Testing the Genano Technology

Growing pains of a verification system for air abatement technologies

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Outline

1. Introduction: test cases within AIRTV
2. Test case 1: the Genano Technology
3. Challenges
4. Test case 1: Genano: results of verification
5. Experiences of a vendor
6. Final conclusions

Introduction

Goal AIRTV

= set-up of an international verification system for air abatement technologies

Test cases within AIRTV: Why?

Verification procedure has to be more than a nice theory

→ Test cases to identify and solve hurdles and problems!

Introduction

Test cases within AIRTV: which technologies?

Dust	
Genano technology	VITO
Wet scrubber	LEIA
Electrostatic precipitator	IVL
VOS	
Regeneration of activated carbon	IFARE
Regenerative combustion	TNO
Ammonia	
Combi-scrubber system	TNO
NOx	
Low emission natural gas burning	INIG
Multi-pollutant	
Turbosorp	UBA-A
Odour	
Applied plasma physics	VITO

Test case 1: the Genano Technology

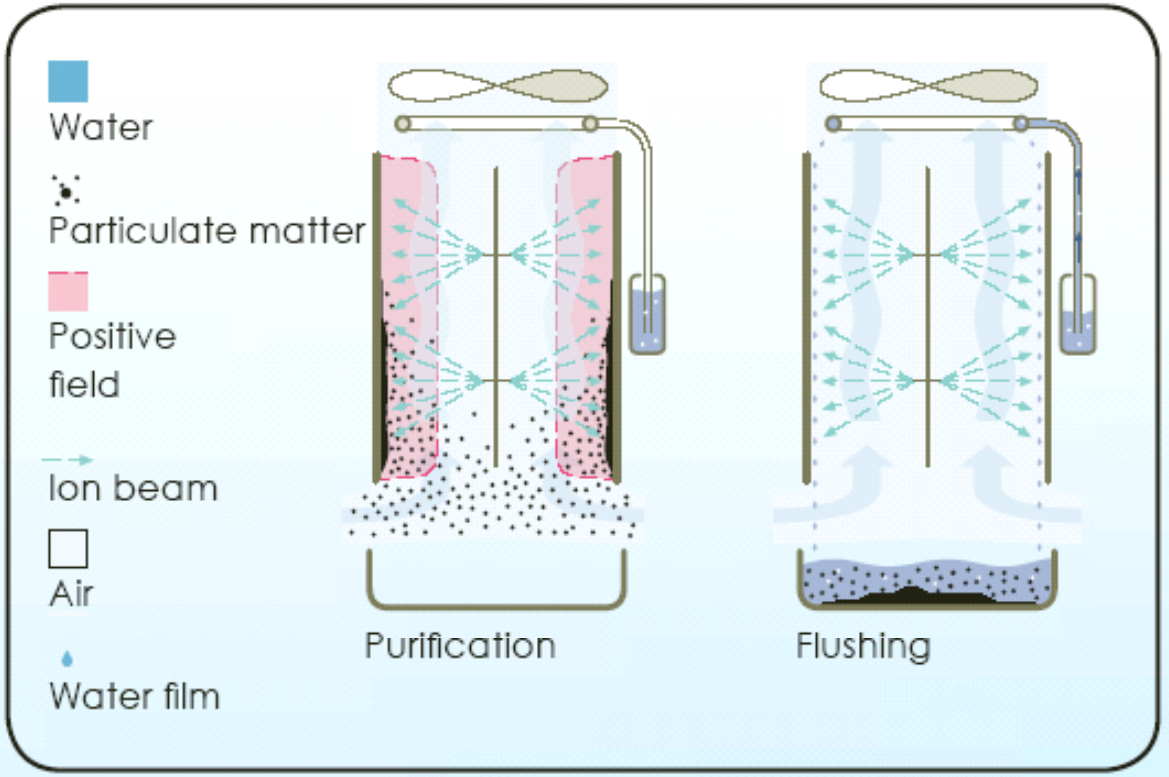
Description of the technology

Application: air purification: removal of entire range of particles from indoor air

Principle: Corona effect phenomenon

Test case 1: the Genano Technology

Description of the technology



1. Air passes between collection surfaces
2. Ion spray forces particles on collection surfaces
3. Accumulated mass of particles is flushed with a water-detergent solution

Test case 1: the Genano Technology

Why is Genano perfect as first test case?

- easy to control and easy to handle
- can be tested in almost every room
- innovative technology but already on the market (target group)
- the technology is doing more than asked for
  → no standards available yet
  → typical technology which can benefit from international verification

Test case 1: the Genano Technology

Set-up of the test case

1. Determination of the claim
2. Writing of the specific protocol (VITO + cross-checking by IVL and LEIA + check by vendor)
3. Data check (VITO + VITO lab)
4. Test plan (VITO + VITO lab)
5. Performing tests (VITO lab): test conditions + parameters to verify claim + additional parameters
6. Test report (VITO lab)
7. Verification report (VITO + check vendor and other partners)

Challenge 1: How to write the perfect claim?

Benefits as indicated by the technology owner

- Removal of particles down to 3 nm with an efficiency up to 99,5 %;
- Self-cleaning and no waste to dispose;
- Low maintenance;
- Long life span;
- Low energy consumption (constant pressure drop);
- Simultaneous removal of viruses, bacteria, soot particles from traffic… ⇦ Application

Suppliers info

Challenge 1: How to write the perfect claim?

The final claim

- The Genano technology claims to remove all particles with a diameter between 20 nm and 10 µm with a filter efficiency between 80 and 99,5 %. Hereby, filter efficiency is defined as the ratio of particles trapped by a filter over the total number of particles found in the air upstream of the filter.
- When the purifier is operating, ozone is generated. Genano claims that the produced ozone concentration will not exceed 0,05 ppm.

Related towards legal standards

Challenge 2: Use of already available data?

Goal: decrease verification costs by using already available data

But: cost-saving or time-consuming?

Problems:

- Measurement methods are not mentioned in detail;
- Measurements not according international standards;
- Test conditions not fulfilled or report doesn't include all necessary operational parameters;
- Only data for a few parameters and these parameters have to be determined again together with other parameters;
- …

Challenge 2: Use of already available data?

Conclusions:

- Use of available data only possible in minority of cases;
- Guidelines “how to perform measurements to make them useful for verification” could help technology developers
  → take into account during development!

Challenge 3: Writing a testplan

Requirements of a testplan:

- Ensure smooth and effective test run
- Time frame fixed
- Autonomous document

→ After reading the test plan, all involved parties have to know:

- what they have to do
- when they have to take action

Challenge 3: Writing a testplan

Problems occured:

- Writing the testplan: who? task of a measurement expert?
- Measurement methods: what if no international standard is available (innovative technologies!)?
- Communication problems: define clearly what you need and when!
- Who decides which test lab?

Test case 1: Genano: measurements

Measured parameters

- Flow rate;
- Temperature;
- Relative humidity;
- Particle mass conc (PM1, PM2.5, PM10);
- Particle number conc (20 – 1000 nm);
- Size distribution;
- Ozone concentration.

Challenge 4: Interpretation of data

Error on measurement

How to handle errors on measurements?

When is a claim verified succesfully?

Particle diameter (nm)	Average filter efficiency (%)	Claim (%)
300 – 350	92 ± 12	80 – 99,5
350 – 400	88 ± 14	80 – 99,5
400 – 450	80 ± 25	80 – 99,5
450 – 500	100 ± 10	80 – 99,5
500 – 550	100 ± 21	80 – 99,5
550 – 600	100 ± 21	80 – 99,5

Challenge 4: Interpretation of data

Transferability of results

Can results be used in other situations/applications or only indication?

Test case 1: Genano: results

Operational parameters:

- Temperature
- Relative humidity
- Air flow

} OK

Additional parameters

Parameter	Unit	Data provided by vendor
Power consumption	W	80
Water consumption (automated cleaning)	cl/cleaning l/year	30 15
Active carbon consumption	filter/year	1
Man-power needed for maintenance	h/year	1
Lifetime of equipment	year	15 – 20
Space needed	cm x cm x cm	45 x 38,5 x 147

Test case 1: Genano: results

Parameters to verify the claim:

Parameter	Claim	Measured value Experiment 1 (without extra fine dust)	Measured value Experiment 2 (extra fine dust by printing)
Filter efficiency			
0 – 50 nm	80 – 99,5 %	96 ± 2	94 ± 2
50 – 100 nm	80 – 99,5 %	95 ± 2	93 ± 1
100 – 150 nm	80 – 99,5 %	91 ± 3	91 ± 2
150 – 200 nm	80 – 99,5 %	92 ± 4	92 ± 3
200 – 250 nm	80 – 99,5 %	92 ± 5	89 ± 4
250 – 300 nm	80 – 99,5 %	94 ± 8	90 ± 7
300 – 350 nm	80 – 99,5 %	92 ± 12	94 ± 18
350 – 400 nm	80 – 99,5 %	88 ± 14	85 ± 18
400 – 450 nm	80 – 99,5 %	80 ± 25	100 ± 10
450 – 500 nm	80 – 99,5 %	100 ± 10	100 ± 11
500 – 550 nm	80 – 99,5 %	100 ± 21	-
550 – 600 nm	80 – 99,5 %	100 ± 21	100 ± 16
20 – 1000 nm	80 – 99,5 %	98 ± 28	85 ± 28
PM 1	80 – 99,5 %	97 ± 3	98 ± 3
PM 2.5	80 – 99,5 %	98 ± 3	98 ± 3
PM 10	80 – 99,5 %	99 ± 3	99 ± 3
Ozone concentration			
Maximal amount	0,05 ppm	0,005 ppm	0,005 ppm

Claim succesfully verified

Test case 1: Experiences of Genano

- Benefit: international value (instead of a validation report in each country)
- Problems: no: only task was delivery and installation of the unit
- Value for money? Technology validation is expensive, but ok if costs verification < sum of costs national validation reports
- Possible hurdle: **flexibility**: verification for innovative technologies
  → continuously improvements/adjustments on technology
  → new verification after every improvement/adjustment?

Final conclusions

Verification: useful tool for innovative technologies

Some problems of verification procedure revealed:

→ Discussions started + changes during other test cases

→ Final goal: reaching a workable verification procedure for air abatement technologies