Supplementary Information

Effect of fuel composition on properties of particles emitted from a diesel-natural gas dual fuel engine

Ali Momenimovahed[1,3,*], Fengshan Liu[1], Kevin A. Thomson[1], Gregory J. Smallwood[1], Hongsheng Guo[2]

1. Measurement Science and Standards, National Research Council, Building M-9, 1200 Montreal Road, Ontario, K1A 0R6, Canada
2. Energy, Mining and Environment, National Research Council, Building M-9, 1200 Montreal Road, Ontario, K1A 0R6, Canada
3. Department of Mechanical Engineering, Imam Khomeini International University, Qazvin, 3414916818, Iran

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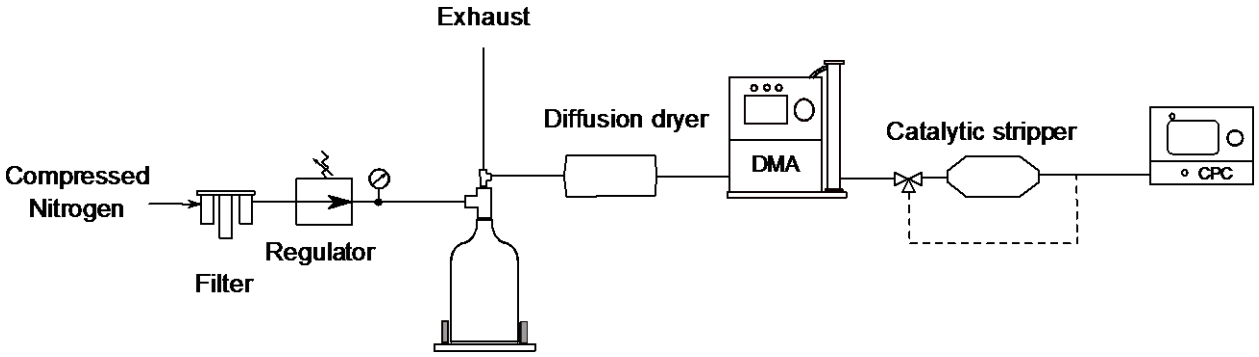

Figure S1. Schematic of the test setup for penetration quantification

* Corresponding author; Email: momenimo@ualberta.ca

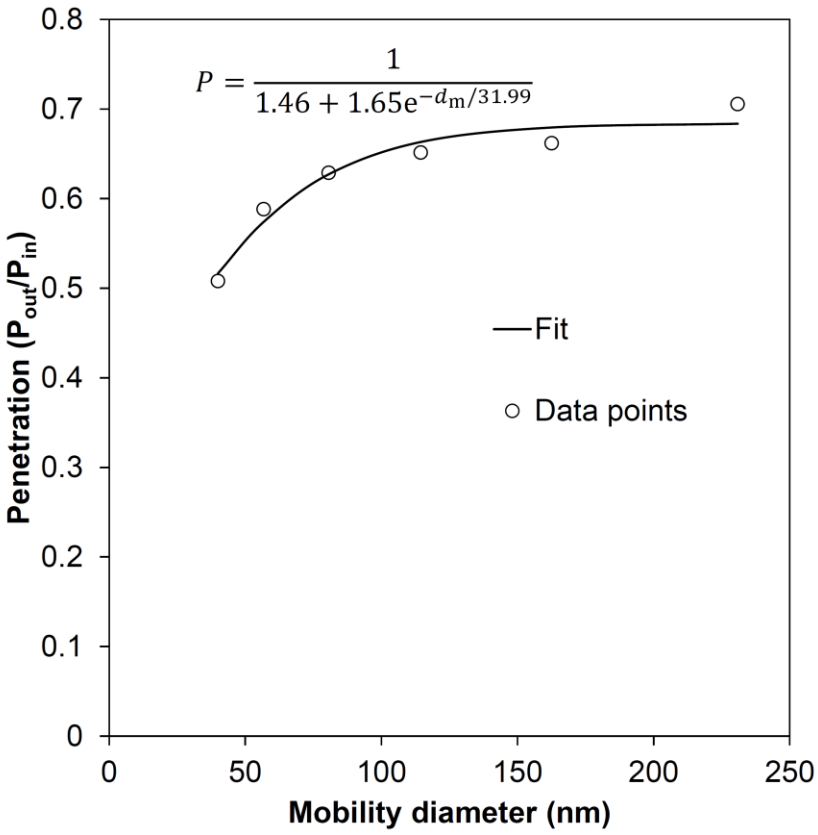

Figure S2. Ratio of particle concentrations from denuder line to bypass line using NaCl particles

Estimating the ratio of semi-volatile to non-volatile mass

The ratio of semi-volatile to non-volatile particle mass can be estimated from Equation 2 in the manuscript.

The semi-volatile mass can be calculated by adding the mass of semi-volatile coating (i.e. $n_{\mathrm{nv}}(m_{\mathrm{n}} - m_{\mathrm{nv}})$) and the mass of pure semi-volatile particles ($(n_{\mathrm{n}} - n_{\mathrm{nv}})\rho_{\mathrm{sv}}V_{\mathrm{p}}$). In the present study, nascent (m_{n}) and non-volatile (m_{nv}) particle masses are quantified at different mobility diameters including 40, 56.8, 80.7, 114.5, 162.6 and 230.9 nm (see section 2.2.3 of the manuscript). The number concentrations of nascent (n_{n}) and non-volatile (n_{nv}) particles are also measured for each particle size using the method explained in section 2.2.4 of the manuscript. We can now simply calculate the semi-volatile mass ($\left[n_{\mathrm{nv}}(m_{\mathrm{n}} - m_{\mathrm{nv}}) + (n_{\mathrm{n}} - n_{\mathrm{nv}})\rho_{\mathrm{sv}}V_{\mathrm{p}}\right]$) and non-volatile mass ($n_{\mathrm{nv}}m_{\mathrm{nv}}$) for each particle size. The total semi-volatile and non-volatile masses can be quantified using the following equations:

$$\sum\left[n_{\mathrm{nv}}(m_{\mathrm{n}} - m_{\mathrm{nv}}) + (n_{\mathrm{n}} - n_{\mathrm{nv}})\rho_{\mathrm{sv}}V_{\mathrm{p}}\right]_i \qquad \text{Total semi-volatile mass} \qquad \text{(S1)}$$

$$\sum\left[n_{\mathrm{nv}}m_{\mathrm{nv}}\right]_{\mathrm{i}} \qquad \text{Total non-volatile mass} \qquad \text{(S2)}$$

$\mathrm{i} = 40, 56.8, 80.7, 114.5, 162.6, 230.9$ nm

Finally, the ratio of semi-volatile to non-volatile particle mass is quantified using:

$$S = \frac{\text{semi–volatile particle mass}}{\text{non–volatile particle mass}} = \frac{\sum\left[n_{\mathrm{nv}}(m_{\mathrm{n}} - m_{\mathrm{nv}}) + (n_{\mathrm{n}} - n_{\mathrm{nv}})\rho_{\mathrm{sv}}V_{\mathrm{p}}\right]_{\mathrm{i}}}{\sum\left[n_{\mathrm{nv}}m_{\mathrm{nv}}\right]_{\mathrm{i}}} \qquad \text{(S3)}$$

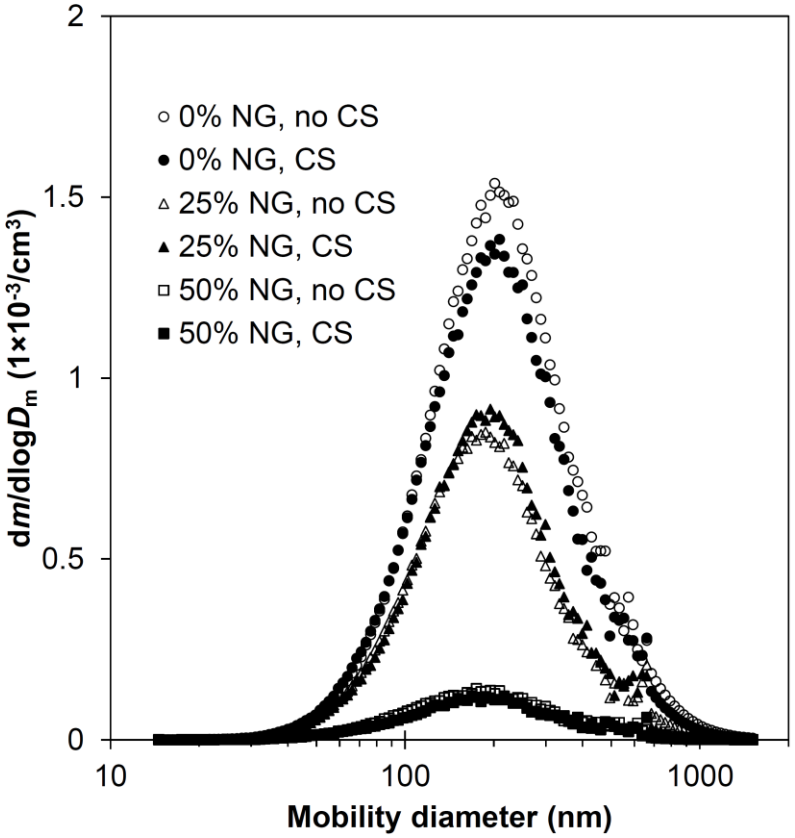

Figure S3. The mass distributions of nascent and non-volatile particles