ARISTOTLE UNIVERSITY OF THESSALONIKI
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GPF pressure drop modeling

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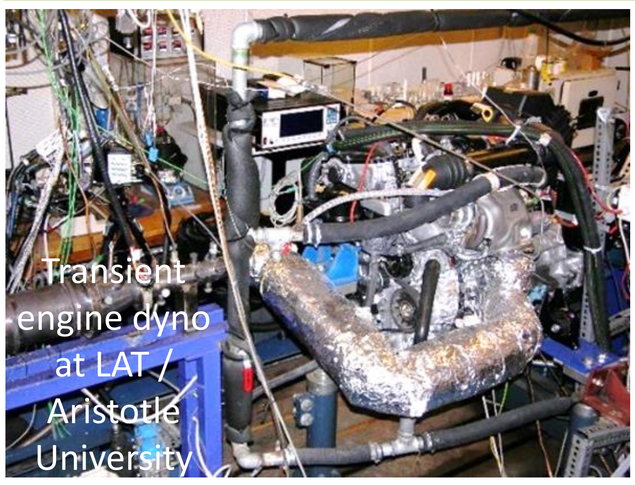
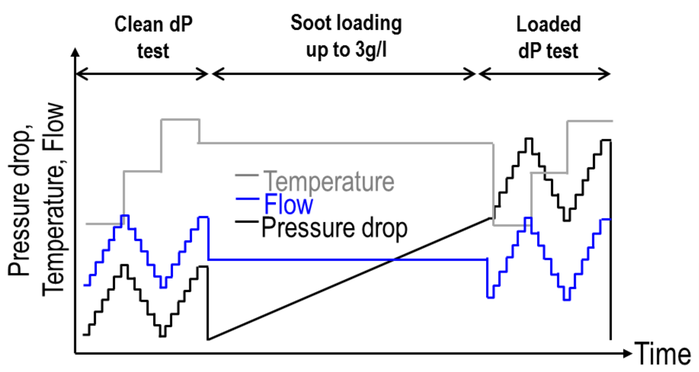
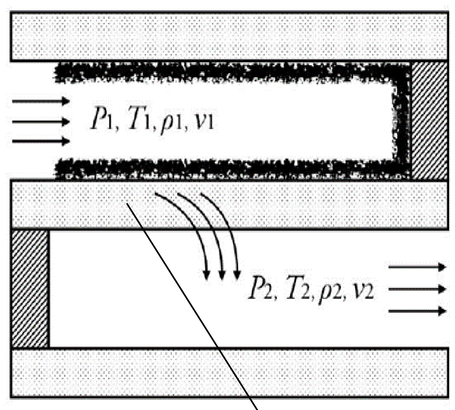
Measurement setup & test protocol



TOYOTA 8AR 2.0 l turbocharged engine EURO 6 (gasoline)



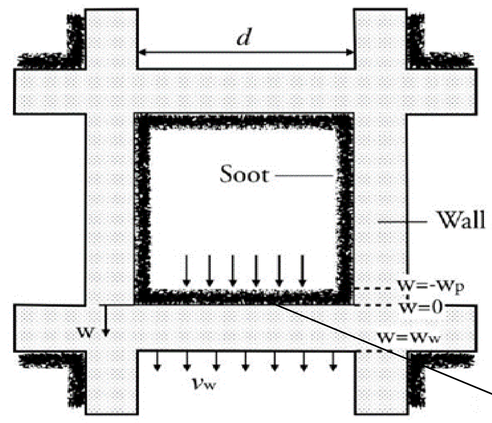
Modeling tool & Main equations



Channel scale

$$\frac{\partial}{\partial z}\left(d_i^2 \rho_i v_i\right) = (-1)^i \cdot 4 d \rho_w v_w$$

$$\frac{\partial p_i}{\partial z} + \frac{\partial}{\partial z}\left(\rho_i v_i^2\right) = -\alpha_1 \mu v_i / d_i^2$$



Wall scale

$$\frac{dP}{dw} = \frac{\mu \cdot v(w)}{k_p}$$

Contraction/expansion losses

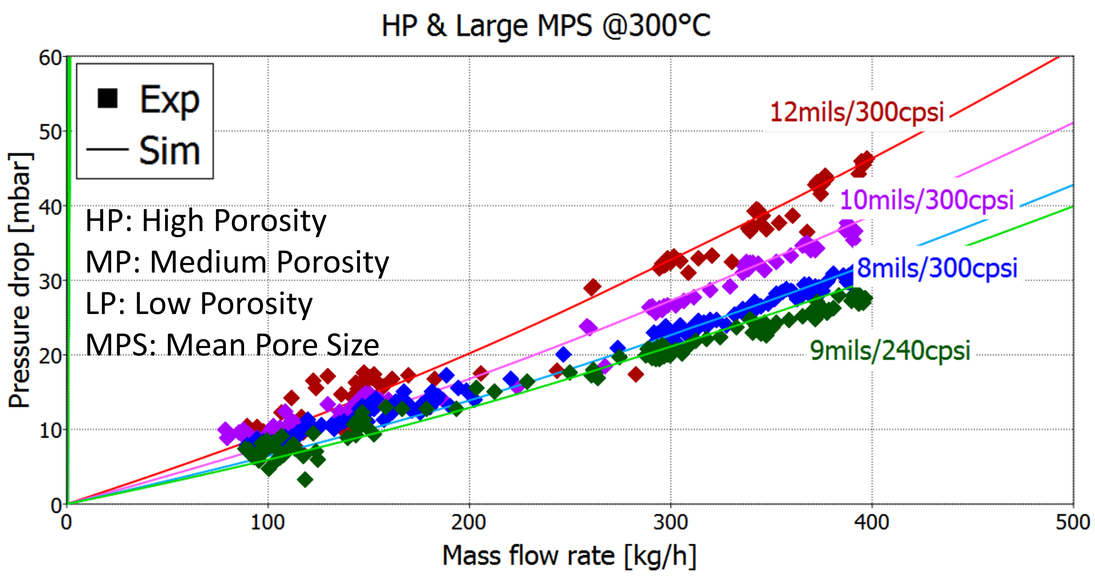
$$\Delta P_{contraction} = \left[1.1 - 0.4\frac{(d-2w_p)^2}{2(d+w_w)^2}\right]\frac{\rho_1 v_1^2\big|_{z=0}}{2}$$

$$\Delta P_{expansion} = \left[1 - \frac{d^2}{2(d+w_w)^2}\right]^2 \frac{\rho_2 v_2^2\big|_{z=L}}{2}$$

Uncoated Gasoline Particulate Filter (GPF) results

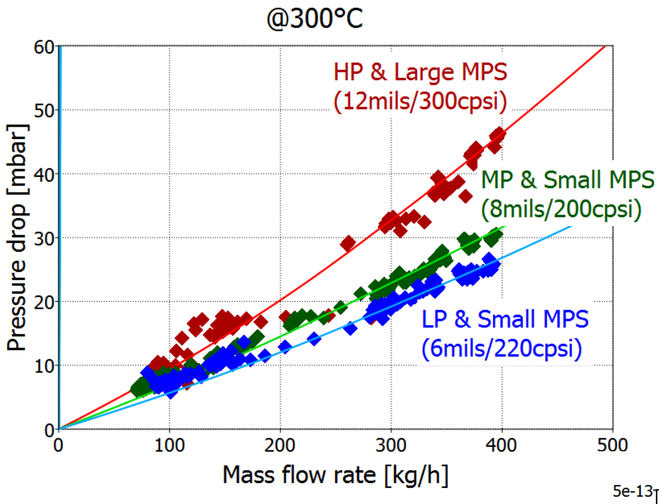
Cell structure effect on pressure drop

Results @ 300+/-10 degC

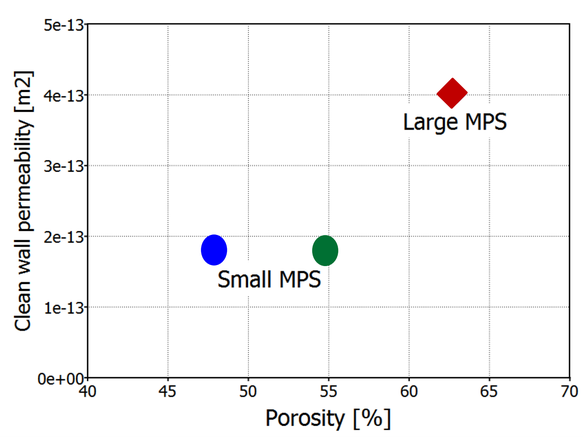


Once the wall permeability is tuned, the model is predictive with respect to changes in wall thickness and cell density

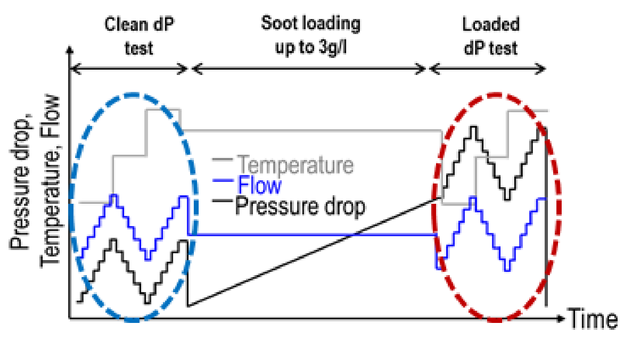
Clean wall permeabilities for different wall microstructures



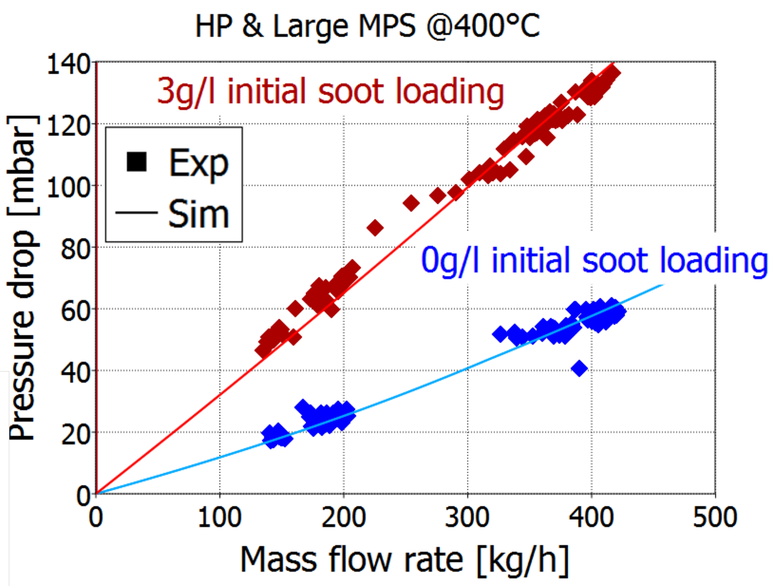
Tuning the wall permeability, the model can predict the behavior of filters with different wall porosity and/or mean pore size.

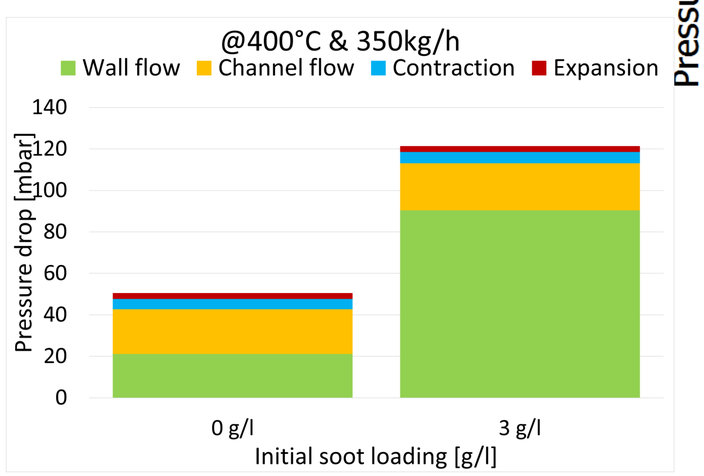


Soot loading effect on deltaP



12mils/300cpsi
DxL 118x127mm





The calibrated model for soot loaded filter is predictive in a wide range of flow rates and temperatures

Next steps

- Further investigation of GPF's:
  - Cell structure
  - Microstructure (Porosity, Mean pore diameter)
  - Coating
  - Position (Under Floor (UF) or Close Coupled (CC))

on:

- Pressure drop
- Filtration efficiency