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## 10<sup>th</sup> International Water Mist Conference

Prague 2 – 4 November 2010

# Low Pressure Water Mist Fire Protection Systems with F-500 Encapsulator Agent



*Roberto BORRACCINO – Chairman*

*Eliana PERRONE – International Sales  
Dept.*



# What is F-500?

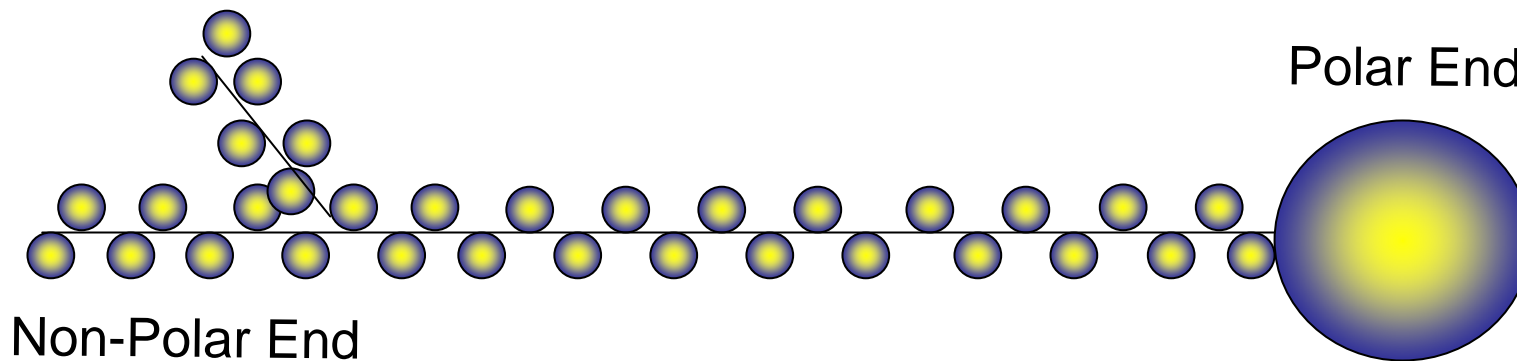


- ✓ F-500 is an Encapsulator Agent
- ✓ A multi-purpose cULus
- ✓ An oil spill & remediation control Agent.

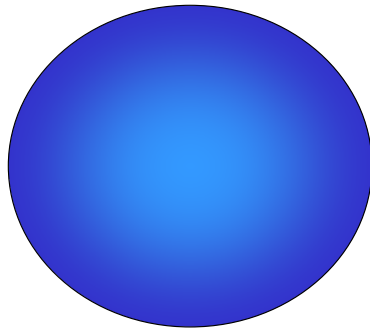


## F-500 Encapsulator Agent Characteristics

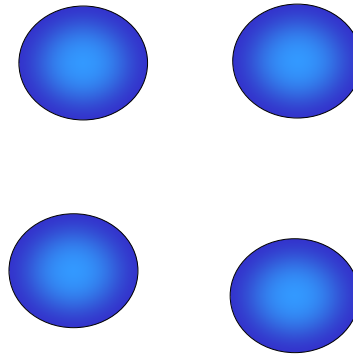
- **Amphipathic Molecules**
  - Large molecule with a polar (hydrophilic) end and a non-polar (hydrophobic) end with sufficient distance between so that each end acts independently
    - **Polar end** (hydrophilic - “loves water”)
      - Soluble in water
    - **Non-polar end** (hydrophobic - “fears/hates water”)
      - Attracts hydrocarbon molecules



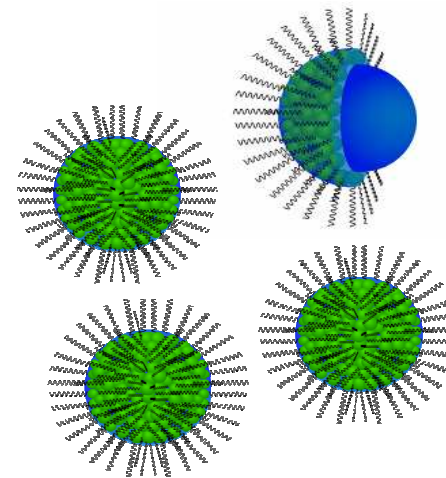
# Droplet Comparison



**Water  
Drop**



**Fire Suppression Agent**



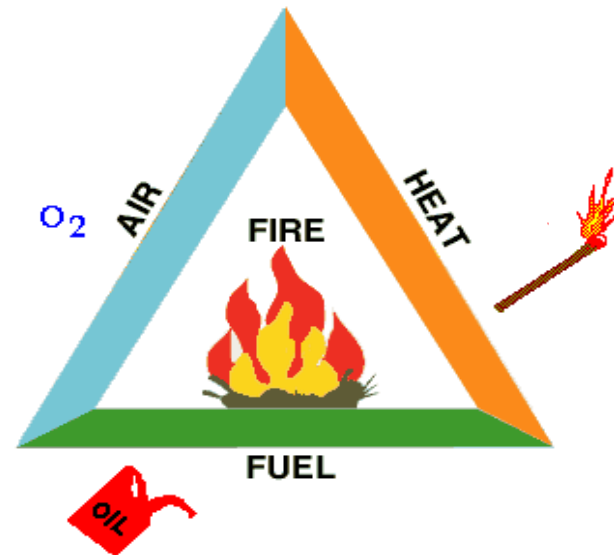
**F- 500  
Agent  
Encapsulator**

# **F-500 Encapsulator Technology**

## **Fire Suppression Mechanics**

# The Chemistry of Fire

- Tetrahedron:
  - Oxygen
  - Fuel
  - Heat
  - Chemical Chain Reaction
- Fire Suppression
  - Elimination of one or more main elements of the fire tetrahedron



# F-500 Encapsulator Technology

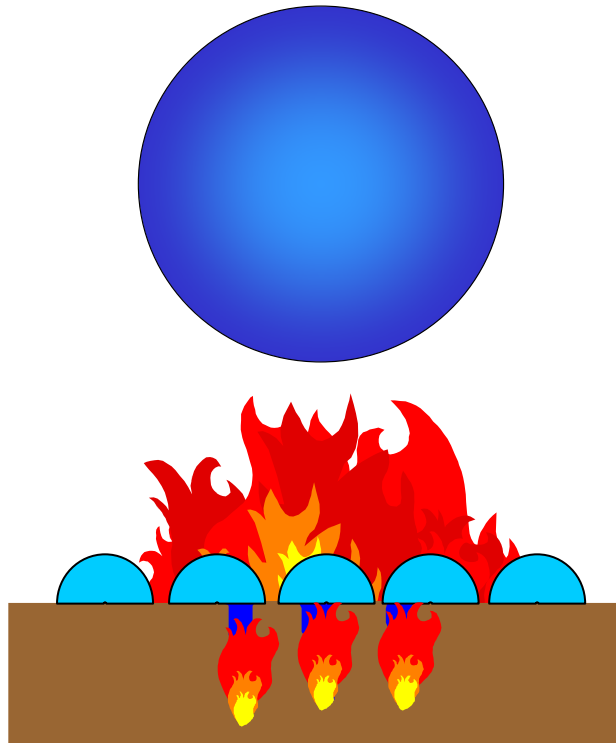
## Fire Suppression Mechanics

- **Surface Tension Reduction**
  - Water Surface Saturation
  - Penetration Increase
- **Rapid Heat Reduction**
  - 1200 °F to 127 °F in seconds
  - Absorption of a big quantity of heat compared to the single water drop.
  - Prevention of the fire re-ignition
- **Encapsulation**
  - Making of a film around a hydrocarbons molecules group
  - Inerting of flammable materials
- **Interruption of the Free Radicals Chain**
  - F-500 acts as inhibitor in the reaction chain by absorbing the energy of free radicals during the collision.
    - Reduction of toxic smokes
    - Visibility Increase
    - Air quality Improvement

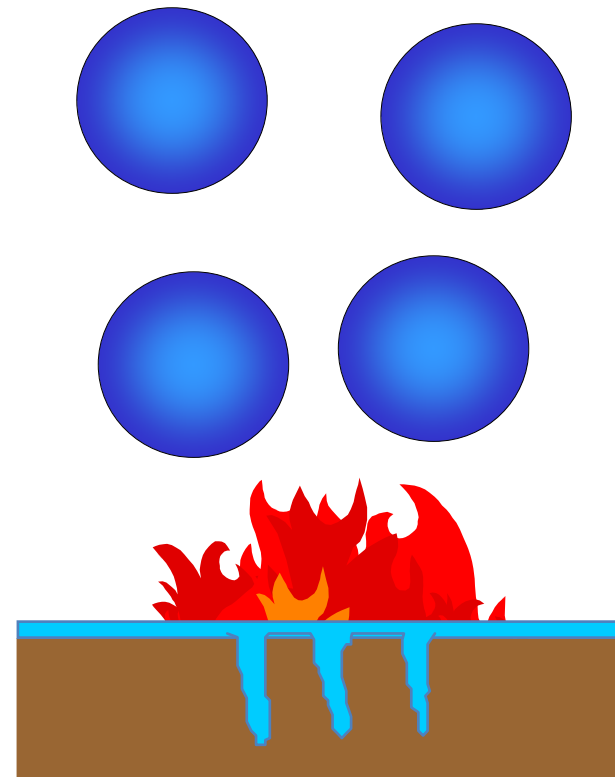


# Surface Tension Reduction

- Spreading and penetration (spreading coefficient)
- Smaller droplets size (increasing surface area)



Water Drop



Fire Suppression Agent



# Rapid Heat Reduction

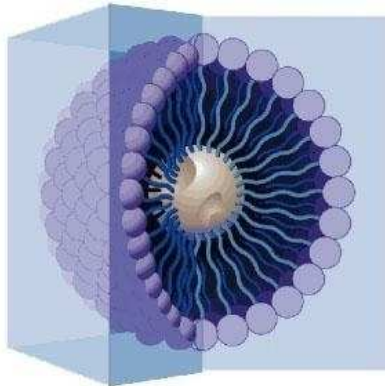
- At 70°C starts a significant release of water steam with a lower temperature compared to the normal vaporization temperature (100°C)
- The increase in the ratio of water vaporization transforms more efficiently the energy of the latent heat of the water itself, by producing a more rapid and effective flames cooling.



# Micelle Formation

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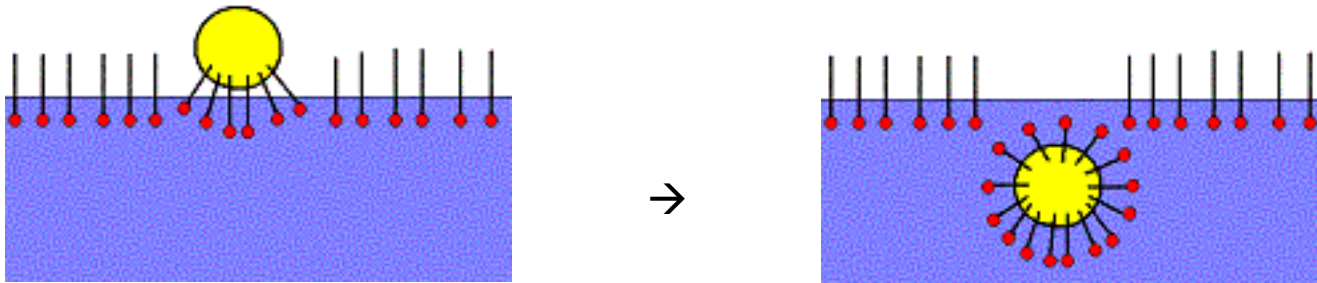
Above a critical concentration of F-500 molecules in the water, molecules will join together, by making Micelles.



The polar ends of the F-500 molecules are surrounded by water, whereas the non-polar ends are collected inside the drop.

## Encapsulation with F-500 Micelles

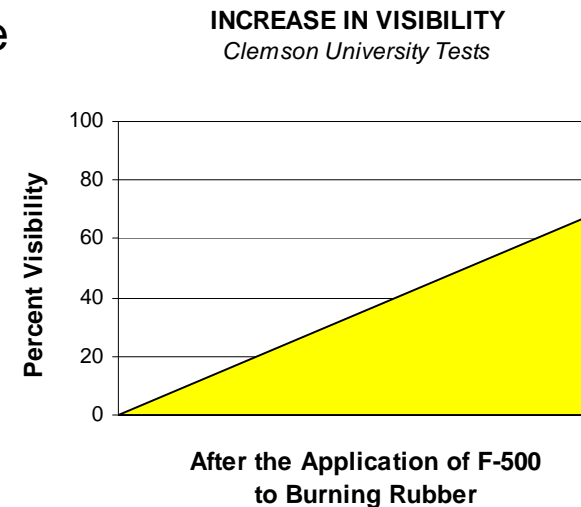
Thanks to the addition of F-500 in water, the insoluble oils (and other hydrophobic substances) can now become soluble in water.





# Interruption of Free Radical Coalescence

- Tests show that the use of F-500 reduces of 97% the presence of fire smokes, obtaining a more breathable air.
  - The reduced smoke formation shows the involvement of F-500 in the interruption of free radical chain reaction
- F-500 can increase visibility at 68%, providing a safer, more visual attack of the fire
  - Can see potential life-threatening hazards and locate victims
  - Allows closer, more aggressive and safer attack of the fire





# F-500 Environmental Advantages

- Non-corrosive
- Non-toxic
- Non-hazardous
- Fluorine-free
  - No PFOS
  - No PFOA
- 100% Fully Biodegradable



- EPA's NCP Product Schedule
  - Listed Surface Washing Agent



## F-500 Environmental Risk Assessment

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- General eco-compatibility - GESAMP 2002
- Biological soil test and assessment on the product biodegradability
- Testing and assessment with respect to wastewater
- Toxicology testing and assessment
- Bacteriological Toxicity analysis
- Biodegradability BOD5/COD
- Biodegradability Times – Fresh and marine water
- Classification into Water Hazard Classes



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# **FIRE SUPPRESSION SYSTEMS WITH F-500**



# **FIRE SUPPRESSION SYSTEMS**

## **WITH F-500**

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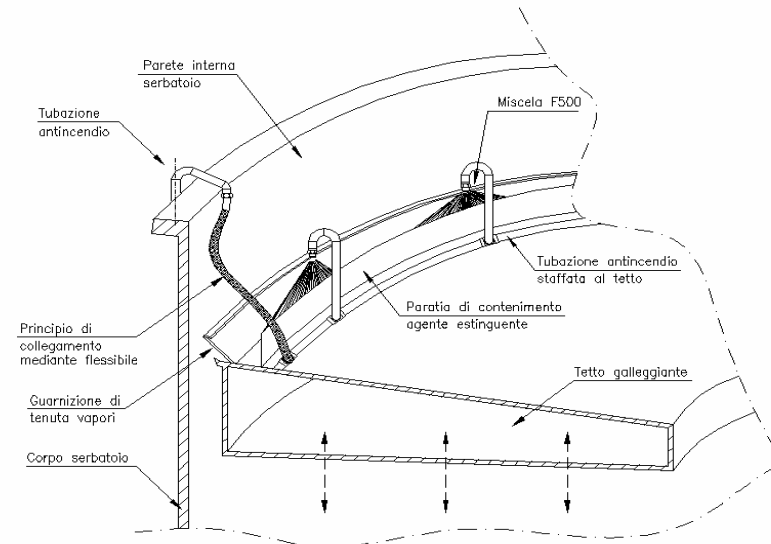
### **FIXED SYSTEMS**

- ✓ **Fire Protection System for Floating Roof Tanks**
- ✓ **Fire Protection System for Railways Carriages**
- ✓ **Fire Protection System for Cables Tunnels**
- ✓ **Fire Protection System of Power Transformers**
- ✓ **Cooling System for Structures and Tanks.**



### Fire Protection System for floating roof tanks

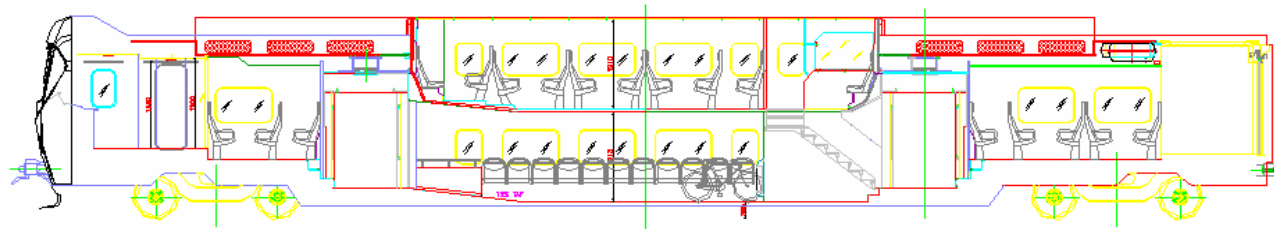
- **Water Mist System**
- **Working Pressure : 5 ÷ 8 bar**
- **Water mist Nozzle ellipse type**
- **Line Mixing fixed percentage  
(1% e 3%)**



# FIRE SUPPRESSION SYSTEMS WITH F-500

## FIXED SYSTEMS

### Fire Protection System for railways carriages



- **Water Mist Fire Suppression Systems according UNI CEN/TS 14972**
- **Working Pressure: 10 ÷ 12 bar**
- **Water mist nozzle**
- **Pre-mixed System**

### Fire Protection System for Cables Tunnels

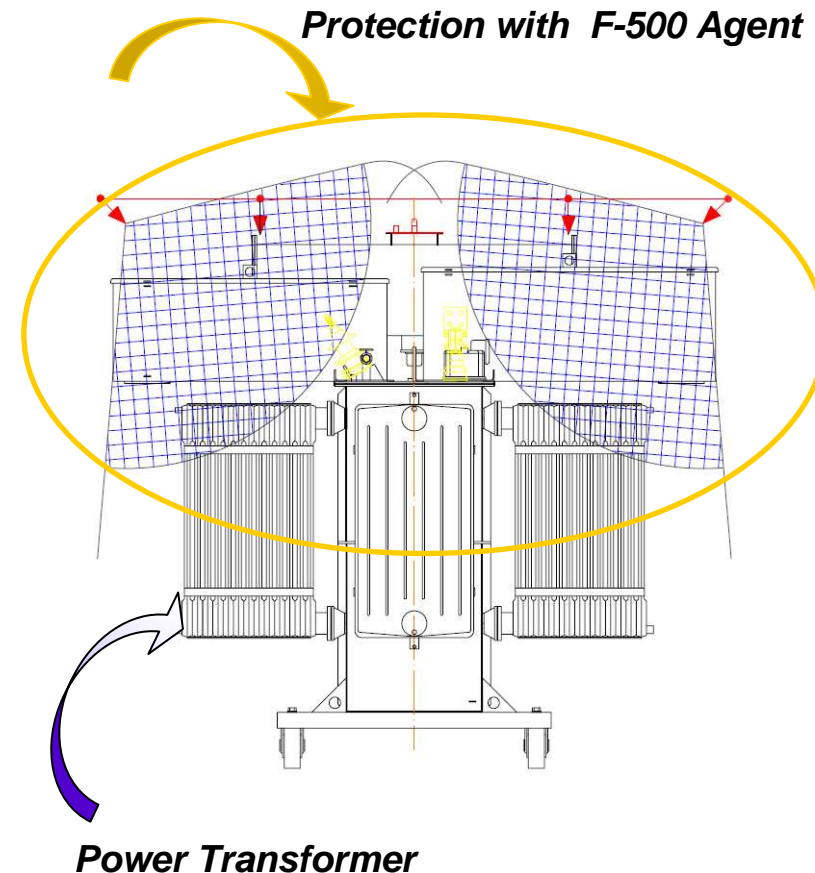
- **Water Mist Fire Suppression System according UNI CEN/TS 14972**
- **Working Pressure: 10 ÷ 12 bar**
- **Water mist nozzles**
- **Line Mixer with fixed percentage (1% e 3%)**
- **Area Subdivision in intervention zones. Fire localization by automatic system. System activation in 3 zones.**



### Fire Protection System of Power Transformers

- Water Mist system
- Working Pressure: 5 ÷ 10 bar
- Traditional Nozzle with internal mixer
- Line Mixer fixed percentage (1% e 3%)

**WATER MIST + F-500**



# FIRE SUPPRESSION SYSTEMS WITH F-500

## FIXED SYSTEMS

### Protection of plants zones with a limited entry



WATER MIST + F-500

- **Water Mist cooling System**
- **Working Pressure : 5 ÷ 12 bar**
- **Water Mist Nozzles**
- **Line Mixing fixed percentage (1% e 3%)**

# AQUATECH

*plus*

***Low Pressure Water Mist***

***Water + F-500***

- Low Pressure Fire Suppression Water Mist (Water + F-500)
- Working Pressure 8-12 bar to the nozzle
- Pumps or Cylinders Pressurization System
- Pre-mixed Systems or with line mixer

## **APPLICATIONS**

- ✓ Confined Spaces
- ✓ Turbines Rooms
- ✓ Power Transformers
- ✓ Road Tunnels, Trains, Railways Carriages
- ✓ Cables and Conduits Tunnels

## System Advantages

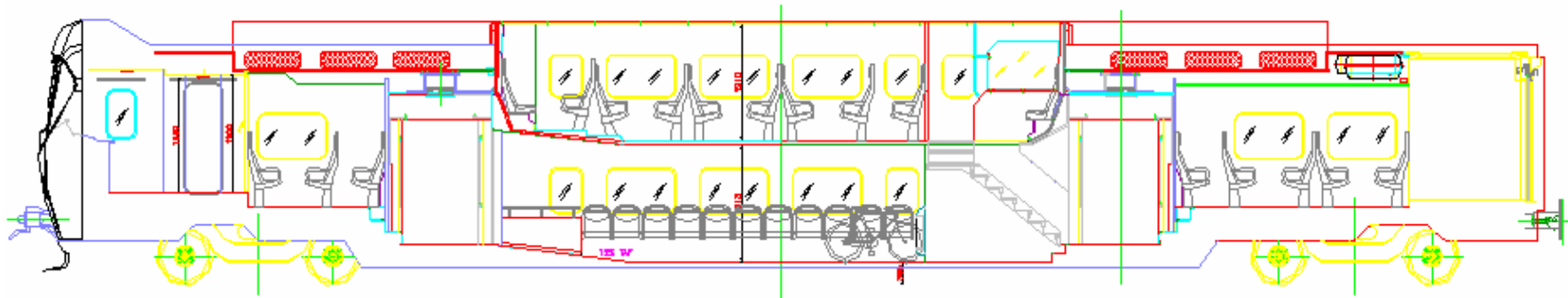
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- ***Very small water quantity***
- ***Absolute safety for people within the protected area with possibility of immediate discharge without warning time***
- ***Very high heat absorption and drastic reduction of the fire dimensions***
- ***Totally environmental friendly***
- ***High capability of smoke and harmful gas depletion***
- ***Easy system installation for piping and fittings small dimensions***
- ***Not necessary room airtight***
- ***No furniture and structure damages caused by water***
- ***Possibility of system solution with cylinders group***
- ***Possibility of system solution with diesel or electrical pumps and section valves***
- ***Very low refilling and maintenance costs.***



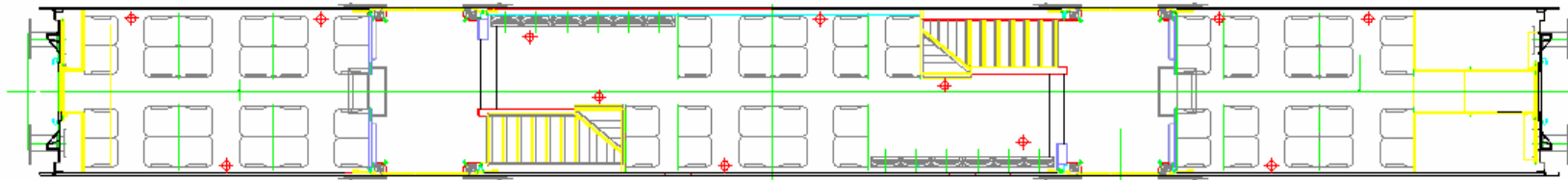
# LOW PRESSURE WATER MIST FIRE PROTECTION SYSTEMS (AQUATECH PLUS) TO PROTECT RAILWAYS CARRIAGES

Application to a real case



# LOW PRESSURE WATER MIST FIRE SUPPRESSION SYSTEMS (AQUATECH PLUS) TO PROTECT RAILWAYS CARRIAGES

## *System Project Data*

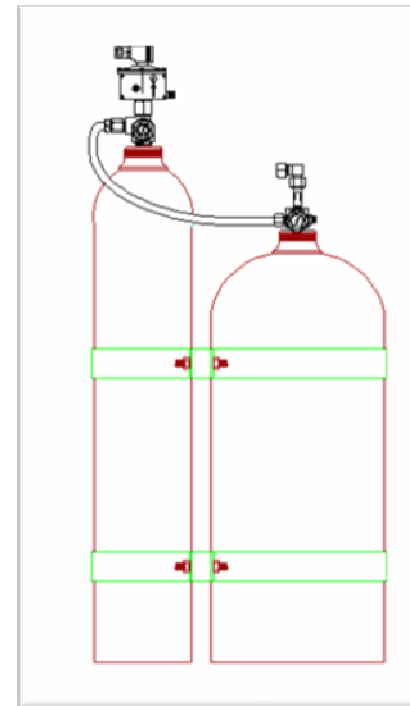


**18 nozzles positioned on side walls under the hats;  
1 cylinders group;  
6 zone valves  
1 main valve**



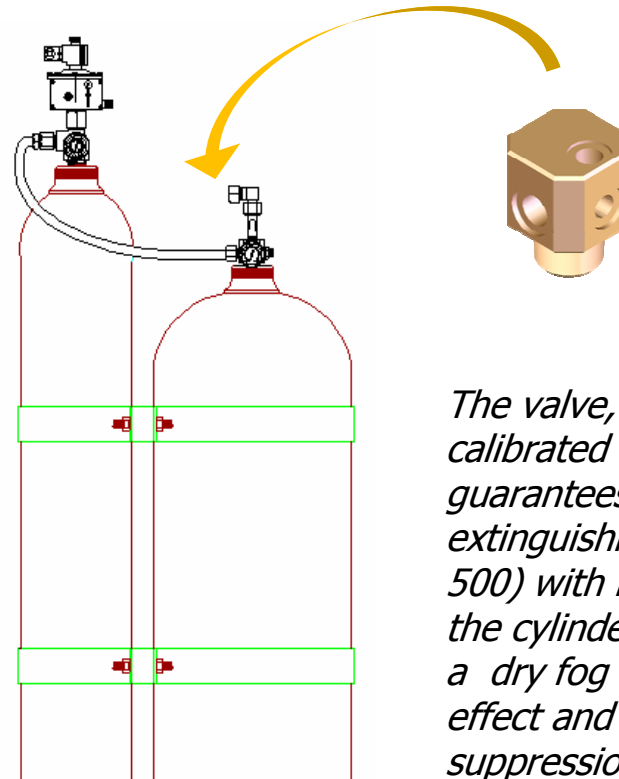
## LOW PRESSURE WATER MIST FIRE SUPPRESSION SYSTEMS (AQUATECH PLUS) TO PROTECT RAILWAYS CARRIAGES

*The stored mixture pressurization will be permitted through the nitrogen cylinder opening that will caused the remixing of water with F-500 and the discharge of the extinguishing mixture in the emergency area.*



## LOW PRESSURE WATER MIST FIRE SUPPRESSION SYSTEMS (AQUATECH PLUS) TO PROTECT RAILWAYS CARRIAGES

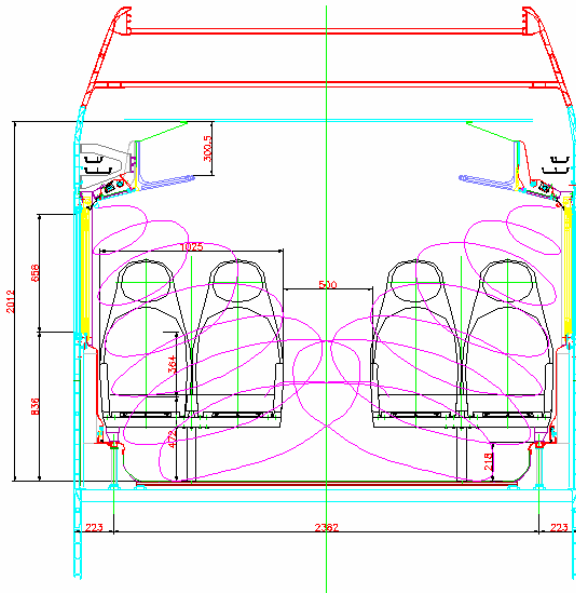
Twin- fluid valves are mounted on the cylinder that contains the mixture water and F-500 and permit to have a twin-fluid mixture of the extinguishing fluid in outlet on nozzles line



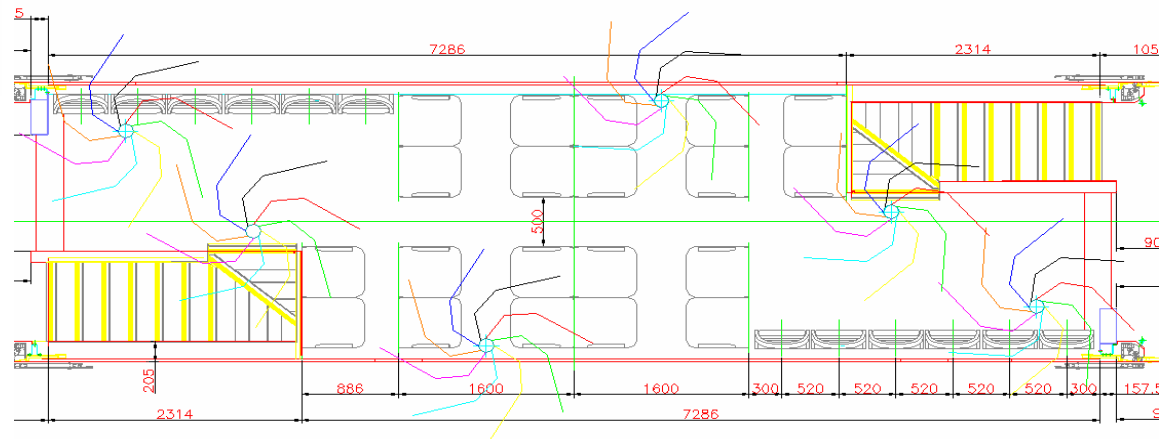
***Valvola twin fluid***

*The valve, through appropriate calibrated holes inside its body, guarantees the mixing of the extinguishing liquid (water and F-500) with nitrogen that pressurizes the cylinder. In this way is obtained a dry fog that reduces the wet effect and improves the fire suppression by using the nitrogen inerting properties.*

## LOW PRESSURE WATER MIST FIRE SUPPRESSION SYSTEMS (AQUATECH PLUS) TO PROTECT RAILWAYS CARRIAGES



*The spray elix type that is generated laps surfaces inside the wagon by producing a faster temperatures breakdown.  
The produced fog wraps seats and people and then going to saturate the upper side of the wagon.*



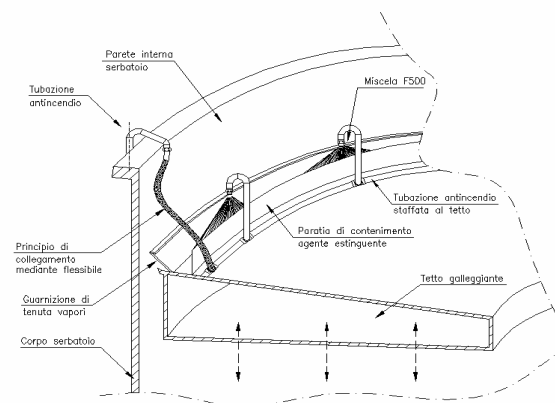
## LOW PRESSURE WATER MIST FIRE SUPPRESSION SYSTEMS (AQUATECH PLUS) TO PROTECT RAILWAYS CARRIAGES

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### ADVANTAGES OF THE SYSTEM:

- ✓ *The **water-mist additived with F-500** is absolutely compatible with the presence of passengers onboard to the railways carriages*
- ✓ *The possibility to use as safe and efficient system for spaces where the water quantities to discharge and collect are limited, make the water mist proposed system the right solution for railways carriages.*

# **AUTOMATIC FIRE SUPPRESSION SYSTEMS WATER MIST WITH F-500 TO PROTECT FLOATING ROOF OIL TANKS**



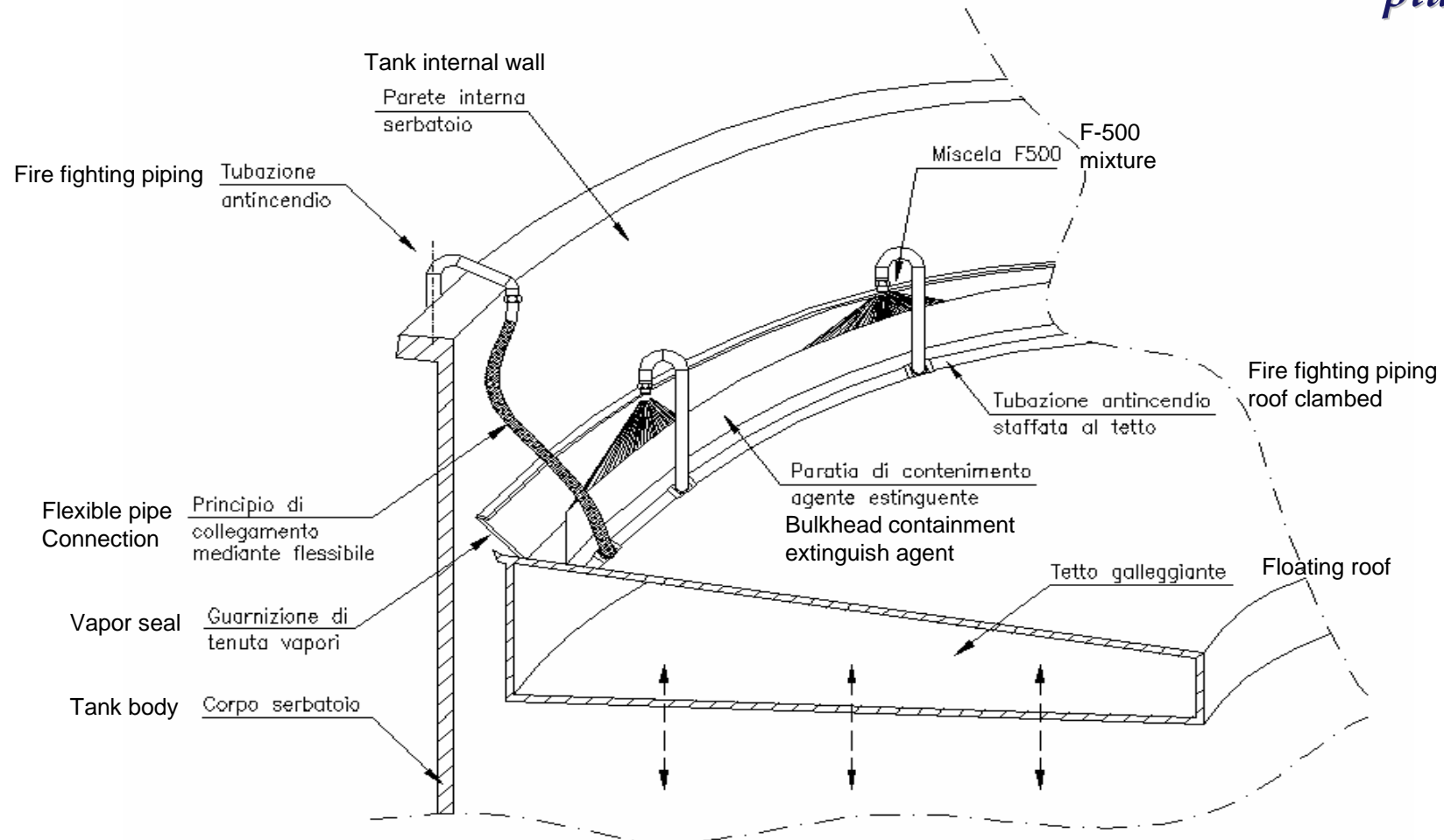
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- The fire of a floating roof tank is characterized by mobile flames along the rim seal and only when a part of the seal will be severely damaged by flames there will be flames localized in the breaking point of the seal.
  - The proposed fire fighting system is dimensioned to intervene on the circular crown between the tank wall and the special bulkhead provided in the roof to contain the foam.
  - The fire fighting system for the protection of this kind of tanks is a “state of art” system that uses water spray nozzles in order to obtain the fire suppression by using the properties of F-500 that amplify the great cooling capability of water.



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- The system philosophy is based on the simultaneous action produced by the nozzle jet to spray the circular crown of the floating roof tank and to cool the side walls of the tank mantle.
  - In this way the encapsulating properties of F-500 that get in touch with the fuel vapors and those refrigerant of the micelle encapsulator wetting agent that invests the tank walls.
  - Encapsulated vapors of the fuel lead to the progressive fire suppression, while the cooling of the tank structure deducts heat to the fire by leading it to a natural depletion and at the same time it preserves the tank from possible structural collapse problems .

## Detail of the tank seal zone

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*plus*



# SYSTEM COMPONENTS

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- ✓ Control System (Deluge Valve)
- ✓ Automatic Control Device (Fire Detectors with thermo-sensitive cable)
- ✓ Storage Tanks and Mixing System
- ✓ Nozzles
- ✓ Feeding network

## Control System (Deluge Valve)

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It is possible to use the same deluge valve used for Sprinkler System

**Working Pressure:** 5 -12 Bar

**Materials :** bronze or stainless steel



## Automatic Control Device (Fire Detectors with thermo-sensitive cable)

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Most of existing fire detection systems installed to protect floating roof tanks are with thermo-sensitive cable type.

No change for existing systems manufactured according the rules in force.

Aquatech Plus System can interface without any change with all type of execution and brand.

**AQUATECH**  
*plus*

## Mixing System

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The Mixing System is made with a static line dispenser and downstream it is mounted a mixer capable to distribute F-500 in the water homogeneously.

**$\Delta P$ :** 35 % about

**Materials:** bronze, light alloy, stainless steel

**Mixing percentage :** 1%, 3%

## Pumping group

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Pumping group shall guarantee the min. pressure of 5 bar to the nozzle, considering the possible pressure loss of the line mixer and in the feeding network.

Usually, in industrial areas, are used pressurized piping network.

## Nozzle

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Heart of the system are nozzles able to generate a spray with an elliptical form that permits the coverage of the sole circular crown.

***Positioning distance:*** 2,50 m for individual flow rates (mixing to 3%) of 25 lt/min

***Positioning distance:*** 1,50 m for individual flow rates (mixing to 1%) of 15 lt/min



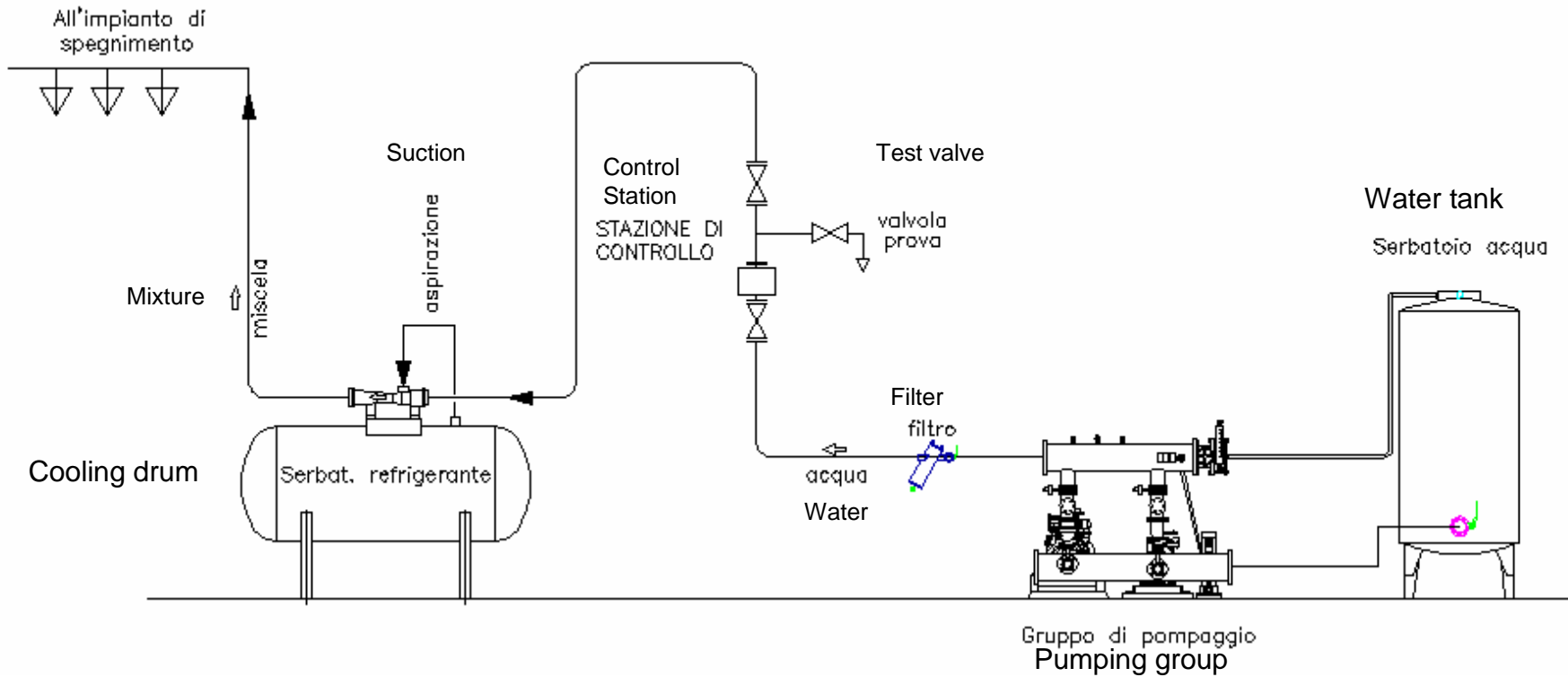
## Feeding network

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- ❖ Water piping of dimensioned by hydraulic calculation.
- ❖ Piping type: carbon steel

# System Layout

To the fire suppression system





*Thank you for your  
kind attention!*

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