

ISO-29461 part 5

Marine and offshore filtration testing

Test procedure evaluation

Objective

Simulate marine and offshore challenges in an accelerated lab test.

Must be repeatable and preferably possible to automate.

Challenge

Offshore symptom is water and salt bypass after a period of time often without experiencing high pressure drops.

In general a limited amount of dust – mostly combustion particles from exhausts.

Relative humidity varies but environment is normally humid.

Generating soot particles

- It is easy to generate soot particles.
- It is very difficult to generate a repetitive and known particle size distribution. Existing equipment is either very expensive or generates very small amounts of soot.
- It is not environmentally friendly and potentially toxic for lab personnel.
- Our trials show that soot particles are not required to generate the failing mechanisms.

Why ultrafine salt particle generation?

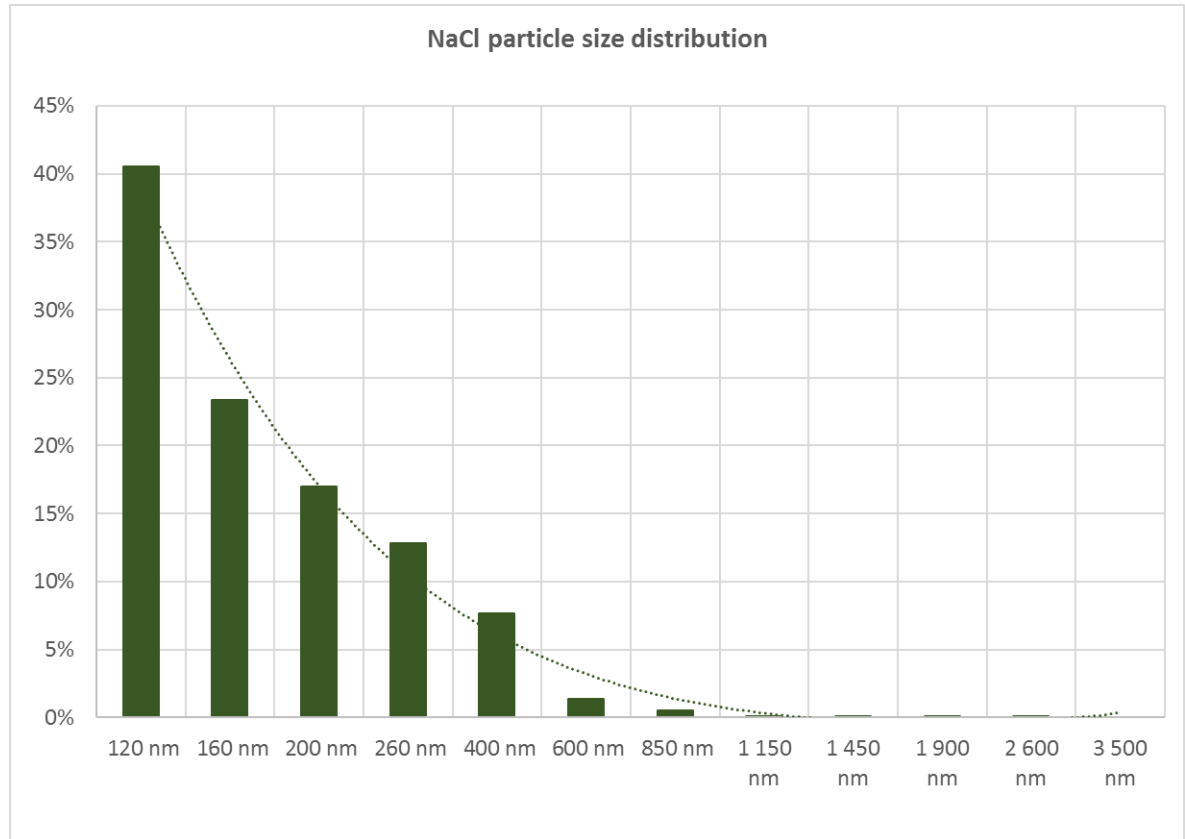
Sea-salt aerosol (SSA) is an important constituent of natural marine aerosol to which anthropogenic aerosols must be compared when assessing their climatic influence. Size distributions of particles, produced by bubbles from coastal oceanic breaking waves, were found to have **sizes as small as 0.01 μm (10nm), with 60% smaller than 0.1 μm (100nm) diameter**. The thermal stability of these particles and their growth factor measured under increasing humidity indicate that most are sea salt.

Source: JOURNAL OF GEOPHYSICAL RESEARCH, VOL. 111, D06202,
doi:10.1029/2005JD006565, 2006

Ultra fine sub micron particles will directly penetrate into the entire 3-dimensional depth of the media where salt water spray droplets will mostly impact on the 2-dimensional surface of the media.

NaCl particle size distribution

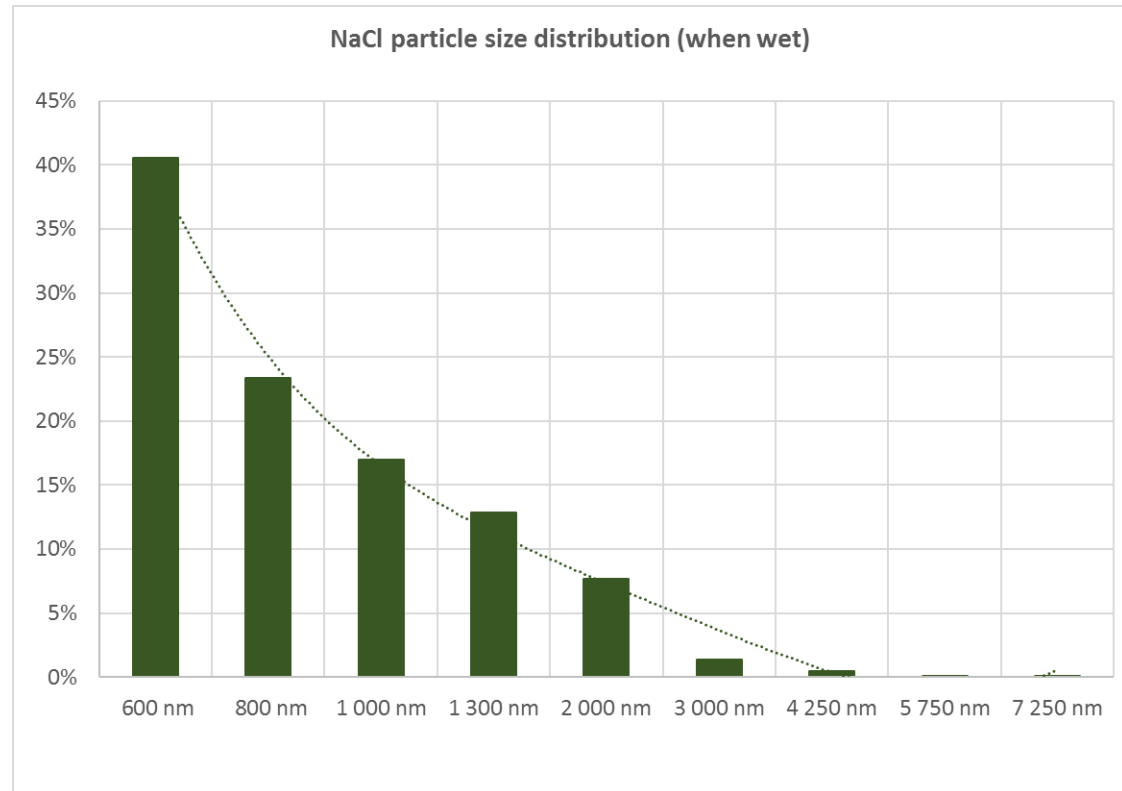
- Majority of particles are smaller than 1 micron



When relative humidity is close to 100%

When wet the salt particles will expand.

In this graph a 5x increase is simulated



Test procedure

- Ultrafine dry NaCl (or KCl) is sprayed continuously throughout the entire test.
- Test starts with ultra fine fresh water spray in 48minutes, 0,2 liter/minute (9,6 liter)
- Relative humidity is cycled Hi/Lo in approx. 1,5h cycles
Hi means close to 100%
Lo means between 25-40%

Time	Simulation	Length
08:00	Water spray	00:48
08:48	Low r.H.	01:33
10:21	High r.H.	01:33
11:54	Low r.H.	01:33
13:27	High r.H.	01:33
15:00	Water spray	00:48
15:48	Low r.H.	01:37
17:25	High r.H.	01:37
19:02	Low r.H.	01:37
20:39	High r.H.	01:37
22:16	Low r.H.	01:37
23:54	High r.H.	01:37
01:31	Low r.H.	01:37
03:08	High r.H.	01:37
04:45	Low r.H.	01:37
06:22	High r.H.	01:37

Advantages

- Can be fully automated
- No dust (=less variation and less messy)
- No need to handle filter during test
- Stable (reasonable tolerance)
- No expensive consumables

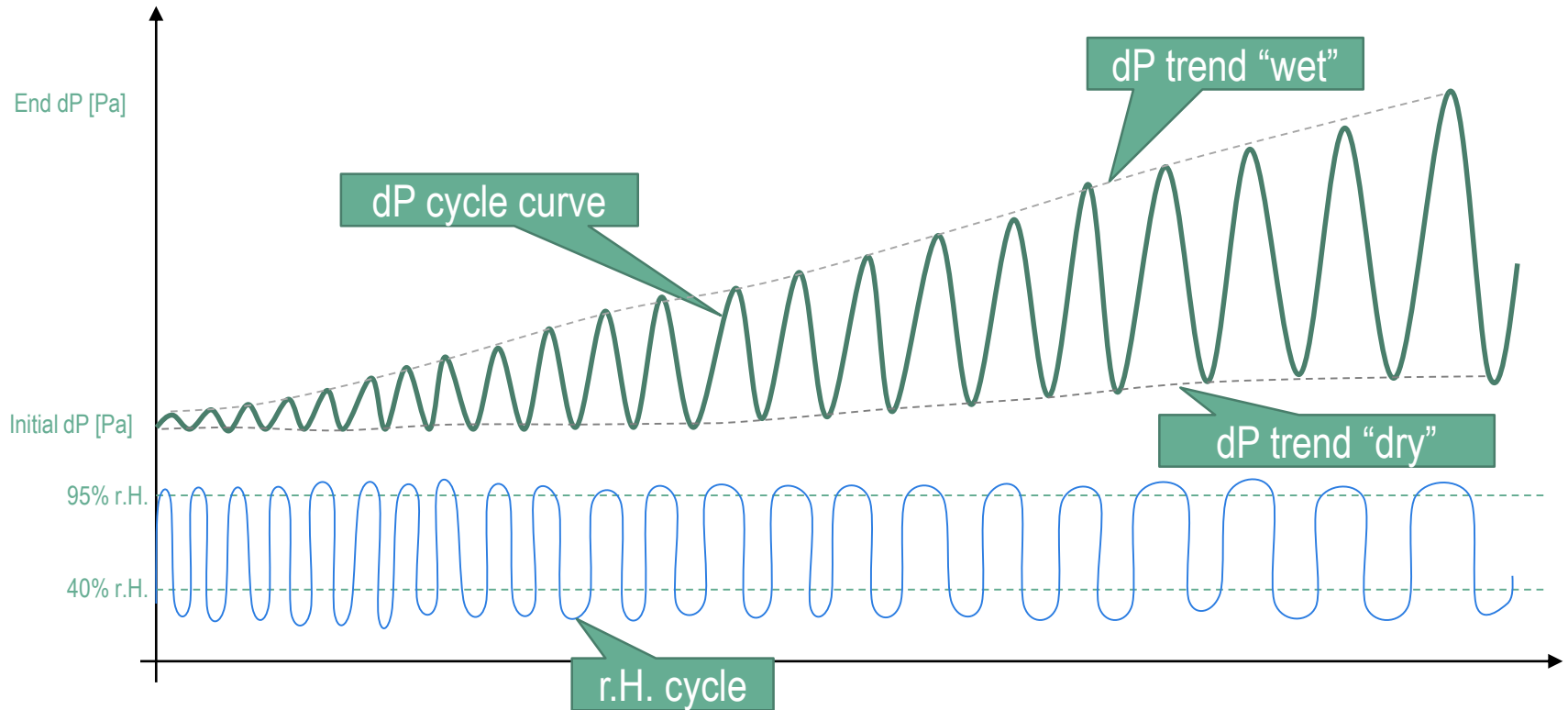
Challenges

- Difficult to quantify size or position of leak
- Visual detection – water spray cycle needs to be monitored by operator or camera.
- Small amounts of water will not run towards a drain unless surface is with very low friction.

Potential result targets

- Poor result is 0-2 cycles = not suitable
- Good result is 15-19
- Excellent result is >20 water spray cycles without any leaks

Filter behavior during test



Observation.

dP did not need to increase much to create leakage through the filter – end vs initial could be a factor of 2.

Slow but continuous increase of dP when exposed to high dP shows that more and more salt is added.

time