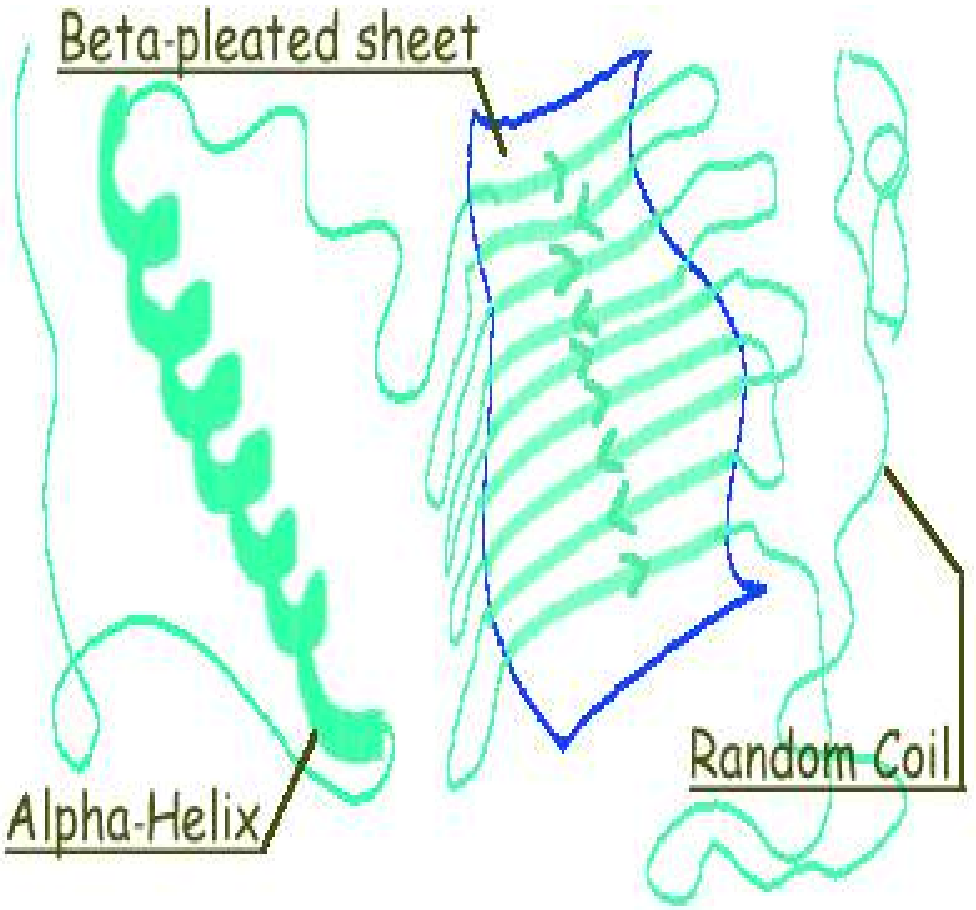
Variation of surface tension for the wool samples depending on absorbed dose

Conclusion

Irradiation of wool fibres with electron beam:

- generation of **S-sulphonate**,
- variation of **humidity uptake** and **release**,
- modifying **surface tension**.

All parameters show some fluctuation depending on ***absorbed dose*** *as well as on conformational composition of* ***wool secondary structure***



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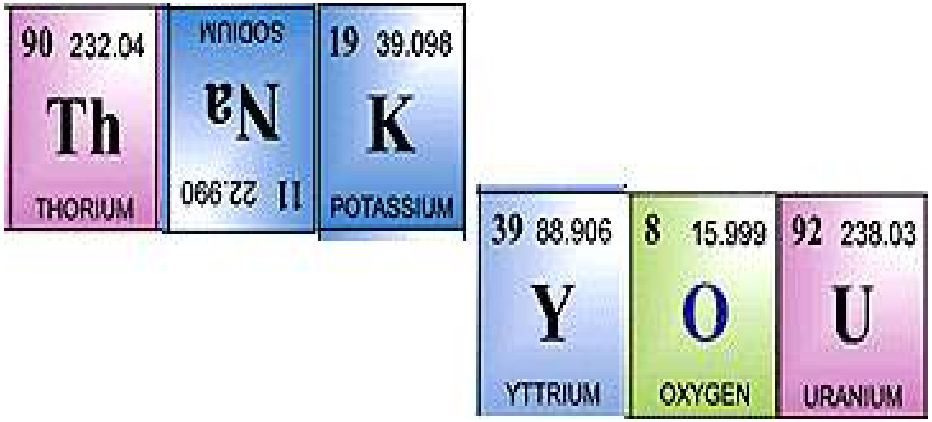


Thank you
for your attention.