

Supplementary Information

An Investigation on Morphology and Fractal Dimension of Diesel and Diesel-Biodiesel Soot Agglomerates

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Definitions of nanoparticles vs. ultrafine particles¹⁻⁵

Although a strict definition and differentiation between ultrafine particles and nanoparticles still is not largely accepted by PM atmospheric chemistry experts, they are not exactly the same. First of all, there are some differences regarding particle size in a broad point of view. For instance, for some authors, “nanoparticles” are defined as particles smaller than 10 nm, corresponding to a new particle formation via nucleation of about 15 to 30 molecules of a given substance. But it may vary depending on how big these molecules are or how their physical properties are or contribute to the formation of a new particle. But for other authors “nanoparticles” are rather particles smaller than 20 or 30 nm and even for others they are particles smaller than 50 nm. So, depending on which definition someone may adopt there will be some superposition between the definition of “ultrafine particles” and “nanoparticles” since the first ones are considered particles smaller than 100 nm (which is more widely accepted than the nanoparticle definition). Yet, if we consider the first nanoparticle definition stated here and the ultrafine particle definition there is a difference of 10 times in particle size between them.

When considering the fractal geometry concept of carbonaceous soot particles, particle agglomerates are constituted of tens to hundreds of primary particles ranging from 10-20 nm each while agglomerates are 100-200 nm. Therefore, we classify the primary particles as “nanoparticles” and particle agglomerates as “ultrafine particles”.

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References

1. Auffan, M.; Rose, R.; Bottero, J.-Y.; Lowry, G. V.; Jolivet, J.-P.; Wiesner, M. R.; *Nature Nanotechnol.* **2009**, *4*, 634.
2. Kittelson, D. B.; *J. Aerosol Sci.* **1998**, *29*, 575.
3. Nowack, B.; Bucheli, T.; *Environ. Poll.* **2007**, *150*, 5.
4. Oberdörster, G.; Oberdörster, E.; Oberdörster, J.; *Environ. Health Perspect.* **2005**, *113*, 823.
5. Wichmann H.-E.; Peters, A.; *Philos. Trans. R. Soc., A* **2000**, *358*, 2751.

Table S1. Physical-chemical characteristics of the B4 and biodiesel (B100) fuels

Characteristic	Levels		Methods	
	B4	B100	B4	B100
Specific gravity / (kg m ⁻³ at 20 °C)	828	892	ASTM D 4052	ASTM D 4052
Corrosivity to copper (3 h at 50 °C)	1a	1a	ASTM D 130	ASTM D 130
Viscosity / (mm ² s ⁻¹)	3.57	6.57/6.40	ASTM D 445	ASTM D 445
Fulgor index / °C	162	170	ASTM D 93	ASTM D 93
Clogging index / °C	–	3	–	ASTM D 6371
Water index / ppm	–	750	–	EN ISSO 12937
IA / (mg KOH g ⁻¹)	–	0.47	–	ASTM D 664
Ester yield / %	–	98	–	–
Monodiacylglycerol / (% , w)	–	0.05	–	ASTM D 6584
Diacylglycerol / (% , w)	–	0.004	–	ASTM D 6584
Triacylglycerol / (% , w)	–	0.005	–	ASTM D 6584
Total sulfur / (mg kg ⁻¹)	0.00812	–	EN ISSO 20846	–
Distillation / °C				
10%	182.2	–	–	–
50%	289.5	–	ASTM D86-07a	–
85%	347.5	–	–	–
90%	361.6	–	–	–

Table S2. Main characteristics of the diesel engine

Characteristics	
Potency NF (NBRISO 1585) / (Cv kw ⁻¹ rpm ⁻¹)	10/22/3000
Number of cylinders	7.0/2500
Maximum torque (NBRISO 1585) / (daNm rpm ⁻¹)	2 verticals
Cylinder diameter / mm	90
Swept volume / cm ⁻¹	1272
Piston displacement / mm	100
Carter capacity / L	6
Compression rate	18:01
Fuel consumption / (g kWh ⁻¹)	272
Feeding injection system	direct
Refrigeration of the engine	air

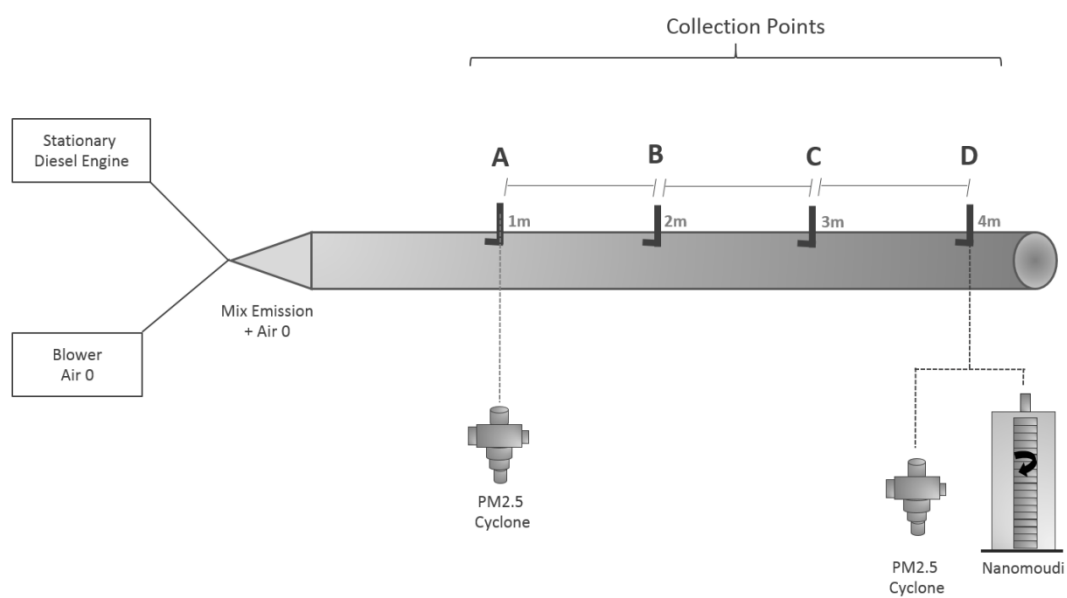


Figure S1. Schematic diagram of the diesel engine settled on stationary dynamometer-CVS system, equipped with PM_{2.5} cyclone samplers and a NanoMOUDI.