Fire Protection for Printing Machines with High Pressure Water Mist

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Case Study PRINOVIS Printing Company

- PRINOVIS is Europe’s largest printing company with 2800 employees and various factories in Germany and UK

- PRINOVIS is specialized in top quality full colour print of magazines, catalogues and brochures

- The printing factory in Dresden (Germany) utilizes retro-gravure printing machines for highest printing finish results

- Fast and flexible reaction to end customer’s needs are an important performance characteristic of PRINOVIS

- Fire protection has always been an important aim to ensure a safe environment for its employees and business continuity
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- The PRINOVIS site in Dresden (Germany) operates 6 large retro-gravure printing machines in a hall of 120 m x 60 m
- Each machine has an overall enclosure of 8 m x 30 m with 10 m of height
- The existing fire protection concept has been developed in close co-operation with the insurance company and the fire brigade
- The fire risk has been assessed to the paint trays containing solvent based colours
- These have been protected with an automatic local protection system utilizing Aerosol
- A manually activated local protection CO$_2$ system has been installed as back-up
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- On 19.05.2013 at 14:00 the fire station of Dresden received an alarm call for fire at the PRINOVIS factory.
- When the fire brigade arrived to the site one of the retro-gravure printing machines was fully on fire.
- Fire control was difficult due to spillage of solvent throughout the printing machine.
- The fire was extinguished after 2 hours by 116 firemen and 25 fire fighting vehicles, utilizing 7000 l of water with 600 l of foam additive.
- For smoke ventilation positive pressure ventilation was employed.
- Soot particles have settled in the entire hall on all surfaces and required thorough cleaning measures.
- Extensive water damage to stored paper material.
- Total loss of the retro-gravure printing machine on fire with eight-digit Euro figure overall damage.
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- Investigations after the fire could not determine the exact reason for the rapid fire spread throughout the printing machine.
- Most likely the solvent-based colours on fire spread from the paint trays to not protected areas and ignited the paint mixing containers.
- In conjunction with the insurance company, PRINOVIS decided to improve fire protection measures within the retro-gravure printing machine enclosures.
- Beside improvement of the automatic fire detection system different fire fighting systems were evaluated.
- An extension of the CO₂ system was no option due to personnel safety.

Water mist was identified as optimal fire fighting system for the fire risk.

Fire Protection for Printing Machines with High Pressure Water Mist
Benefits of High Pressure Water Mist

High pressure water mist technology was selected to be most favourable due to:

- Fire test proof of extinguishing effect
- Safe for personnel
- No requirements for pre-warning times
- Best cooling abilities with smallest water amounts (lowest damage potential)
- Low impact to electric components
- Simple system retrofit to the existing machines and to the periphery
- Lowest business interruptions
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Development of a fire protection concept in co-operation with:

- Client (PRINOVIS)
- Insurance company (HDI)
- Fire brigade
- Water mist system manufacturer (FOGTEC)
- Fire test laboratory (IFAB)
- System acceptance body (VdS)

Full scale fire tests were defined based on Annex B of CEN TS 14972 defining:

- Fire load
- Arrangement of fire load
- Ventilation conditions
- Acceptance criteria

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Fire Tests for Printing Machine Protection

Fire Test Arrangement
- Fire test hall with 10 m x 15 m floor area and 5 m ceiling height with 2 m x 3 m door opening
- Dimensions of the fire test mock-up equivalent to the dimensions in the real printing machine
- Natural ventilation conditions by open doorway in the fire test hall

System Acceptance Criteria
- Fire extinguishment within 15 minutes of system discharge
Fire Tests for Printing Machine Protection

Fire Loads
- n-Heptane was chosen as representative fire load for solvent based colours containing Toluene as solvent
- Diesel was chosen as representative fire load for lubricants
- Original paper rolls

Fire Load Arrangement
- n-Heptane pool fire of 2,5 m x 0,8 m to simulate spilled solvent based colours
- n-Heptane pool fire of 2,0 m x 0,6 m to simulate spilled solvent based colours
- Diesel pool fire of 2,0 m x 0,6 m to simulate spilled lubricants
- n-Heptane spray fire to simulate ruptured solvent based colour supply (8 bar; 2,84 l/min)
- Diesel spray fire to simulate ruptured lubricant supply (90 bar; 2,84 l/min)

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<tbody>
<tr>
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<td>-7</td>
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Mock-up
- Mock-up simulates the space between two printing units, the paint mixing units at one side of each printing unit and the gears at the other side of each printing unit

Instrumentation
- Thermocouple TE 1, TE 2 and TE 3 to monitor extinguishment of pool fire 1
- Thermocouple TE 5, TE 6 and TE 7 to monitor extinguishment of pool fire 2
- Thermocouple TE 9 to monitor extinguishment of the spray fire
- Thermocouple TE 4 and TE 8 to monitor the temperature at the position of the linear heat detection cable
Fire Tests for Printing Machine Protection

Scenario 1

Combined shielded pool fire and spray fire with n-Heptane to simulate a rupture of a solvent based colour supply and a spillage of solvent based colours at a paint mixing unit.

Water Mist System

- Open water mist nozzles arranged as object protection along the printing machine
- 5% AFFF additive

Activation

When reaching temperature of 70°C at position of linear heat detection cable (+ 50% safety)
Scenario 1

Combined shielded pool fire and spray fire with n-Heptane to simulate a rupture of a solvent based colour supply and a spillage of solvent based colours at a paint mixing unit.

Fire Test Results

- Pool fire extinguished at 32 sec of system discharge
- Spray fire extinguished at 9 min 24 sec of system discharge
Fire Tests for Printing Machine Protection

Scenario 2

Pool fire with n-Heptane to simulate a spillage of solvent based colours between two printing units

Water Mist System

- Open water mist nozzles arranged as object protection between the printing units
- 5% AFFF additive

Activation

When reaching temperature of 70°C at position of linear heat detection cable (+ 50% safety)
Fire Tests for Printing Machine Protection

Scenario 2
- Pool fire with n-Heptane to simulate a spillage of solvent based colours between two printing units

Fire Test Results
- Pool fire extinguished at 28 sec of system discharge
Scenario 3

Combined shielded pool fire and spray fire with Diesel to simulate a rupture of a lubricant supply and a spillage of lubricant at the gear of a printing unit

Water Mist System

- Open water mist nozzles arranged as object protection along the printing machine

- No additive

Activation

When reaching temperature of 70°C at position of linear heat detection cable (+ 50% safety)
Fire Tests for Printing Machine Protection

Scenario 3

Combined shielded pool fire and spray fire with Diesel to simulate a rupture of a lubricant supply and a spillage of lubricant at the gear of a printing unit.

Fire Test Results

- Pool fire extinguished at 5 min 58 sec of system discharge
- Spray fire extinguished at 7 min 48 sec of system discharge
Fire Tests for Printing Machine Protection

Scenario 4

Paper fire to simulate an accumulation of paper within the printing machine

Water Mist System

- Open water mist nozzles arranged as object protection along the printing machine
- No additive

Activation

When reaching temperature of 70°C at position of linear heat detection cable (+ 50% safety) respectively 90 sec after ignition
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Scenario 4

Paper fire to simulate an accumulation of paper within the printing machine

Fire Test Results

- Paper fire extinguished at 1 min 36 sec of system discharge
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Protection Concept

- Improvement of existing Aerosol local protection systems in the paint trays of the five remaining printing machines with a high pressure water mist system in three layers within the machines

- Deluge system with nozzle layout based on full scale fire test results (560 open nozzles)

- Subdivision of each retro-gravure printing machine into 4 water mist sections via 4 section valves, whereby only one section is discharging water mist with 5% AFFF additive (20 section valves)

- Integration of manual water mist fire fighting guns in wall cabinets for use by trained printing machine operation personnel (2 FOGGUN wall cabinets)

- Fire detection by linear heat detection throughout the printing machine
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System Layout within Printing Machine

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Protection Concept

- Small bore stainless steel pipework can ideally be retrofitted to the printing machines without extensive business interruptions.

- Jockey pump to prefill main pipe from pump unit to decentralized section valves.

- Safety concept foresees simultaneous activation of one complete retro-gravure printing machine and one water mist fire fighting gun.

- Centrally located independent water mist system pump unit with 8 x 120 l/min at 120 bar.

- AFFF injection unit at the high pressure pump unit.

- Water mist system supplied by fresh water from a 29 m³ tank assuring 30 minutes autonomy.

- AFFF storage tank for 60 minutes autonomy.
Conclusion

High pressure water mist has demonstrated excellent extinguishing abilities for printing machine environment

PRINOVIS and their insurance company are very satisfied with the achieved results, assuring best possible fire protection to their assets
Thank You for Your Attention