Efficiency of mobile air purifiers in private homes

Kaare Press-Kristensen[1)], Tanja Willumsen[1)], Stig Koust[2)], Christel Søgaard Kirkeby[3)], Freja Rydahl Rasmussen[2)], Naja Villadsen[2)] og Peter Egholm Bøgh Pedersen[2)]

[1)]Green Transition Denmark, [2)]Technological Institute, [3)]Danish Consumer Council

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DENMARK

Background

Candles, cooking, wood burning, and smoking are important indoor air pollution sources of ultrafine particles (UFP) and fine particles ($PM_{2.5}$). The sale of mobile air purifiers increases significantly – How efficient are purifiers in private homes?

Purpose

To test mobile air purifiers in private homes and compare the results with the efficiency of an extractor hood, manual aeration, and mechanical ventilation.

Measurements

UFPs were measured with newly calibrated P-Traks from TSI, $PM_{2.5}$ was measured with newly calibrated DustTrak DRX from TSI Inc.

Experimental setup

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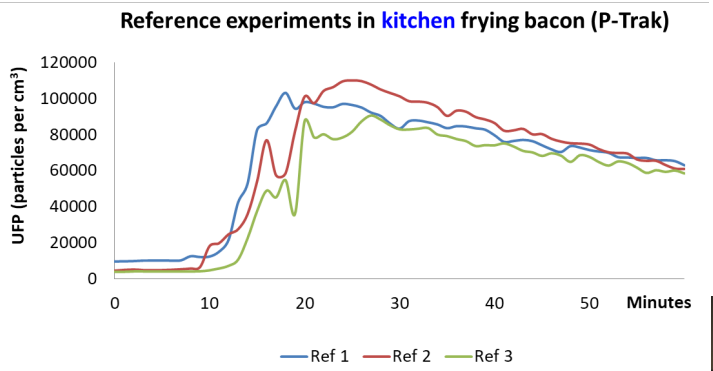
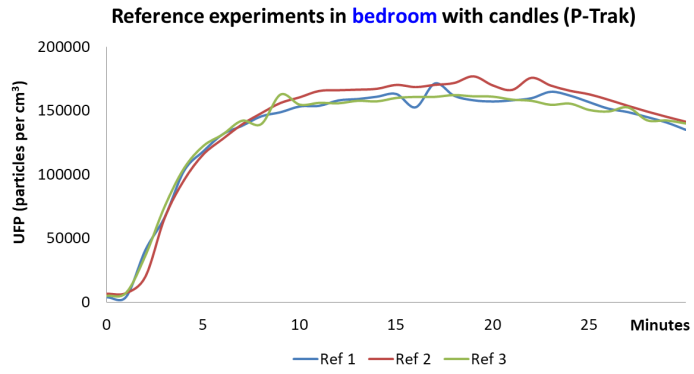
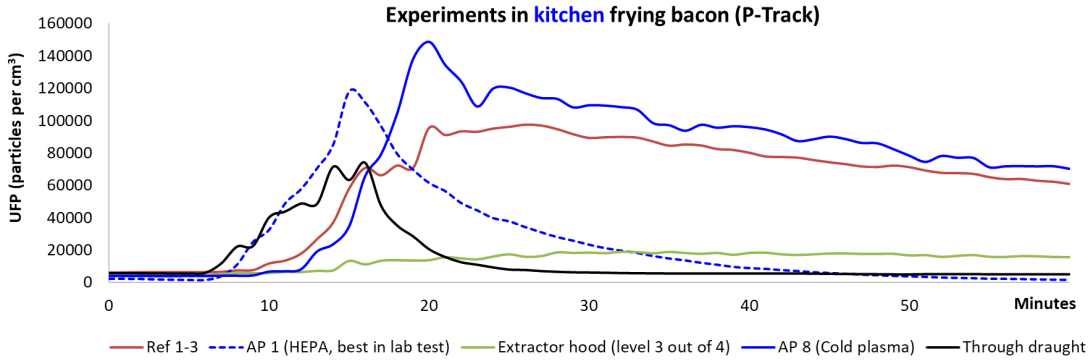
Kitchen area/volume: 43.5m^2 / 165m^3

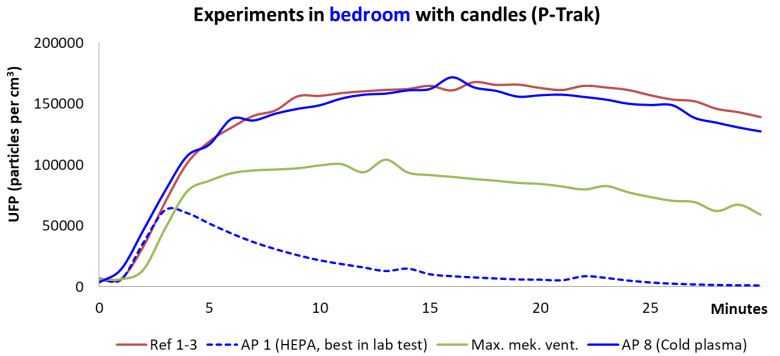


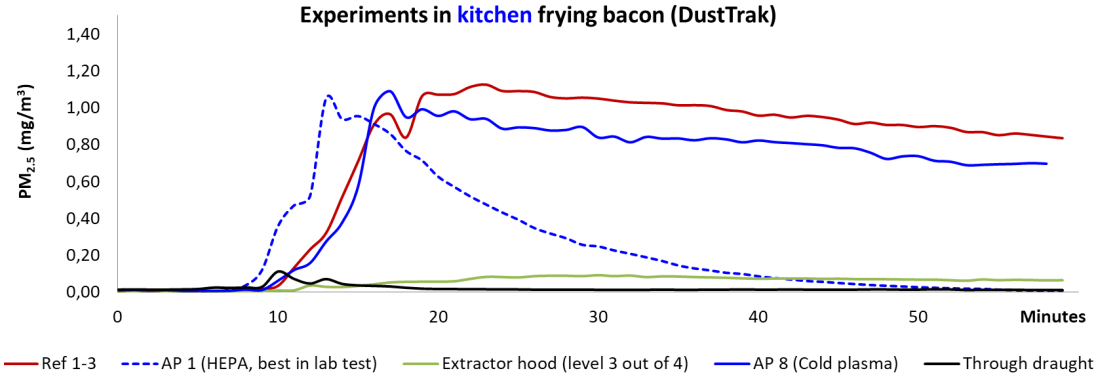


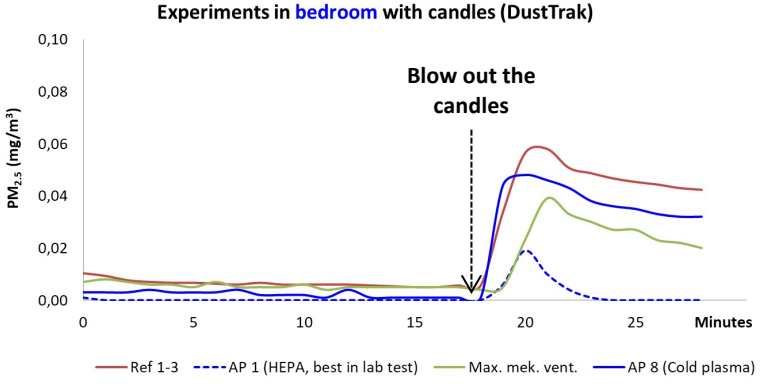
Bedroom area/volume: 12m^2 / 30.5m^3

Results


Experiments in kitchen frying bacon (P-Track)
UFP (particles per cm³)
160000
140000
120000
100000
80000
60000
40000
20000
0
0
10
20
30
40
50
Minutes
Ref 1-3
AP 1 (HEPA, best in lab test)
Extractor hood (level 3 out of 4)
AP 8 (Cold plasma)
Through draught


Experiments in bedroom with candles (P-Trak)
UFP (particles per cm³)
200000
150000
100000
50000
0
0
5
10
15
20
25
Minutes
Ref 1-3
AP 1 (HEPA, best in lab test)
Max. mek. vent.
AP 8 (Cold plasma)


Experiments in kitchen frying bacon (DustTrak)
PM2,5 (mg/m³)
1,40
1,20
1,00
0,80
0,60
0,40
0,20
0,00
0
10
20
30
40
50
Minutes
Ref 1-3
AP 1 (HEPA, best in lab test)
Extractor hood (level 3 out of 4)
AP 8 (Cold plasma)
Through draught


Experiments in bedroom with candles (DustTrak)
Blow out the candles
PM2,5 (mg/m³)
0,10
0,08
0,06
0,04
0,02
0,00
0
5
10
15
20
25
Minutes
Ref 1-3
AP 1 (HEPA, best in lab test)
Max. mek. vent.
AP 8 (Cold plasma)

Reduced exposure compared to reference

	Performance: $PM_{2.5}$			Performance: UFP		
	Lab	**Kitchen**	**Bedroom**	**Lab**	**Kitchen**	**Bedroom**
Reference average concentration	**3.90** mg/m^3	**0.766** mg/m^3	**0.024** mg/m^3	**475,787** part./cm^3	**59,283** part./cm^3	**137,879** part./cm^3
Room (floor size in m^2/volume in m^3)	**8 / 20**	**43.5 / 165**	**12 / 30.5**	**8 / 20**	**43.5 / 165**	**12 / 30.5**
Duration of test (minutes)	**30**	**60**	**30**	**30**	**60**	**30**
Extractor hood (3 out of 4)	**---**	**92%**	---	**---**	**81%**	---
Through draught (heavy airing)	**---**	**97%**	---	**---**	**75%**	
Mechanical vent. (4 out of 4)	**---**	---	**29%**	**---**	**----**	**48%**

Conclusion

- Some mobile air purifiers can significantly reduce pollution with ultrafine and fine particles while other purifiers have limited or no significant effect.
- Mobile air purifiers with HEPA filters typically show high removal of ultrafine and fine particles – however, the capacity of the purifier must fit the room size.
- Using through draught and extractor hoods can be (at least) as efficient as mobile air purifiers in removing high particle concentrations from cooking; while mechanical ventilation is less efficient in removing particles from candles than good purifiers.
- Air purifiers found efficient under laboratory conditions were typically found efficient in private homes as well – but did **not** reduce exposure by 99% or more.

Acknowledgement

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