

VERT GPF RETROFIT FOR PETROL ENGINES

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REDUCING TAILPIPE EMISSIONS FROM PETROL ENGINES

AeroSolfd is a Horizon Europe project focusing as an innovation action on developing market-ready retrofit solutions to immediately decrease the harmful effects on health and the environment of transport-related emissions with effective filtration devices for tailpipe emissions and non-tailpipe emissions, i.e. brakes emissions and semi-closed environments. The name AeroSolfd stands for cleaner, healthier urban environment, free from toxic aerosols, by market-ready retrofit solutions. VERT is responsible for retrofitting petrol engines, both GDI and PFI, with high efficiency GPF at low cost. In particular, VERT will use high efficiency CORNING second generation GPF as illustrated below.

BACKGROUND & OBJECTIVES

- VERT, investigated high efficiency GPF technologies to be applied in the AeroSolfd retrofit project for Petrol engines. There are two main paths to improve the collection efficiencies of nanoscale particles, without soot cake formation and with no impact on filter backpressure. These are membrane filter and hierarchic pore structure [1,2]. Hierarchic pore structures are more suitable for vehicle applications and have been selected by VERT for the AeroSolfd project. For this purpose, an extremely fine-pored structure made of a ceramic material is placed upstream of each "coarse" wall pore, mimicking the process used in the formation of soot cake, whereby the porosity curve can be suitably selected with a view to low counterpressure.
- Within the AeroSolfd project, 50 vehicles from 4 vehicle families will be equipped with GPF retrofit, CORNING new generation (GEN2) GPF technology, APT GC 2.0 (200/8) uncoated and tested in everyday use for 8 months [3]. The GPF will be placed underfloor in the location of the muffler (Fig.1), pressure will be monitored upstream and downstream the filter as well as temperature upstream and at the outer surface. The new generation GPF are designed for very high filtration efficiency at a pressure drop close to CORNING Gen 1 components available today. The technologies are designed for uncatalyzed filter applications. The first generation (GEN 1) CONING GPF technology was developed based on the traditional approach of optimizing porosity, pore size and distribution, combined with cell design such as cell density of 200 cpsi, to minimize the frictional contributions of the clean pressure drop; nominal web thickness of 8.5mil (0.216mm), to balance pressure drop with filtration and strength; medium porosity of 55% to enable high permeability, clean and with soot, at sufficient strength; range of pore sizes to enable the target filtration efficiency.

GPF RETROFIT & NEXT GENERATION GPF TECHNOLOGY

- Corning's new APT technology with hierarchical microstructure allows a system to achieve very high filtration efficiencies with almost no pressure drop penalty. In addition, the new DuraTrap GC 2.0 APT technology allows for very consistent products with respect to pressure drop and filtration, which would be very challenging with the conventional methods in this very high filtration range, as can be seen from the shape of the trendlines in Figure 2. The equivalency to the proven Gen 1 technologies with respect to the thermomechanical robustness of the new technology has been demonstrated. First on-road durability test data showed stable, very high filtration efficiency and stability in the pressure drop response to soot load from the fresh state to the targeted mileage.

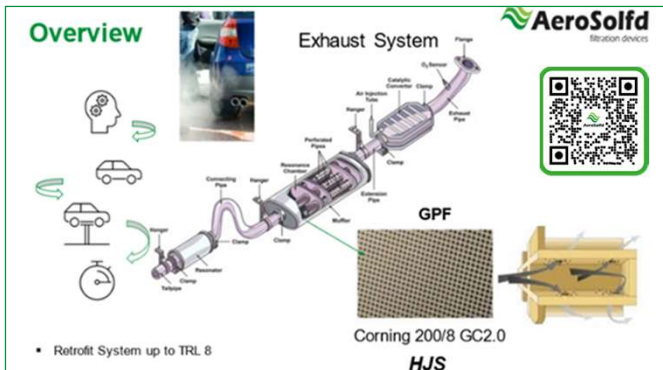


Figure 1: Schematic of the AeroSolfd Retrofit GPF-system installed in the exhaust in place of the the muffler.

REFERENCES

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- (2) Thorsten Boger, Dominik Rose, Suhao He, Ameya Joshi: Developments for future EU7 regulations and the path to zero impact emissions - a catalyst substrate and filter supplier's perspective; Transportation Engineering 10, 2022. <https://doi.org/10.1016/j.treng.2022.100129>.
- (3) L. Rubino et AL, FILTECH 2023 Conference, Feb 14-16, 2023 Cologne, Germany.

- VERT GPF-Retrofit system within the HORIZON AeroSolfd project will use Corning's new APT technology with hierarchical microstructure to achieve very high filtration efficiencies (> 95%) with almost no pressure drop penalty;
- The new DuraTrap GC 2.0 APT technology will be applied for retrofitting 50 Petrol engine vehicles, both GDI and PFI in 3 different locations (Germany, Switzerland, Israel);
- On-road durability CORNING test data showed stable, very high filtration efficiency and stability in the pressure drop response to soot load from the fresh state to the targeted mileage for the CORNING GPF.
- Limiting the harmful effects of transport-related emissions by retrofit solutions is urgently needed in the transition towards cleaner mobility.
- The project progress can be followed at <https://aerosolfdproject.eu/2023/03/15/filters-for-cleaner-air/>

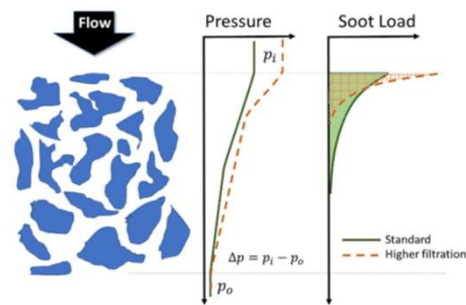


Figure 2: Schematic representation of flow, pressure and soot collection (filtration) across a porous wall. Solid and dashed line represent two kinds of microstructure with standard and higher filtration efficiency [1].

Product Concept - Next Generation Filter Technology GC 2.0 APT

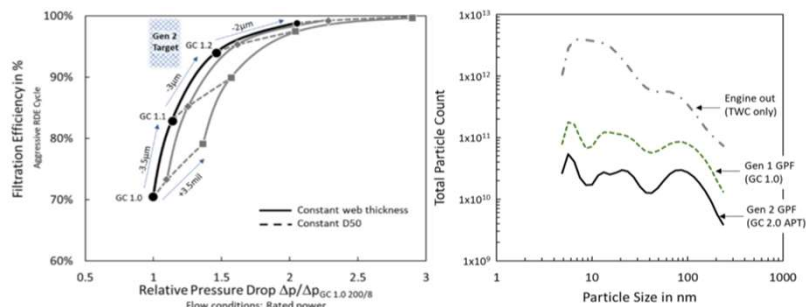


Figure 3: Trade-off between filtration efficiency and pressure drop for Gen 1 filter technologies. Variables are the median pore size (D50), solid lines, and the web thickness, dashed lines [1].

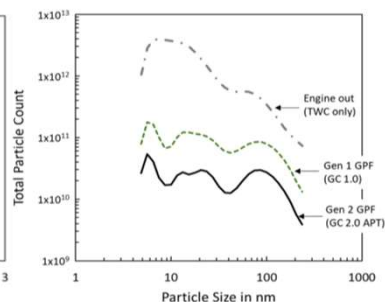


Figure 4: Cumulative tailpipe particulate emissions over WLTC with a EU6d TEMP vehicle as function of the particle size; engine out (TWC only), Gen 1 and the new Gen 2 filter technology [1].

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