Intake of ambient air

Efficient Snow & Droplet Separation

Munters - The Humidity Expert

Founded in 1955 by the Swedish inventor Carl Munters.

3 Global Divisions:

Dehumidification (DH)

A global, application and service driven niche business in air treatment from a base in dehumidification

Moisture Control Services (MCS)

A global leader in temporary humidity control and damage restoration services

HumiCool (HC), including Mist Elimination (ME)

A global leader in systems for selected cooling/ humidification and mist elimination applications

Public company listed at the **SSE**

Subsidiaries in more than **30 countries**, +**3400** employees

Representatives and agents in many more countries

Annual sales of more than 550 M€

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Global Business Area Mist Elimination

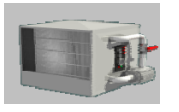
Setup

R&D

Business fields



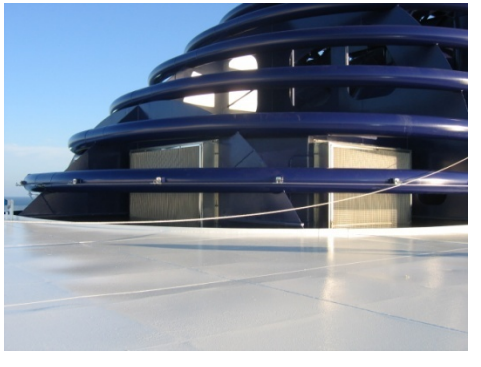


Products

Applications

Installations & References



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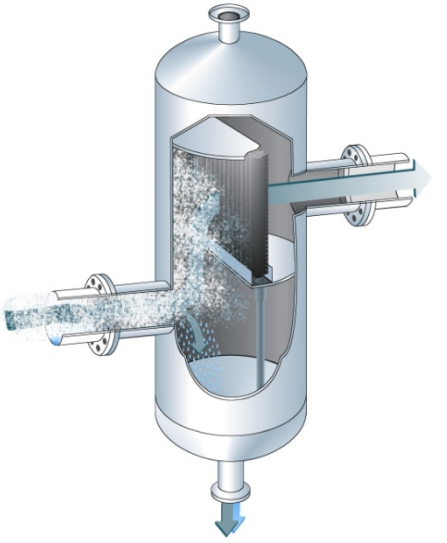
Global Business Area Mist Elimination

Staff size:	300
Annual Sales (2006):	50 Mio EUR
Distribution:	EMEA /Asia / Americas
Headquarter:	Aachen, Germany
Experience:	43 years in business
Characteristic:	World market leader in vane separation technology for exhaust gas cleaning applications



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Global Business Area Mist Elimination

- Munters Sales office
- Representatives
- Manufacturing

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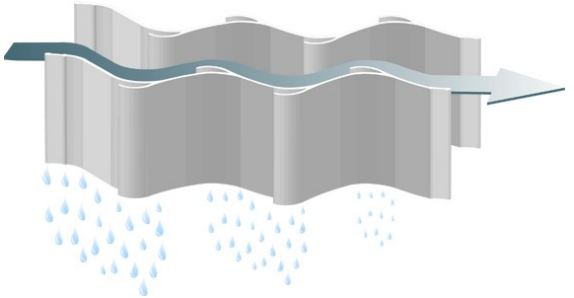
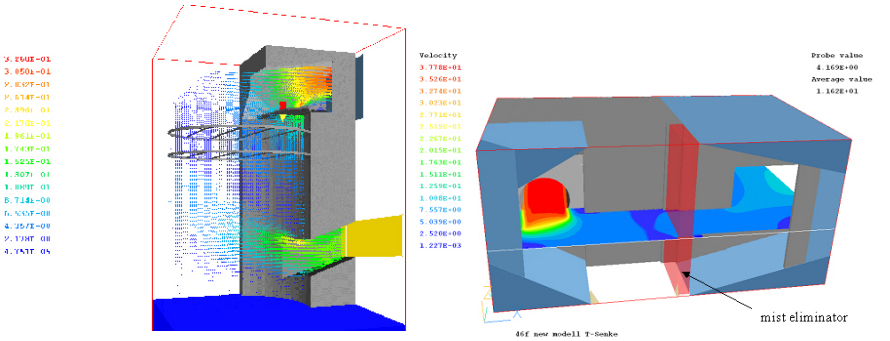
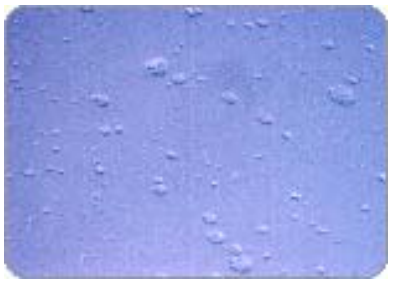
ME - R&D Services



Basic research in mechanical separation technology



Computational fluid dynamics (CFD)



Field measurements

Laboratory testing facility

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ME Business fields

Exhaust gas cleaning

Flue gas desulphurization
Exhaust systems
Gas cleaning scrubbers
Stack rain separation

Evaporation

Pulp and paper
Sugar
Seawater desalination
Distillation processes

Intake of ambient air

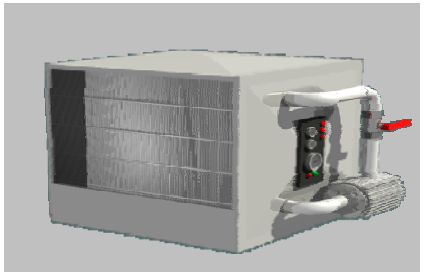
Gas turbine inlets
Inlets Landbased
Marine & Offshore
Coastal / Arctic / Desert

Gas cooling

Compressor stations
Intercooler for diesel engines
General process gas cooling

Oil & Gas

Process carry-over
Condensed liquids
Contamination



Air conditioning (HVAC)

Air washers
Condense water removal
Spray humidification
Spray cooling

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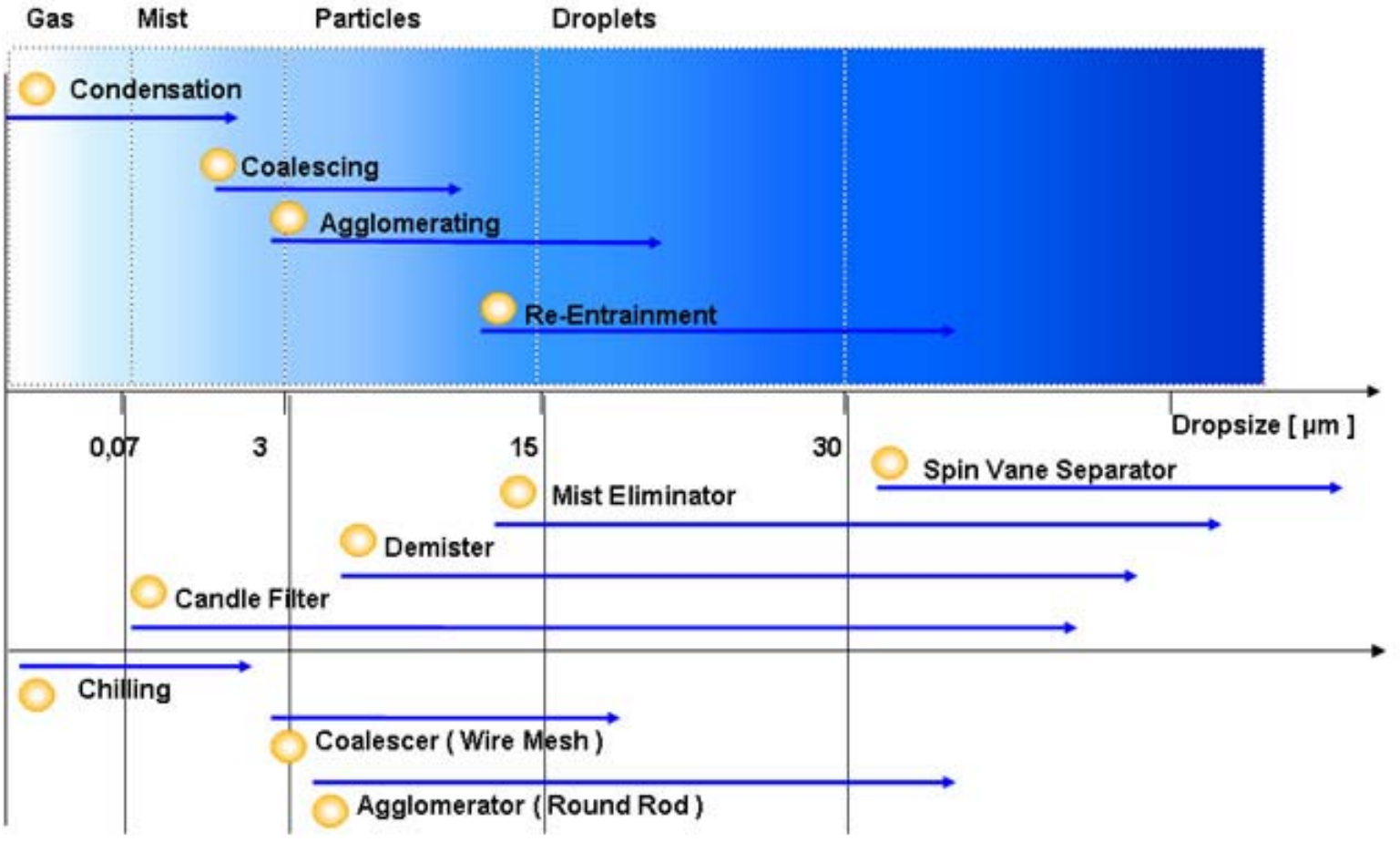
Mist Elimination – Droplet Sizes



See also: creation of aerosols

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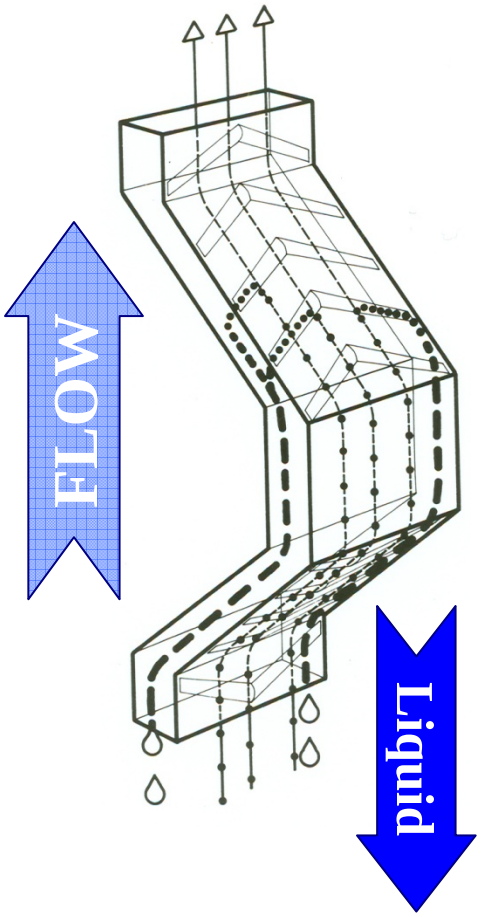
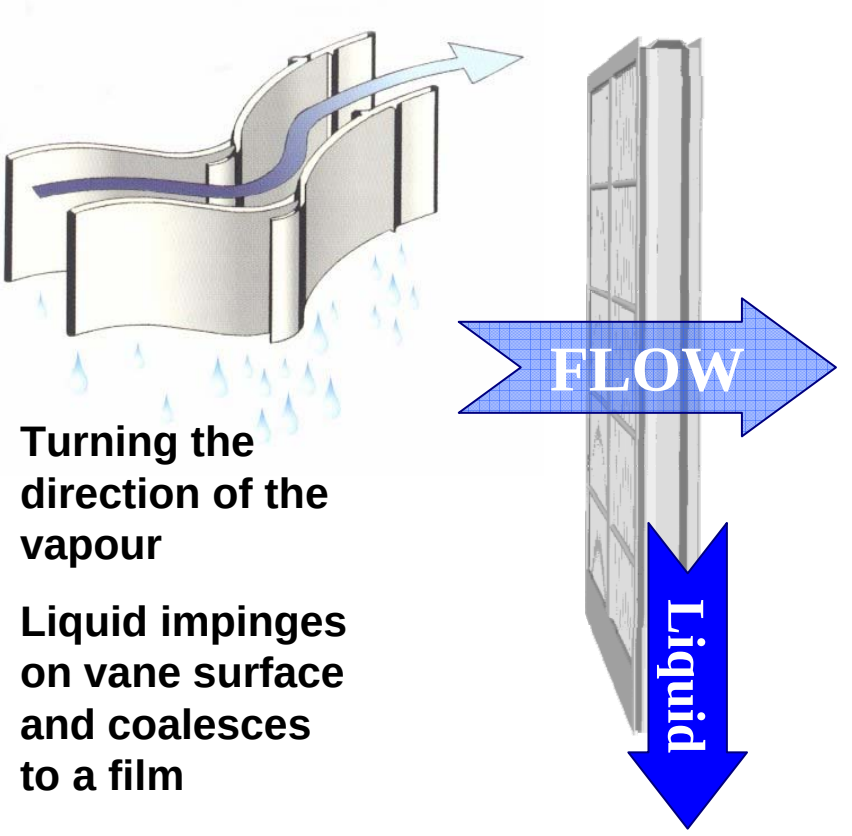
Vane type mist eliminator – working principle



Vertical upflow of vapour

Collection of droplets in drain channels

Liquid drains down by gravity



Turning the direction of the vapour

Liquid impinges on vane surface and coalesces to a film

Liquid drains down by gravity

70 Intake of ambient air

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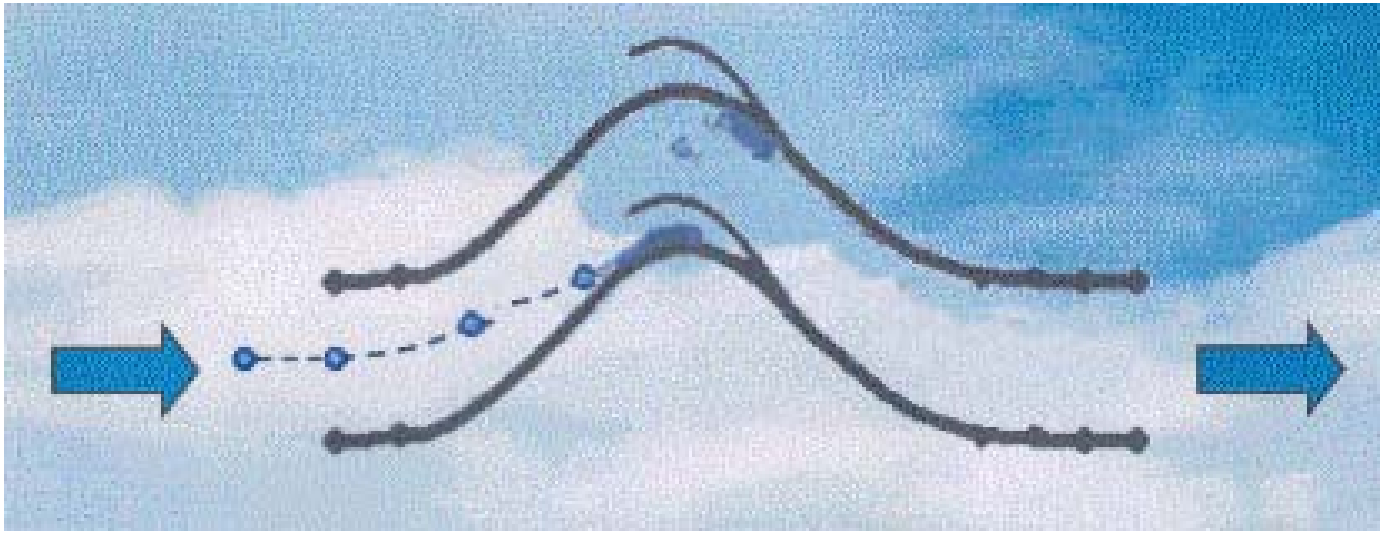
Mist Elimination – Working principle



The liquid droplets are not following the path of the gas but inertial forces brings them into contact with the surface of the lamella. They form a film on the surface of the profile.

The hook generates a dead zone in front of the hook where the liquid film builds up and drains down to the bottom.

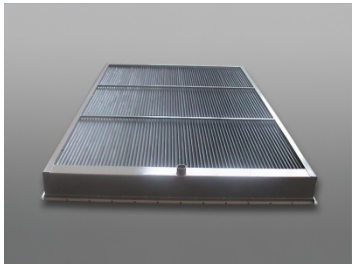
Products

Single stage units

Munters **DF** Series

Munters **25** & **35**

Munters **DFH**



3 - stage systems

Munters **DFF** Series

2 - stage systems

Munters **DCF** Series

Type 1, 2, 3

Munters **35F**

Filterboxes

Munters G-Series

Munters F-Series

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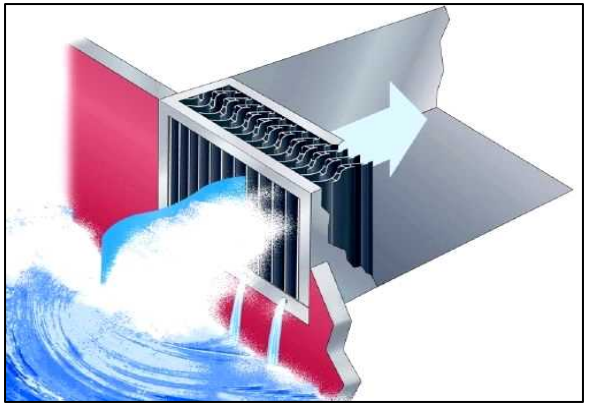
Products

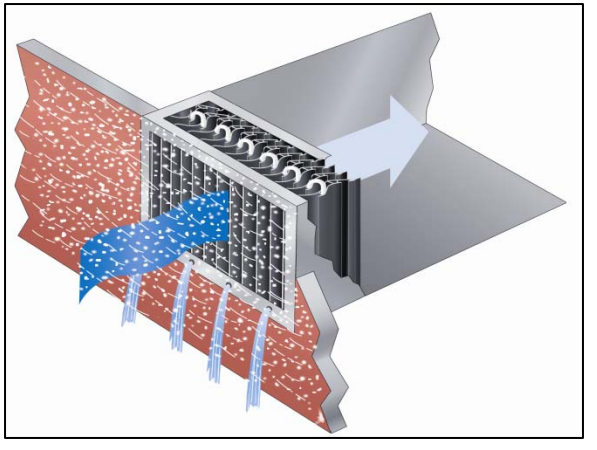
Single stage units

DF & DFH-Series

Single stage mist eliminators

Prevention against rain, heavy rain, larger sea spray particles, snow and prevention of icing





Typical applications:

AC-unit air-intakes

less critical engine room

ventilation intakes

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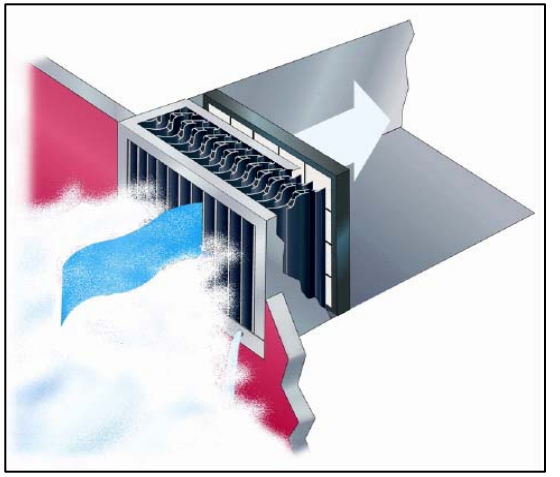
Products

2 stage systems

DCF-Series

2 -stage systems

Prevention against all liquid particles, sand and dust-particles;



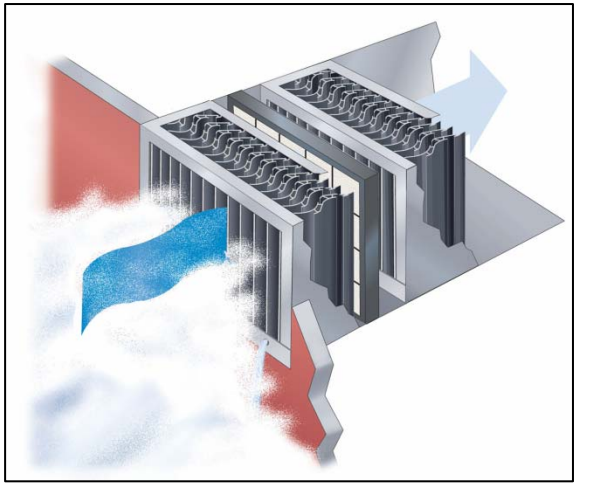
Typical applications:

High-quality supply air of AC-units

Supply air for diesel engines and compressor intakes

Products

3 stage systems



DFF-Series

3-stage mist eliminators

Prevention against all sort of particles coming from the ambient air

Typical applications:

Supply air for diesel engines
gas turbine supply air

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Applications

- Combustion air for gas turbines

  (Protection against compressor fouling and corrosion)

  - Process air in marine and offshore climates

    (Protection of ventilation systems against corrosion and prevention of mildew)

    - Process air in land-based facilities

      (Protection of ventilation systems against corrosion and prevention of mildew)

      - Process air in cold climates

        (Prevention of icing and protection of filters against snow and other liquid droplets)

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Applications

- **Intake of combustion air for gas turbines**

  (Protection against compressor fouling, corrosion and “wet“ pressure loss)

70 Intake of ambient air

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Application

Area of application field:	**Intake of ambient air**	
Name of application:	**Intake of combustion air**	
Number of application:	**71**	
Typical velocity range:	**2 to 5 m/s. Offshore can be higher**	
Typical temperature range:	**-40°C to +45 °C**	
Typical static pressure:	**ambient conditions**	
Typical liquid loads:	**Typically very low loads up to flushes of sea water, salt crystals**	
Sizes of particles	**Rain**	**>300µm**
	Heavy rain	**>1000µm**
	Snow / Hail	**>1000µm**
	Sea spray & salt	**>1µm**
	Mist & Fog	**>10-20µm**

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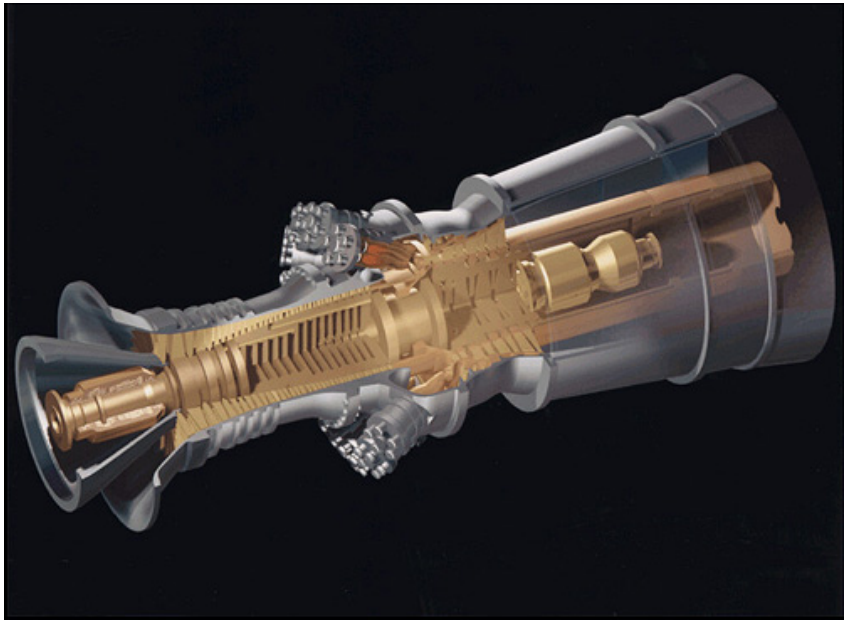
Problem description

Objective of gas turbine:

1. Maximize continuous power output
2. Maximize life time of equipment

Power loss due to compressor fouling

Down time for washing



Loss of production

Power loss caused by high pressure loss

Down time for repair

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Problem description

Sizes of particles	Source	Min Design velocity	Particle size
	Rain	1 m/s	>300µm
	Heavy rain	1 m/s	>1000µm
	Snow / Hail	2-3 m/s	>1000µm
	Sea spray & salt	Appr. 3m/s	>1µm
	Mist & Fog	>5m/s	>10-20µm

Design of velocities

Wash through effect

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Application

Production Loss

Gas Turbine

Operating days		365	days
availability		97%	
hours		24	h
Yield		100%	
Change in net power		500	MW
Selling value		4.248.600	MWh
cts/KWh	3	127.458.000	€
Interruptions [days]	1	338.724	€
Loss percentage		0,08%	
Pressure loss [Pa]	50	95.594	€

Total loss		434.318	€

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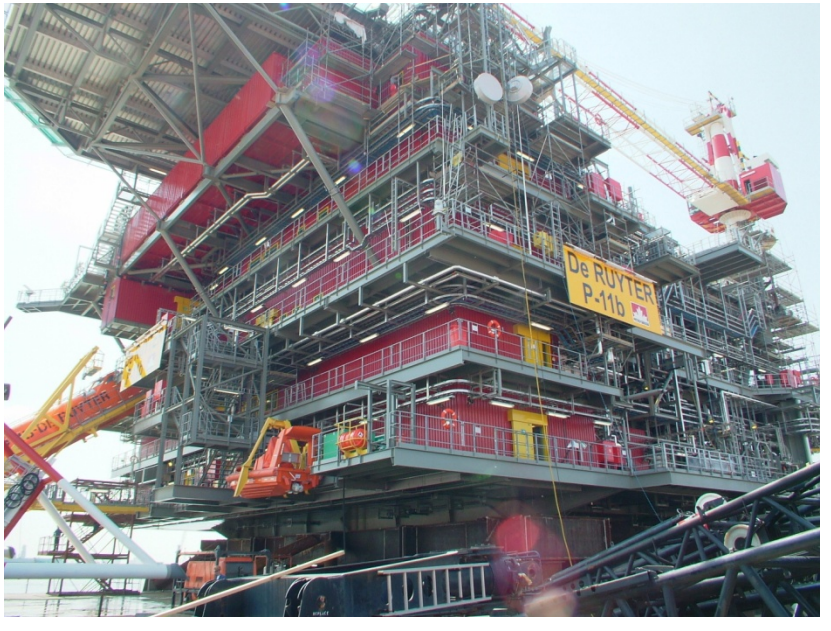
Applications

Process air in marine and offshore climates

(Protection of ventilation systems from corrosion and prevention of mildew)



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Problem description

Objective of ventilation intake systems for AC units:

1. Maximize continuous air volume, minimize pressure loss
2. Maximize life time of filter elements
3. Maximize life time of ventilation equipment

Objective of engine room ventilation intake

1. Maximize continuous air intake, minimize pressure loss
2. Maximize life time of filter elements
3. Maximize life time of ventilation equipment

Problem description

Energy consumption
Ventilation intake system

Operating hours	5.000	h
Airvolume	800.000	m³/h
Pressure loss	50	Pa
Electrical efficiency	85%	-
Diesel efficiency	33%	-
Energy consumption	198.059	KWh
Diesel consumption	39.612	Liters

2. Filter changing cycles and related costs

3. Costs of the investment

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Applications

Process air in land-based facilities

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Problem description

Process air in land-based facilities

Objective of ventilation intake systems for AC units:

1. Maximize continuous air volume, minimize pressure loss
2. Maximize life time of filter elements
3. Maximize life time of ventilation equipment

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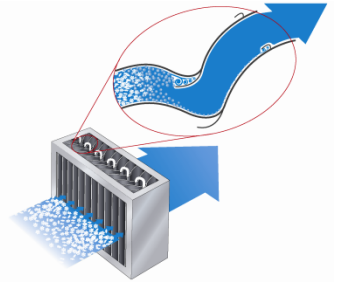
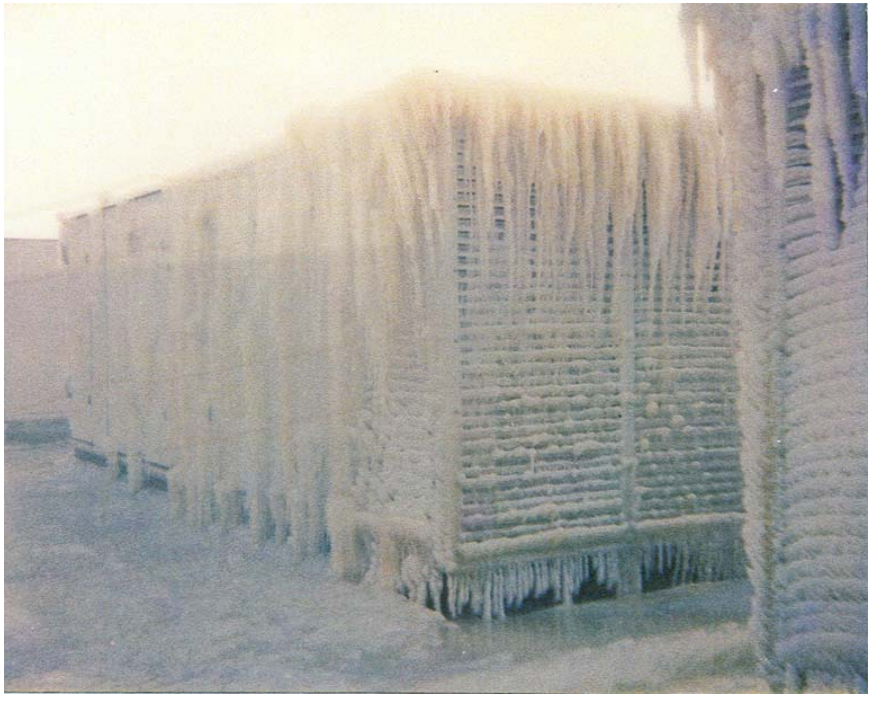
Applications



Process air in cold climates



January 06, northern Germany (coastal)

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Problem description

Process air in cold climates

Objective of ventilation intake systems for AC units:

1. Maximize continuous air volume, minimize pressure loss
2. Maximize life time of filter elements
3. Maximize life time of ventilation equipment

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Installations

Containership

Deckhouse of the containership

Air volume:	1.069.000 m³/h
Surface:	94m² Intake sections
System:	Munters DCF 2 stage

Type of vessel:
Container – PANMAX
Name of vessel:
MAERSK BOSTON
Shipyard:
Volkswerft Stralsund GmbH

Front view of Mist eliminators

Munters

Installations

Containership

DCF 2 (left) and DCF 1 (right)
Quick-opening device for filter-change

DCF 2 from the backside in the workshop:

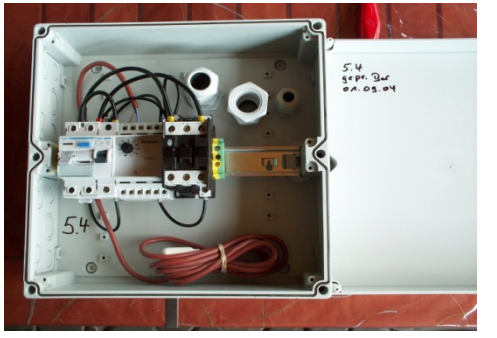
- 316L Stainless frame
- PP-Low temperature vanes
- Glasfibre double layer filter

Installations

Utility vessel for arctic climates

DFH installed in the intake section for engine room ventilation

Type of vessel:
Research Vessel
Name of vessel:
Maria S. Merian
Shipyard:
Gdynia Shipyard



Airvolume:	262.000 m³/h
Surface:	17 m² Intake sections
System:	Munters DFH single stage
Design temperature:	-30°C

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Installations

Utility vessel for arctic climates

Munters DFH

70 Intake of ambient air

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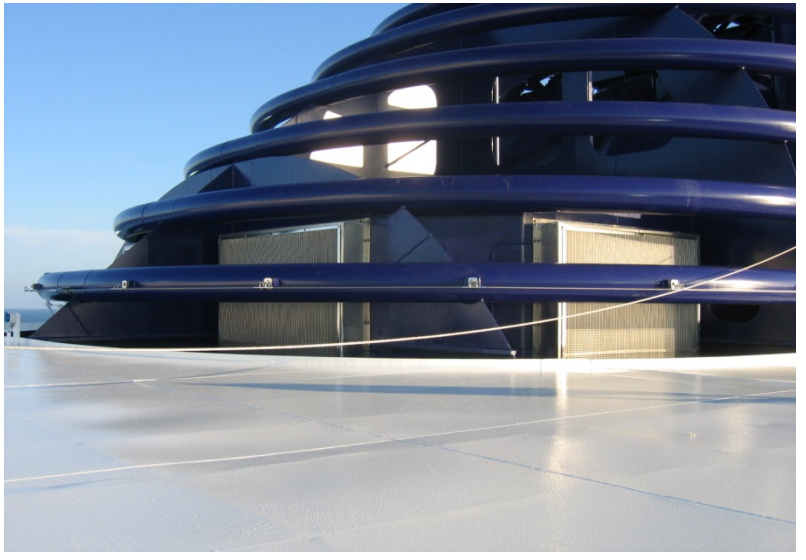
Installations

Cruiser



Deck 16 engine room intakes

AC-Air volume:	1.463.000 m³/h
Engine-room:	1.032.000 m³/h
Surface:	114 m² AC-Intake sections
System:	Munters DF2100
	Munters DF3500

Type of vessel:
Cruiser
Name of vessel:
Norwegian Jewel
Shipyard:
Josef L. Meyer GmbH

70 Intake of ambient air

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Installations

Cruiser

Deck 5 splash proof DF3500

System:
Half round shaped DF3500
Aluminum splash proof single stage
Mist eliminator

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Installations

FPSO

Type of vessel:
FPSO
Name of vessel:
P43 Caratinga
Shipyard:
Jurong, Singapore

PetroBras P43 FPSO

AC-Airvolume:	820.000 m³/h
Surface:	48 m² Intake sections
System:	Munters DF2100
	Munters DCF 2 stage

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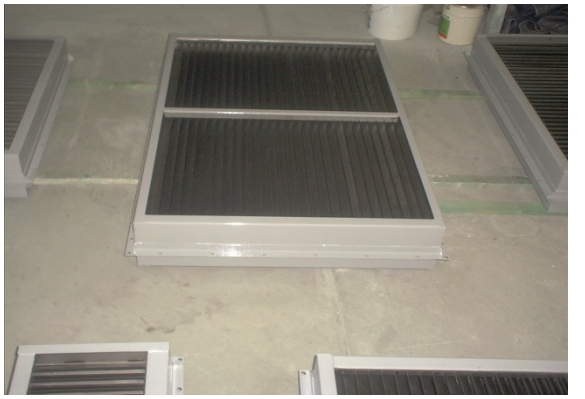
Installations

FPSO

DCF Type 2 with Magnehelic and extended surface design (ESD)



DF2100 Single stage

Filterbox

70 Intake of ambient air

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Installations

Special Utility vessel

DF3500 Single stage mounted into the pylons

Type of vessel:

Utility vessel

Shipyard:

Barkmeijer, Netherlands

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Installations

Platform

AC-Airvolume:	45.000 m³/h
Surface:	12 m² Intake sections
System:	Munters DCF 2 stage

Type:
Platform
Maker:
De Ruijter, Netherlands
Operator:
Wintershall, BASF Group

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Key References

Cruisers
Alstom Chantier de L'atlantique
Fincantieri
Meyerwerft
Aker Finnyards

Container
Volkswerft Stralsund GmbH
IHI Kure
MHI Nagasaki
Meyerwerft

Utility
Barkmeijer
HDW
Damen Shipyards

Vessels for arctic climates
Aker Langsten
Gdynia
Krögerwerft
Novenco Offshore

+ another 60 shipyards in US, Italy, Spain, UK, France, Norway, Denmark, Benelux, Finland

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