Testing and engineering for automotive

11 April 2016 - GE Florence Learning Center – Florence - Italy

ETN Air filtration meeting

TEXA S.r.l.
Massimo Ellena
Pier Giorgio Tronville

TEXA Ltd.

Texa Ltd. was established in 1997 as an engineering company specialized in:

• Vibration and shock tests;

• Thermal cycles under temperature and relative humidity control;

TEXA Ltd.

- Mechanical endurance by means of hydraulic, pneumatic or electric actuators;

- Cycled pressure endurance with oil or air, together with temperature;

- **PARTICULATE AIR CLEANER ASSESSMENT**

Air Filtration Laboratory

Air filter testing according to the following standards:

For **engine/cabin application**:

- ISO 5011:2014 "Inlet air cleaning equipment for internal combustion engines and compressors - Performance testing"

The air filtration laboratory is accredited according to ISO 17025 by ACCREDIA for ISO 5011:2014 tests

LAB N° 1566

- EN 15695-2 "Agricultural tractors and self-propelled sprayers - Protection of the operator (driver) against hazardous substances - Part 2: Filters, requirements and test procedures“
- ISO 10263-2 "Earth-moving machinery - Operator enclosure environment - Part 2: Air filter element test method“

Air Filtration Laboratory

Air filter testing according to the following standards:

For **engine/cabin application**:

- ISO 14269-4: "Tractors and self-propelled machines for agriculture and forestry - Operator enclosure environment - Part 4: Air filter element test method"
- ISO 11155-1 "Road vehicles - Air filters for passenger compartments - Part 1: Test for particulate filtration“
- ISO 19713-1 "Road vehicles – Inlet air cleaning equipment for internal combustion engines and compressors – Part1: Fractional efficiency with fine particles (0,3 to 5 µm optical diameter)“

Air Filtration LABORATORY

Air filter testing according to the following standards:

For **general ventilation**:

- EN 779 - "Filtri d'aria antipolvere per ventilazione generale - Determinazione della prestazione di filtrazione"
- ASHRAE 52.2 "Method of Testing General Ventilation Air-Cleaning Devices for Removal Efficiency by Particle Size "
- ISO/FDIS 16890-2 "Air filter for general ventilation — Part 2: Measurement of fractional efficiency and air flow resistance “

The test rigs were designed and mostly manufactured by Texa with a multi-year effort and in cooperation with the Department of Energy of Politecnico di Torino

Water/salt test facilities

STATIC /CARTRIDGE FILTER

- Test rig built in 2012 to carry out the hydrophobicity test using water-salt (according to General Electric specifications)
- Operated with negative pressure and has the V-shape duct (with section 650x650mm).

Main capabilities:

1. To feed and to collect salt/water upstream and downstream the test filter to obtain:
   - Pressure drop caused by the filter;
   - Water quantity upstream/downstream of the filter;
   - Salt concentration in the water collected.

2. To generate a synthetic aerosol (DEHS) to measure the efficiency by particle size of the filter

3. To introduce standardized synthetic dust to artificially age the filter

Water/salt test facilities

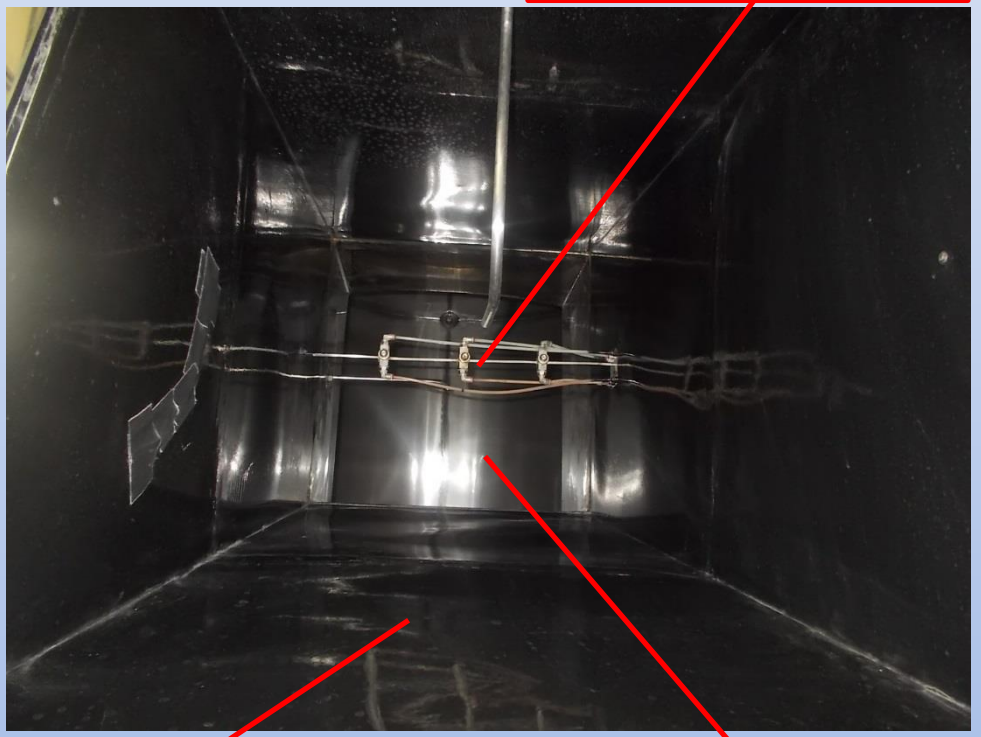
Upstream sampling tube

Downstream sampling tube

Dust feeder for Ahrae dust

V-shape test system

N°3 nozzles for feeding water-salt

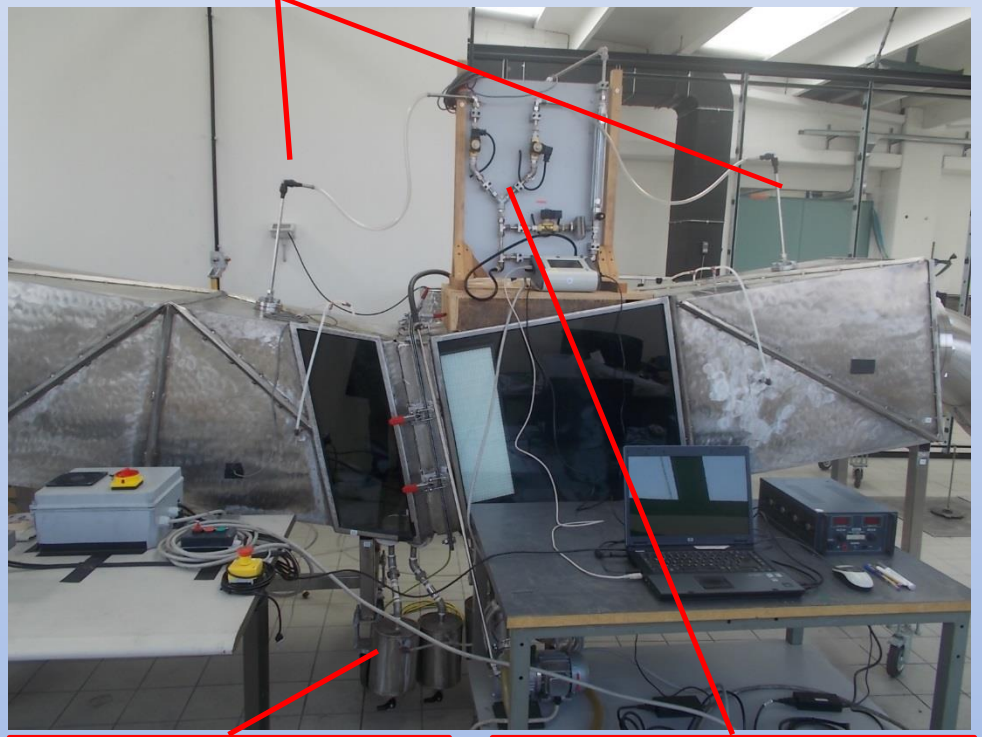


Upstream inner duct

Mixing chamber for water-salt or DEHS in the airflow

Water/salt test facilities

Upstream/Downstream sampling tube



N°4 tanks to collect water

Sampling system for efficiency according to Ashrae 52.2 standard

Mixing chamber for water-salt or DEHS in the airflow

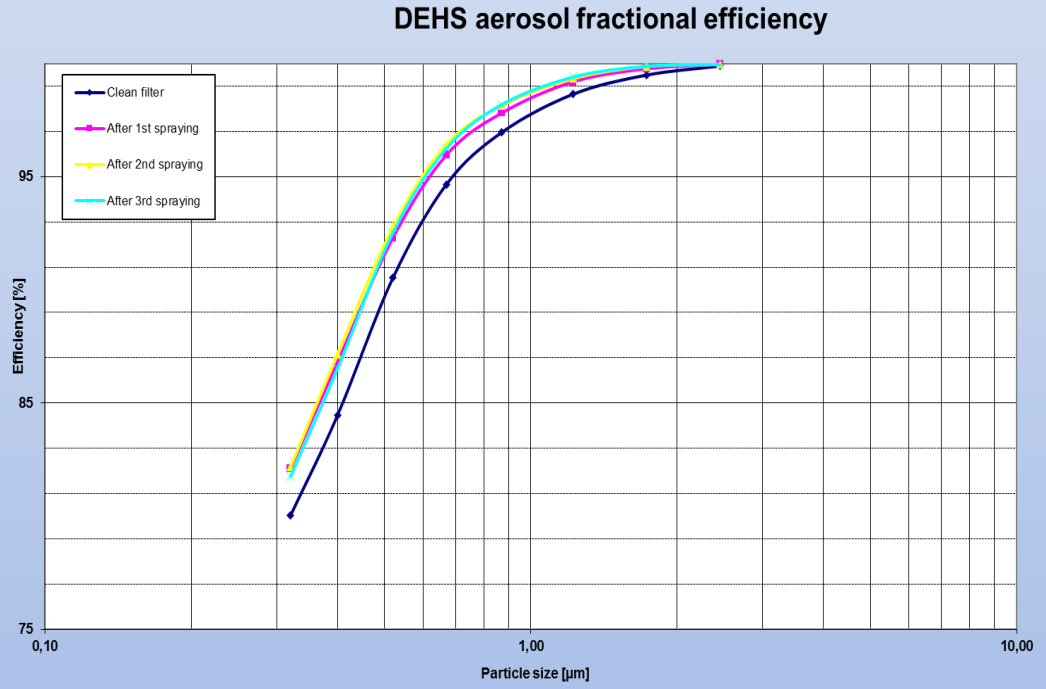
Plenum/laboratory

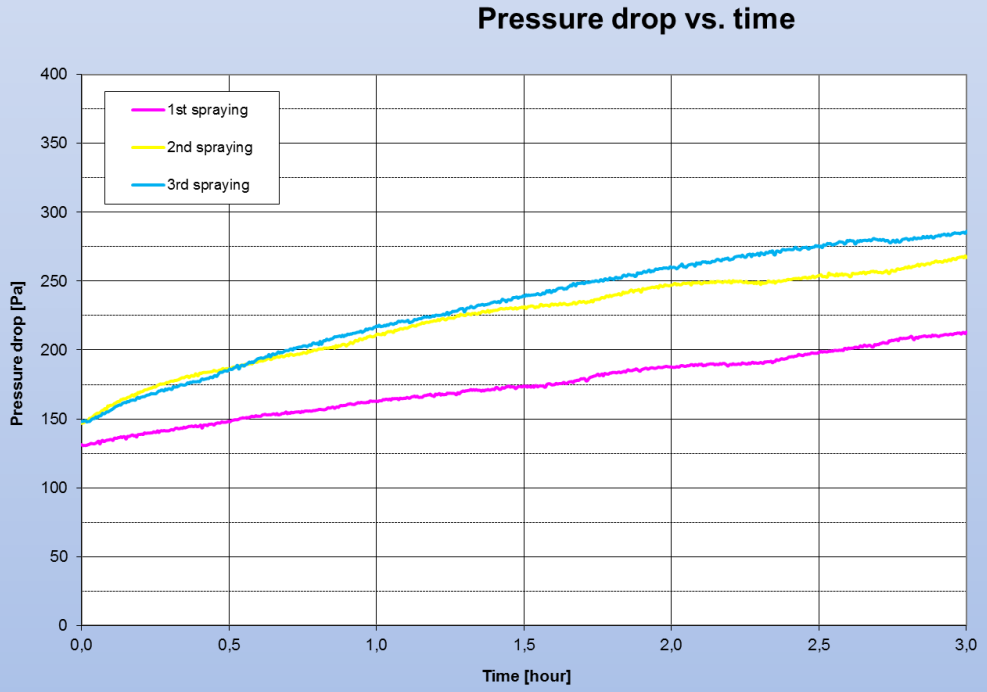
Munters: facility for the producing in T and Ur controlled

Instrumentation available for water/salt testing

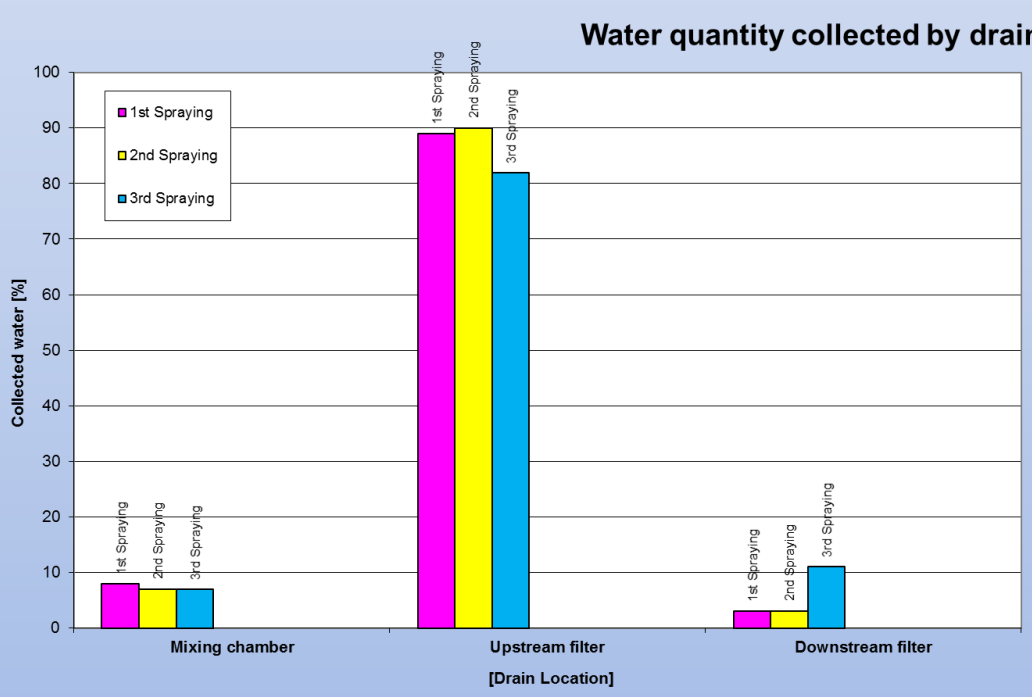
- Differential pressure transducers 0-20 mbar and 0-300 mbar;
- Thermo-hygrometers;
- Nozzles for measuring airflow rates up to 4800 kg/h;
- Optical Particle Counters;
- Nozzles to feed saltwater inside the system;
- Automatic dust feeder for ASHRAE dust according to EN779:2012 requirements and Topas dust feeder for ISO 12013 dusts;
- Electrical conductivity meter to measure NaCl concentration;
- PLC for automatic control of airflow
- Munters MX 5000 to produce air in temperature and relative humidity controlled: 18÷28°C; 20÷95% RH

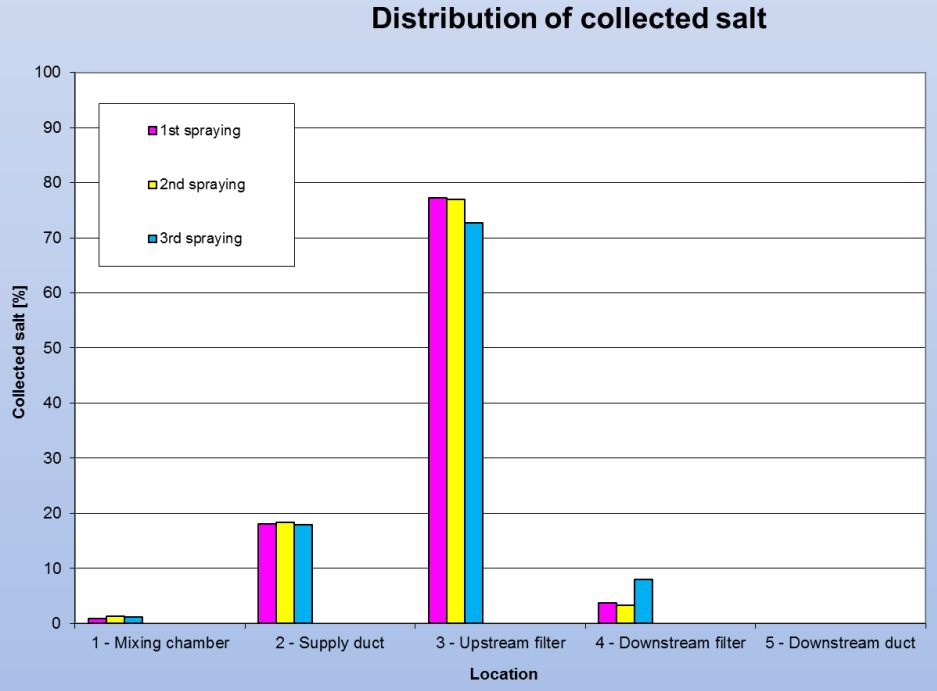
Water/salt test DATA - Example





Water/salt test DATA - Example





Water/salt test COMMENTS

The key questions and comments required

1. which spray solution?
2. generated how?
3. particle size distribution?
4. Flowrates for saline solution ?
5. Measurement systems?
6. Test repeat how many times?
7. This test is aimed at single filter elements?
   - Pre-filters
   - Fine filters
   - EPA filters
8. If a combined air filtration system was tested this way then you could run this test for days before a downstream reading is recorded ?

Water/salt test COMMENTS

ITEM 1. Which spray solution?

We suggest to use water-salt aerosol generated by spraying nozzles only:
- to increase the pressure drop of the test filter;
- to evaluate salt concentration upstream and downstream of the filter.

We suggest to use synthetic DEHS aerosol:
- to evaluate the efficiency by particle size of the test filter.

Considerations:
- DEHS is stable and salted water aerosol is not stable after being sampled;
- DEHS could provide correct data for measuring the efficiency by particle size;
- It would be possible to carry out test at 80%-85%RH and not necessarily with RH ≥90%;
- The cost of the test would be ultimately lower.

Water/salt test COMMENTS

ITEMS 2 and 3. Particle size distribution and generated how

Water-salt aerosol:
We have been using **air atomizing nozzle** series 1/4J with round spray by Spraying System, working up to 11.9 dm^3/h.

The water-salt particle size distribution obtained by TEXA (Fig.1), with initial concentration 35g/l of NaCl, is similar to the shape of the marine aerosol particle size distributions (Fig. 2 and 3) shown in the book of Seinfeld and Pandis "Atmospheric chemistry and physics" (see §8.2.2)
From the book:
«Typically, the coarse-particle mode (Diameter > 0,6µm), representing 95% of the total mass but only 5 — 10% of the particle number (Figure 3), results from the evaporation of sea-spray produced by bursting bubbles or wind-induced wave breaking."

We suggest to consider the particle size range:

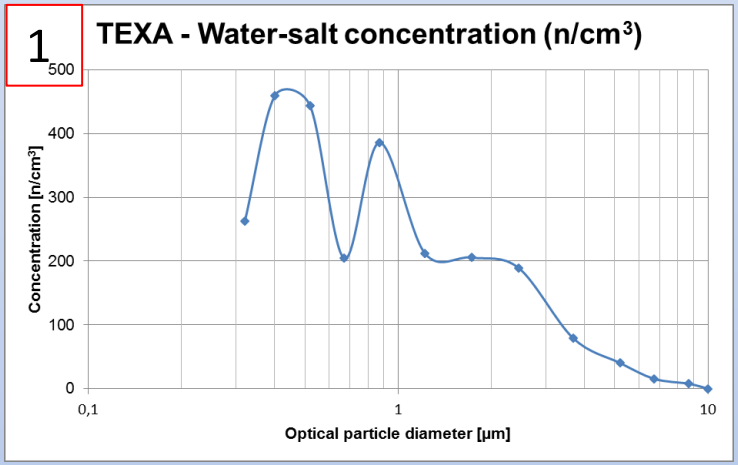
0,3÷3µm

Which is covered by DEHS aerosol for efficiency test

Water/salt test COMMENTS

ITEMS 2 and 3. Particle size distribution and generated how

1



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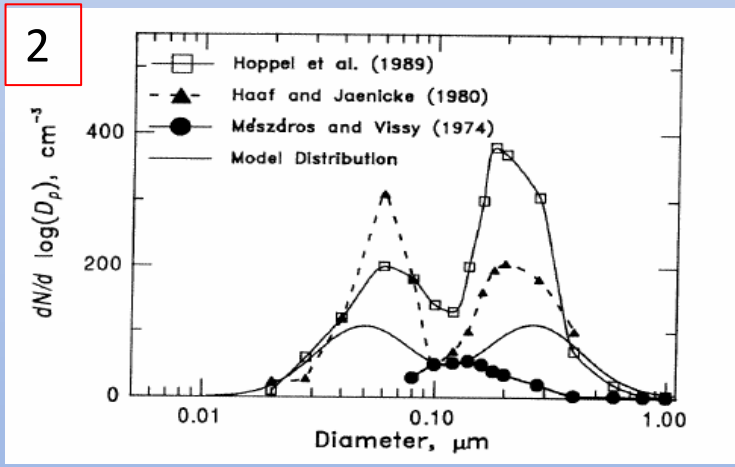

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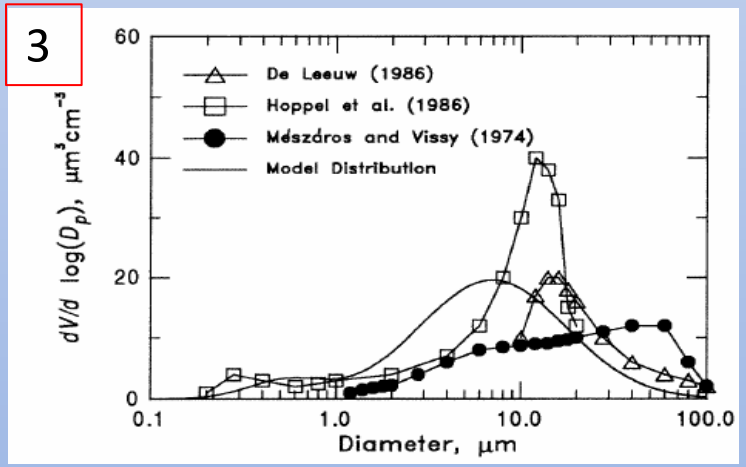

Water/salt test COMMENTS

ITEM 4. Flowrate for saline solution

We believe your proposal to use a flowrate 2-5ml/m^3 is adequate

ITEM 5. Measurement systems

- OPC for efficiency test using DEHS synthetic aerosol;

- Electrical conductivity-meter to evaluate the saline concentration in water solution before and after spraying upstream and downstream the filter under test;

- Environmental sensors (thermo-hygrometers) upstream and downstream of the filters under test.

Water/salt test COMMENTS

ITEM 6. Test repeated how many times

We agree with the proposal of the repetitions indicated in the §§ 6.3 and 7.3 of the 1° draft Water/Salt test procedure extracted from the ISO29461-Part 5. We have not reasons to use different number of repetition

ITEMS 7/8 Test aimed at single filter element?

Testing the complete filtration system could be the adequate solution.
In any case we think is better to focus the test on every single filter (Pre-filter, Fine filter and EPA filter). We get:

- Full characterization of each filter element;
- Test rig more simple

However, we are open to study and build a specific test rig for a complete filtration system if there is the availability of funding

Thank you for your attention!

massimo.ellena@texaengineering.it

piergiorgio.tronville@texaengineering.it