



BOLLFILTER
Protection Systems

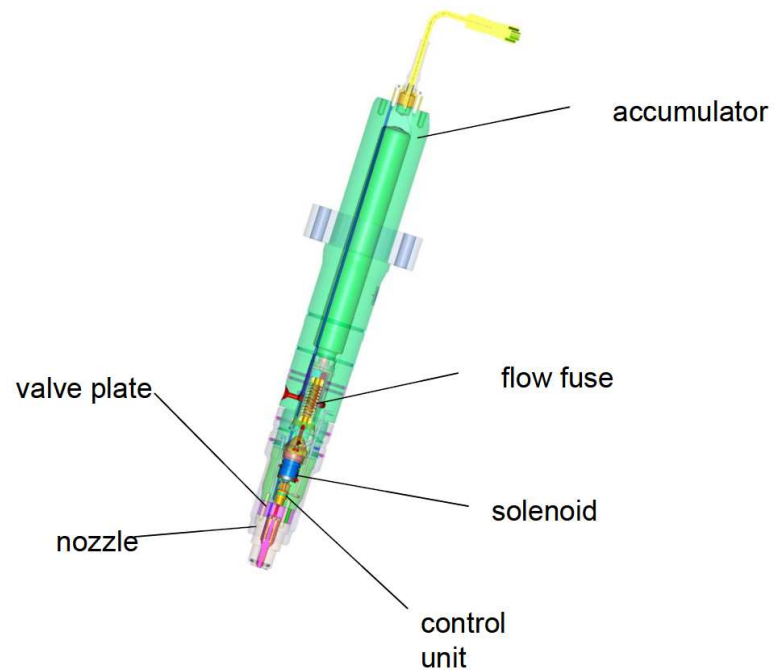
**Influence of filtration on component
lifetime
of common rail injection systems**

Agenda

- Abrasive particles limiting the lifetime of CR injectors
- Experiences with different filtration levels
- Filtration technology which overcomes the problem
- Conclusions

Target of the development

Safe operation of common rail injection system exceeding 8.000 running hrs with heavy fuel oil

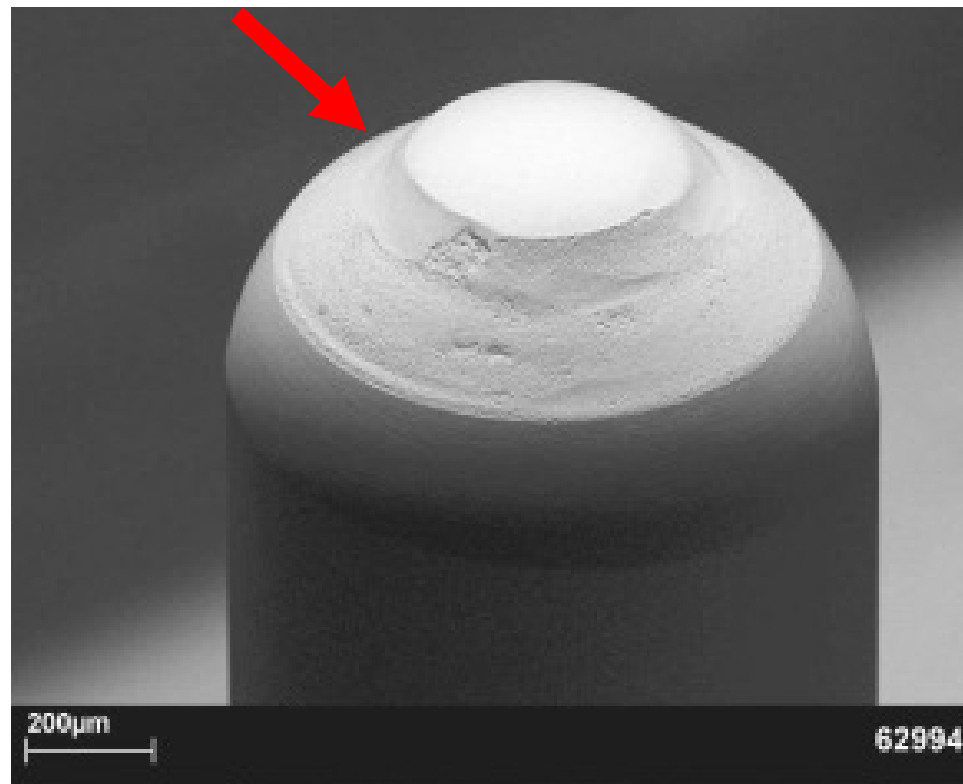


Source: CIMAC Congress 2010, paper no. 119, L'Orange
Name Presenter | Slide 3

Target of the development

Injector shut-off valves worn-out dramatically in very short time

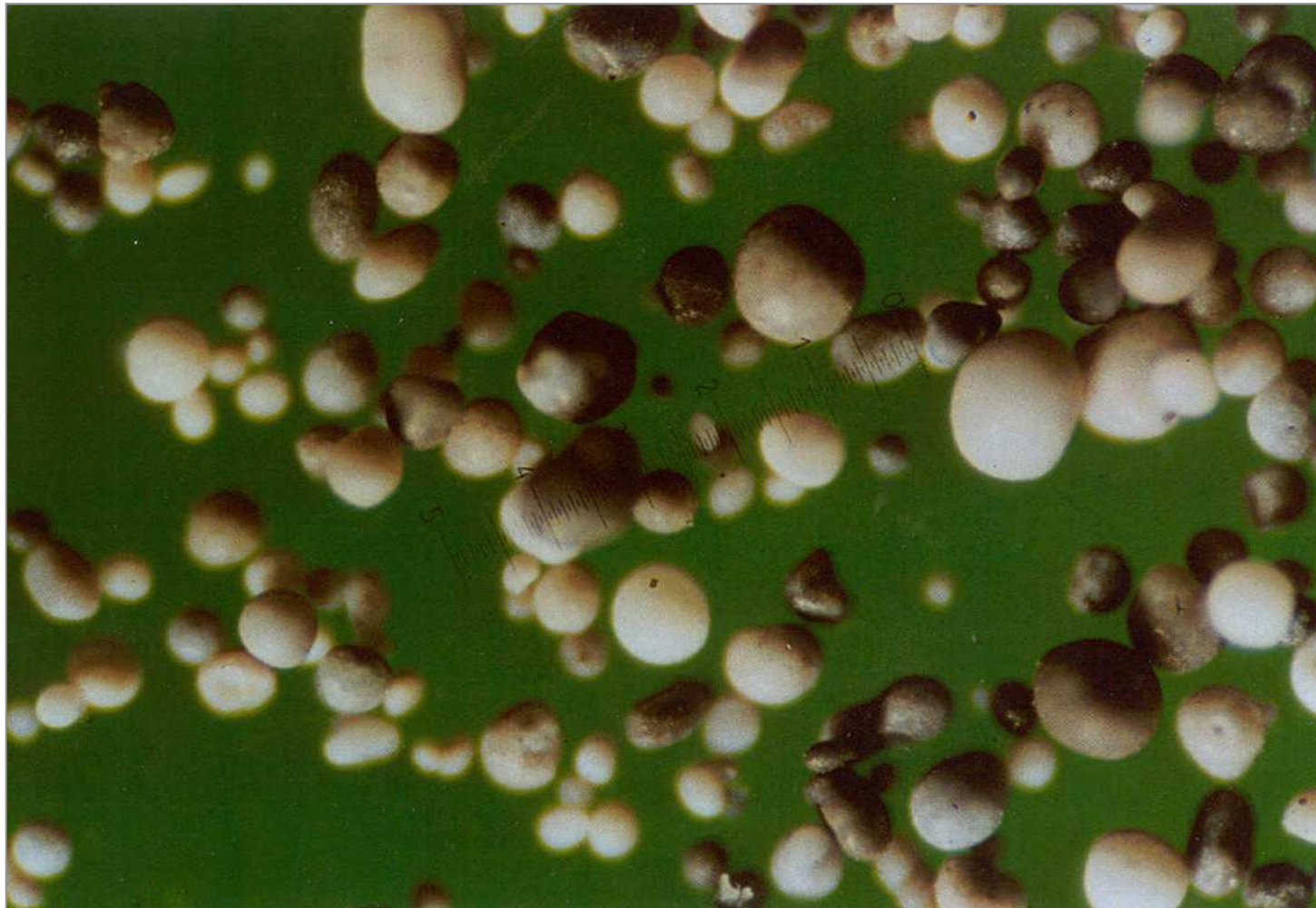
typical wear on the tip of a control pin
after 500 running hrs



Source: Wärtsilä

Abrasive particles in the heavy fuel

Catfines



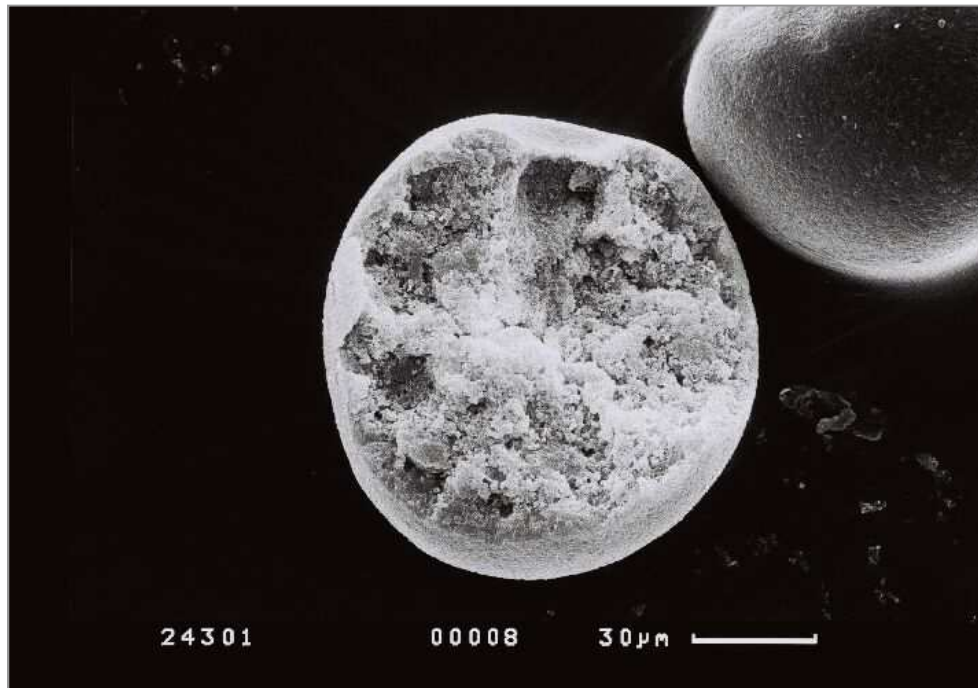
Abrasive particles in the heavy fuel

Catfines

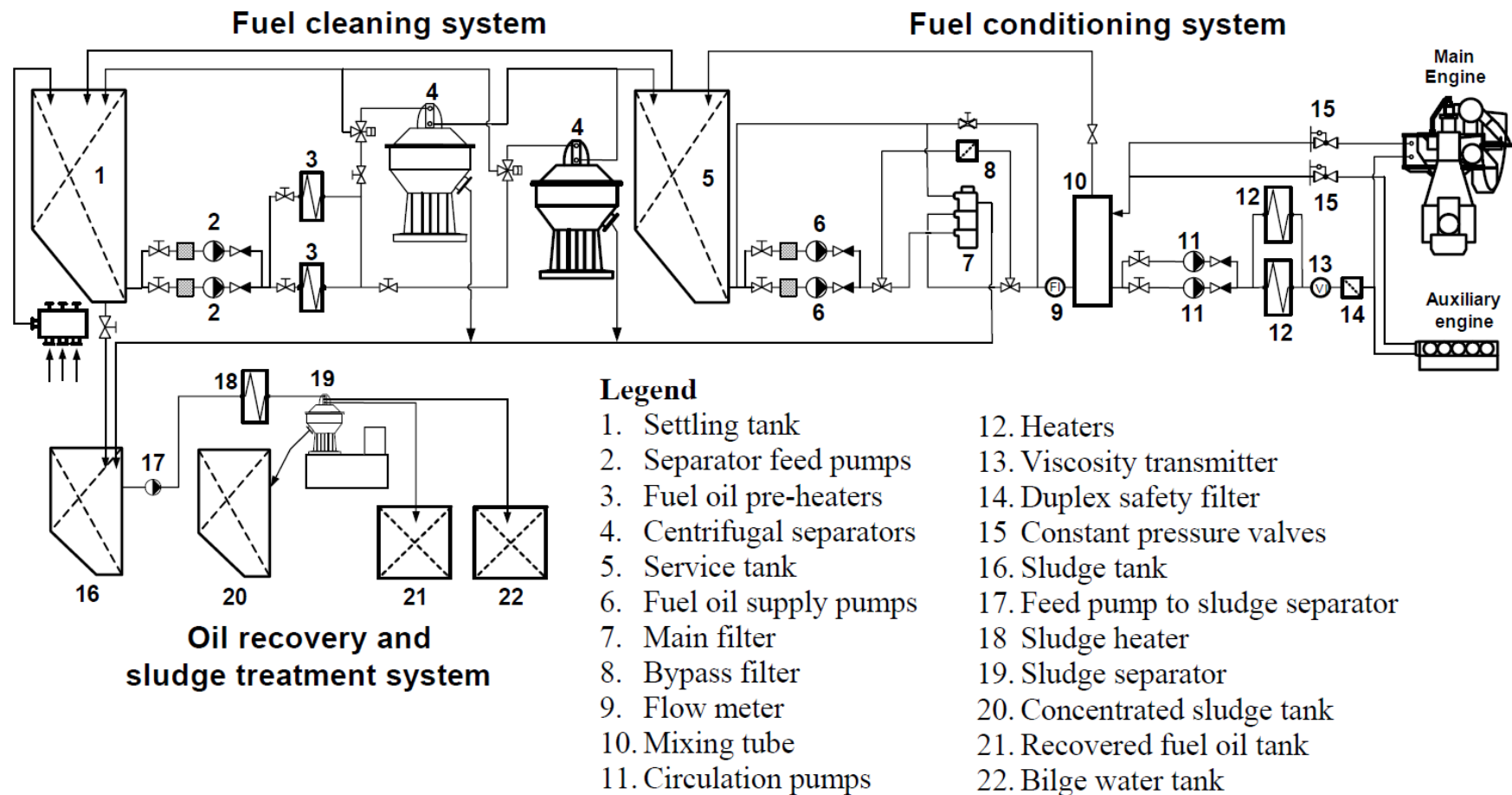
chemical composition: Al_2O_3 , SiO_2

size (raw cat fine): 20 – 80 μm

mechanical: hard, abrasive

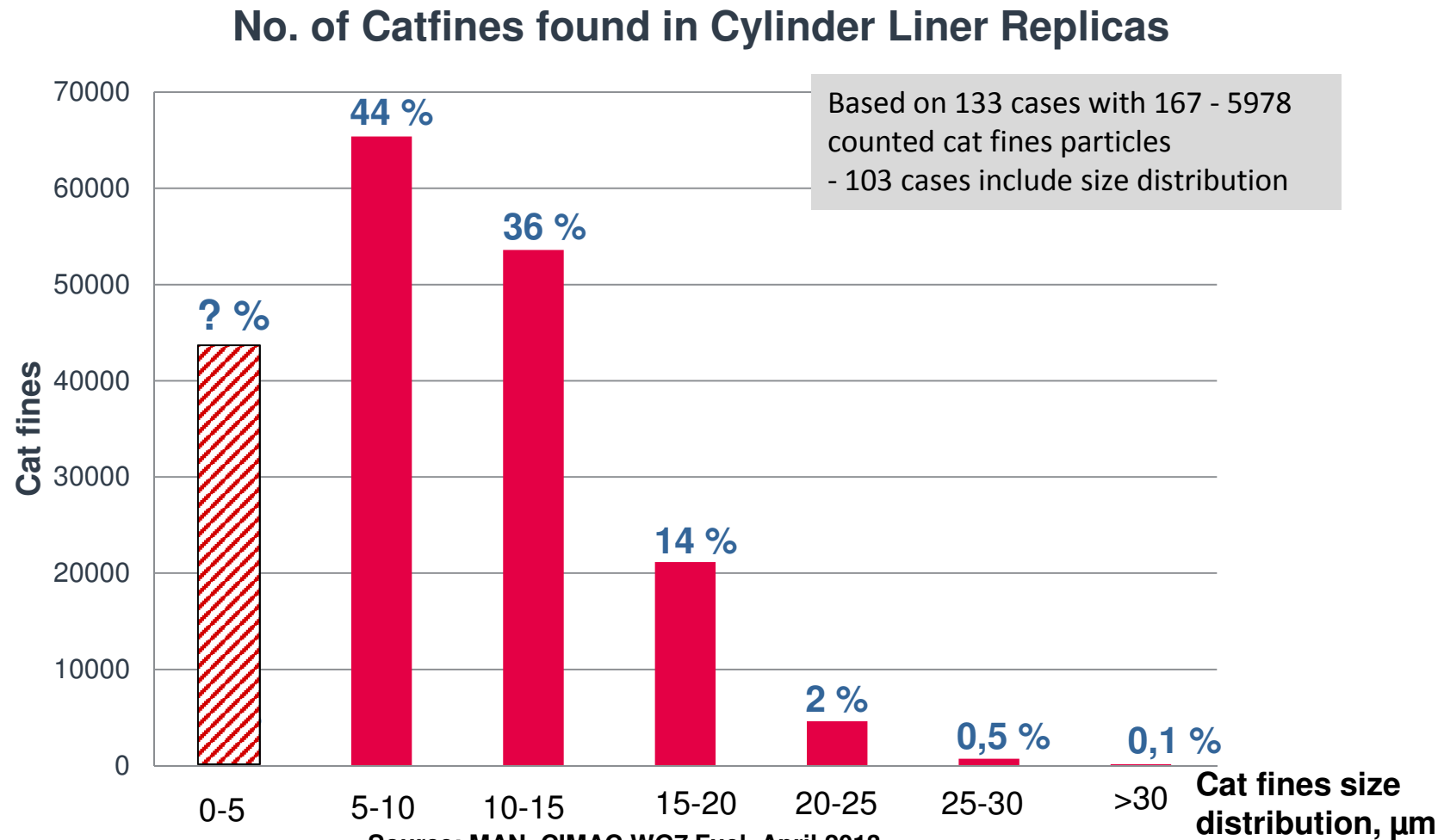


Fuel treatment system



Abrasive particles in the heavy fuel

Catfines downstream separation



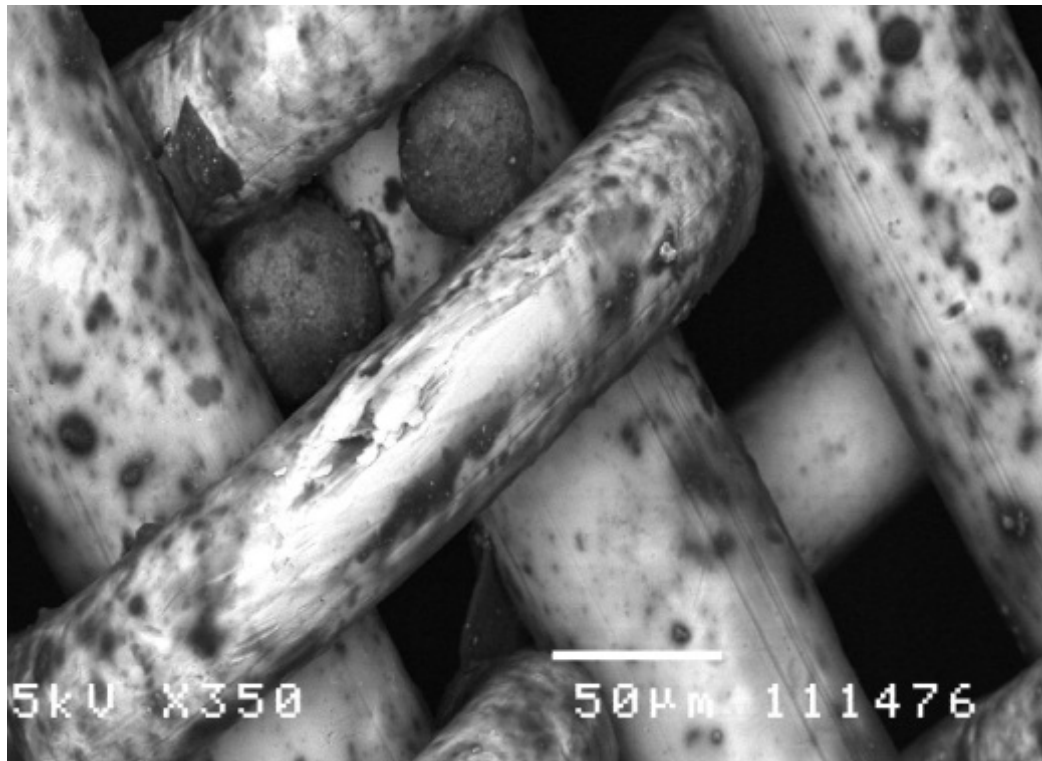
Abrasive particles in the heavy fuel

Catfines

Most of the catfines broken bits are smaller than 5 micron.

Separation is not efficient at this size

but each particle itself, small or big, has got grinding properties on a surface!



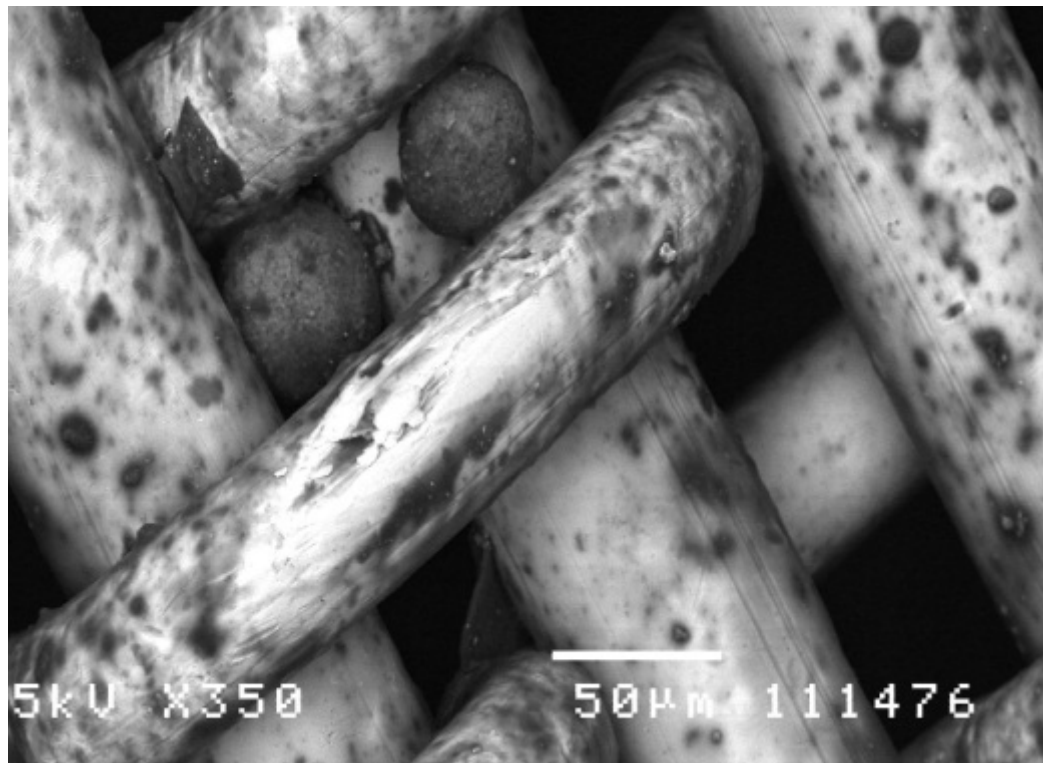
Abrasive particles in the heavy fuel

Catfines

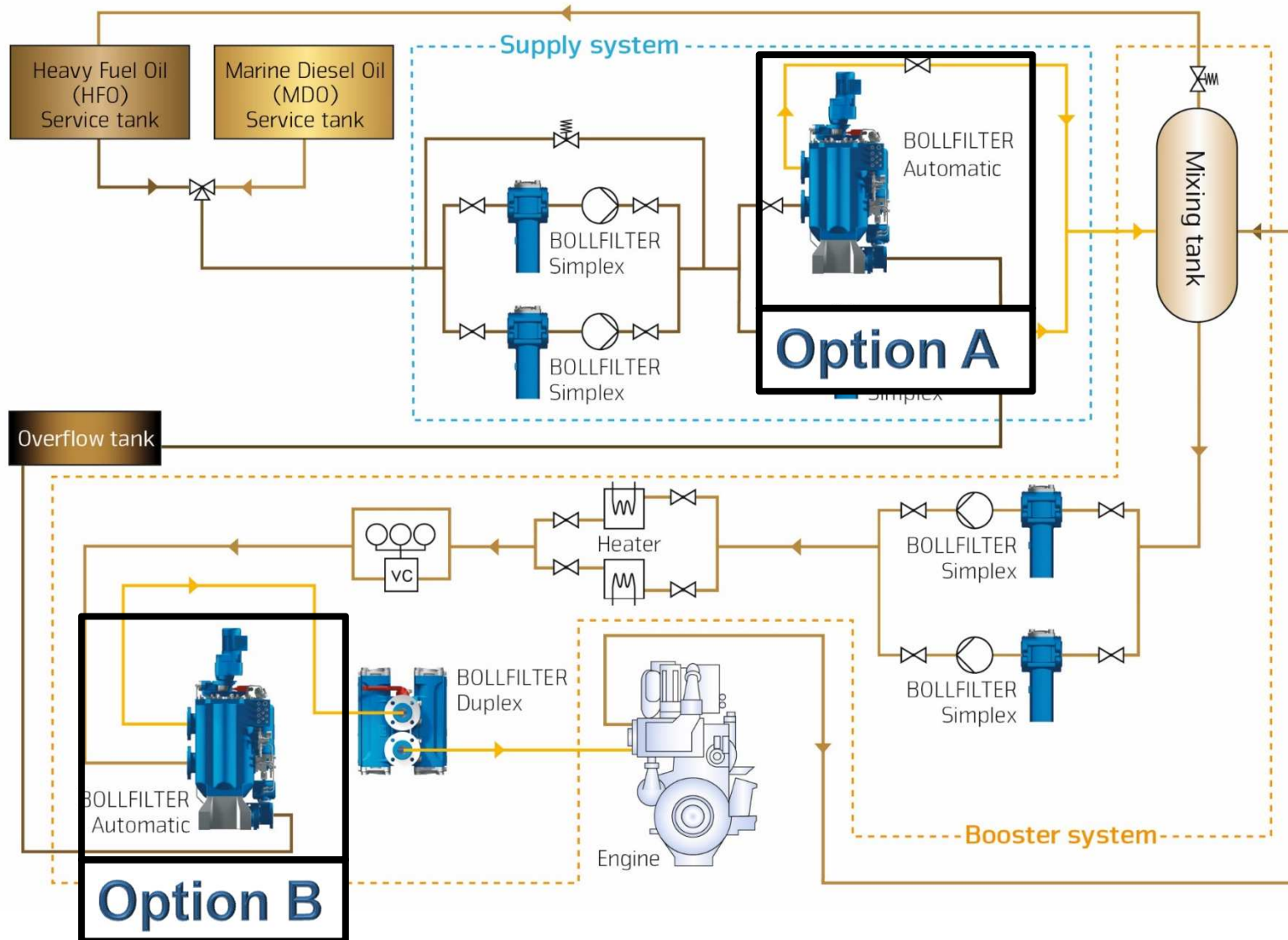
In order to reduce abrasion

You do not have to reject big particles only

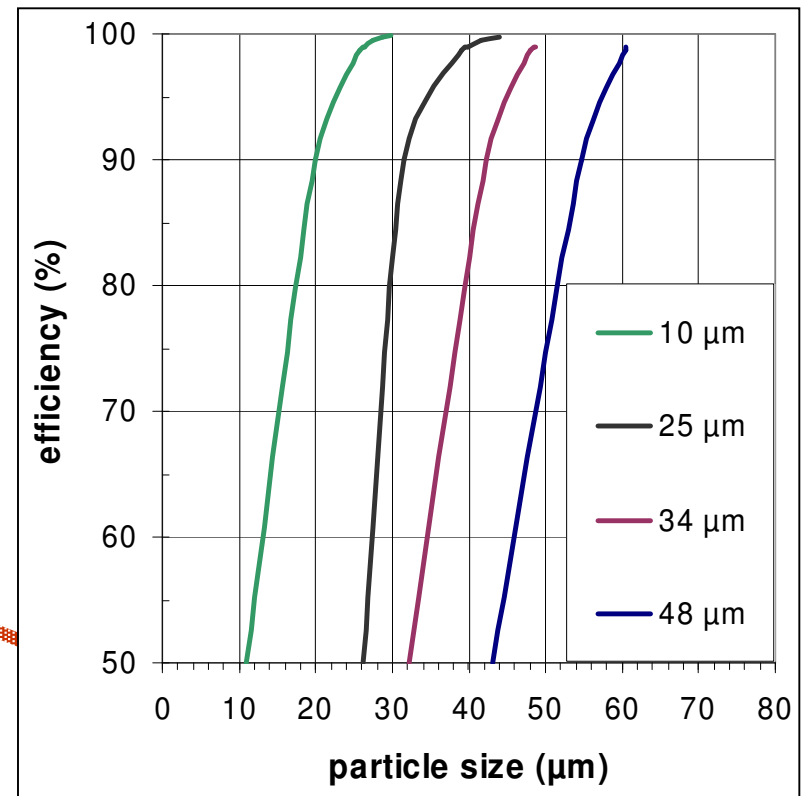
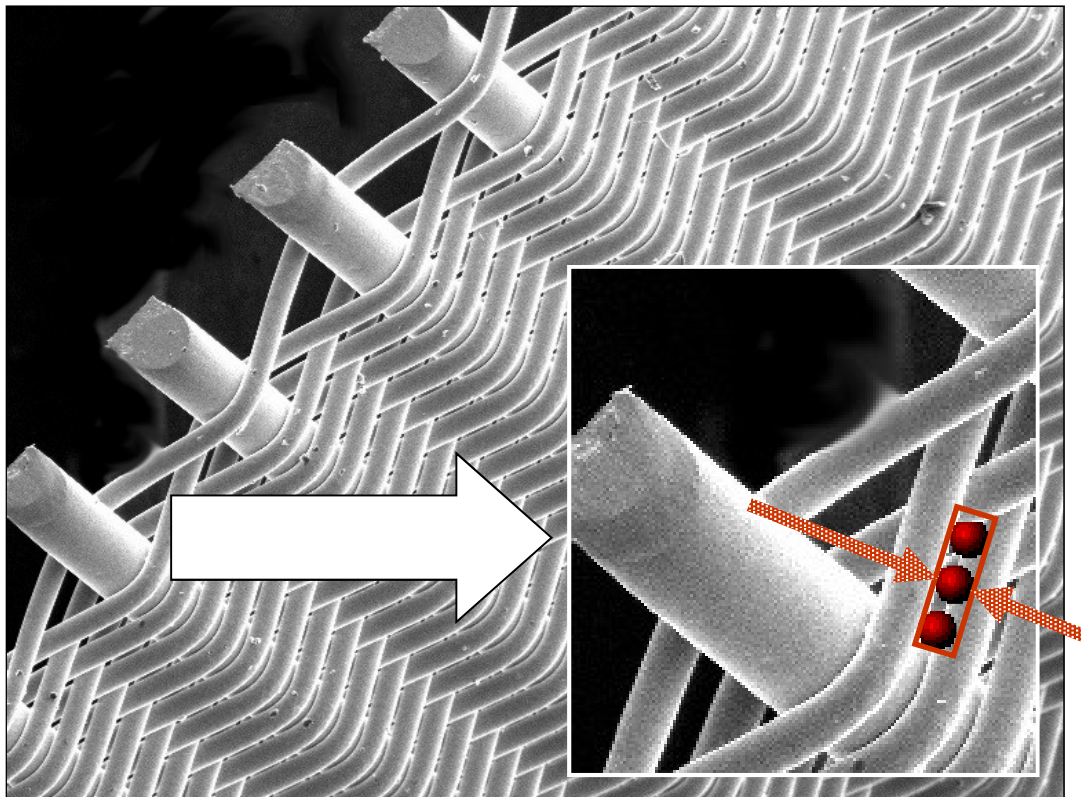
But you have to catch as many particles possible



Fuel conditioning system

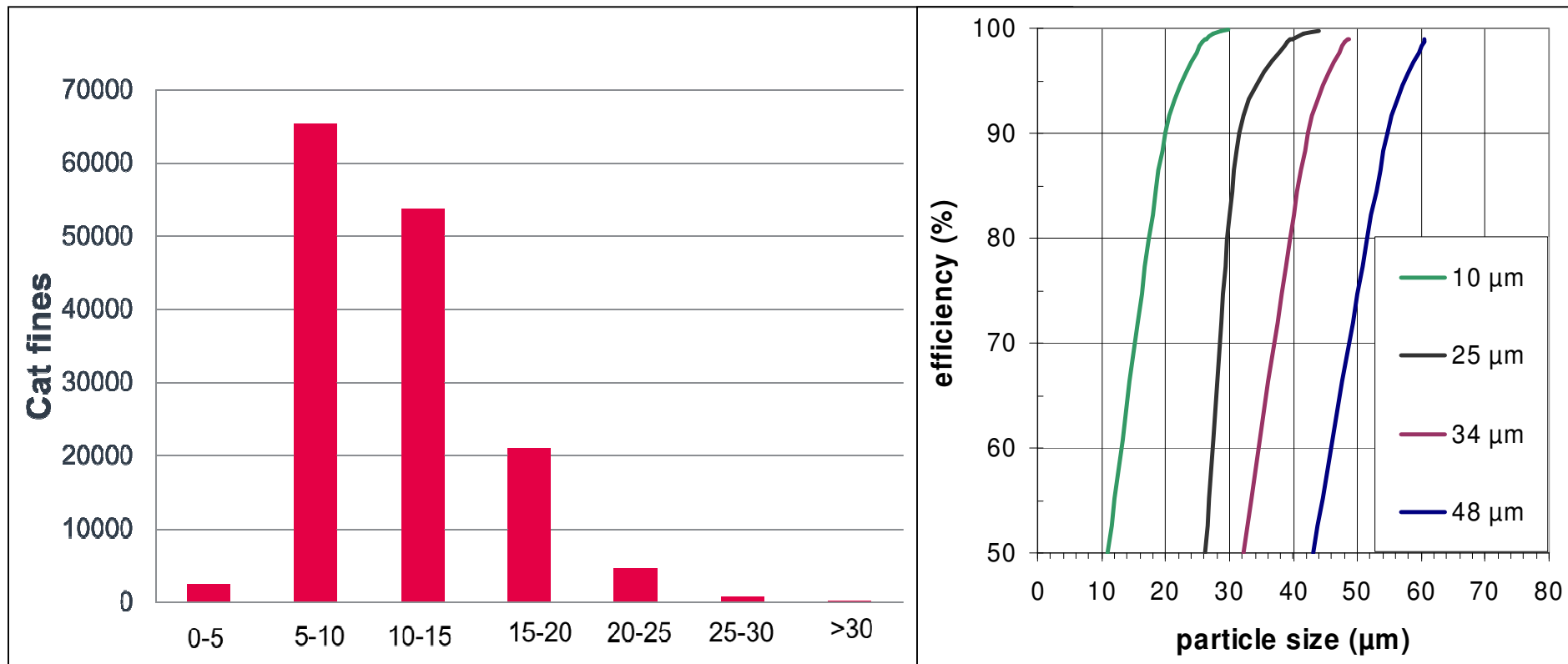


conventional fuel filters
are equipped with 34 or 25 micron „absolute“



Abrasive particles in the heavy fuel Catfines

With conventional filtration grades of 25 or 34 micron the uppermost amount of catfines passes the filter.

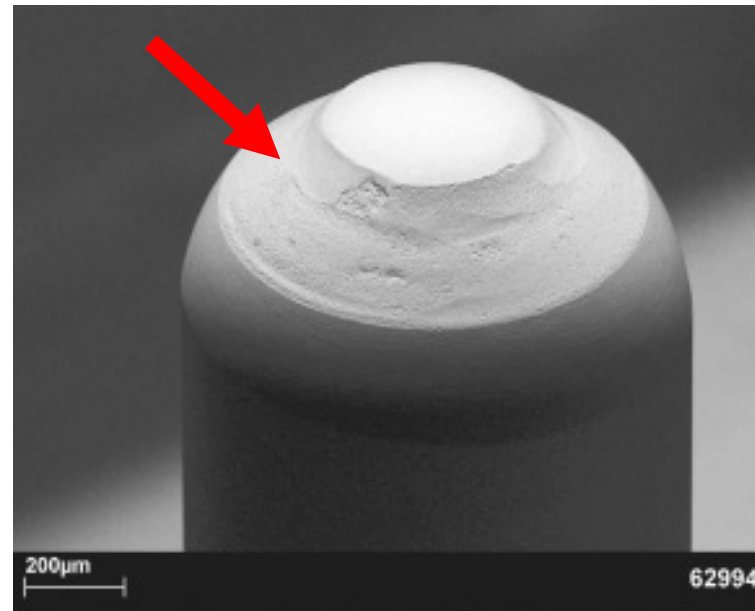


Experiences during lifetime testing

Typical wear with 34 micron mesh filtration

on the tip of a control pin
after 500 running hrs

All tests at rail pressures
more than 1.500 bar (150 MPa).

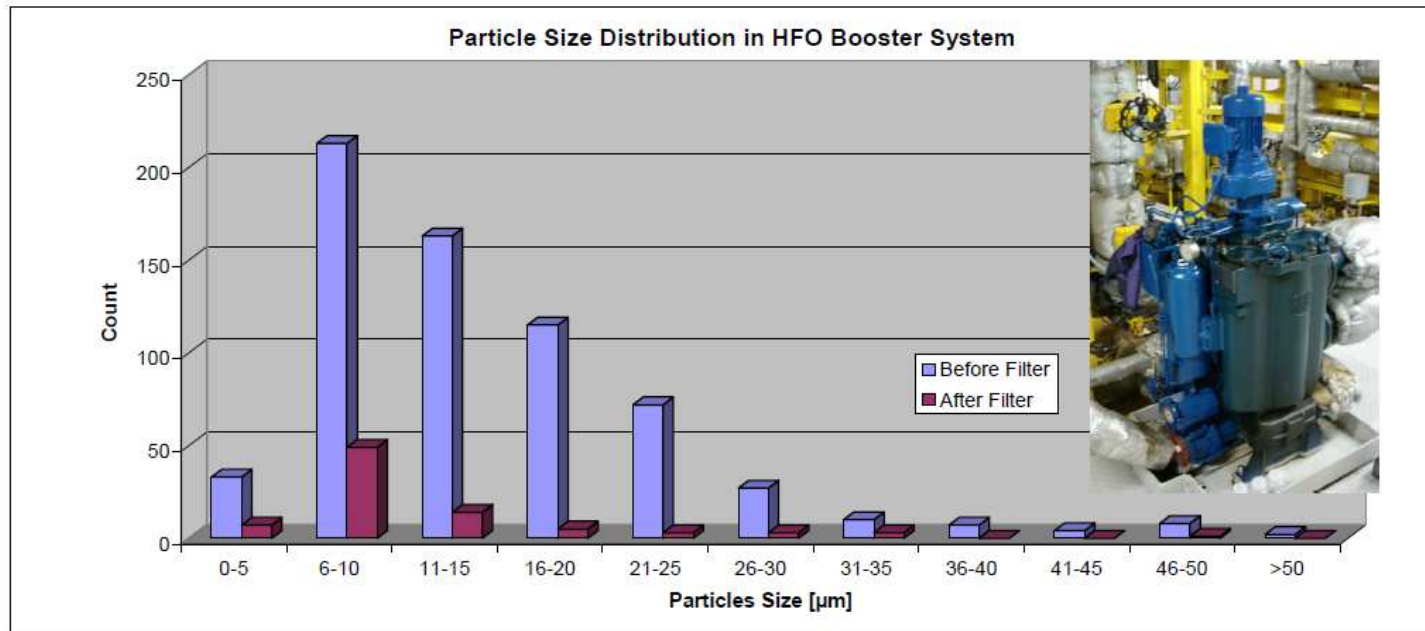


Source: Wärtsilä

- The injection becomes unefficient very soon and common rail is wasting fuel !

Field experience with 10 micron mesh

Filter type: 6.64 DN125
Grade of filtration: 10 µm absolut
Sample: HFO
Sampling point: STENA BRITANNICA, booster system before and after automatic filter
Sampling date: 19.09.2011
Laboratory: DNV Petroleum Service Pte. Ltd., Singapore
Screening conditions: 0,50 g of sample was filtered through a 2 micron filter



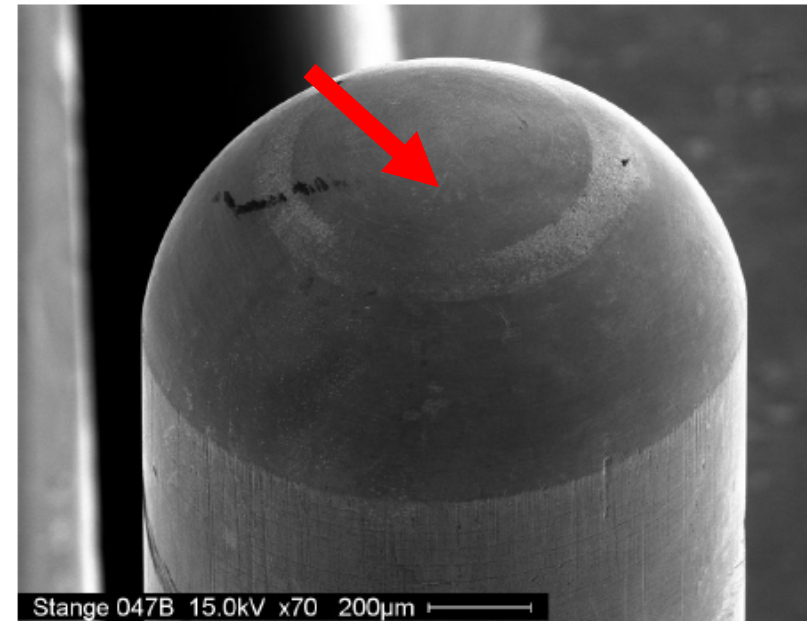
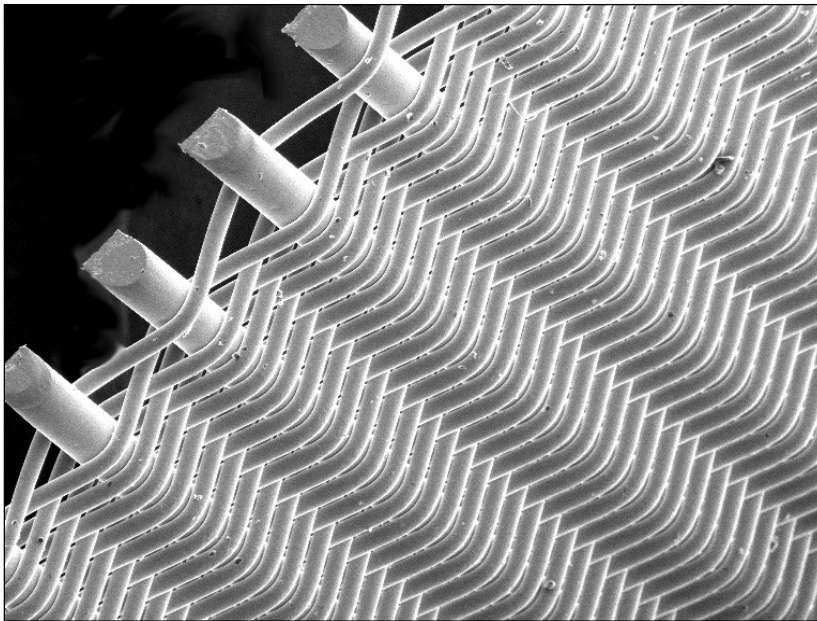
09.01.2012 Pir

Source: MAN / Boll&Kirch

Experiences during lifetime testing

Typical wear with 10 micron mesh filtration

on the tip of a control pin



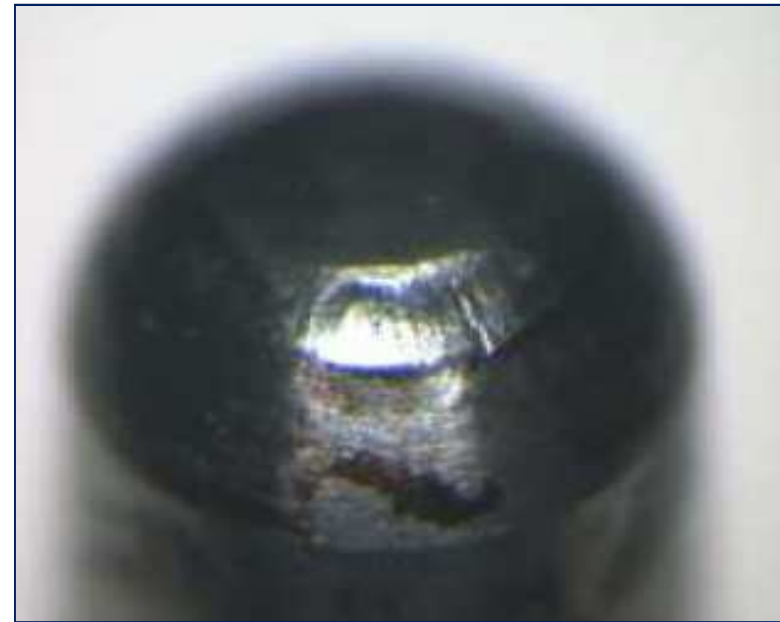
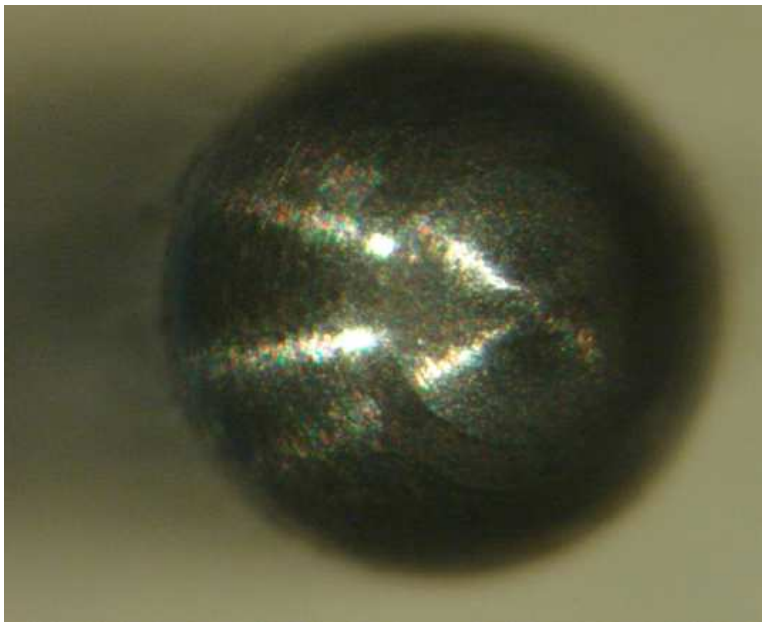
- Abrasion is starting at 500 running hours.

Source: Wärtsilä

Experiences during lifetime testing

Typical wear with 10 micron mesh filtration

on the tip of a control pin
after 1.200 running hrs

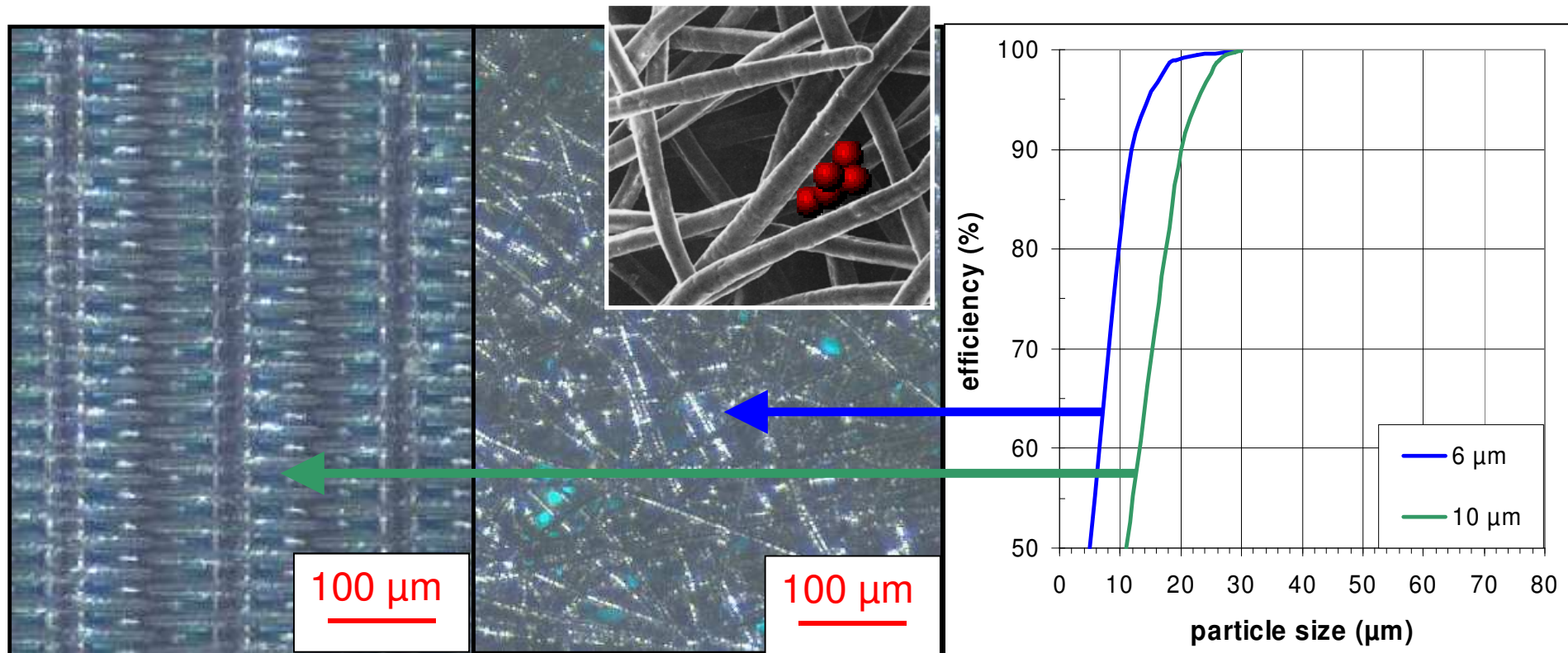


After 1.200 running hours first score marks became visible.

- Thus lifetime is still limited !

Experiences during lifetime testing

Adoption from hydraulic oil filtration: metal fleece



10 micron „absolute“
woven mesh

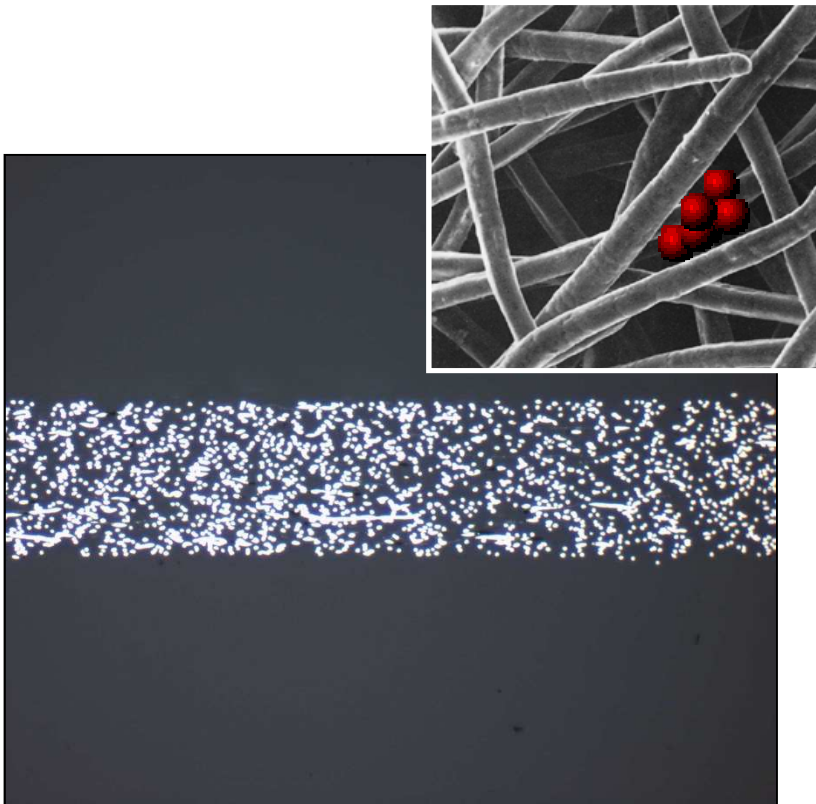
6 micron „absolute“
metal fibre fleece

Source: CIMAC Congress 2007,
paper no. 253, Stefan Schmitz

Experiences during lifetime testing

Typical wear with 6 micron metal fleece

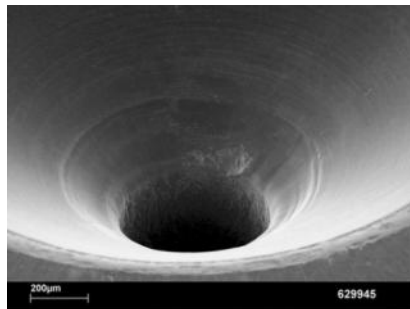
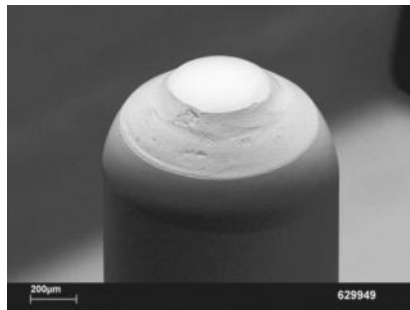
**NO score marks
after 3.000 running hrs !**



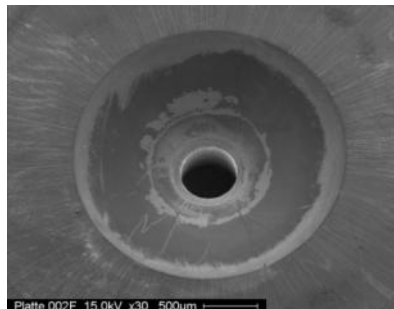
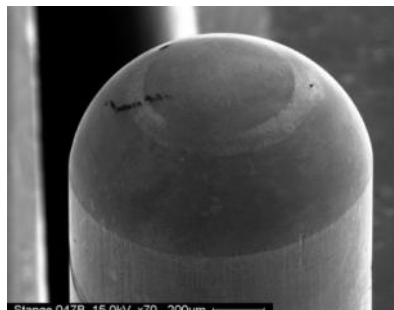
Experiences during lifetime testing

Summary

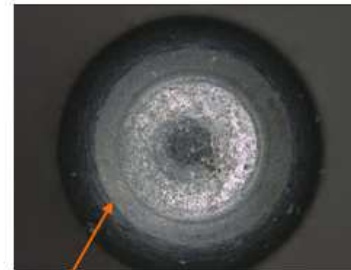
500 h on rig,
34 micron mesh



500 h on rig,
10 micron mesh



3000 h on field engine,
“6” micron fleece



seat area at control pin in excellent condition



seat area in excellent condition

Source: Wärtsilä

Filtration technology

Automatic backflushing with compressed air

3-dimensional metal fleece requires high impulse for proper cleaning

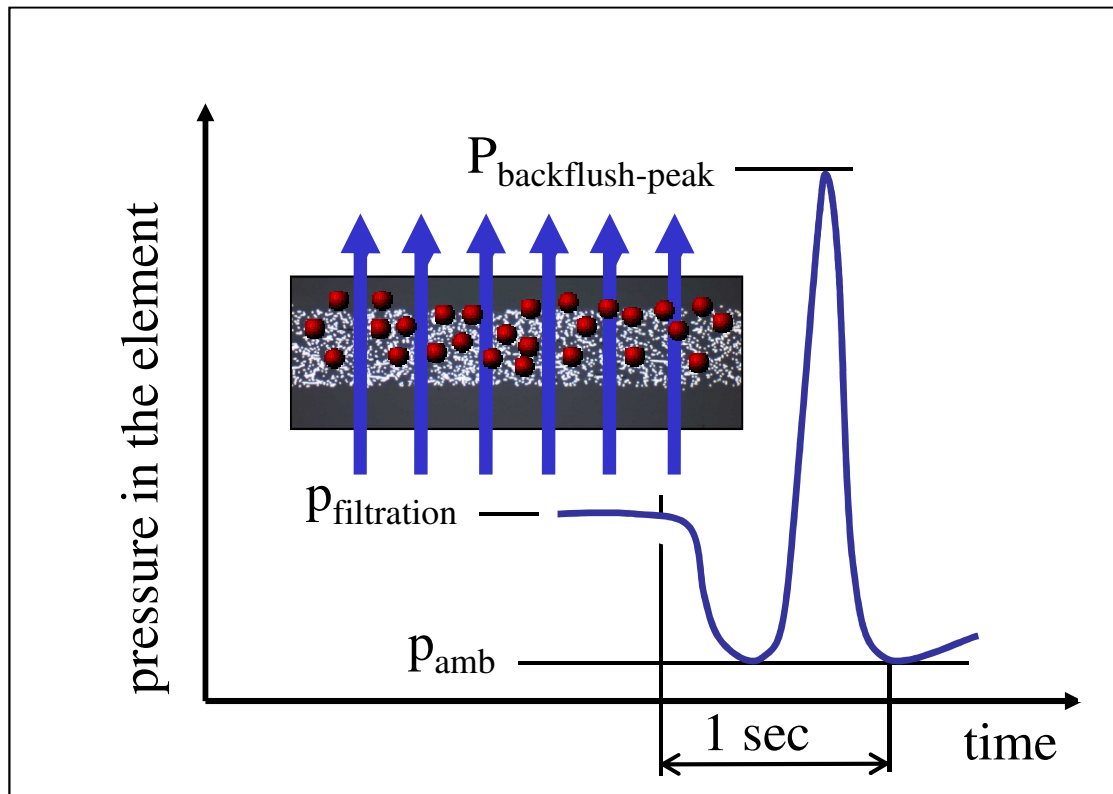


6 micron fleece after 5.400 flushing processes, 2.700 running hrs

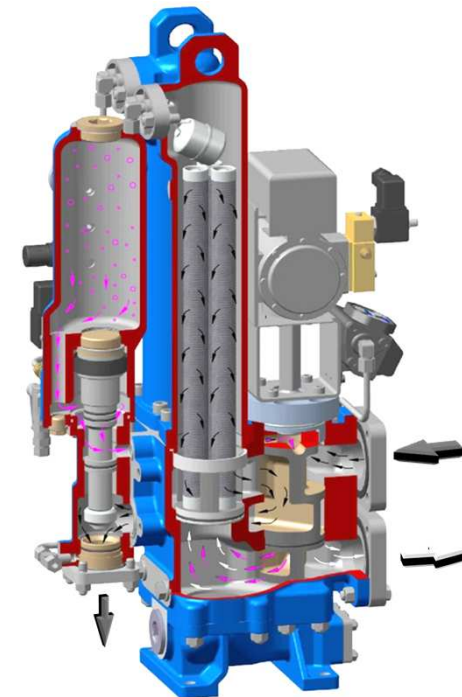
Filtration technology

Automatic backflushing with compressed air

3-dimensional metal fleece requires high impulse for proper cleaning



Cleaning impulse generated by compressed air



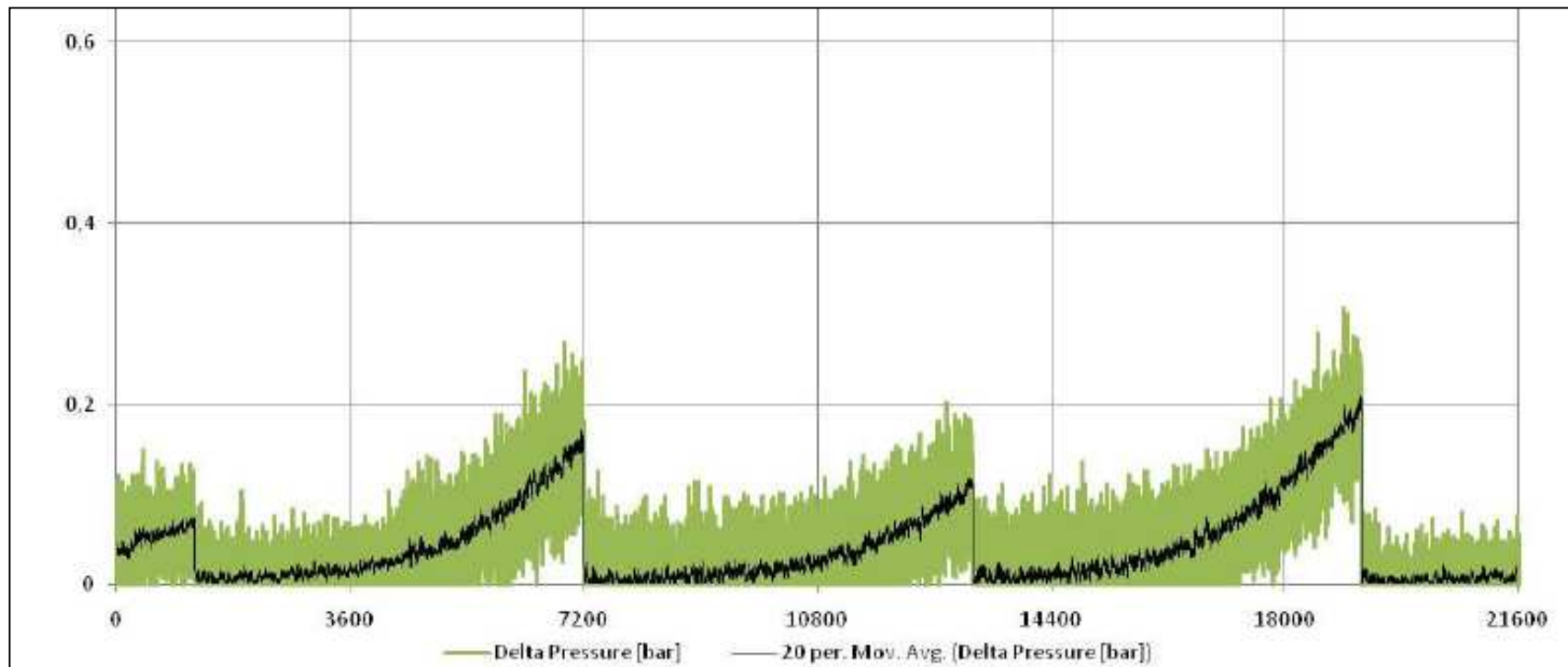
Filter type 6.72

Sea trials

Tanker Excello

Tanker „Excello“ running mainly on heavy fuel

Differential pressure after ~ 1.000 running hours with 6 micron

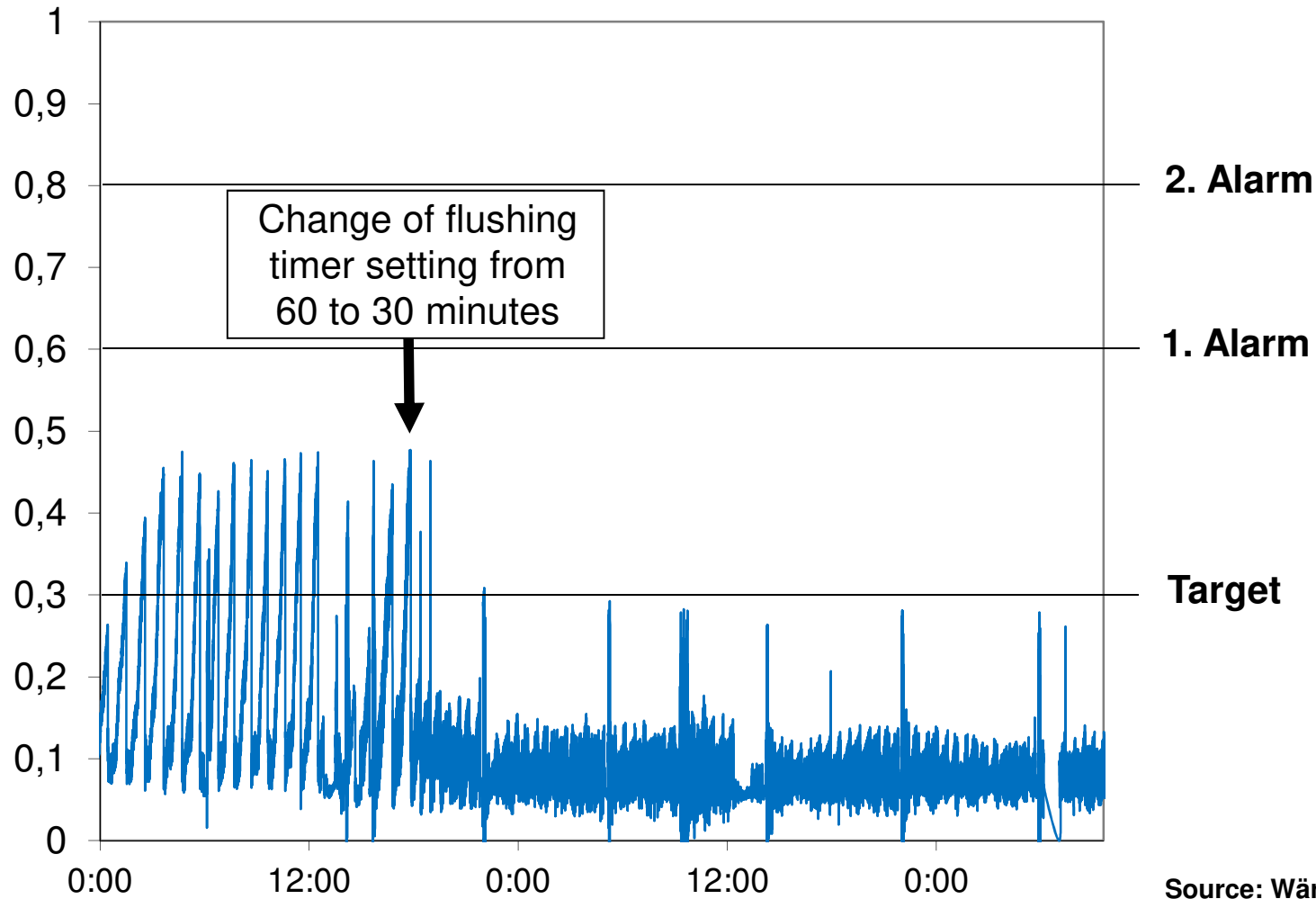


Timer setting for backflushing 1 per hour.

Source: Wärtsilä

Sea trials

Tanker Excello

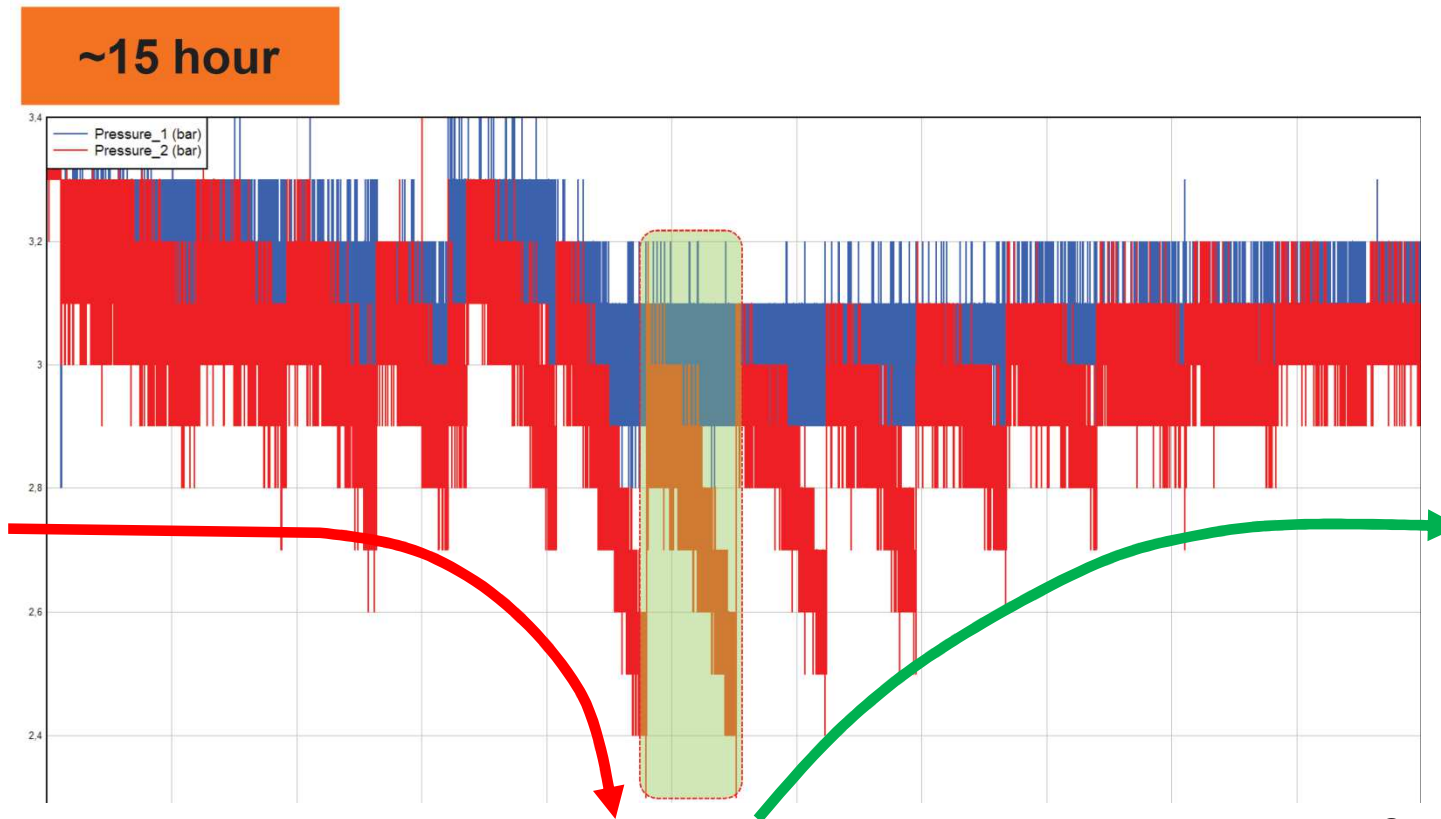


differential pressure (bar) over time

Sea trials

Tanker Excello

Tanker „Excello“ running mainly on heavy fuel
Coincidental blocking-up disappeared



Automatic filter recovered and proves its reliability !

Source: Wärtsilä

Sea trials



Source: Wärtsilä

M/T Excello

more than

7,500 running hours

Sea trials



Superspeed 1
Axel Maersk

more than
more than



13,000 running hours
5,000 running hours

Source: Wärtsilä

Sea trials

MV Princesse Benedikte
Scandlines Ferry, Baltic Sea

Automatic filter type 6.72 DN65 in booster system

Engine:	MAN 6L32/44 CR
Start with 10 µm:	07.05.2010
Start with 6 µm:	29.04.2011
Fuel:	HFO 380
Booster pressure:	5,5 bar
Booster temperature:	130 °C
Flow rate:	7,5 m³/h (four engines)



Sea trials



FS Princesse Benedicte

more than 10,000 running hours

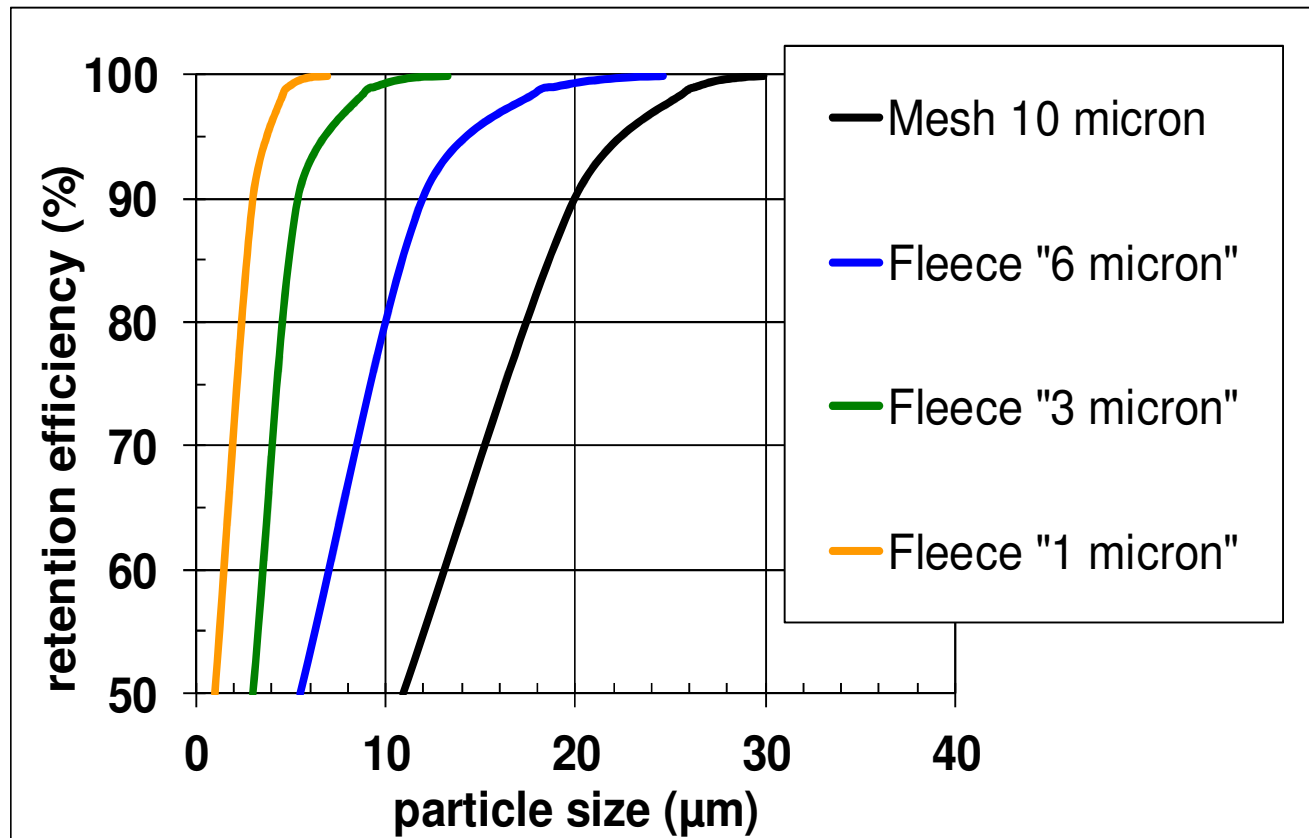
FS Schleswig Holstein

more than 17,000 running hours

Future potentials

Automatic backflushing with compressed air

even finer metal fleece variations than 6 micron are on test today



Conclusions

Automatic filtration with impulse backflushing

- metal fleece 6 micron requires more energy for cleaning than conventional filter meshes
- impulse backflushing with 6 micron is validated in marine application
- 6 micron both in feeder and booster systems

6 micron is applicable in the standard impulse back-flushing filters without any additional technology!

Conclusions

Wärtsilä 2-stroke engines recommendation

Engine delivery date	mesh-size absolute
Before summer 2005	50 micron
After summer 2005	34 micron
After spring 2012	10 micron

Wärtsilä released and specified 6 micron
for future common rail generation.

**Thank you very much
for your kind attention!**

**BOLL Filtrator
TYP 8.64/8.72
BOLLFILTER Automatik
TYP 6.64/6.72**

