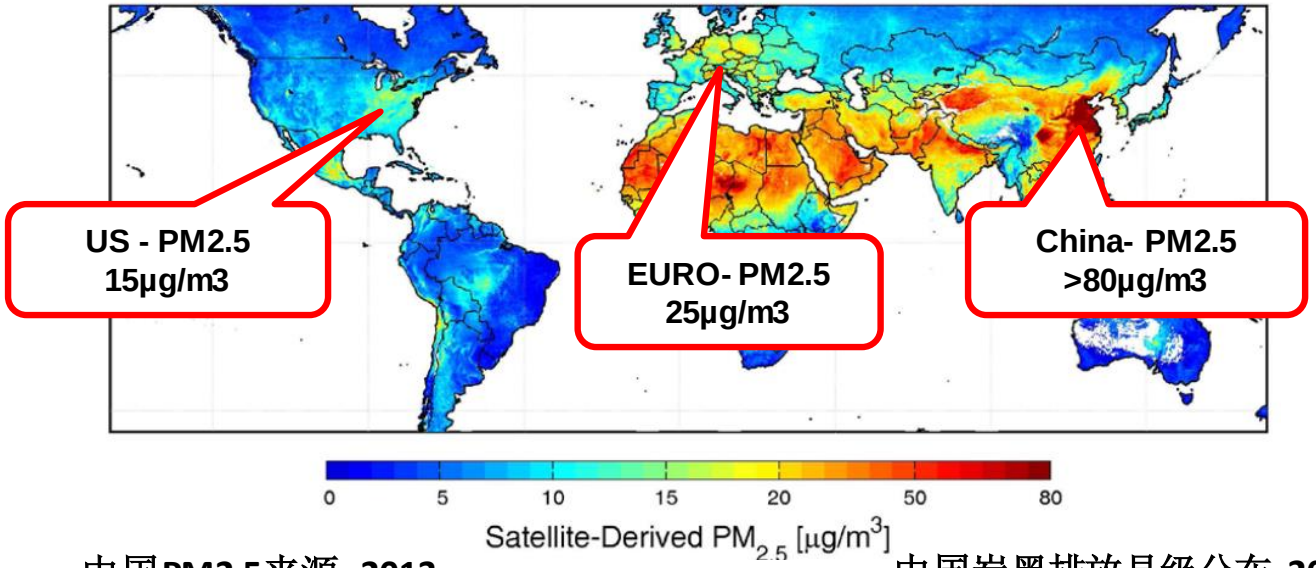
暖通行业现状及H&V滤材解决方案
TCTA Taiwan

Gloria Geng
2016/12/12

Advanced Materials for a Cleaner World
Hollingsworth & Vose

全球PM2.5污染

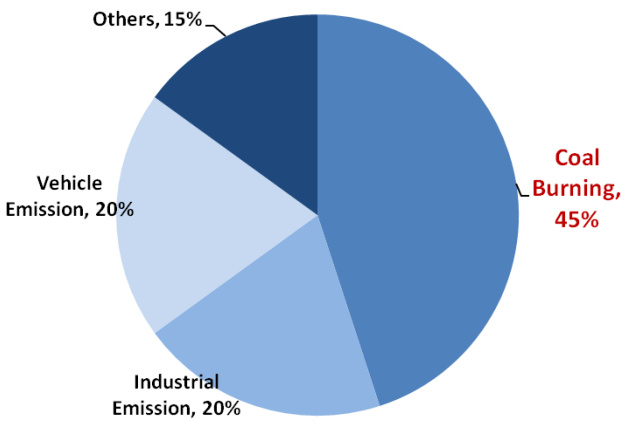
- PM2.5颗粒物在大气中的分布 --- 美国宇航局2001-2006 人造卫星探测图



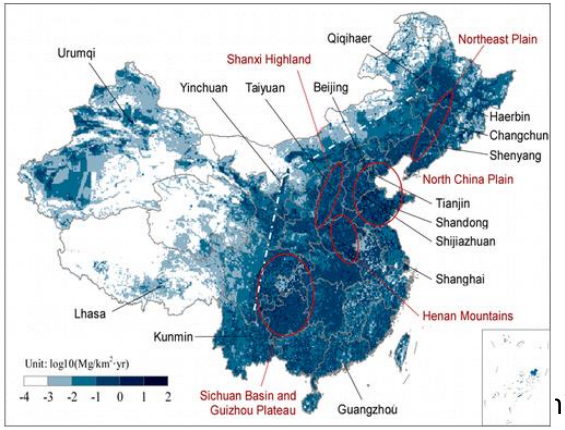
WHO安全值：

-PM2.5年平均浓度10μg/m3

中国PM2.5来源，2013

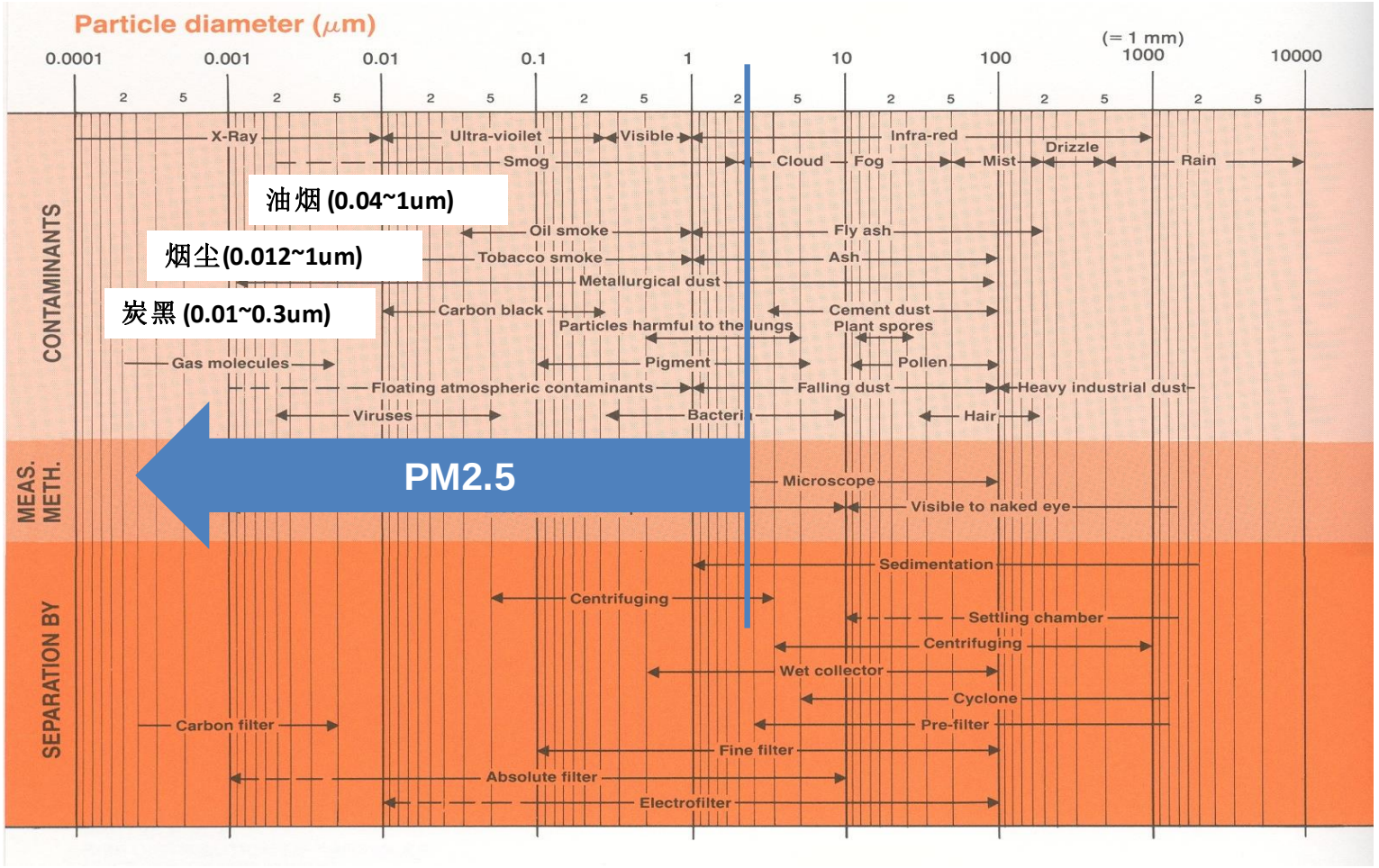


中国炭黑排放县级分布 2007



ical Society

不同粒径颗粒物的概览

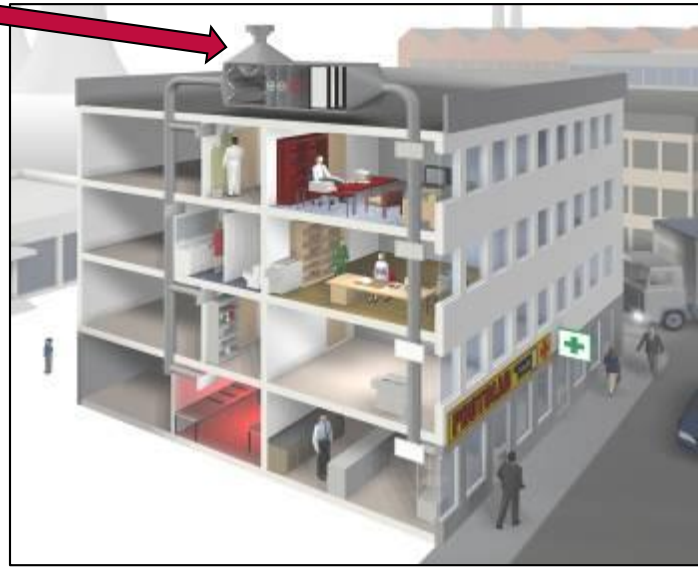


- 粗效过滤器不能去除，需要F7效率级别以上的过滤器

暖通空调

HVAC 系统

- 工业厂房



- 商业楼宇

工业厂房暖通空调过滤系统

G3/G4/G5

E10/E11/
E12/H13

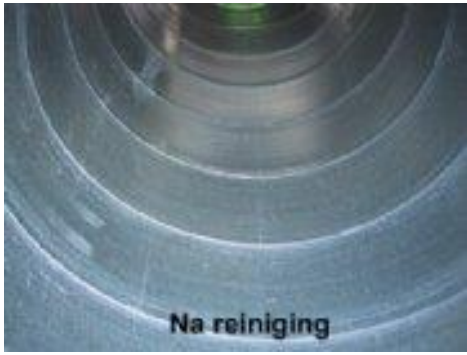
MAU/AHU

M6/F7
/F8/F9

H13/H14/U15/U16

洁净室

商业楼宇暖通空调过滤系统

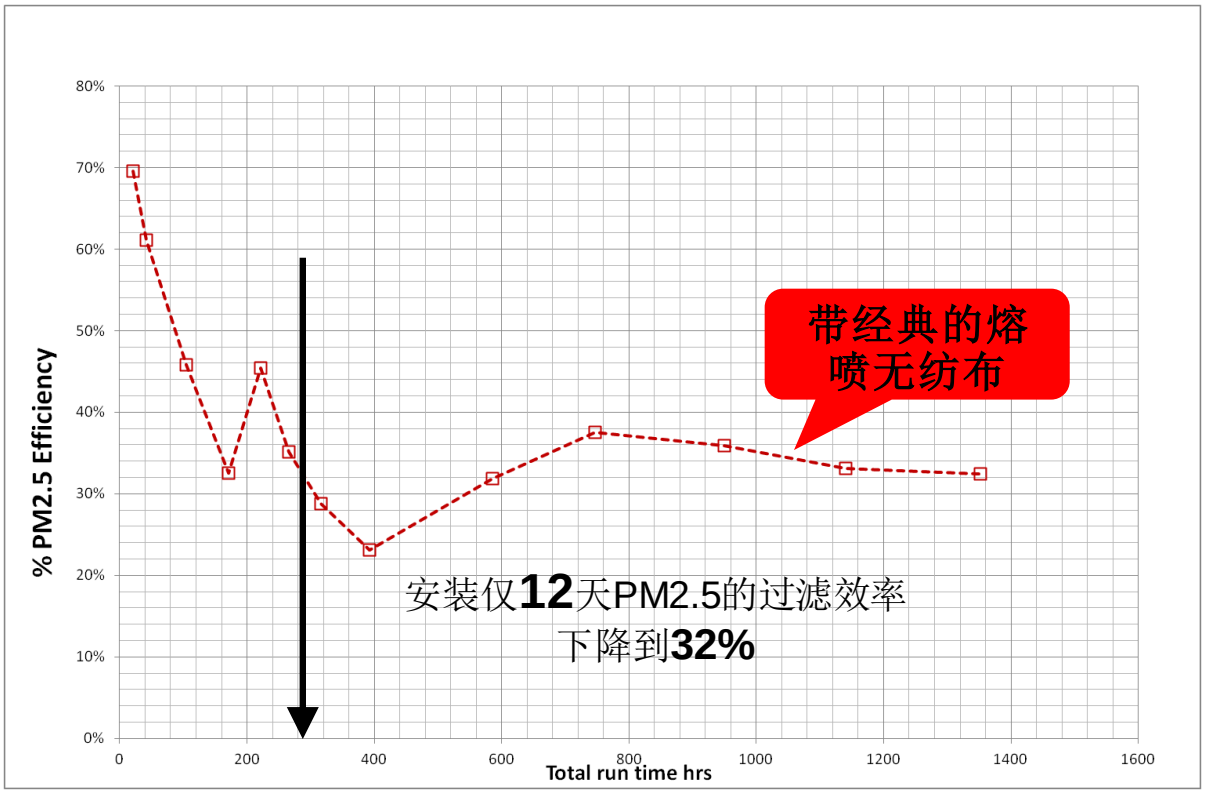


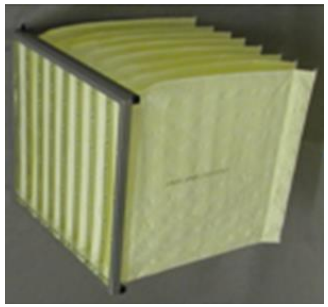
G3/G4/G5

M6/F7/F8/F9

熔喷无纺布在实际使用中的效率

- **F7熔喷无纺布过滤器的现场实验**





- **熔喷无纺布的效率下降很快，不能稳定保护室内环境和后端过滤器**

暖通空调－欧洲EN779:2012标准

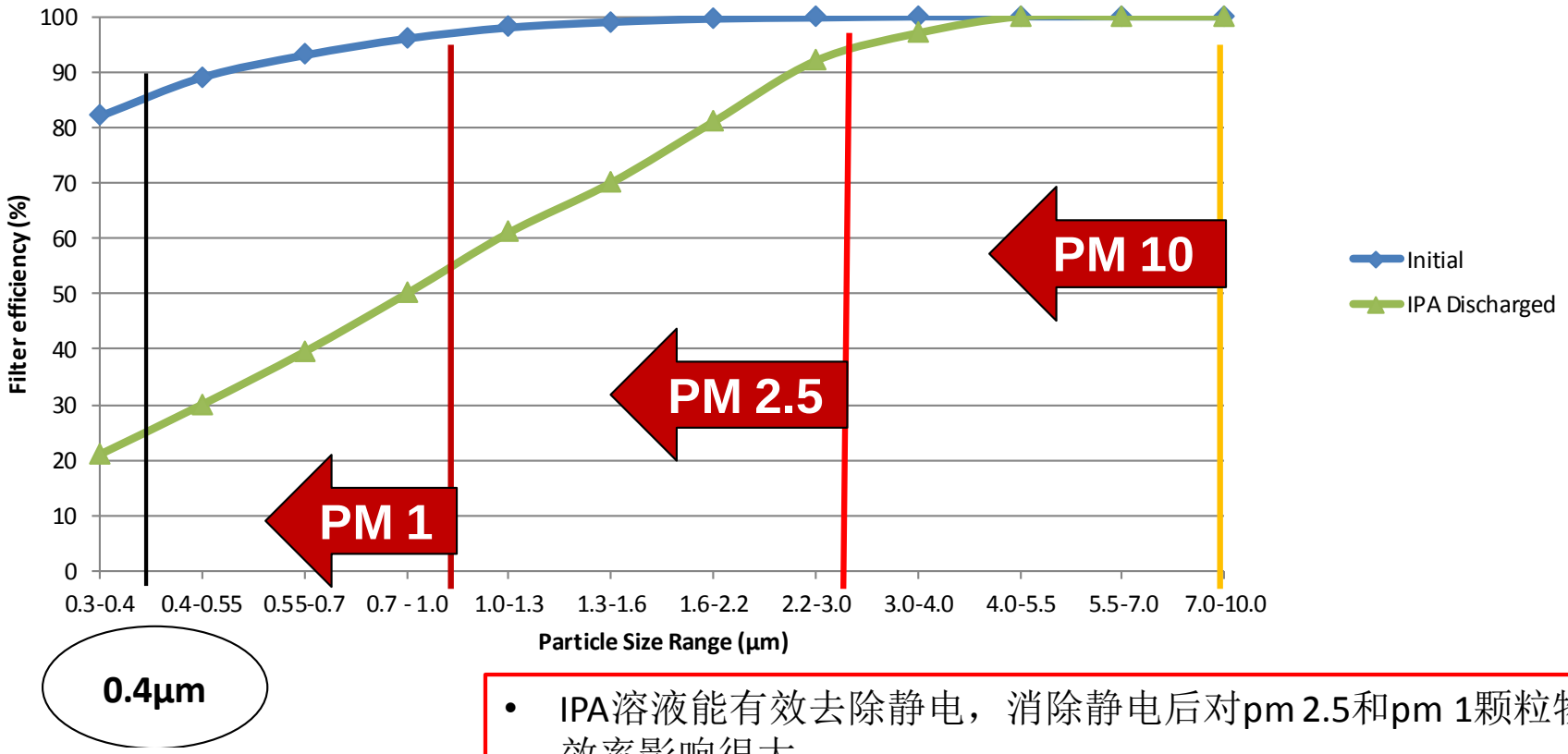
- 在F7～F9的评级中增加了0.4μm的ME(最小测试效率）
  - 初始效率
  - IPA（异丙醇）溶液消除静电后的过滤效率
  - 在加载粉尘实验中所测得的最低效率 －－－取最小值

Classification of filters according to EN779 : 2012

组	分级	试验终阻力（Pa）	人工尘平均计重效率(Am)%	0.4μm颗粒物的平均效率(Em)%	(*) 0.4μm颗粒物的最低效率%
Coarse	G1	250	50 ≤ Am < 65	-	-
	G2	250	65 ≤ Am < 80	-	-
	G3	250	80 ≤ AM < 90	-	-
	G4	250	90 ≤ Am	-	-
Medium	M5	450	-	40 ≤ Em < 60	-
	M6	450	-	60 ≤ Em < 80	-
Fine	F7	450	-	80 ≤ Em < 90	35
	F8	450	-	90 ≤ EM < 95	55
	F9	450	-	95 ≤ Em	70

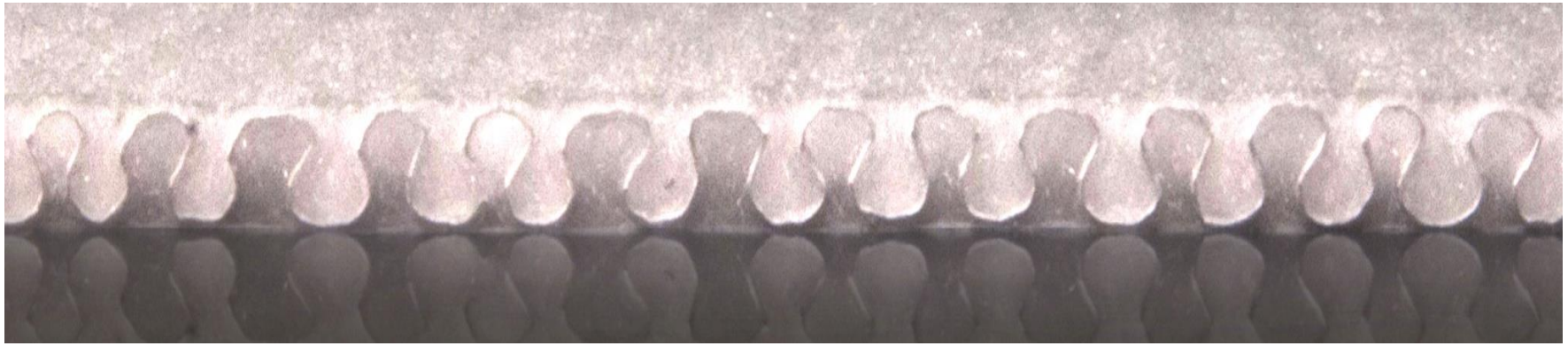
暖通空调—熔喷无纺布的消静电实验

带静电的熔喷无纺布材料



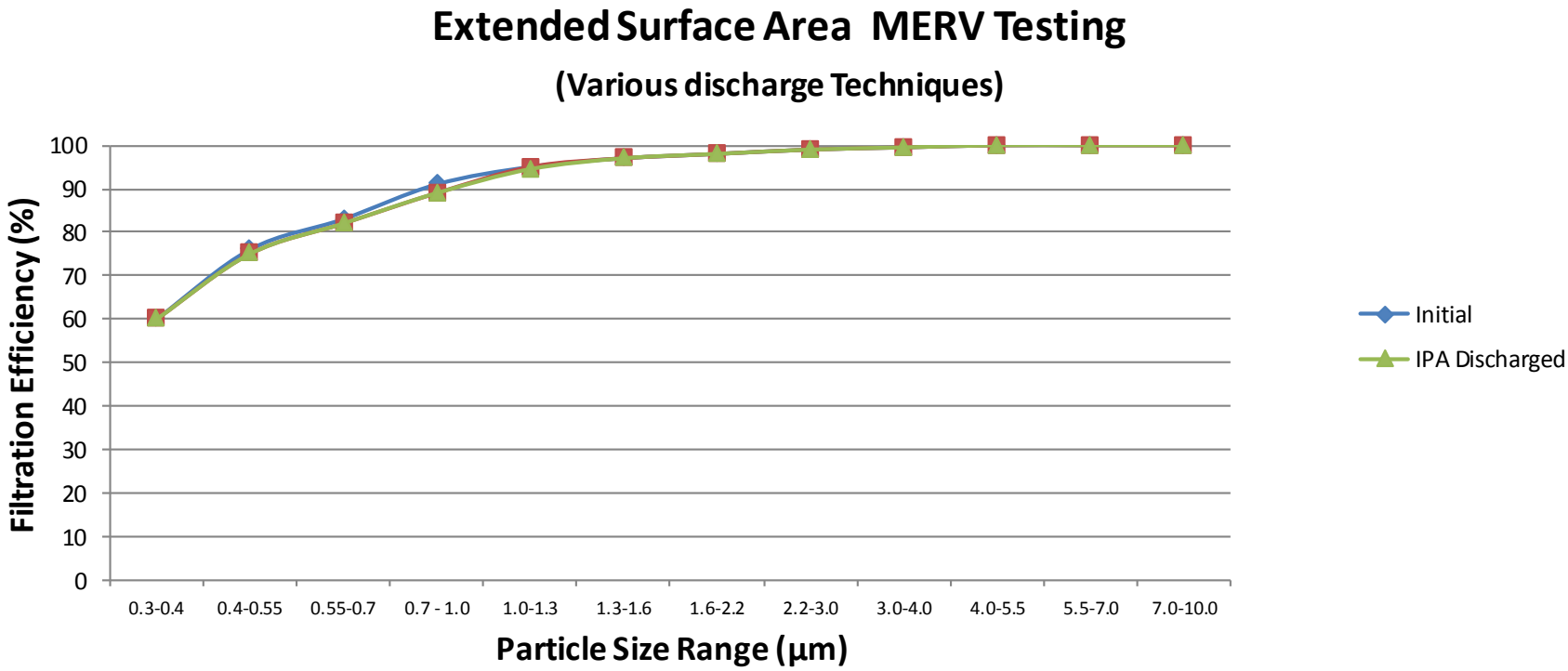
- IPA溶液能有效去除静电，消除静电后对pm 2.5和pm 1颗粒物效率影响很大。

NanoWave®



- **机械过滤（M5—F9）**
  - high discharged efficiency according to EN779:2012
- **高容尘量**
  - 容尘量是传统化纤材料的2—3倍
- **低气阻**
  - 更具Eurovent RS 4/C/001-2015可到达最高评级A+
- **100%化纤材料**
  - 环保，回收成本低
- **滤材挺度好**

Nanowave® 滤材的去静电测试



NanoWave® 滤材不带任何静电，其过滤性能稳定，能够给人们和生产提供长效性的保护

NanoWave®

Filter rating acc. ISO 16890

- Proposal in ISO standard ratings

Average, not minimum

Group designation	Requirement			Class reporting value
	$ePM_{1,\,min}$	$ePM_{2,5,\,min}$	ePM_{10}	
ISO Coarse	—	—	<50 %	Initial grav. arrestance
ISO *e*PM10	—	—	≥50 %	ePM_{10}
ISO *e*PM2,5	—	≥50 %	—	$ePM_{2,5}$
ISO *e*PM1	≥50 %	—	—	ePM_{1}

  - Not a classification system. Only minimum requirements.
  - Performance ratings : ISO 60% ePM_{10}, ISO 85% $ePM_{2.5}$ or ISO >95% ePM_{1} The efficiencies reported are "mean efficiencies" with 5% incremental values, rounded downwards.
  - Translation of EN779 classifications into ISO ePM_{x} to be agreed upon. Eventually for ASHRAE 52.2

Major Differences : EN 779 vs. ISO 16890

EN 779 : 2012

- Classification based upon 0.4µm particle performance (M5 – F9)
  - Particle **count** (fractional efficiency)
  - Test aerosol DEHS (0.3 – 3µm)
- Discharge of separate piece of media by soaking in liquid IPA
- Loading dust :
  ASHRAE test dust
- Classification after dust loading
- Dust loading on filter as supplied
- Final pressure drop : 250 / 450 Pa dependant on performance

ISO 16890

- Rating based upon ePM_{10}, $ePM_{2.5}$ and ePM_1 performance
  - Particle **mass** (derived from frac. eff.)
  - Test aerosol : DEHS (0.3 – 1µm) and KCL (1 – 10µm)
- Discharge of complete filter
  IPA vapor
- Loading dust :
  ISO 12103 PT1. A2 Fine
- Rating before dust loading
- Dust loading on discharge filter
- Final pressure drop 200 / 300 Pa dependant on performance

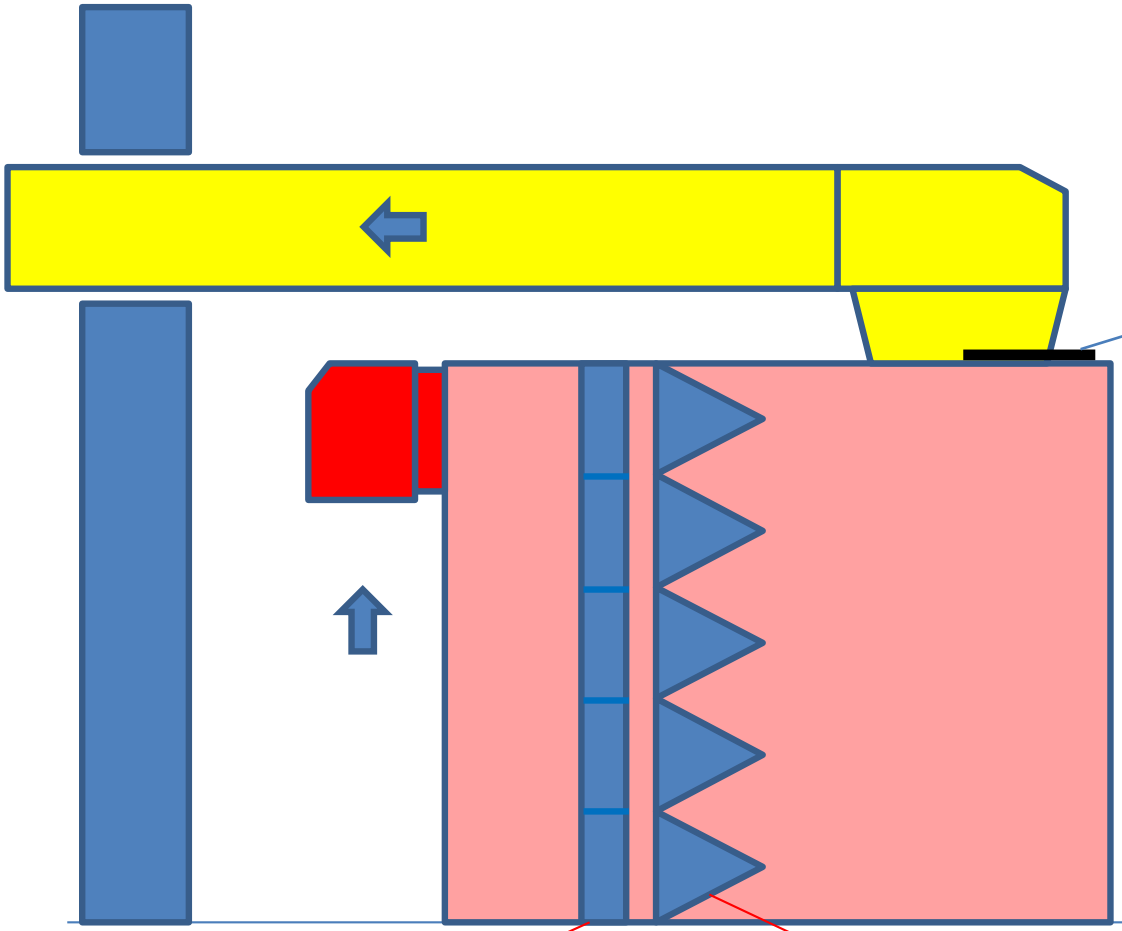
不同材料制作的过滤器的实地测试

地点：H&V公司苏州工厂

Advanced Materials for a Cleaner World

Hollingsworth & Vose

H&V 苏州工厂空调箱



风量调节阀

AHU turned 90°
in drawing

20 G4预过滤器

20 x F7 袋式过滤器

空气处理机组（AHU）及测试数据

NanoWave®

- AHU中过滤器的配置
  - 预过滤器：G4 – 板框式过滤器
  - 后端过滤器：F7 – 袋式过滤器
    - 1 AHU:20 F7 过滤器(玻纤棉制成);
    - 1 AHU:20 F7 过滤器(Nanowave®制成);
    - 1 AHU:20 F7 过滤器(国产熔喷无纺布制成);
- 风量: 50,000 至 55,000 m^3/h
- F7过滤器参数:
  - 滤材面积：2.65 m^2
    每个AHU滤材总积：53 m^2
  - 滤材面风速：0.26 m/s
- 每两周取下过滤器至实验室进行测试

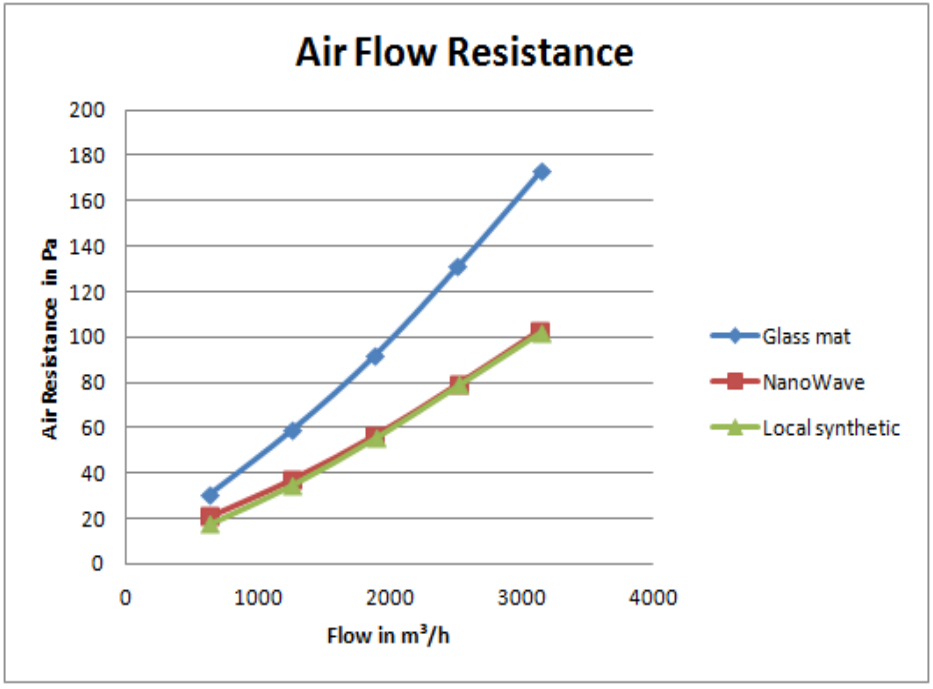
依据EN779-2012 测试过滤器性能

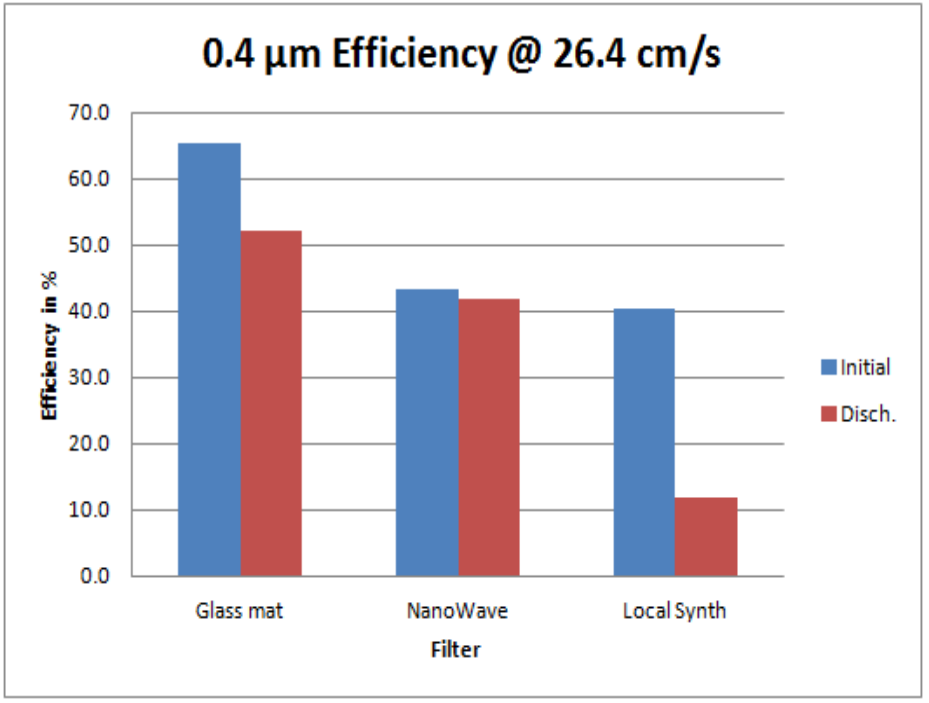
EN779 : 2012 test results @ 2520 m³/h

Media velocity : 26.4 cm/s

F7 Media	Initial Air Resistance Pa	Init. Eff. 0.4µm %	Av. Eff 0.4 µm @ 450 Pa %	DHC @ 450 Pa g	Filter rating acc. EN779:2012	Energy rating kWh	Flat media 0.4 µm Eff in % @ 26.4 cm/s Initial	Disch.
Glass mat	130	64.9	82.7	194	F7	1440	65.4	52.1
NanoWave	80	42.9	85.3	253	F7	1150	43.3	41.7
Local Synth	77	54.7	77.6	116	M6	*1543*	40.3	11.9

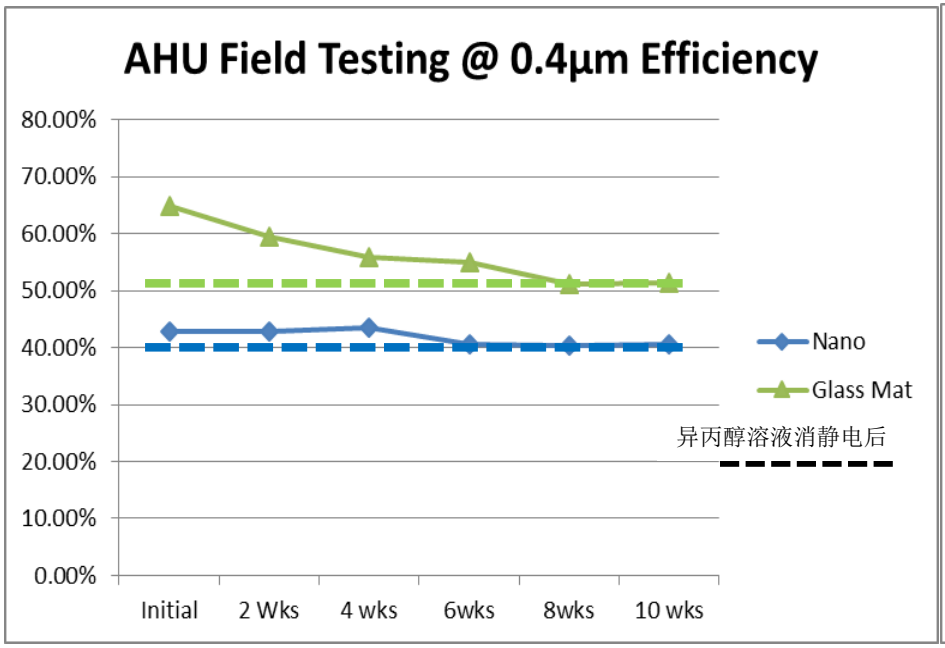
from point of view of F7 / 100 g dust loading.

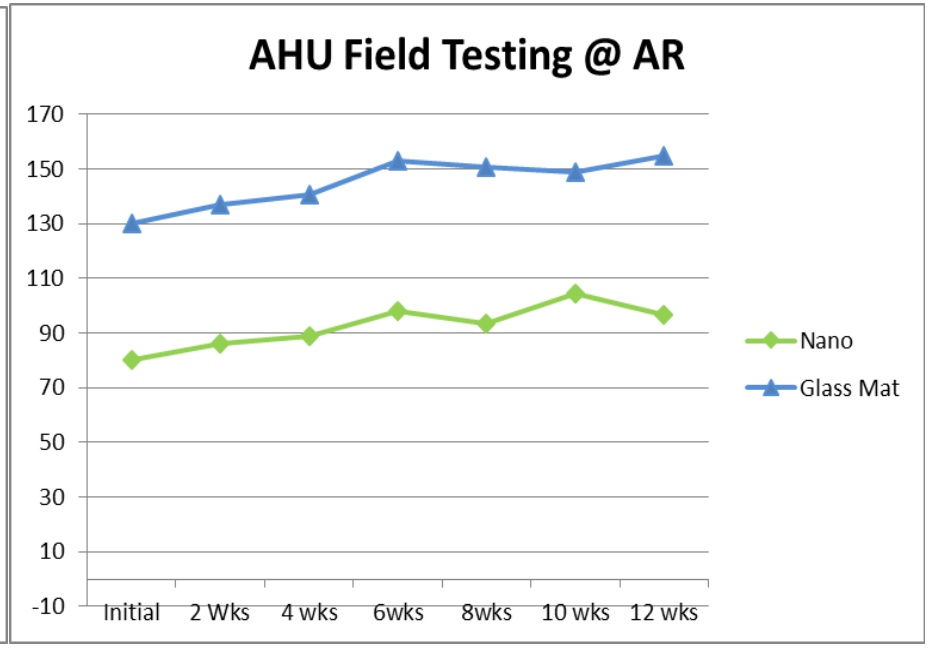




在实地测试过程中 测试过滤器性能

- 过滤器0.4μm过滤效率的变化
- 过滤器阻力的变化





IPA discharging method well addressed the real air discharge situation!

Glass Mat AR is much higher than Nanowave®

能耗评级－欧洲Eurovent RS 4/C/001- 2015

Classification / Colors from 02 2014	Filter Class	G4	M5	M6	F7	F8	F9
	ME	-	-	-	ME> 35%	ME> 55%	ME> 70%
	Dust loading	M_G = 350 g ASHRAE	M_M = 250 g ASHRAE		M_F = 100 g ASHRAE		
	A	0 - 600	0 - 650	0 - 800	0 - 1,200	0 - 1,600	0 - 2,000
	B	601 - 850	651 - 950	801 - 1,100	1,201 - 1,700	1,601 - 2,300	2,001 - 3,000
	C	851 - 1,100	951 - 1,250	1,101 - 1,400	1,701 - 2,200	2,301 - 3,000	3,001 - 4,000
	D	1,101 - 1,350	1,251 - 1,550	1,401 - 1,700	2,201 - 2,700	3,001 - 3,700	4,001 - 5,000
	E	1,351 -	1,551 -	1,701 -	2,701 -	3,701 -	5,001 -

Classification / Colors from 01 2015	Filterklasse		M5	M6	F7	F8	F9
	Mindest-wirkungsgrad		-	-	ME> 35%	ME> 55%	ME> 70%
	Staubaufgabe		M_M = 250 g ASHRAE		M_F = 100 g ASHRAE		
	A+		0 - 450	0 - 550	0 - 800	0 - 1,000	0 - 1,250
	A		451 - 600	551 - 650	801 - 950	1,001 - 1,200	1,251 - 1,450
	B		601 - 700	651 - 800	951 - 1,200	1,201 - 1,500	1,451 - 1,900
	C		701 - 950	801 - 1,100	1,201 - 1,700	1,501 - 2,000	1,901 - 2,600
	D		951 - 1,200	1,101 - 1,400	1,701 - 2,200	2,001 - 2,700	2,601 - 4,000
	E		1,201 -	1,401 -	2,201 -	2,701 -	4,001 -

欧共体大力推进滤料和过滤器生产厂商研发在不损失过滤性能（即保障室内空气质量）的前提下，尽可能的降低能耗。

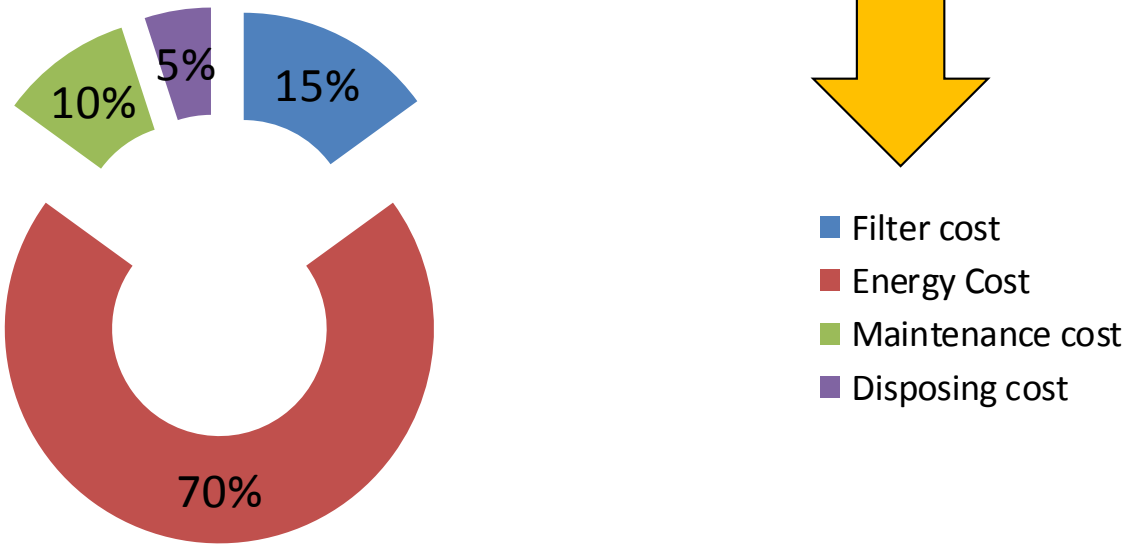
Drivers for selecting filters

Should purchase price cost be the most important driver?

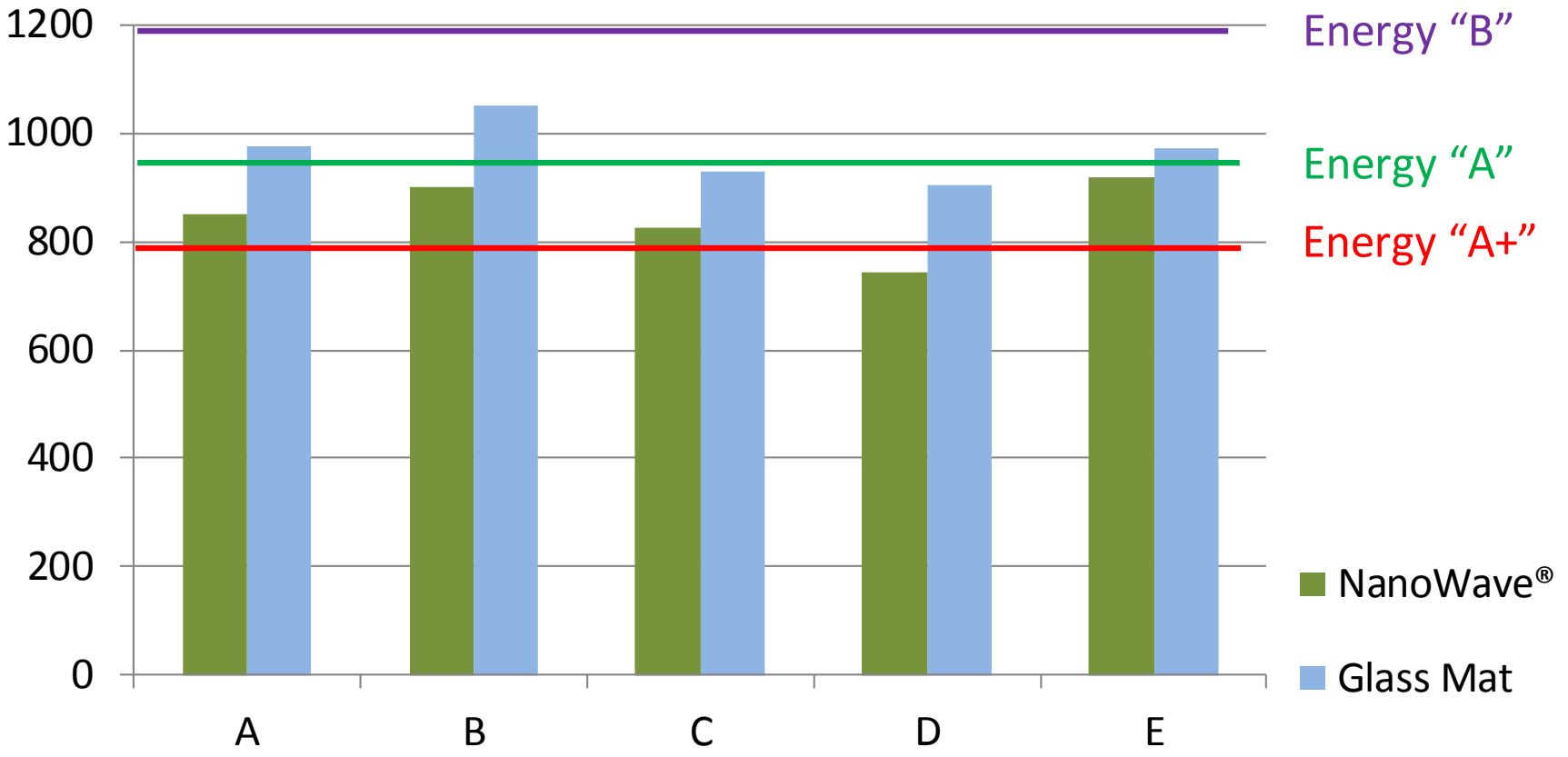
What matters for the end-user?

- ✓ Meet standards
- ✓ Reliable performance
- ✓ Easy and safe installation & maintenance
- ✓ Lowest total-cost

Total Cost HVAC Unit



NanoWave® Benchmark Data F7 Filters



Data F7 pocket filters with 10 pockets : 592x592x600-630 mm
All data represent official customer test reports from certified labs.

NanoWave® —低运行成本

F7 运行成本总结

	NanoWave	玻纤棉
Best Rating	A+	A
Average Rating	A	B
KWh Average	848	966

电费 1 kWh = 0.85 RMB

财务数据:

- 比玻纤棉节省了118 kWh = RMB160/年/每个过滤器
- 假设一个新风系统装有16 个过滤器，每年的能耗节省为：
  - 比玻纤棉省 2560 RMB

NanoWave®

Benefits of NanoWave® compared to glass

- NanoWave® has got the lowest initial and slowest rising pressure drop curve. **This results in favorable energy consumption.**
- NanoWave® offers the highest dust loading capacity of all filter media in the market, hence offers the longest life-time. **This results in increased service intervals for end-users and less maintenance cost.**
- The **handling** of NanoWave® containing filters is **easy for end users and the most environmental friendly:**
  - No skin irritation as it is fully synthetic
  - No special protection necessary (glassed, gloves, respiratory) as no fiber shedding is possible
  - During disposale it releases energy while other filters will absorb additional energy

NanoWave®

Conclusions

- NanoWave® media is a 100% synthetic product
- NanoWave® performs consistently, it has no charge.
- NanoWave® media combine increased media surface with fine fiber synthetics. This results in
  - Best Energy Rating and Lowest Operating Cost
  - Longer Filter Life
  - Maintains the filter efficiency over time to have consistent protection
- Total-life-cycle cost is more important than initial purchase price
- Sustainability and handling aspects are getting more important

Hollingsworth & Vose

谢谢!

Gloria.Geng@hovo.com.cn

Advanced Materials for a Cleaner World

Hollingsworth & Vose