Nanofibers Technologies in Air Filtrations

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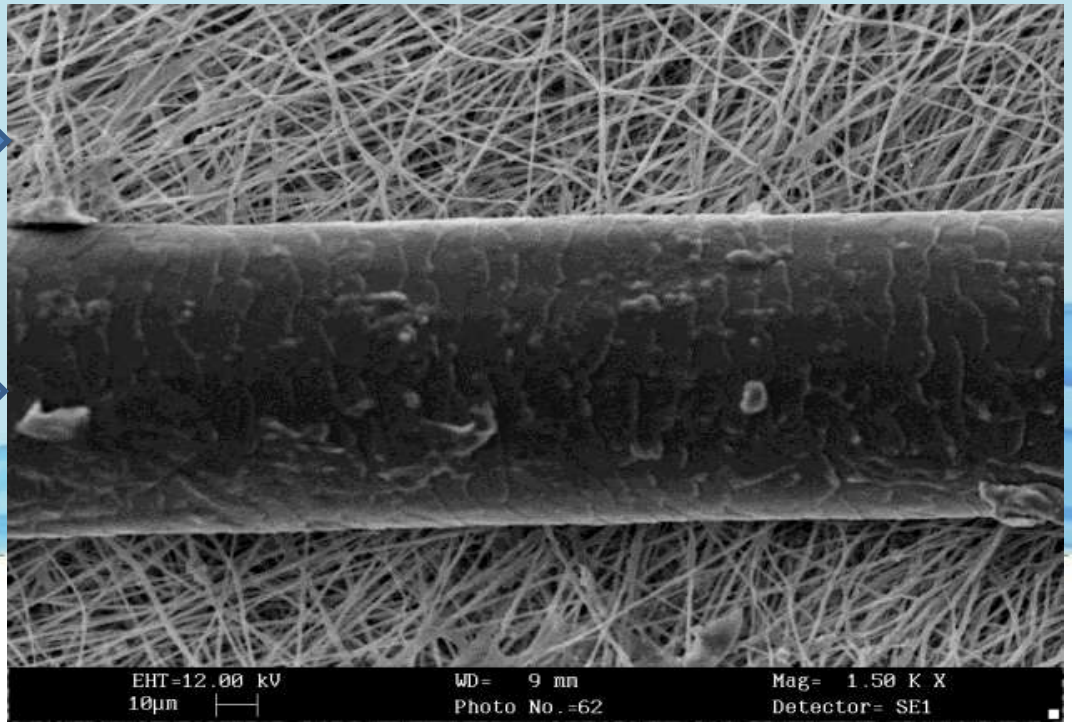
A comparison

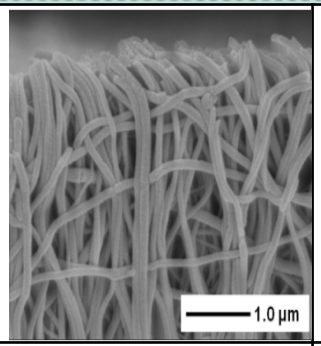
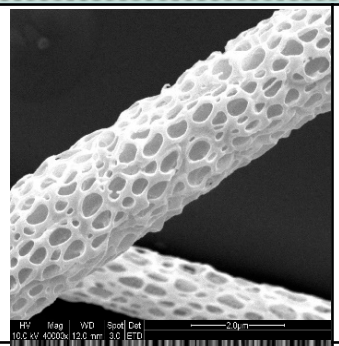
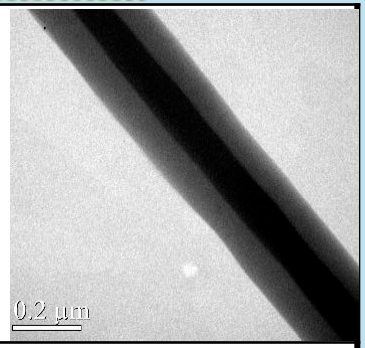
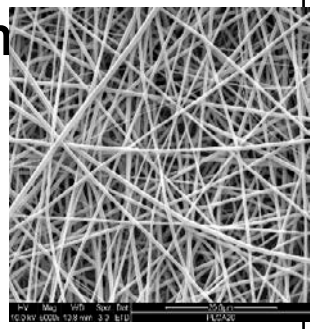
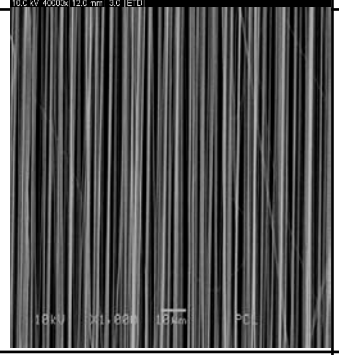
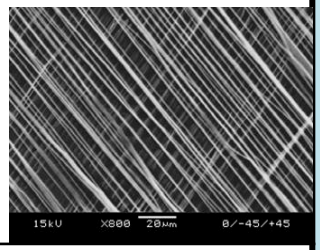
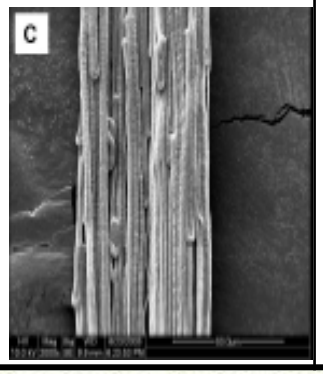
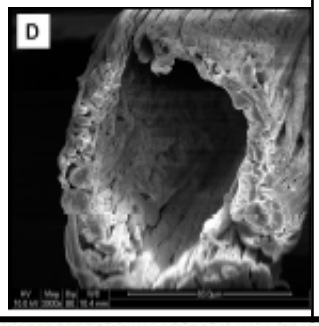
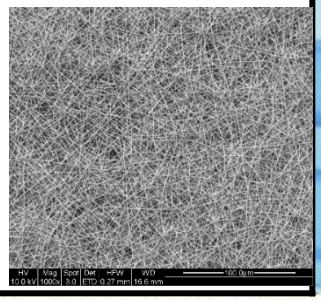
	Length (mm)	Diameter (nm)	Volume (mm^3)	Number of Fibers	Surface area of 1 fiber (mm^2)	Surface area of total fibers (mm^2)
A Human Hair	1000	100000	7.85	1	31.4	31.4
A nanofiber	1000	100	7.85×10^{-6}	1000000	0.0314	31400

Nanofibers

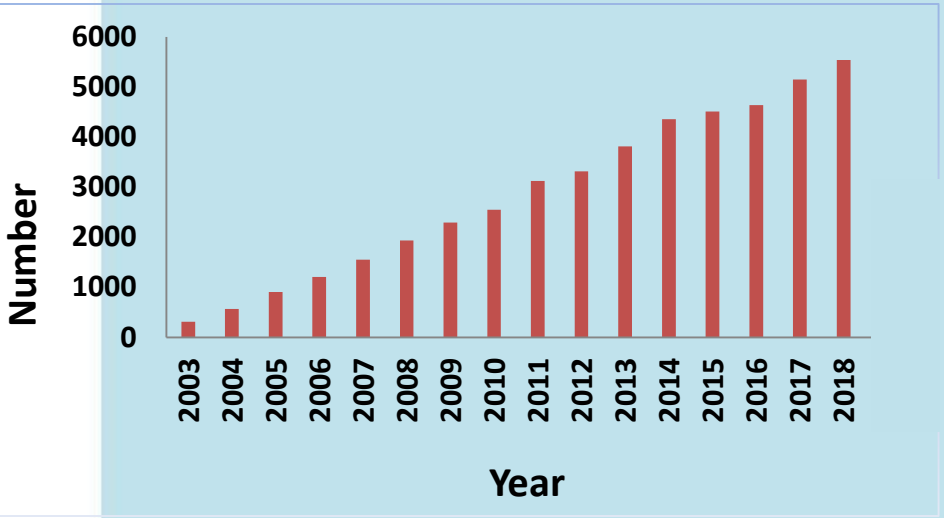
Human Hair

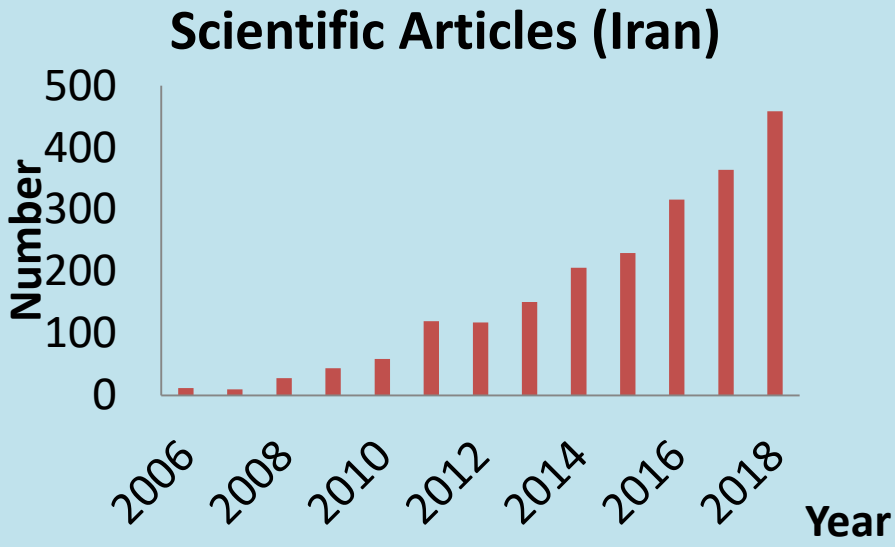


Variety of Electrospun Nanofibers

Solid 	Porous 	Core-shell 
Random 	Aligned 	Layered 
Yarn 	Hollow yarn 	Membrane/Sheet 

Scientific publications





World

Iran

Source: Scopus till end of 2018

Applications

Industrial	Filtration	• Air and liquid filter • Anti-microbial filter
	Catalysis	• Chemical Catalysts • Electrochemical Catalysts • Photocatalysts
	Electronic Devices	• Field-Effect Transistor • Chemical Sensors
Medical	Drug delivery	
	Wound dressing	
	Tissue engineering	• Scaffolds • Implants • ECM mimicking medium
	Biosensor	• Chemical • Electrochemical

Li, Z. and C. Wang, One-dimensional nanostructures: electrospinning technique and unique nanofibers. 2013: Springer.

7th World Health Summit Regional Meeting
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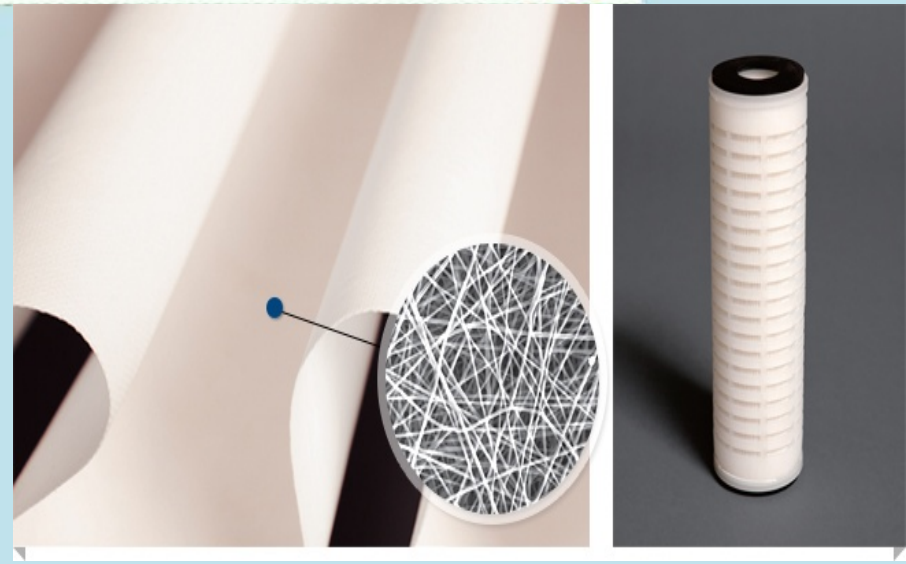
KISH ISLAND, I.R. IRAN | 29-30 April 2019

Filter Application

Major Performance Characteristics for Air Filters based on Market Survey

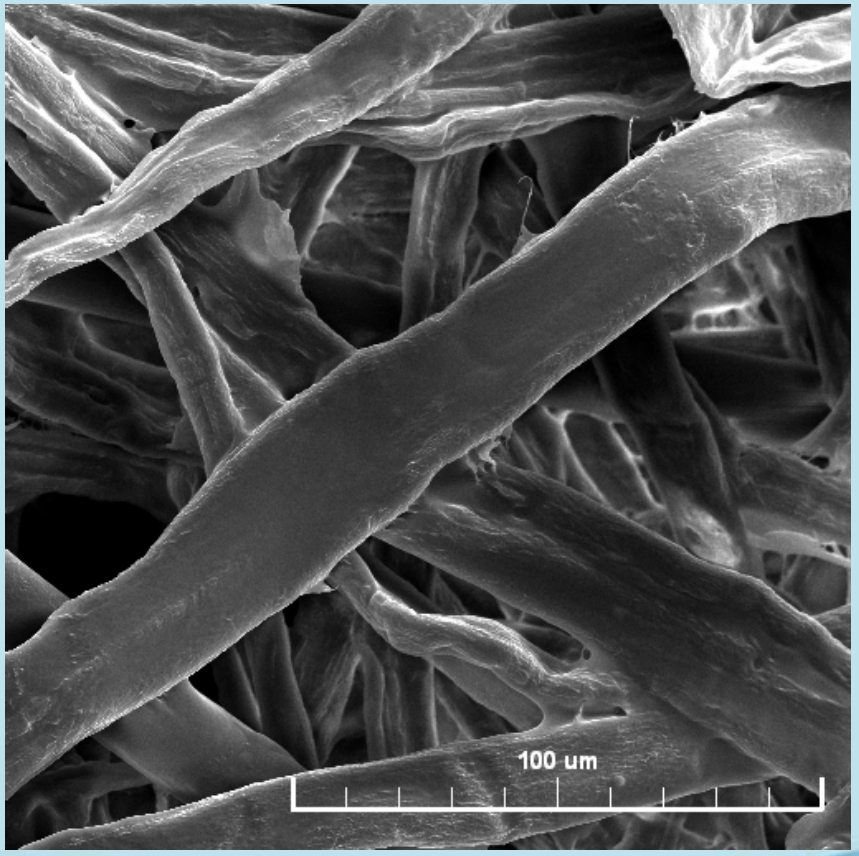


1-Efficiency

2-Pressure Drop

3- Dust holding Capacity (Life Time)

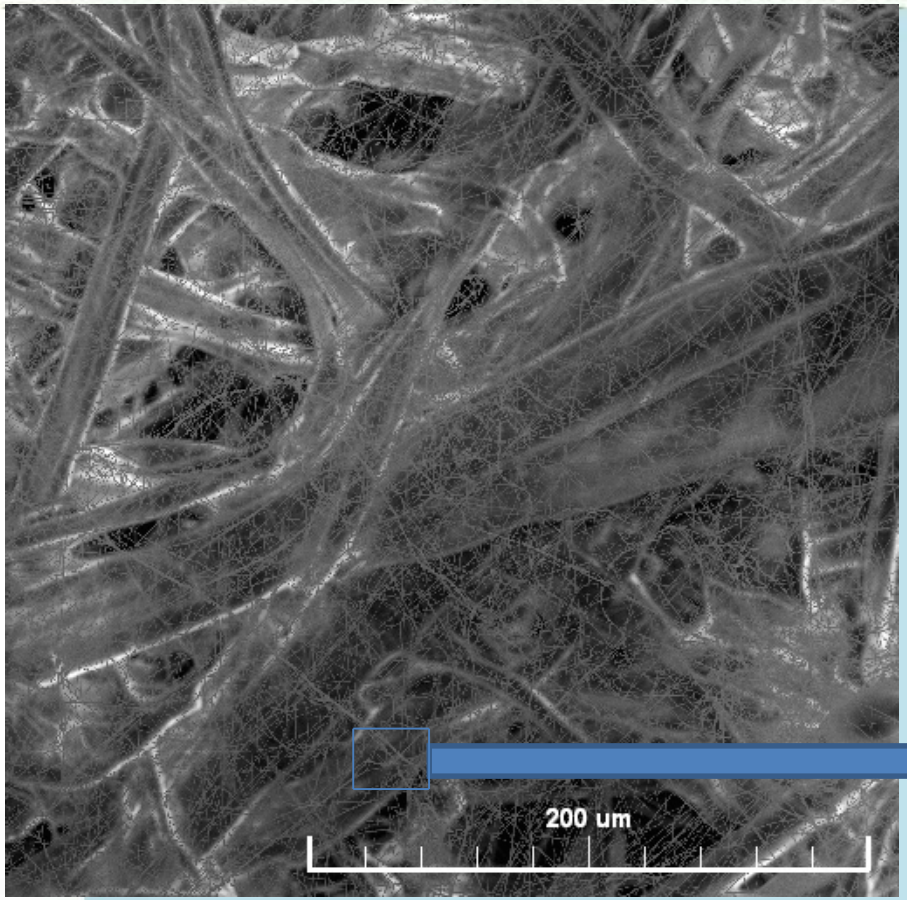
Microfiber of main filters paper

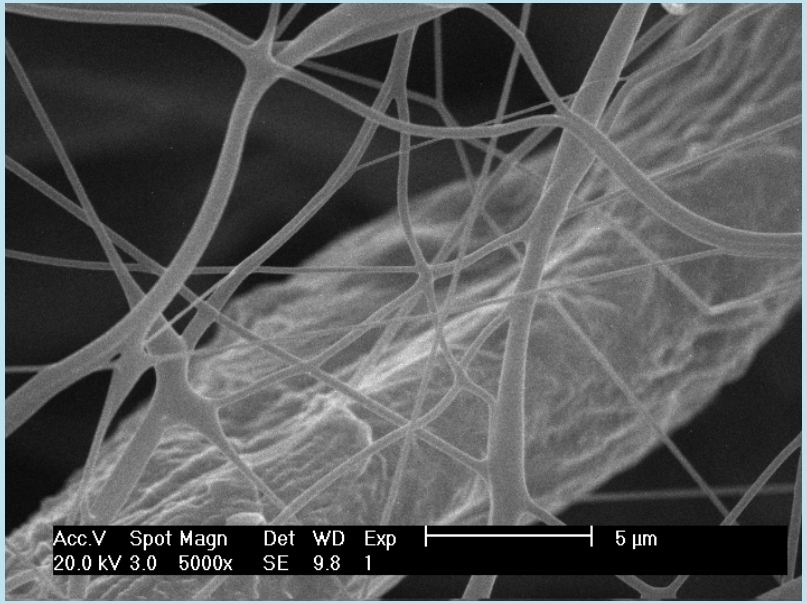


Filters' paper classification

Class	Final Pressure Drop Pa	Average efficiency (Em) of 0,4 µm particles %
F7	450	80 ≤ Em < 90
F8	450	90 ≤ Em < 95
F9	450	95 ≤ Em

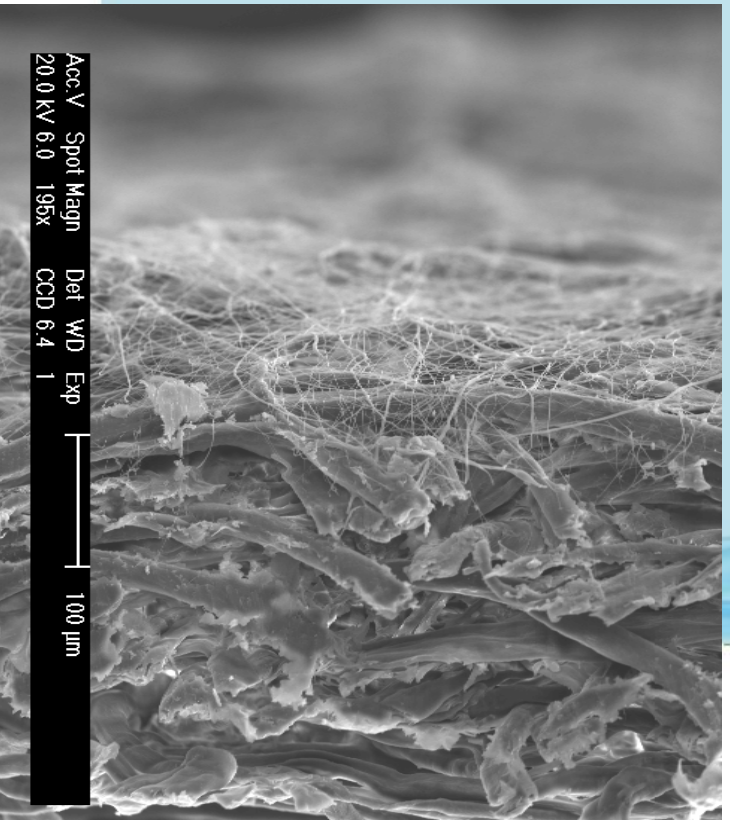
Filtration

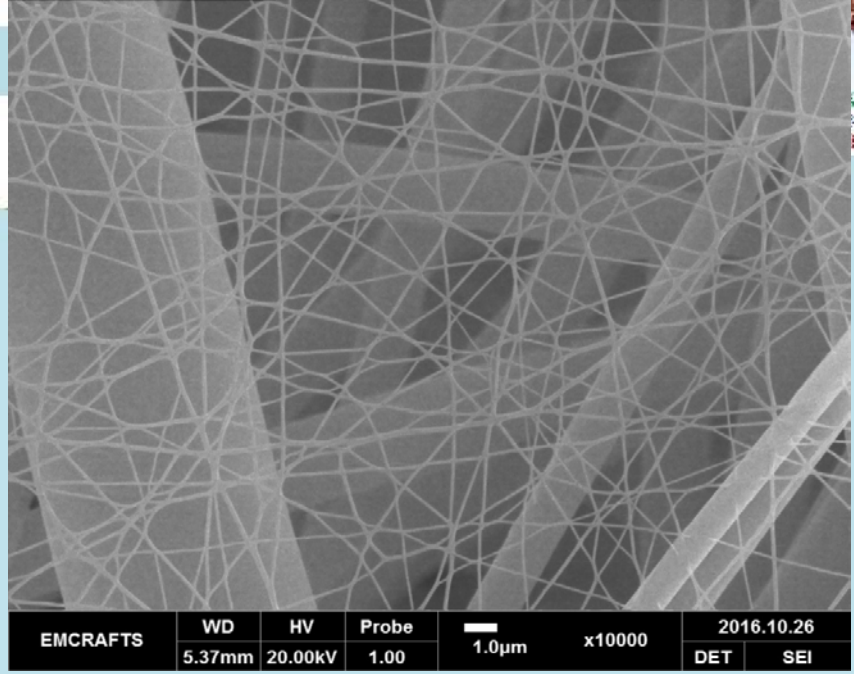


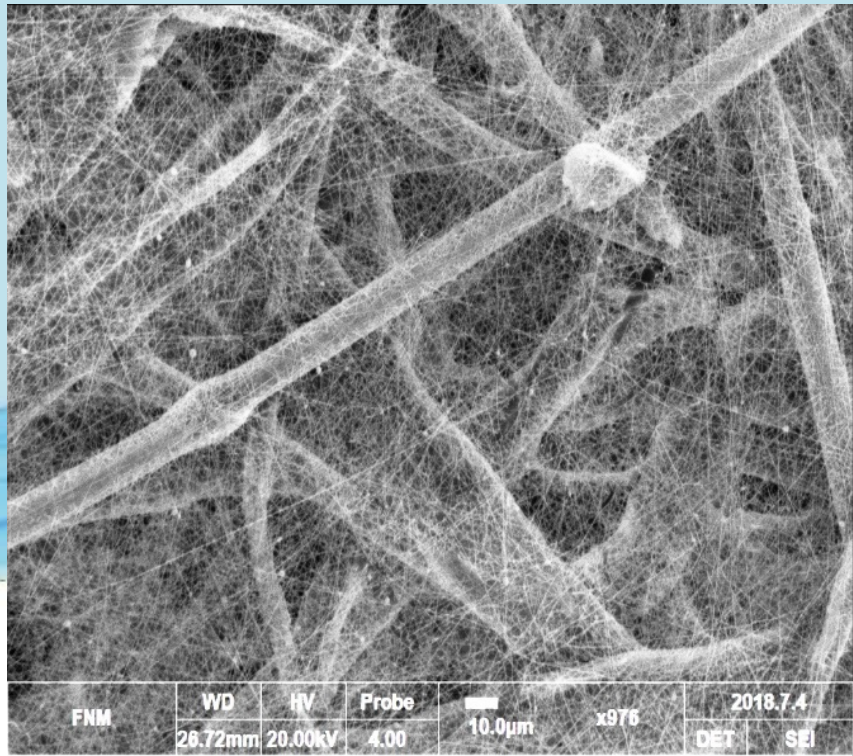


× 40

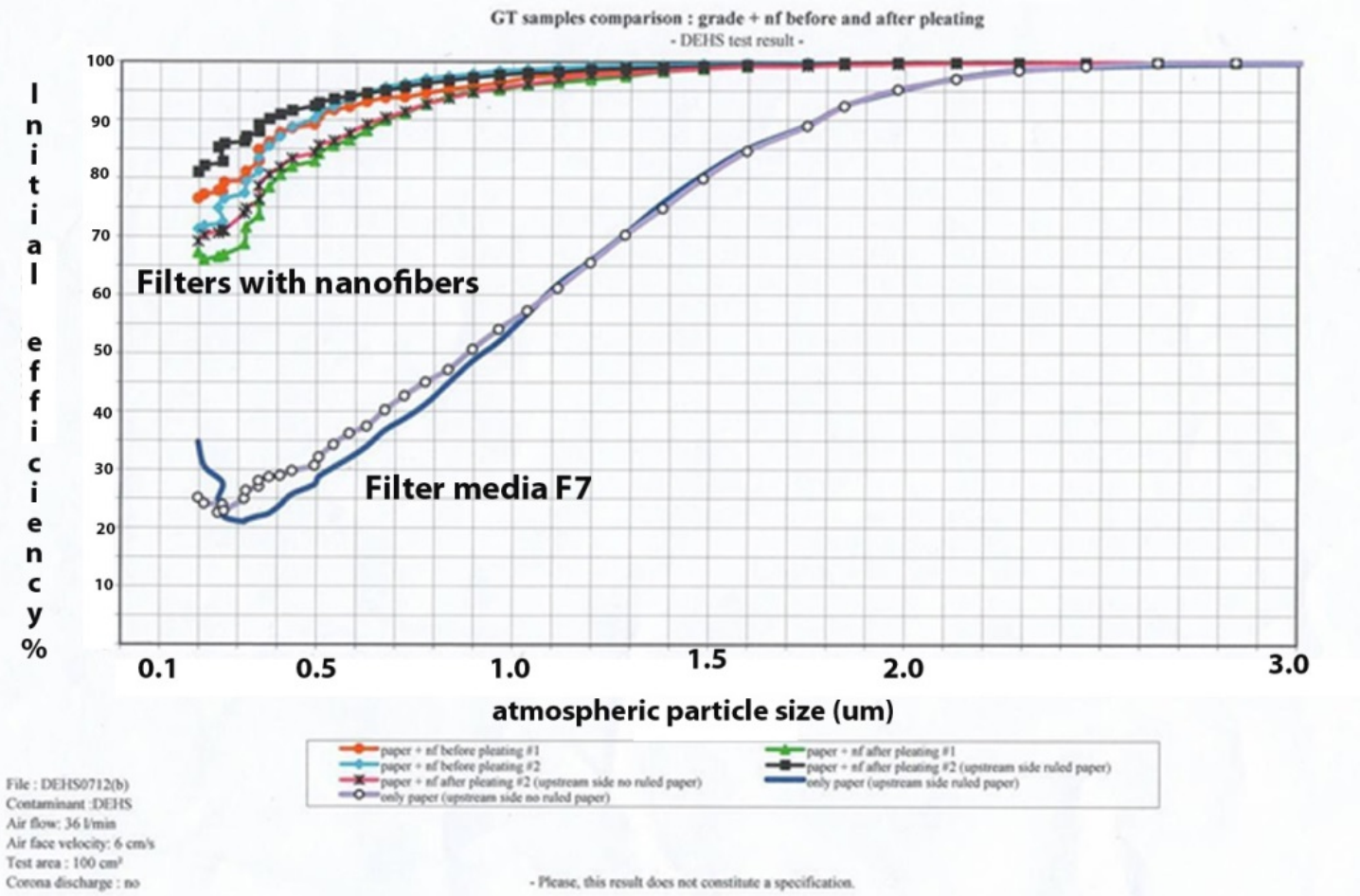
SEM Images of Nanofibers on filter paper







Filtration Efficiency tests



EN 779:2002. AIR FILTER TEST RESULTS

GENERAL

Test no.:	122876	Date of test:	28.6 and 16.- 17.7.2012	Supervisor:	RHo
Test requested by:	Behran Filter Co.			Device receiving date	
Device delivered by:	Behran Filter Co.			16.5.2012	

DEVICE TESTED

Model	Manufacturer	Construction
Gas Turbine Air Filter V94.2	Behran Filter Co.	Cylindrical filter
Type of media	**Net effective filtering area**	**Filter dimensions (diameter x length) (The length includes gaskets)**
90/40 EPE K WB2-G+NANO	19 m²	328 mm x 624 mm

TEST DATA

Test air flow rate	Test air temperature	Test air relative humidity	Test aerosol	Loading dust
0.347 m³/s	24 - 25 °C	38 - 43 %	DEHS	ASHRAE

RESULTS

Initial pressure drop	Initial arrestance	Initial efficiency (0,4 µm)	Dust holding capacity	Untreated / discharged efficiency of filter material (0.4 µm)
238 Pa	>99 %	72 %	8 / 226 / 504 g	
Final pressure drop	**Average arrestance**	**Average efficiency (0,4 µm)**	**Filter class (450 Pa)**	
250 / 350 / 450 Pa	>99 / >99 / >99 %	79±1 / 97±0 / 99±0 %	F9 (0.347 m³/s)	Non Applicable

Remarks: -

NOTE: The performance results cannot by themselves be quantitatively applied to predict filter performance in service. The results relate only to the tested item.

Industrial Nanofiber production line (INFL)

Winder and rewinder

- Servo motor control system
- Substrate speed: 100 to 600 m/h
- Maximum substrate width: 1 meter

Nanofiber diameters:

· 60 to 500 nm

Electrospinning Unit:

· 4-8 units

2015

Market in Iran

Power Plants which are using this technology in Iran:

Kerman
Persian Gulf
Parsian
Hasheninejad
Tabriz
Bandar abbas
Yazd
Damavand
Natural Gas zones
Some petrochemical unites
…

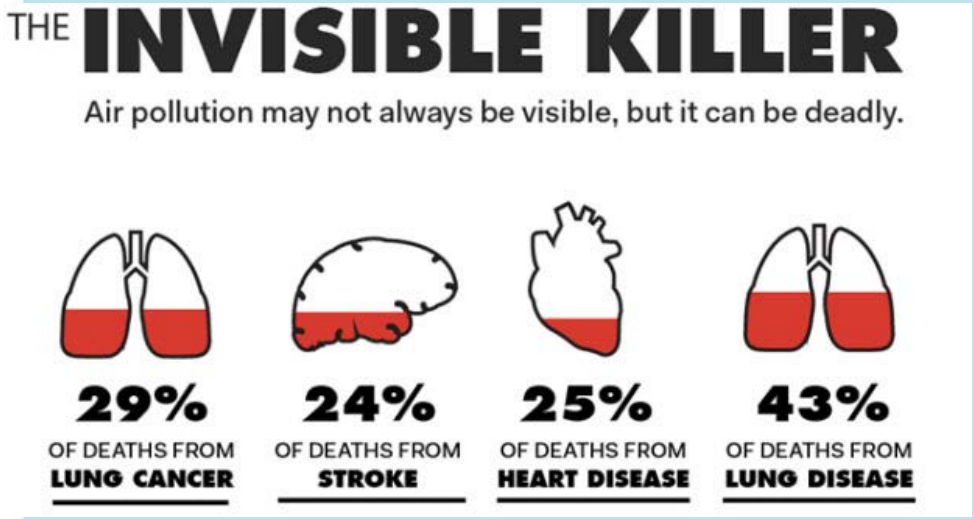
Improvement of energy converting in power plant

Using these nanofilters, 0.25-0.5 % improvement in energy conversion can be achieved. That means:

Total Natural gas combustion In power plant in Iran	1% improvement	Saving cost of fuel (0.3 USD per 1 Cubic meter)	Reducing warming energy in environment	Reducing pollution
100 billion m^3	250-500 million m^3	75-150 Million USD	8000-16000 MJ (or 1500-3000 MWhr)	??

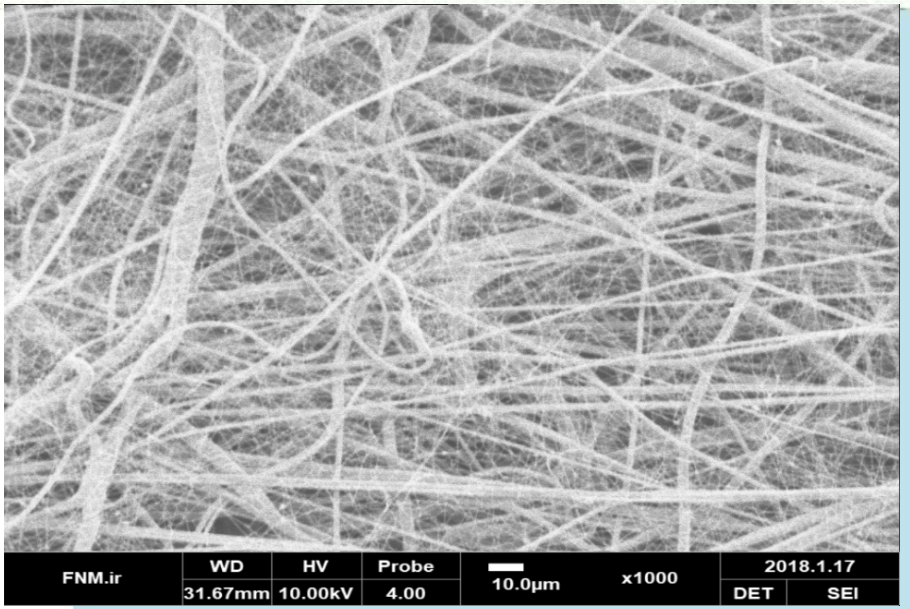
Moreover we should add saving related to
1-the life time of blades used in power plant
2-and also decreasing shutting down time related to exchanging blade and used filters

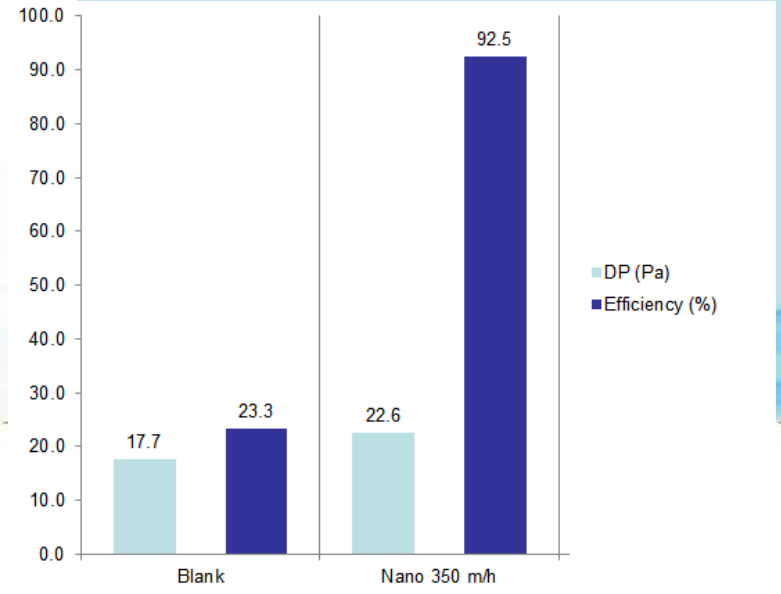
pollution



Air pollution was estimated to cause 4.2 million premature deaths worldwide per year.
(April of 2019, www.who.int/airpollution/en/)

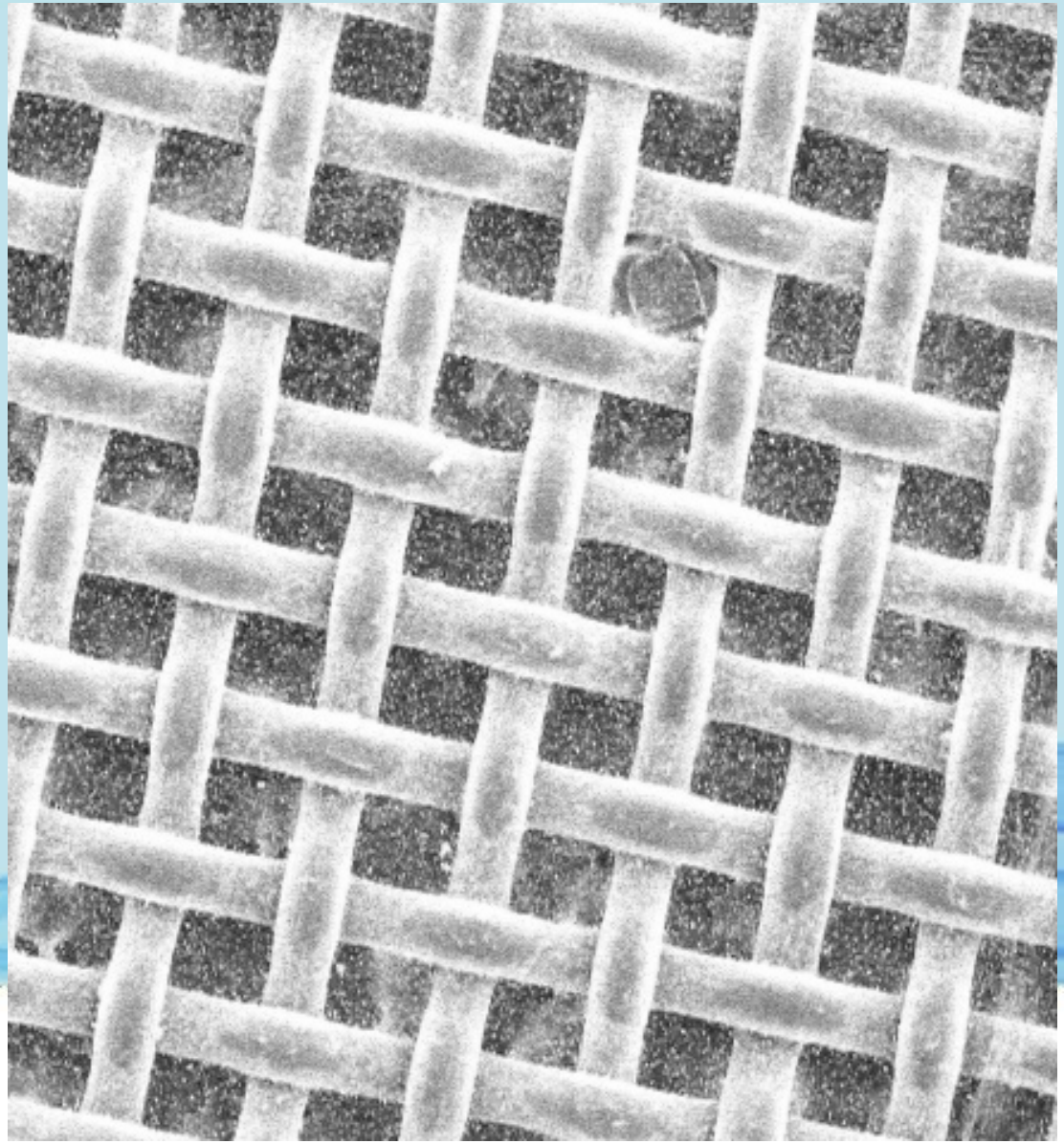
Respiratory Face Mask





Window Screen

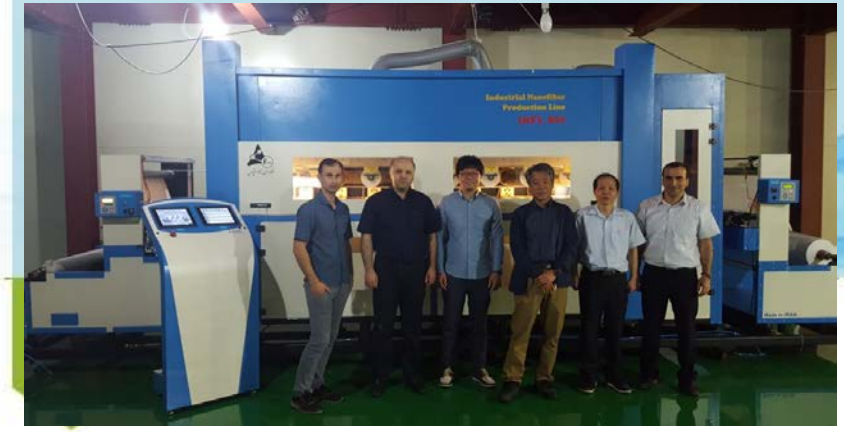
- ✓ Insects protection
- ✓ dusts protection
- ✓ Appearance



Industrial-scale nanofibers production units

Now:

- ✓ 6 machines in China (2018-2019)
- ✓ 1 machines in South Korea (2016)
- ✓ 3 machines in Malaysia (2016-2018)
- ✓ 10 machines in Iran (2014-2018)



Thank you for your attention!