

# **Aerosol turbines for mitigation of harmful emissions and firefighting: efficiency comparison versus traditional techniques**

**Francesco Fritz**  
**EmiControls**



# Who we are

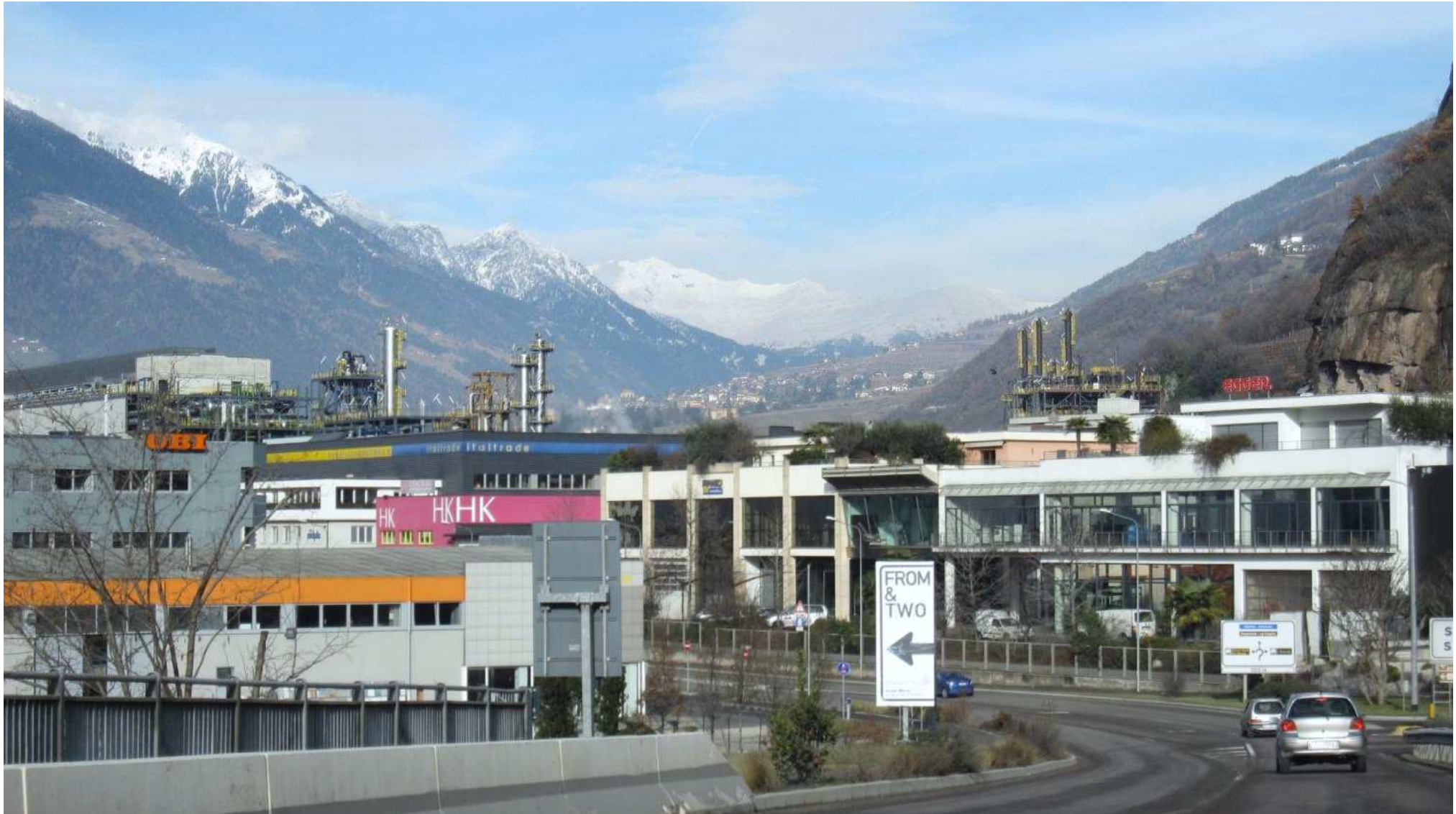
worldwide leader in turbine based systems



# 1. ABATEMENT OF HARMFUL EMISSIONS

# Trichlorosilane plant

Urban constructions getting closer to chemical plant



# Requirements for gas mitigation system

Traditional technique:

- Too much water employment
- Unknown efficiency

Requirements for the system:

- Limited water consumption (to avoid major reengineering of extinguishing water network)
- Static installation required by civil authority
- Proven efficiency required by civil authority
- „best available technique“ according to SEVESO guideline

# Tests of mitigation efficiency in IdF Tunnel



**INSTITUT der  
FEUERWEHR**  
Sachsen-Anhalt

# Traditional technique vs...



... vs Watermist Turbine

400 l/min





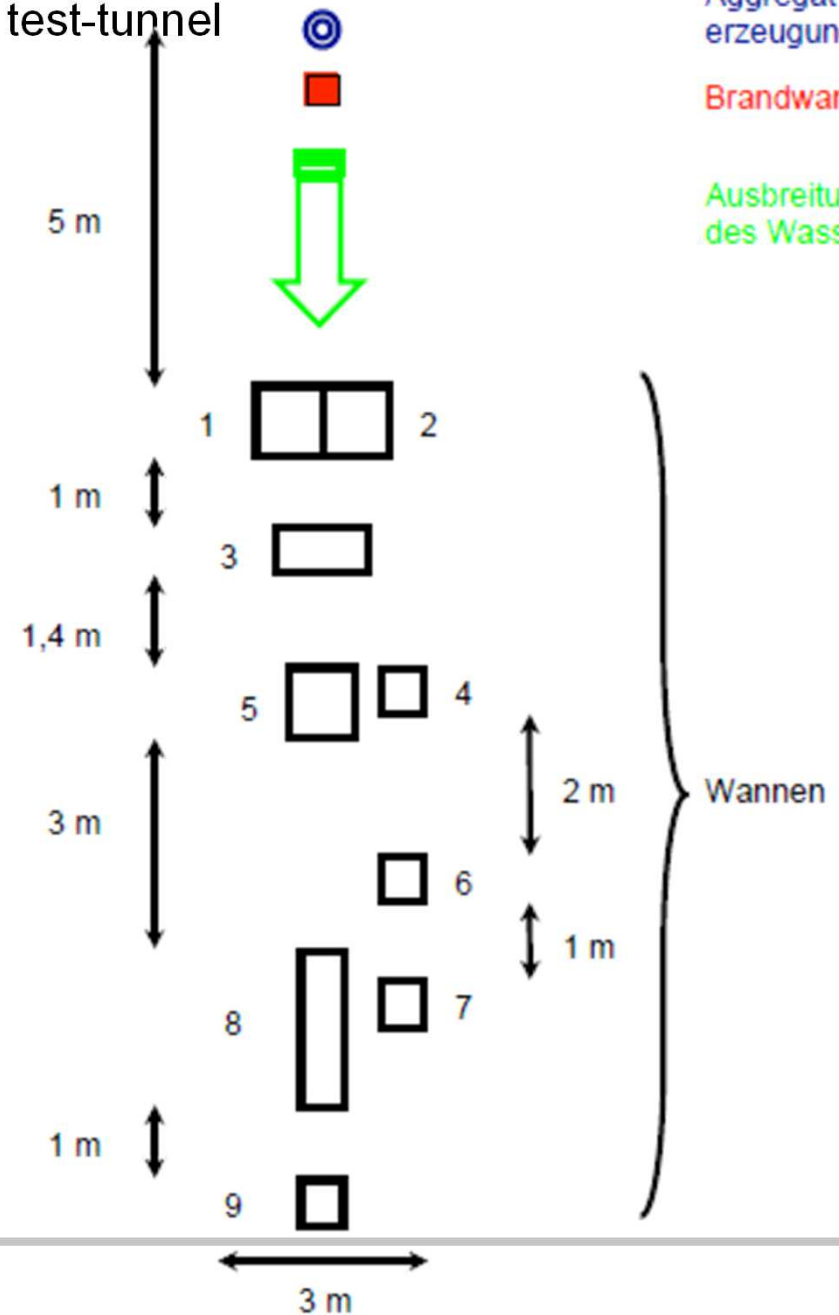
# Testing in IdF Magdeburg

Abatement of Trichlorosilane vapour and smoke in the test-tunnel

Aggregat für Aerosol-  
erzeugung

Brandwanne für TCS

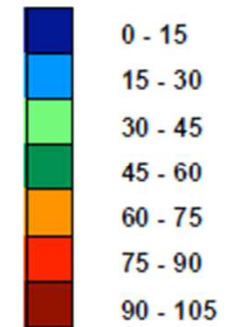
Ausbreitungsrichtung  
des Wasseraerosols



# Testing in IdF Magdeburg



**Analysis of chloride concentration in each tray**



# Testing in IdF Magdeburg

## Measurements:

Waterflow monitoring

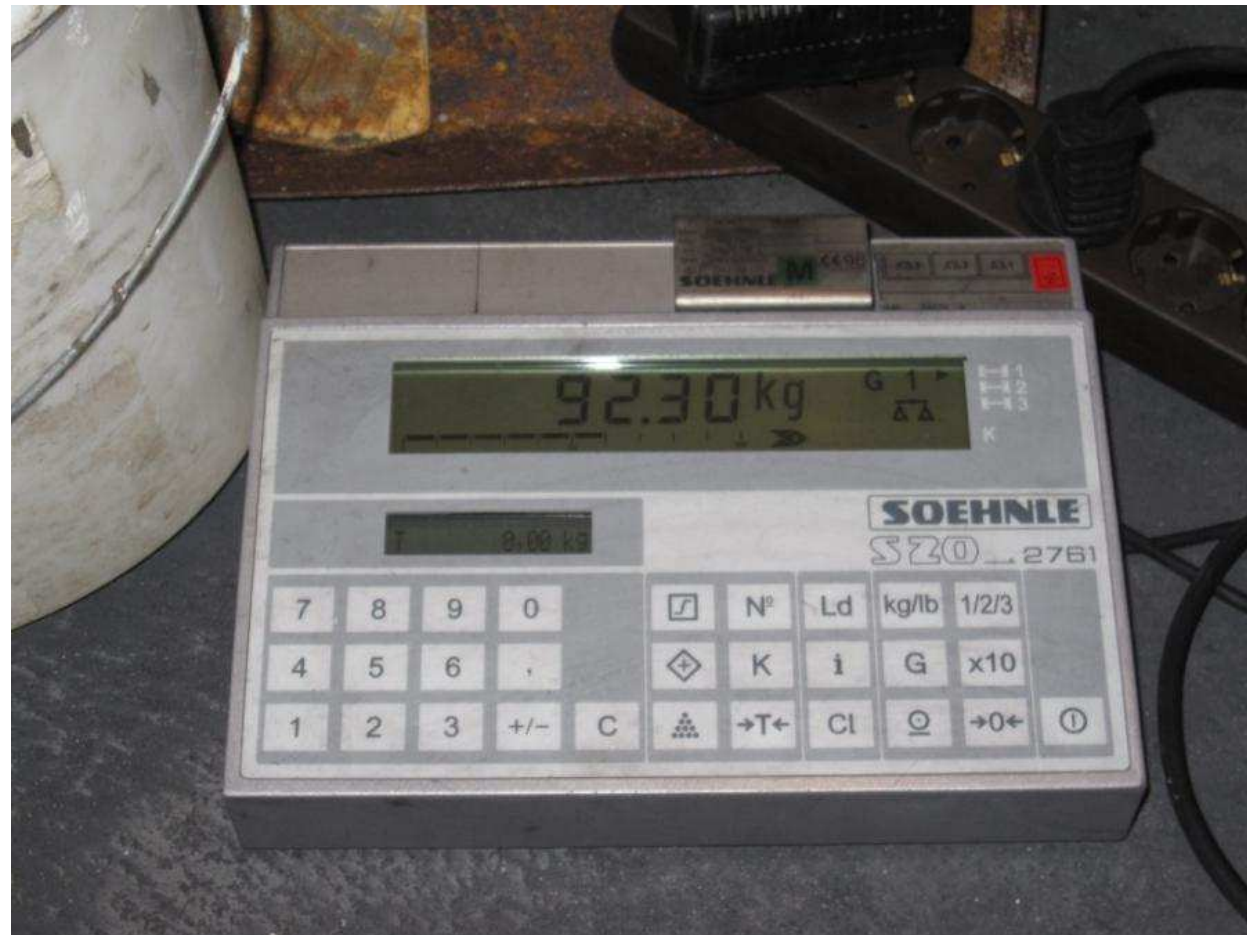
Video recording

IR recording



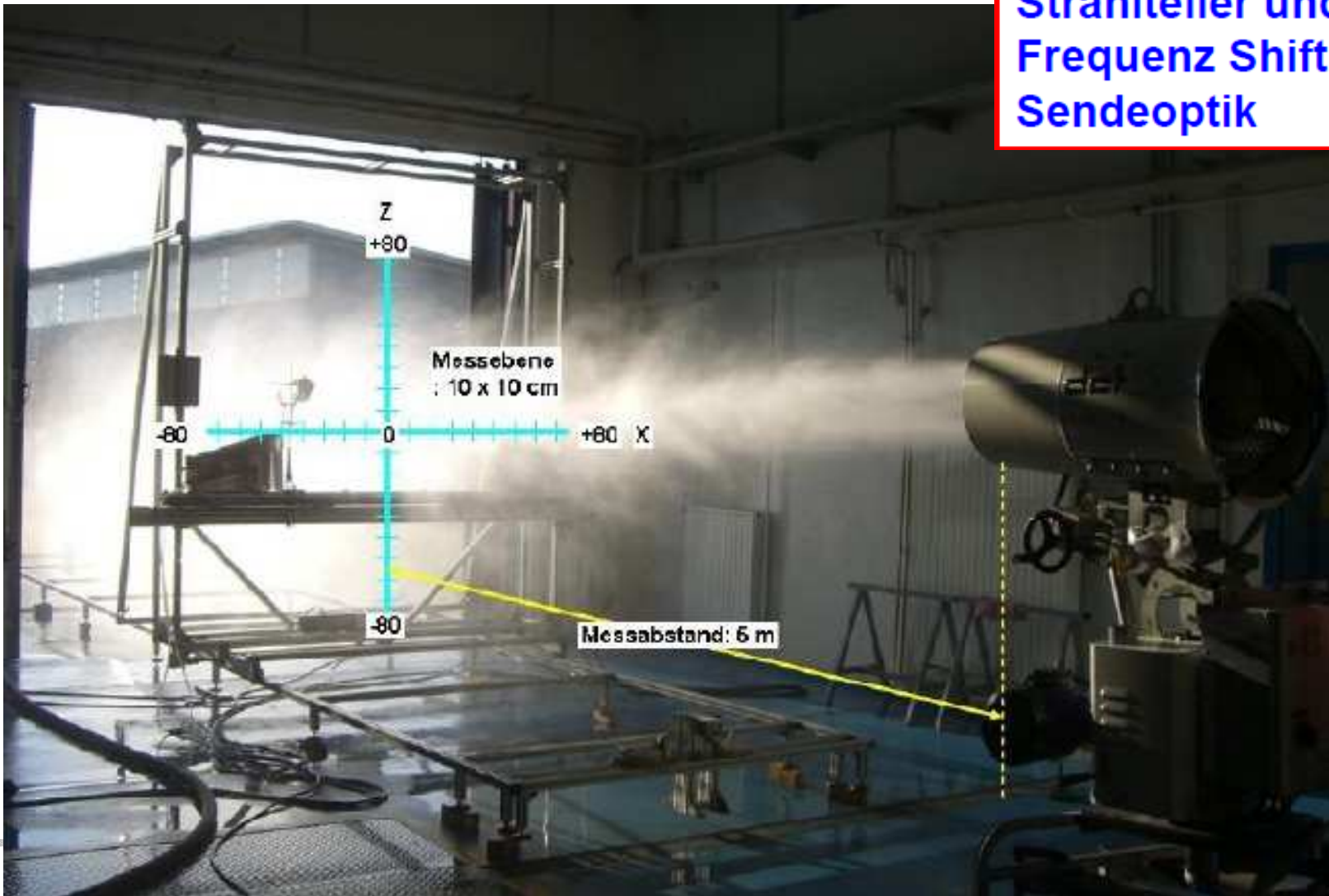
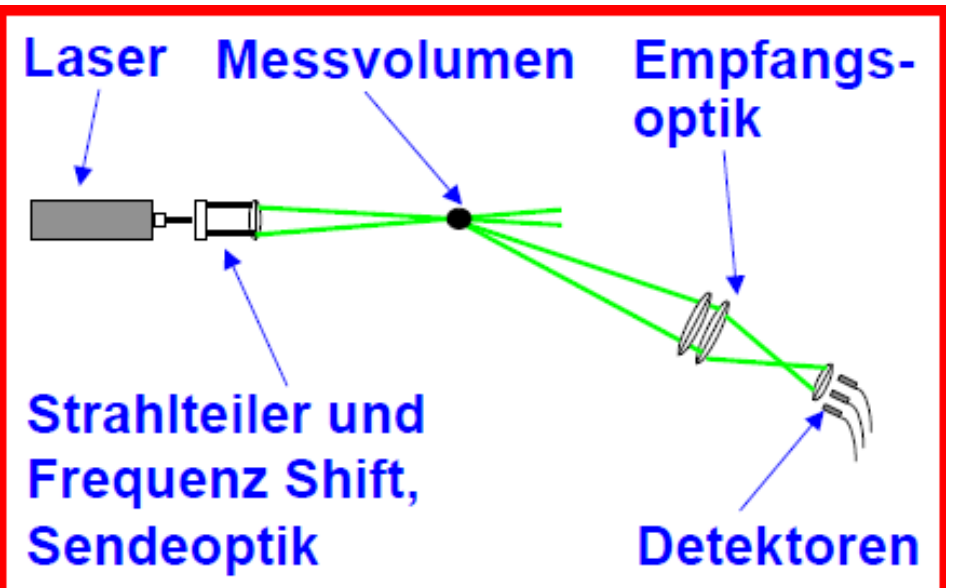
# Testing in IdF Magdeburg

Monitoring of evaporation and burning rate of Trichlorosilane



# Testing in IdF Magdeburg

Droplet size measurement with  
Phase Doppler Particle Analyzer



# Testing in IdF Magdeburg



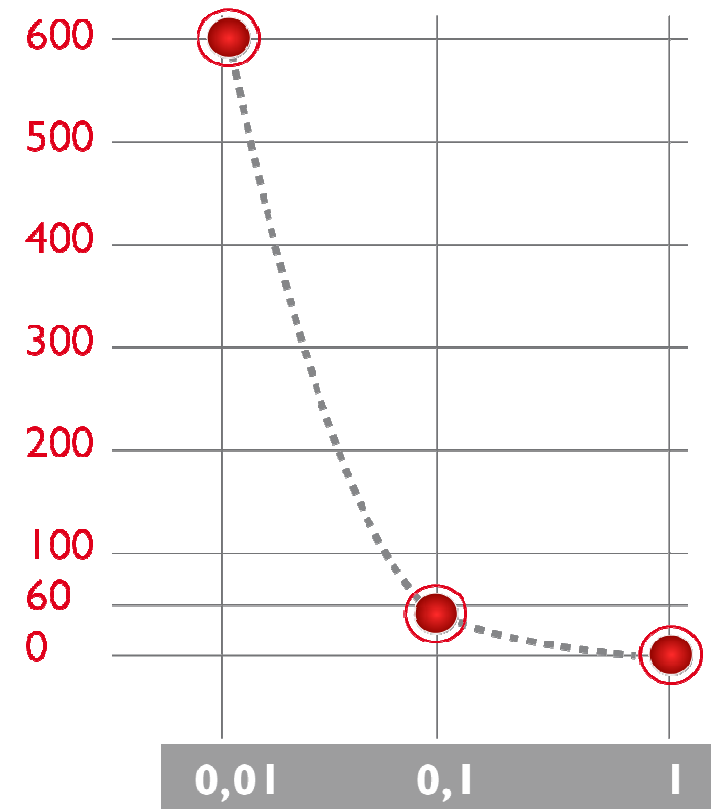
# Areas of Aerosols

Total area inversely proportional  
To the diameter of droplets

For example:

1 l water sprayed in droplets of:

- 1 mm diameter → 6m<sup>2</sup>
- 100 μm diameter → 60m<sup>2</sup>
- 10 μm diameter → 600m<sup>2</sup>



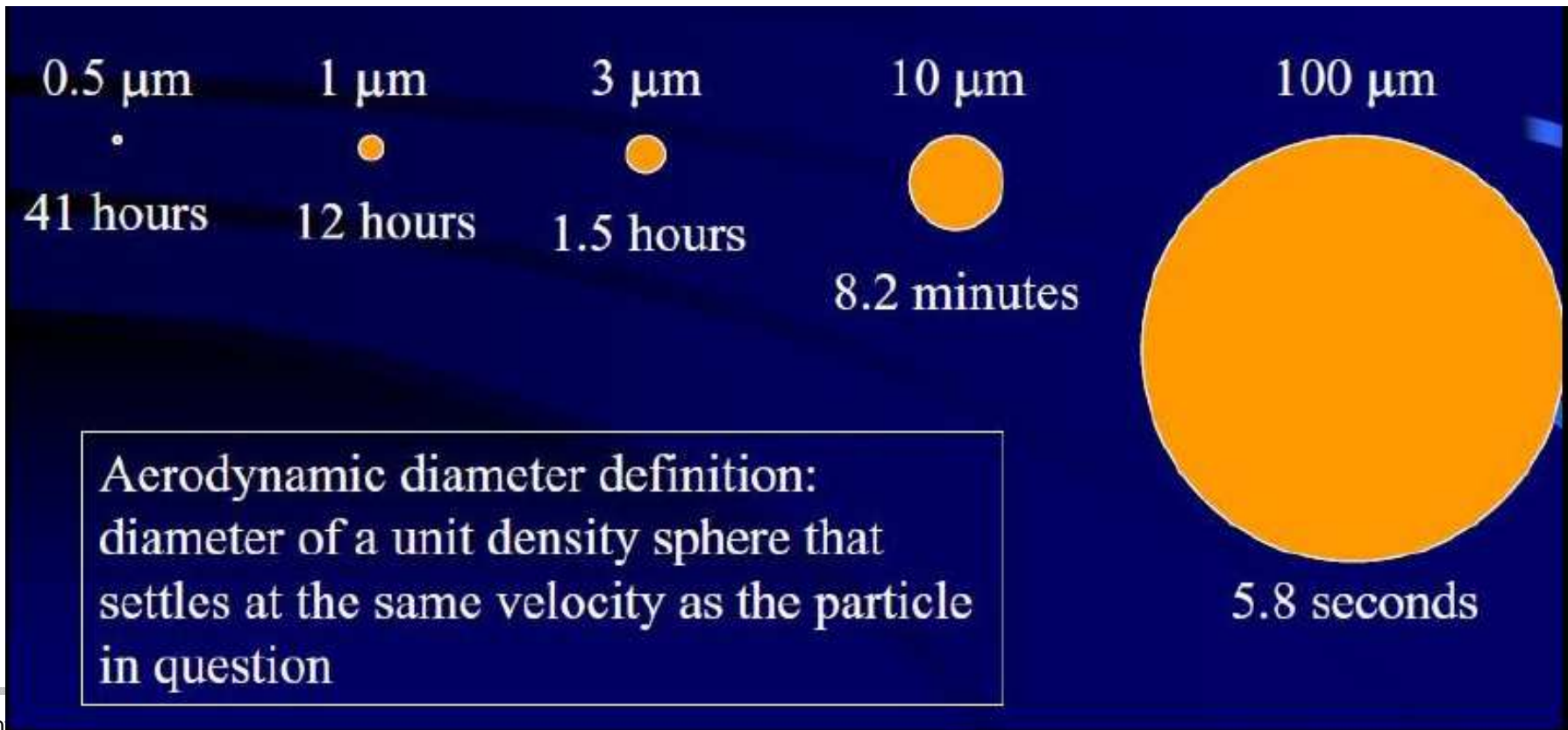


A: Surface  
d: Drops  
diameter

$$A_{H_2O} \sim \frac{1}{d}$$

# Sedimentation time

of solid particles from  
1.5m quote in calm air

Paul Baron  
Division of Applied Technology  
National Institute for Occupational Safety and Health  
Centers for Disease Control and Prevention





# Watermist Footprint with wind

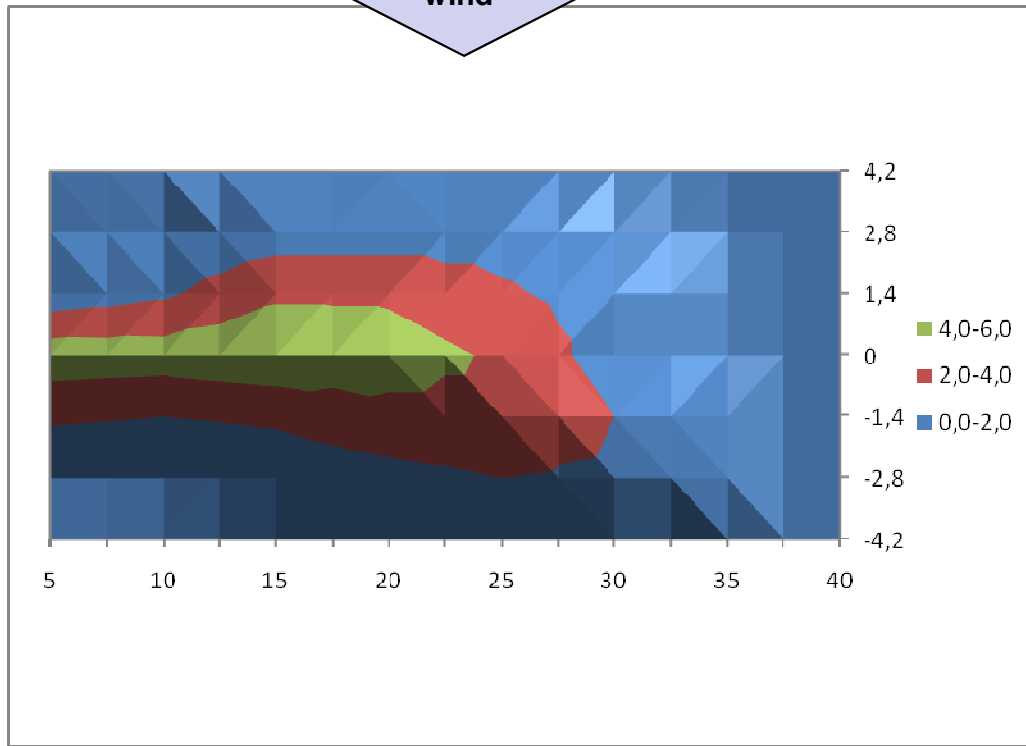
Assessment of throw geometry with side wind



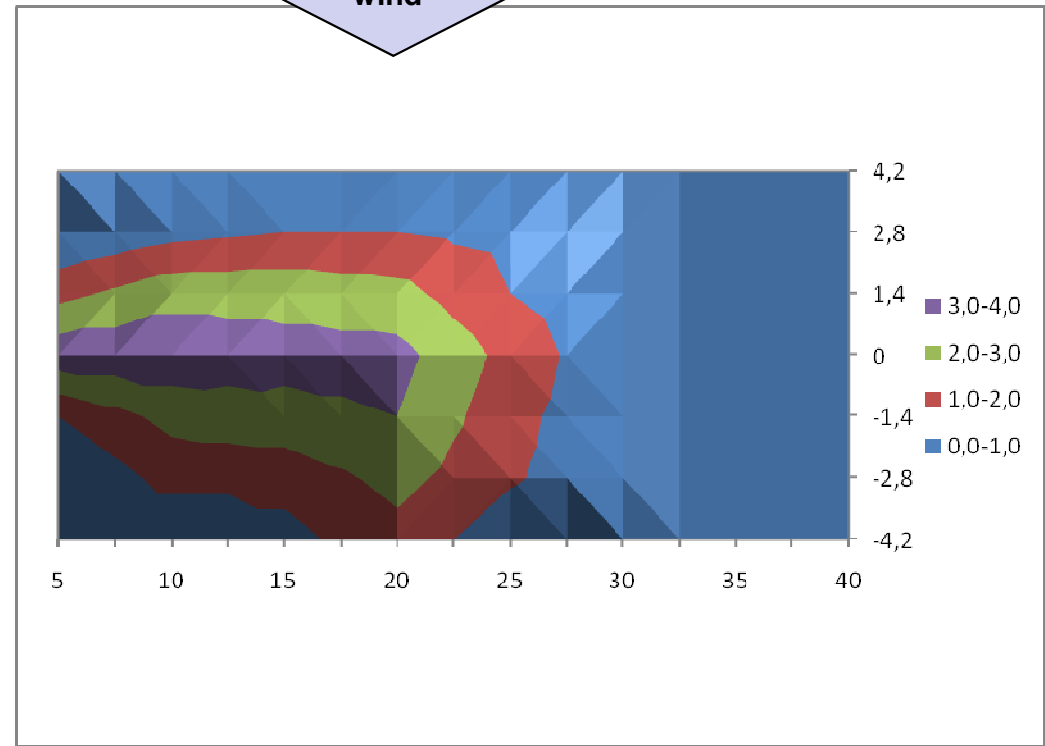


# Watermist Footprint with wind

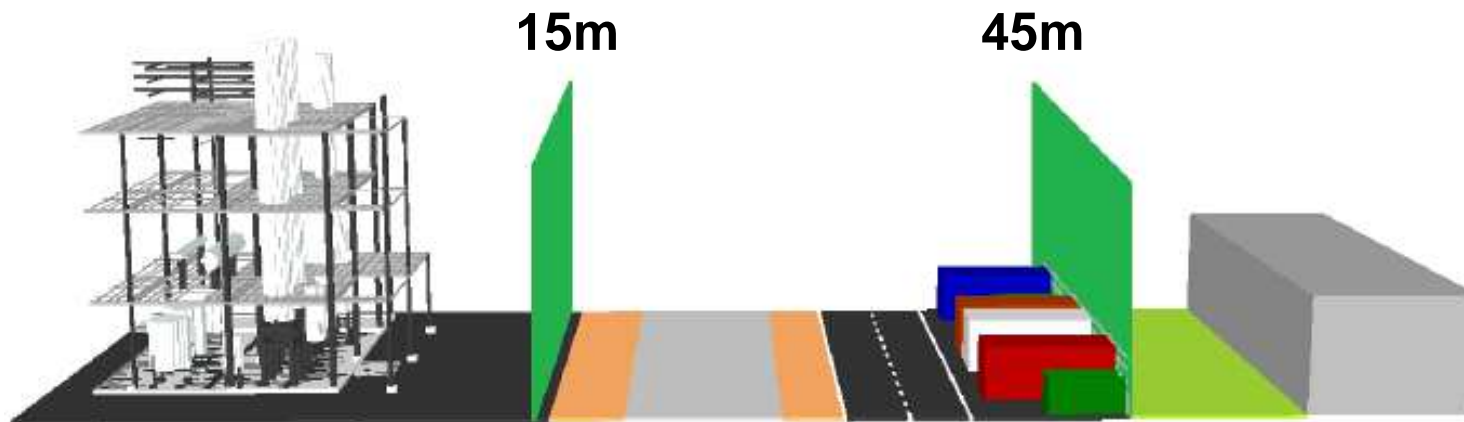
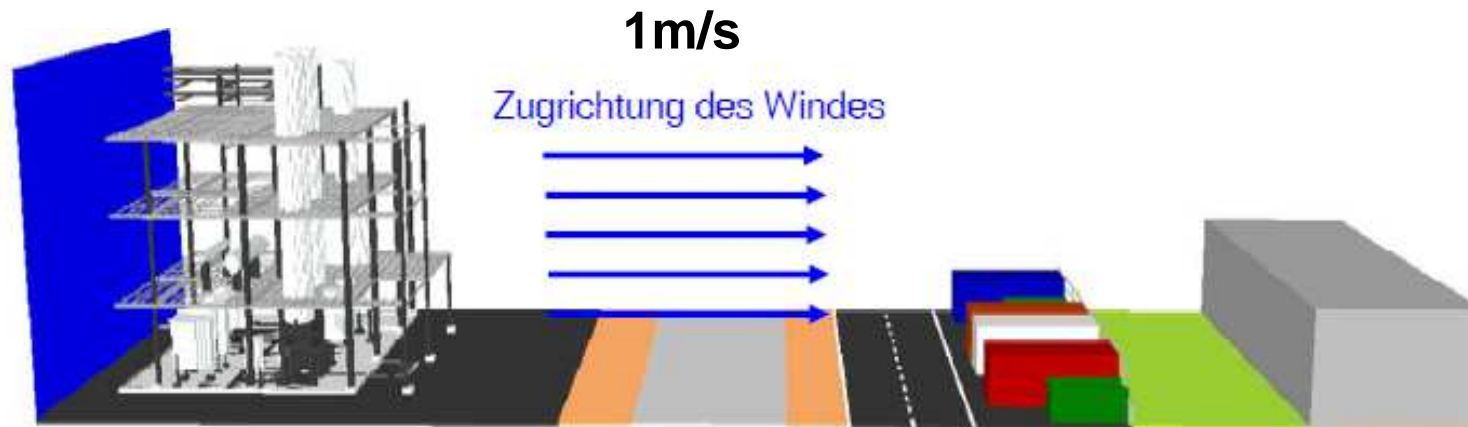
1 m/s  
wind



3 m/s  
wind



# Detail – customer's trichlorosilane plant



# Results on customer's Trichlorosilane plant

Rate of abatement at 15 m: from 9000 ppm to 600 ppm (-93%)

Rate of abatement at 45 m: from 2000 ppm to 160 ppm (-92%)

Limited use of water : 1.600 l/min

# Efficiency: Citation from TÜV study

## Wirksamkeit / Effizienz störfallbegrenzender Maßnahmen im Hinblick auf die Ausbreitung gasförmiger Stoffe

Auftraggeber: Landesamt für Natur, Umwelt und Verbraucherschutz NRW

### Ziel:

Treffen von Aussagen, inwieweit störfallbegrenzende aktive und passive Maßnahmen hinsichtlich ihrer Effizienz möglichst quantitativ zu bewerten sind

TÜV Rheinland Industrie Service GmbH

Bearbeiter: Dr. rer. nat. Wolfgang Kaiser  
Dipl. Ing. Silke Godager  
Dipl.-Geogr. Edgar Neuhalfen  
Dipl. Ing. Rainer Kornek  
Dr. rer. nat. Manfred Schindler  
Dipl.-Ing. Björn Thrun



# Efficiency: Citation from TÜV study

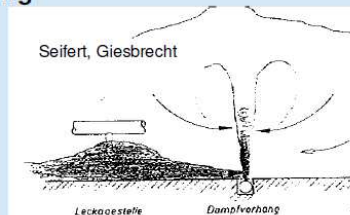
Recherchen zur  
Wirksamkeit  
F/E-Berichte

Fazit aus F/E-Arbeiten

1. Wassersprays und Hydroschilde sind zur Störfallbegrenzung erfahrungsgemäß wirksam. Es zeigen sich stoff-, anlagen-, orts- und wetterspezifische Einflussfaktoren für die Minderung freigesetzter Gefahrstoffwolken.  
**Die besten nachvollziehbaren Wirkungen ließen sich mit Wasseraerosolen erreichen, die mittels beweglicher Turbinen erzeugt werden.**
2. Eine verallgemeinerungswürdige, alle gasförmigen gefährlichen Stoffe und Bedingungen umfassende quantitative Bewertung der Wirksamkeit von Wassersprays und Hydroschilden ist nicht möglich.
3. Reaktionsfähige Zusätze im Wasserschleier verbessern die Wirksamkeit (Grenzen: ökonomische Aspekte bei der Auswahl der Zusatzstoffe)
4. Abdecken von verdunstenden Lachen mit Löschschaum ist eine sehr wirksame Maßnahme

## Beispiele für die Störfallbegrenzung

Wasserschleier/Dampfvorhänge  
(aufwärts, abwärts)



Aerosole  
Spezialturbine  
(TechnoAlpin, SecurPlan)



13 | 31.05.2011

Effizienz störfallbegrenzender Maßnahmen | Dr. Kaiser

TÜVRheinland®  
Genau. Richtig.



14 | 31.05.2011

Effizienz störfallbegrenzender Maßnahmen | Dr. Kaiser

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Genau. Richtig.

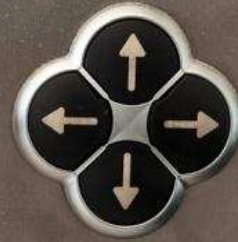
**Pictures of final project**





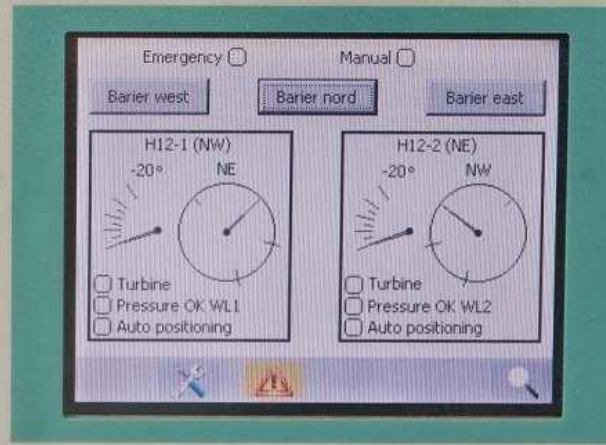






SIEMENS

SIMATIC PANEL



ARRESTO  
TURBINA N. O.



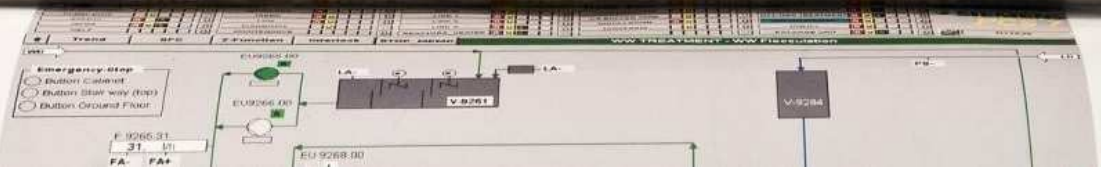
AVVIO  
TURBINA N. O.



ARRESTO  
TURBINA N. E.



AVVIO  
TURBINA N. E.





## 2. FIRE FIGHTING

# Testing efficiency in training ground of FER refinery - Hungary

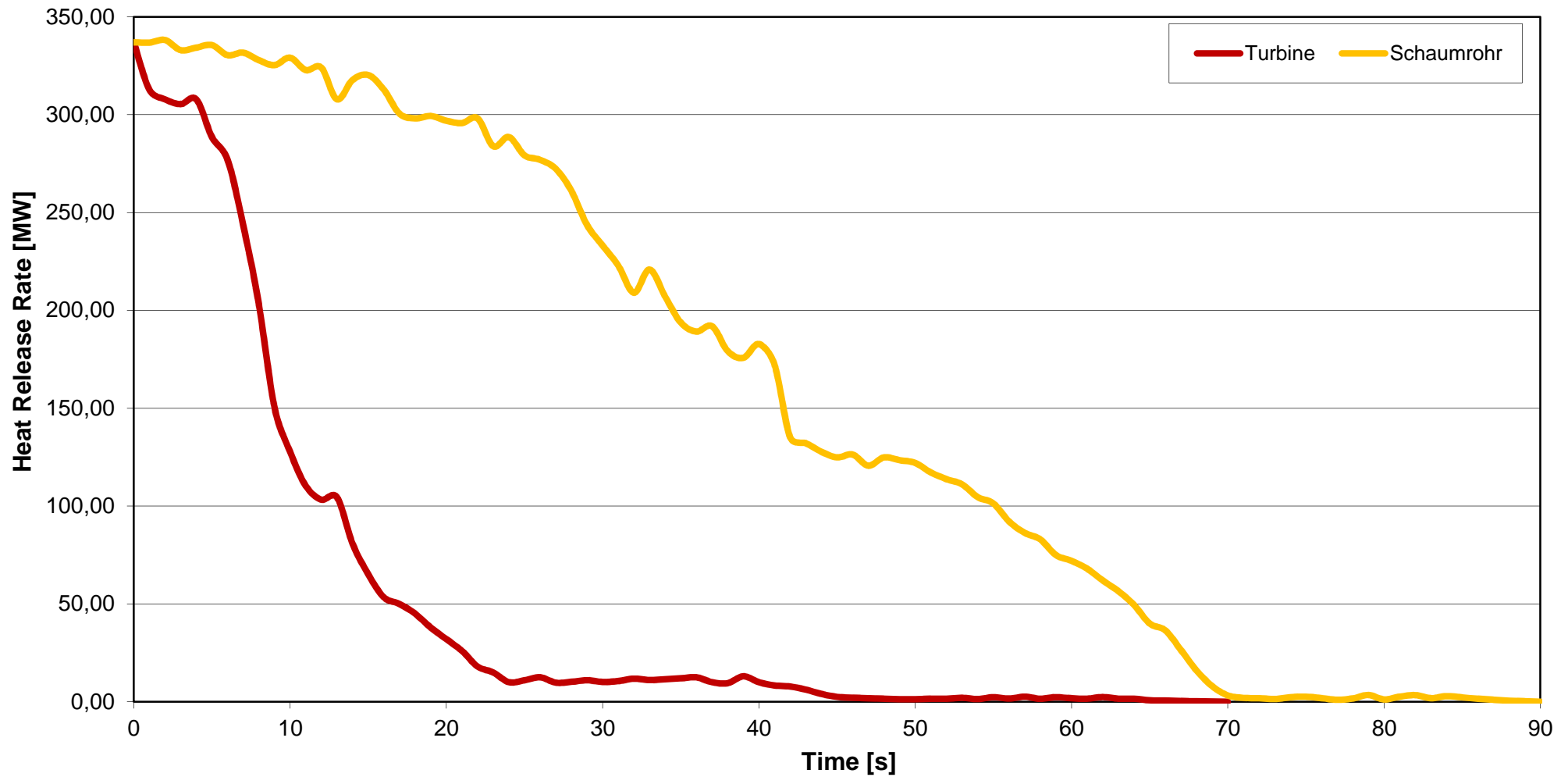


**Test:** 160m<sup>2</sup> surface - 2400l fuel – 350MW HHR – 1% AFFF foam







# Result: Heat release rate vs. time

Water mist turbine (red) vs. traditional monitor nozzle (yellow)





# Benefits of Turbine Aided Firefighting

-  **quick knock-down** of flames and fire
-  **reduced employment** of water and foam
-  **gentle application** of foam on fuel surface
-  **surrounding** effect on 3D objects

# 3. COOLING

# Cooling effect of watermist stream

**350MW fire**  
**160m<sup>2</sup> surface**  
**2400l fuel**

**Temp measured on fire ~ 1.200°C**

**Temp measured behind watermist stream ~ 139°C**

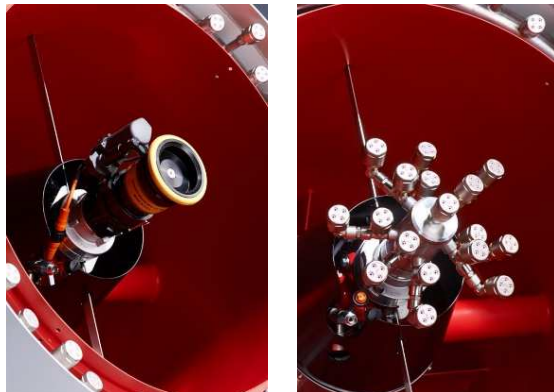


# 4. SOLUTIONS AND APPLICATIONS

# TAF<sup>®</sup> - Turbine Aided Firefighting



- **High Water mist flow**  
from 100 l/min to 1.500-3.500 l/min
- **Medium**  
Water, salt water, Foam, Retarder, Gel
- **High manoeuvrability**  
(360° rotation; -20°/+50° tilting)
- **Power:** electric or oil-hydraulic



# Adjustable spray pattern

## Fine water mist mode

Max efficiency  
0 to 1.500 l/min



## High flow mode

water mist  
0 to 3.500 l/min



## High flow mode

max throw distance  
0 to 3.500 l/min



# TAF on vehicle

AirCore



# TAF on robot



TAF35



remote control



# TAF on stationary installation






# Fields of application

- Tunnel
- Refineries / Chemical industry
- Forest fire
- Urban
- Airports



# Key takeaways

-  Only certified system on the market for hazardous gas abatement
-  First high quantity water mist and foam cannon for fire extinction
-  Applications: rapid firefighting, effective cooling, mitigation of harmful gas emissions

