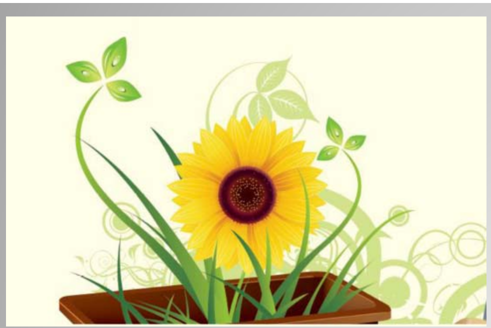

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Obtaining bi-layer particulate filters with the participation of a layer of electrospun nanofibers

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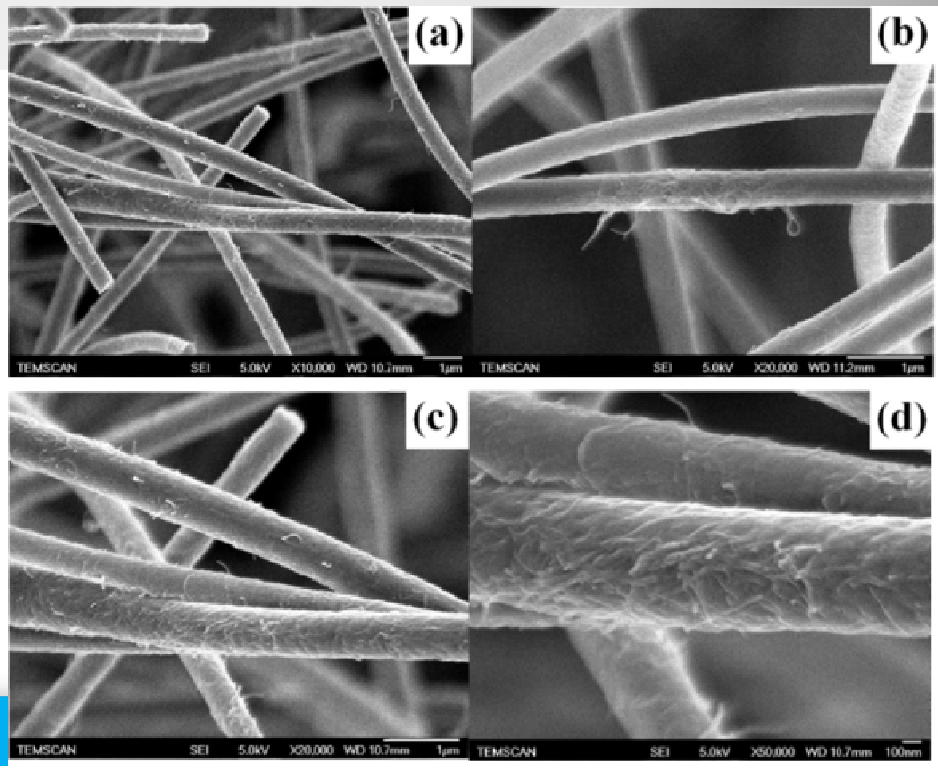
Nano-composite fiber-based structures:

- ✓catalysts,
- ✓sensors,
- ✓carriers and transmitters of information,
- ✓solar cells,
- ✓ heat accumulators,
- ✓electrical insulators,
- ✓bio-functional,
- ✓possessing fire-resistant, non-flammable and healing-cosmetic properties.



AIM OF THE WORK

to demonstrate the possibility of applying a layer of nanofibers on a layer of waste cotton fibers and powders obtained by the wet method of an installation constructed in Technical University-Sofia under project BG161PO003.1.1.05-0261 "Filter media of non-woven fabric".

Major problems in production of nanofiber mats and combinations with their participation:

- ✓production of nanofibers or nanoparticles;

- ✓finding a suitable textile carrier and forming a composite material with the participation of a certain type of nanolayer;

- ✓quality control of the nanofiber wool depending on the nature of the lap, the polymer used and the composition of the solution / smelt undergoing electrospinning.

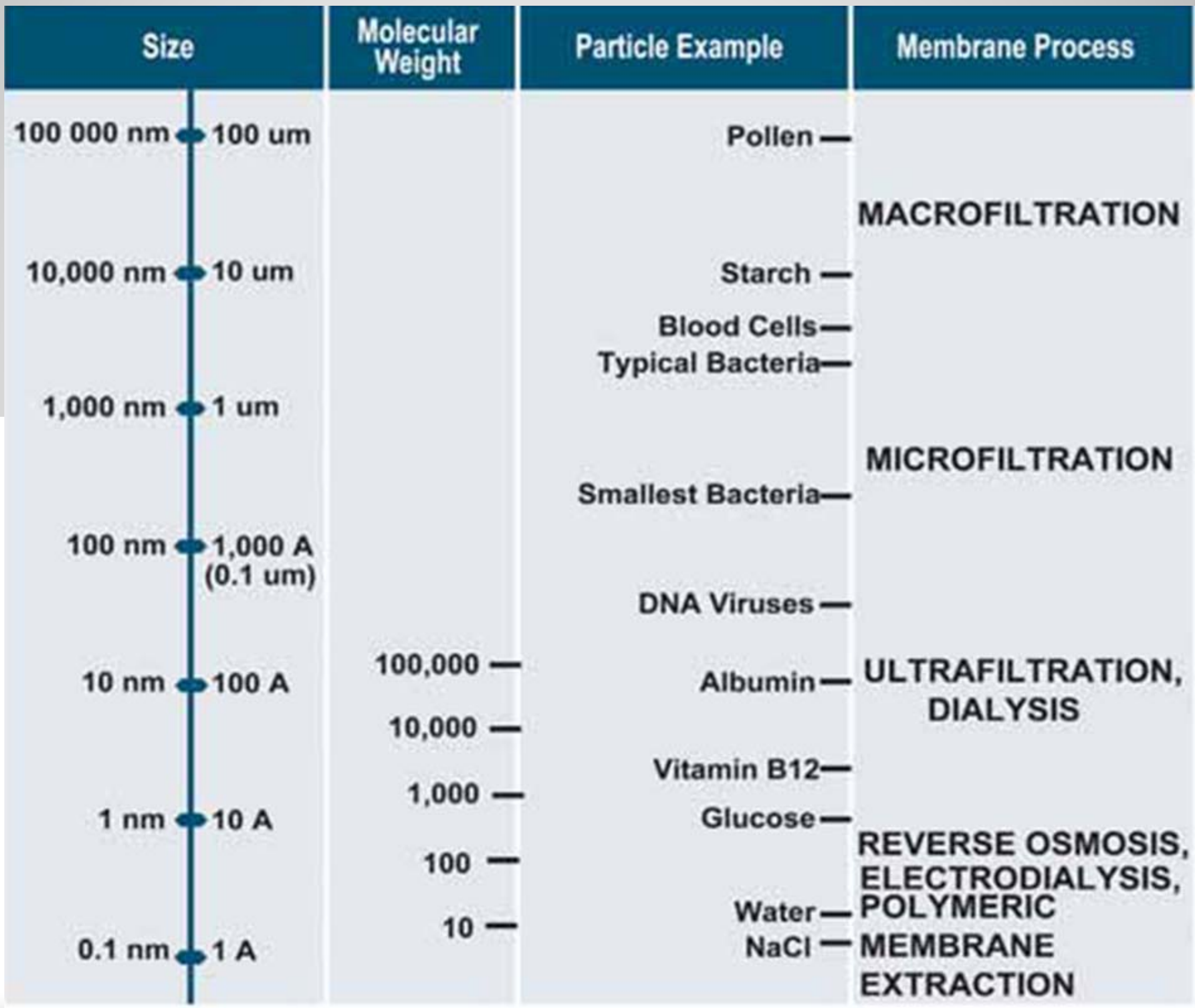
Basic set of parameters is active in the electrospinning / electrospraying process:

- ***Solution parameters*** - Polymer selection (molecular weight, average degree of polymerization, molecular weight distribution), solution properties (viscosity, conductivity and surface tension, electrical potential, flow type and concentration).

- ***Process parameters*** - nozzle/collector screen distances, environmental parameters (temperature, air humidity in the chamber and in the room), collector movement.

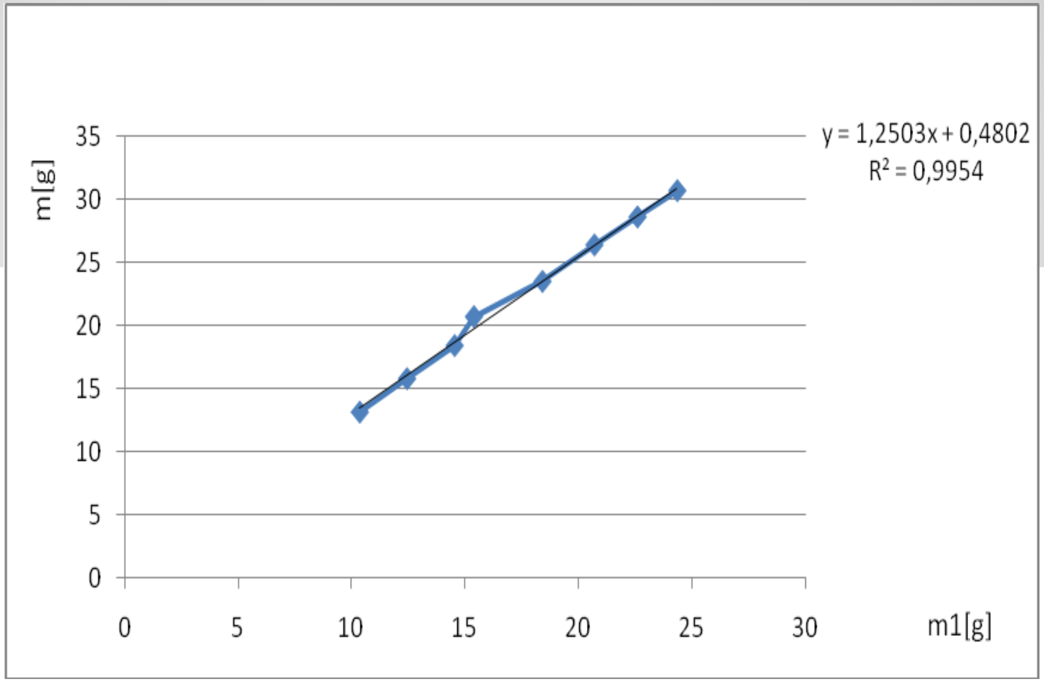
- ***Parameters of the collector or carrier of the nanofiber mat*** – foil, fabric, nonwoven fabric obtained by different methods.

Relation between the filter pore parameters and the particle size they retain



Obtaining the mats:

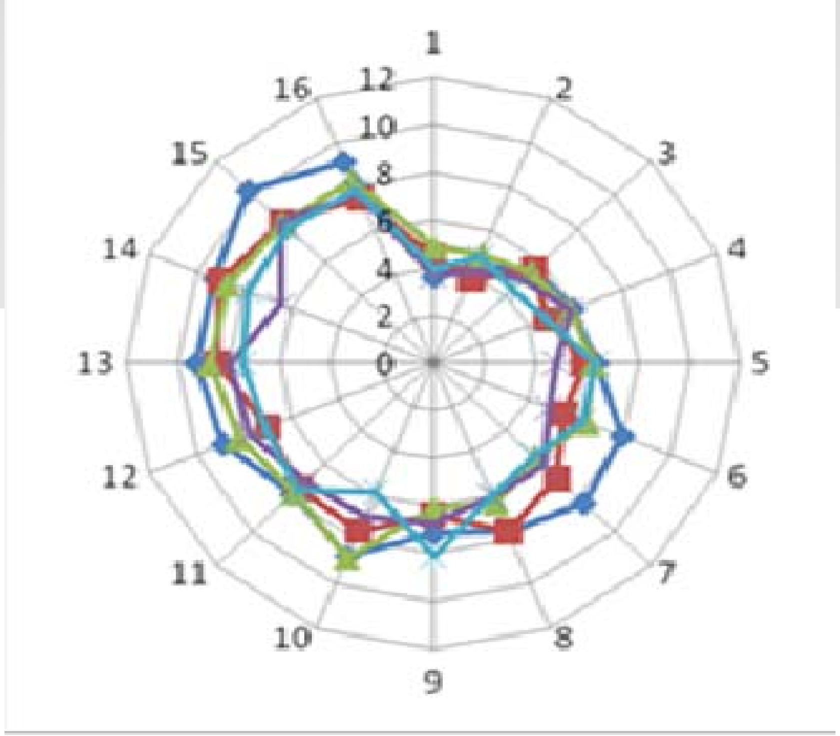
- by precipitating different amounts of fiber
- the amount of the primary binder remains unchanged.



Linearly increasing the mass of the mat (m) when increasing the mass of the fiber during casting (m^1)

Results and discussion

Thickness of the samples depends on the site of measurement
- specificity of the working area of the apparatus used
- affects the process of spinning.



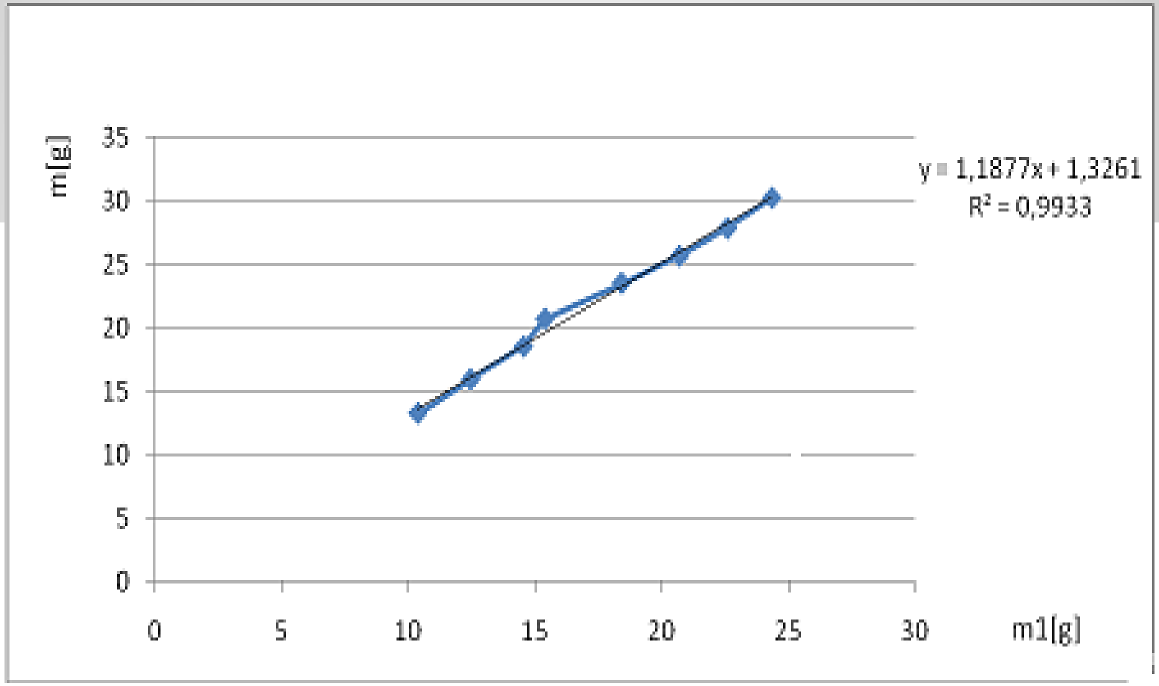
Distribution of the sample thickness in the working area

Measurement - in the center from a pre-labeled mark at 0, 90, 180, 270 degrees.

When changing the thickness at different point, the air permeability also changes.

Reducing the mass and thickness - air permeability increases

- affects electrospinning process and parameters of the bi-layer material;
- no change in the mass of the bi-layered article after electrospinning on a mat.



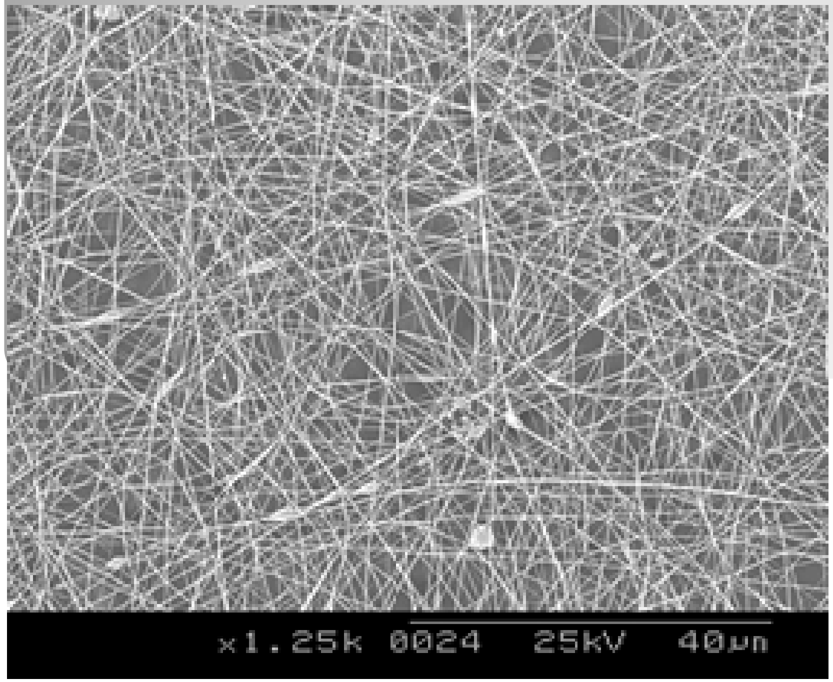
Increasing of the mat's mass (m) after applying a nanofibers layer depending on the quantity of fibers in the lap (m^1).

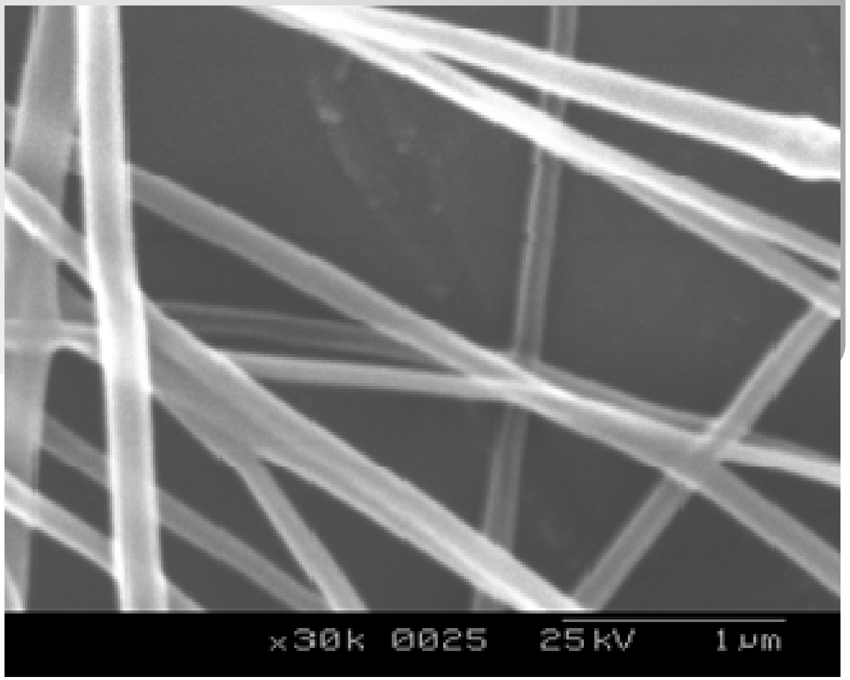
Spinning

✓performed vertically from a 9% solution of polyvinyl alcohol (PVA) for 1 hour
✓at 190 mm distance between the nozzle and the collector,
✓15 kV voltage
✓ 27G nozzle size
✓ 0.1 ml/h flow rate of the polymer solution.


Material prepared by the wet method before and after electrospinning.

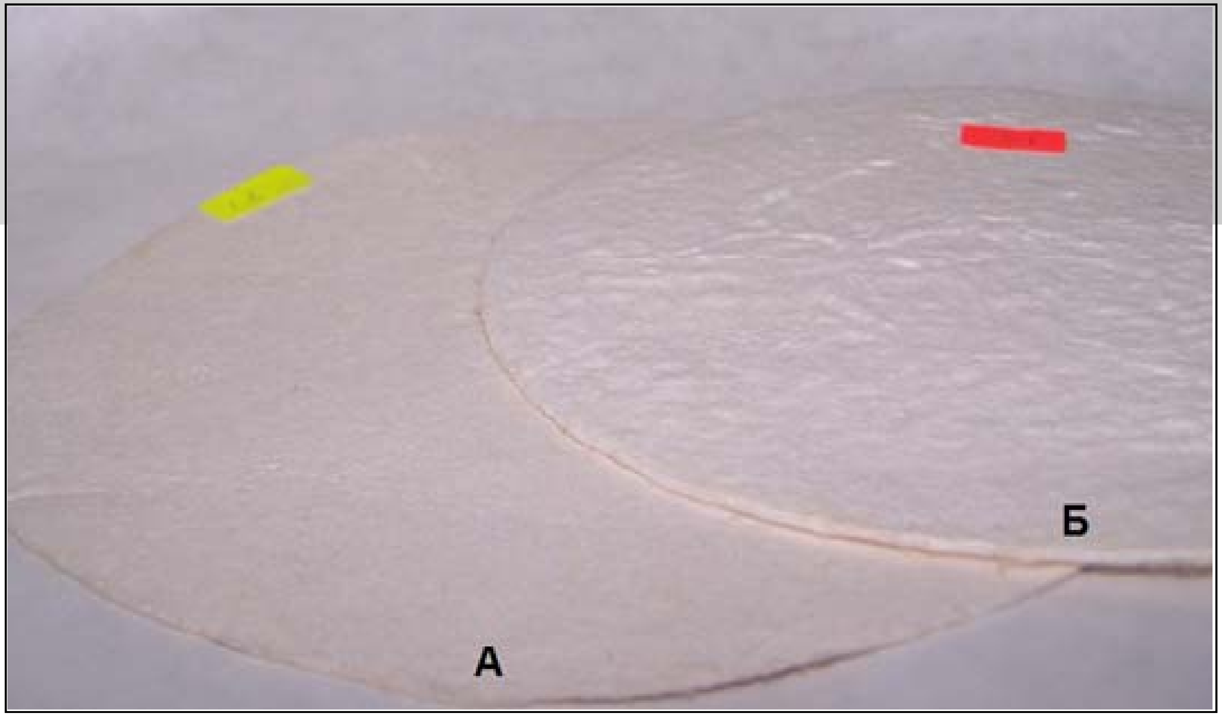
Fiber line and pore distribution represented by scanned electron microscopy (SEM) images of the nanofibers layer





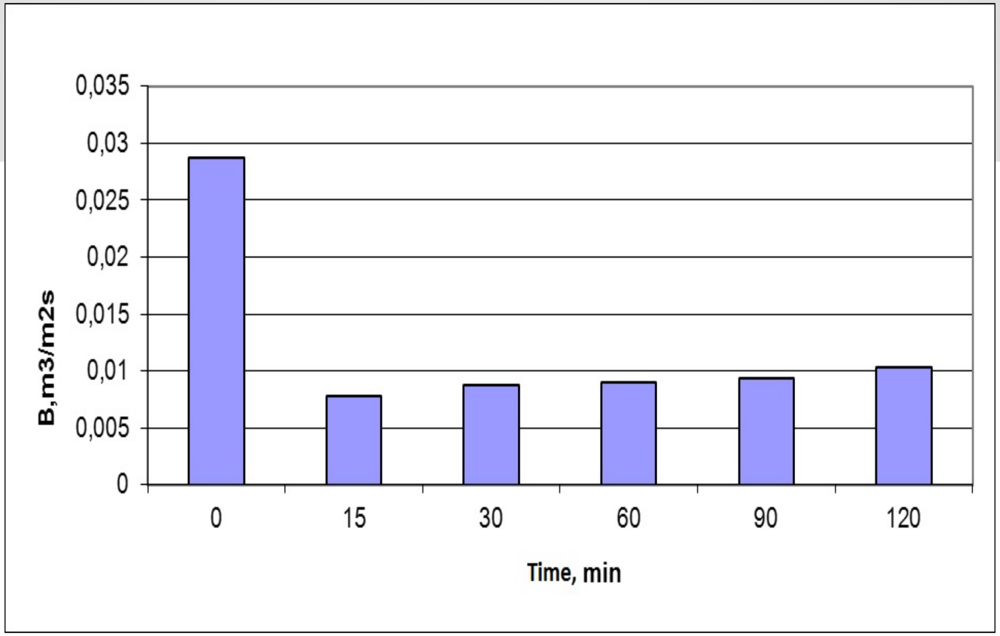
SEM picture of a mat of nanofibers applied on nonwoven fabric obtained by the wet method.

Appearance of the resulting filter barriers



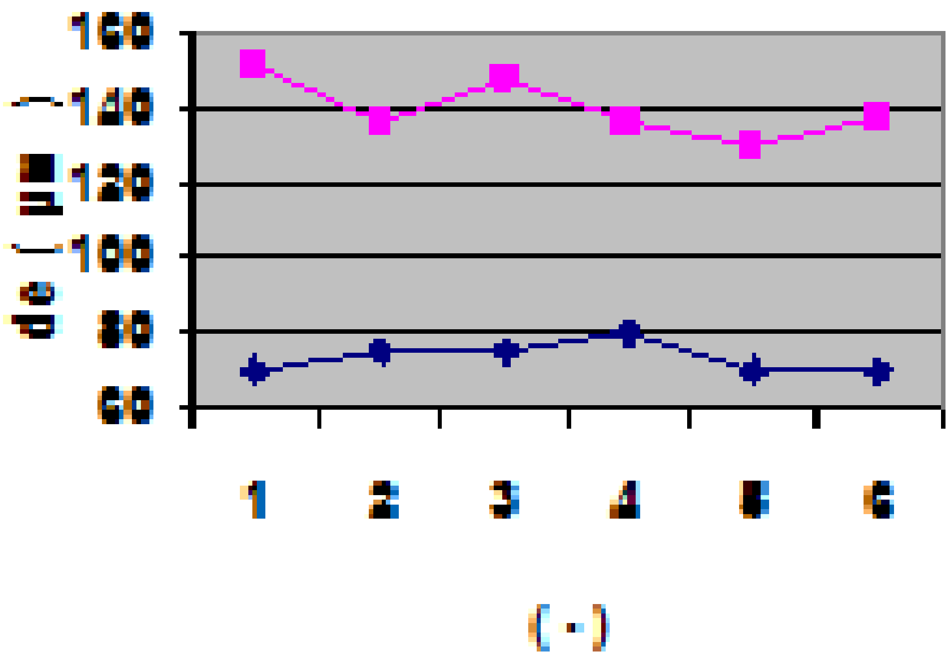
Air permeability of the bi-layer materials

- greater uniformity and a significant reduction in the air permeability coefficient
- established improved uniformity in air permeability after electrospinning a nanolayer - due to penetration of the fibers with nano-sized volume into the pores and the coating with a net of nanofibers.



Change of air permeability after application of a nanofibers layer with the electrospinning time.

Determination of the pore size change of the hybrid material



Pore size change after laying a mat of nanofibers before (■) and after electrospinning (◆).

➢possibility of moving the hybrid filter into a higher class and its application for specialized small size particle retention.

Conclusions

- It has been decided to continue working with powders of varying particle size and determining the efficiency of the hybrid bi-layer.
- The resulting mats by the wet process from cotton waste powders may be used as carriers of nanofibers layer.
- The technology for their preparation has been determined so as to allow laying of a second layer of nanofibers and obtaining of filters for micro- and nanoparticle retention.

THANK YOU FOR YOUR ATTENTION!

Acknowledgements

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