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FINE WATER SPRAY SYSTEMS FOR THE PROTECTION OF CHIP BOARD AND MDF PRESSES

New fine risks require modifications to existing fire protection designs.

Fire risks require special fire protection concepts that cover almost the entire spectrum of fire extinguishing engineering:

- Sprinkler systems are automatically triggered water-based fire extinguishing systems and are used mainly for volume protection in manufacturing areas. They also protect storage areas. If there are special risks, e.g. with the storage of flammable liquids, a film-forming foam compound is added to the sprinkler system.
- Water deluge systems are suitable for silos containing wood dust and chips as well as for special objects such as scraper chain conveyors.
- CO_2 extinguishing systems are generally used for the protection of paint spraying systems and similar risks. They also pro vide effective protection for storage areas containing flammable liquids.
- Spark extinguishing systems were first developed for the prevention of fires and explosions in pneumatic suction and conveyor systems. Such a system has spark detectors which identify sparks before they have left the conveyor duct, where they are then extinguished by an automatic extinguishing device.

These fire extinguishing systems have been in common use. However, new board pressing processes have led to new fire risks, so that existing fire protection designs need to be amended.

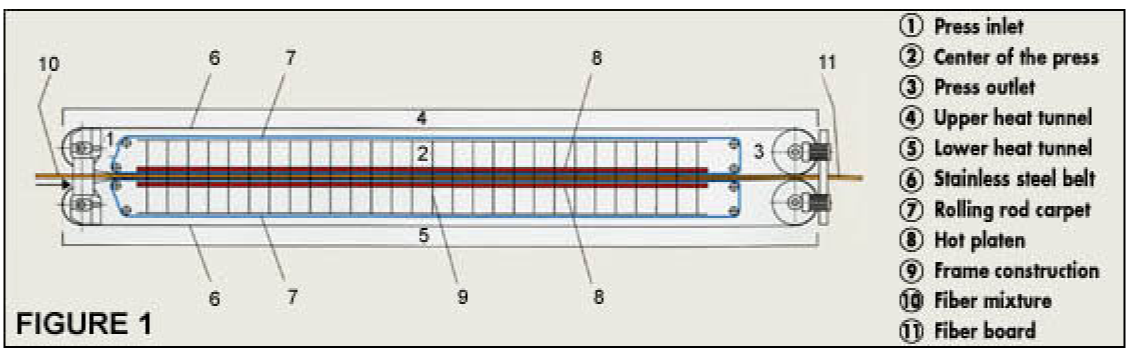
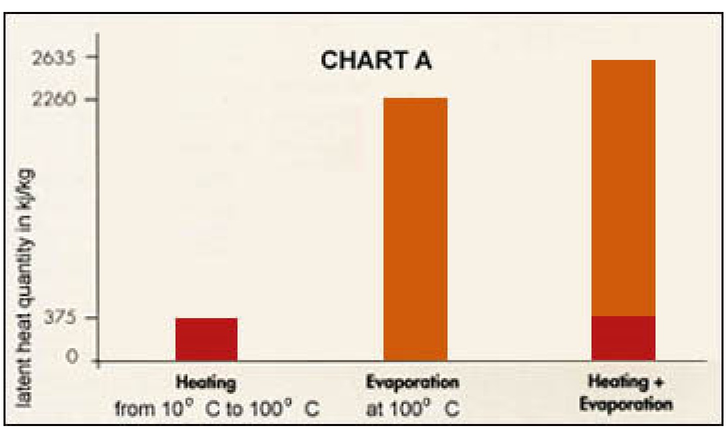


FIGURE 1



NEW FIRE RISKS

Using compressive force and heat, continuous presses (Figure 1) condense a mixture of fiber and glue into an endless board along a manufacturing line of up to 50 m (164 ft.), between two stainless steel belts running continuously. The hot platens, which run on thermal oil, reach temperatures of up to 250° C (482° F). In a typical continuous press system, two rolling rod carpets also running continuously transmit the compressive force and heat from the hot platens to the steel belts. The compressive force is absorbed by a frame construction at the center of the press. In the heat tunnels, the rolling rod carpets and the steel belts run from the press outlet back to the press inlet.

The combustible materials used for this pressing method (fibers, glues, paraffin, lubricating, thermal and hydraulic oils) pose a considerable fire risk wherever they collect on hot surfaces.

This concerns, in particular, the press inlet and outlet, as this is where the mixture of fiber and glue (and later, the board) is exposed. As soon as oxygen is added, a smoldering fire can turn into a major con flagration. At the press outlet a further big fire risk results from the lubricating oil fog, which collects in the upper heat tunnel.

Another dangerous area is the lower heat tunnel where the fiber-glue mixture adhering at the steel belt can collect. At the center of the press, the source of dang er mainly comes from fiber deposits, condensed lubricating oil fog and oil leaks.

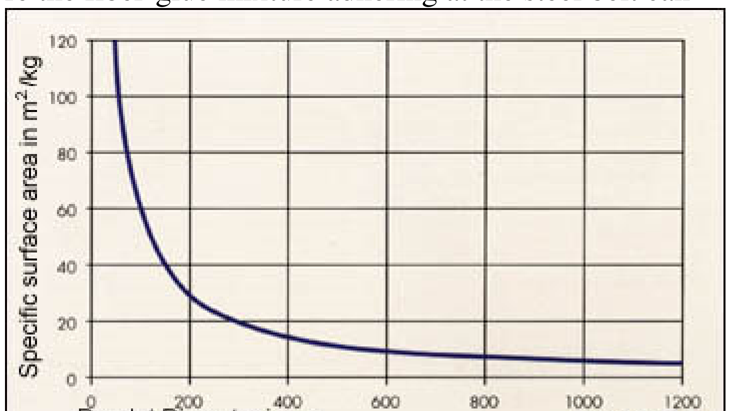


CHART B

Experience has shown that a fire tends to be transmitted from one area to another and to spread quickly along a manufacturing line.

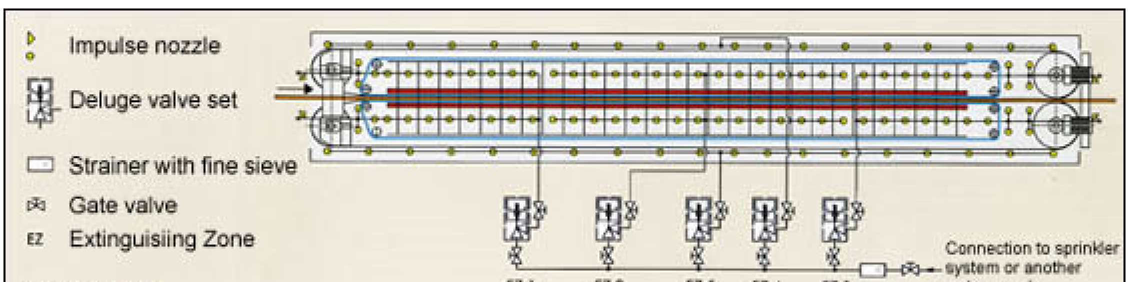


FIGURE 2

POSSIBLE SOLUTIONS

In view of these fire risks, press manufacturers, press operators, manufacturers of fire extinguishing systems and insurance companies have been discussing a variety of options.

In the past, machines with similar fire risks have been effectively protected by CO_2 extinguishing systems. Nevertheless, there is a tendency to prefer fine water spray systems on continuous presses a further development of conventional water based extinguishing systems for the following reasons:

- CO_2 systems can be used most effectively in enclosed rooms. However, the entire press is not usually encased. The only enclosed areas are the heat tunnels. The press inlet and outlet and the center of the press are large open areas which must be protected with well-directed local application nozzles, if using a CO_2 system. This means that large quantities of extinguishing agent need to be used and stored.

- If you use large quantities of CO_2, you need to take special care to protect human life. Before releasing the extinguishing agent, the area around the press has to be evacuated. With a fine water spray system, extinguishing can start as soon as a fire has been detected.
- Installation of a CO_2 system on a continuous press generally requires far more investment than a fine water spray system. This is because the latter can be connected to the water supply of a sprinkler system, which is usually there already. A CO_2 system, by contrast, tends to require a supply of extinguishing agent (e.g. CO_2 low pressure vessel) of its own. After all, even if a CO_2 system is already in use for other areas of the plant, the available amount of extinguishing agent is usually inadequate for the protection of the press.

Nevertheless, because of its excellent effectiveness, a CO_2 system continues to be an attractive option for the protection of chip board and MDF presses.

When it comes to protecting continuous presses, fine water spray systems are pre ferable to conventional water-based systems for the following reasons:

- The extinguishing qualities of water can be improved by reducing the size of the droplets. As a result, the required water volume can be minimized.
- The use of relatively small finely sprayed quantities of water minimizes the danger of thermal warping in hot parts of the machinery.

However, the reduction of the droplet size also poses application limits on a fine water spray system. To achieve a reliable extinguishing effect, you therefore need to take account not only of the fire risks but also of the basic physical principles of such technology when planning a project.

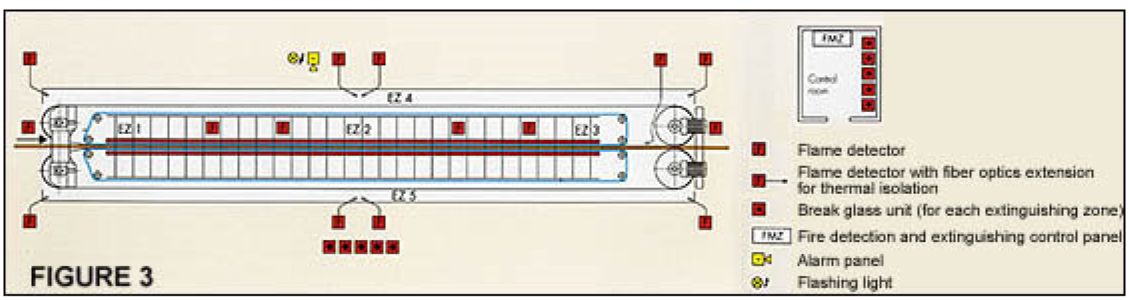


FIGURE 3

FINE WATER SPRAY

As with all other water-based systems, the extinguishing effectiveness of fine water spray systems is largely based on the high heat capacity and evaporation heat of water (Chart A). The cooling effect disturbs the thermal reaction conditions in the fire source, thus reducing the reaction speed.

The more finely a given amount of water is sprayed, the larger its specific surface (surface-mass ratio, Chart B) and thus also the contact area for the transmission of heat. Small droplets heat up and evaporate more quickly than big ones. Fine water spray systems therefore have a better cooling performance and allow more effective use of the extinguishing water than traditional water-based fire extinguishing systems.

As well as a cooling effect, fine water spray systems can also have a suffocating effect. After complete evaporation, the volume of the water has increased 1,600 times, which may reduce the concentration of oxygen. Suffocation is most effective when a large amount of vapor is produced quickly. This happens if the fire releases a large amount of heat and if a sufficient amount of water, sprayed into the fire source, is atomized as finely as possible.

In practice, the combination of suffocation and cooling generally leads to fast control over the fire. As the fire diminishes, extinguishing is then mainly a matter of cooling. Seen against this background, it makes no sense to compare a fine water spray system with the suffocating effect of an inert gas system, such as a CO_2 system. With inert gas volume protection, the input point of the extinguishing agent is almost totally independent of the location of the fire. With a fine water spray system, on the other hand, the extinguishing nozzles need to be arranged in such a way that they evenly cover the entire protection area, even if atomization of the water is extreme. At the same time it's necessary to circumvent large obstructions to the spraying and to avoid inaccessible areas.

As said before, the effectiveness of cooling and suffocation increases as the droplets delivered into the fire source get smaller. However, the size of the droplets cannot be reduced indefinitely. This is because small droplets:

- have a larger specific surface and therefore more air resistance than large ones, which makes them much slower.
- have less kinetic energy due to their smaller mass.

The smaller the size of the droplets, the smaller the discharge range of the nozzles and the internal resistance of the droplets in relation to the hot air currents of the fire. To enter the finely sprayed water into the fire source, the extinguishing nozzles need to be installed closer to it. However, the spatial conditions often do not allow this, so that fine water spray systems are not a standard solution. Nevertheless, if a specific protection design is used which is specially tailored to suit a given application, such a system can provide reliable fire protection in a large number of areas, while at the same time requiring a fairly small amount of water.

PROTECTION DESIGN

The Germany company Minimax (represented as Flamex in North America) has designed a special protection concept for chip board and MDF presses. It is based on Minifog, a fine water spray system that has been developed, among other things, for the protection of machinery.

Minifog is a modified version of a conventional water deluge system and works on the proven and reliable basis of low pressure technology. The machinery is protected by open impulse nozzles, whose full cone spray pattern produces an even discharge density for the objects it protects. With an operating pressure of 4 to 8 bar and K factors between 3 and 9, a water mist is sprayed through the helical opening of each nozzle, with an average droplet diameter of approximately 0.15 mm. This size warrants excellent effectiveness for the extinguishing effect of the water. At the same time, the combination of the droplet size and the special design of the nozzles allows a maximum distance between the nozzles and the fire source, so that intelligent solutions are generally possible for spatial conditions found at local applications.

Impulse nozzles provide a further benefit: Their uncommonly large cross-sections are very unlikely to become clogged, so that their very use warrants a high degree of operational safety.

Additional operational safety is achieved through the following measures in compliance with the VdS (German Damage Insurers' Assn.) guidelines for fine spray nozzles and the transitional arrangements for the VdS guidelines for water deluge systems:

- Each nozzle has a fine sieve.

- A protective cap is fitted onto each nozzle if there is any danger of dirt getting in from outside.
- A strainer is installed at the water supply inlet.
- Only galvanized steel pipes or higher quality pipes are used.

When planning a fire protection design for continuous chip board and MDF presses, each section of the press needs to be taken into account:

- Press outlet
- Press inlet
- Upper heat tunnel
- Lower heat tunnel
- Center of the press

Although the fire risk differs from one section to another, it's important that the entire press should be protected. This is because a fire in the press outlet, for instance, could easily spread to the center.

The impulse nozzles of the Minifog system are arranged in such a way that the entire protection area is covered with water mist (Figure 2). The full cone spray pattern of the nozzles ensures that the water mist can also enter the inside of the press and can fight the fire there.

To circumvent any obstruction to the spraying, the arrangement of the nozzles needs to be adjusted to suit the geometry of the object as accurately as possible. This applies particularly to the press inlet and outlet, where every nozzle needs to be directed individually. To achieve an even distribution of the water mist in the heat tunnels, the impulse nozzles in these sections must, if possible, be installed at the level of the stainless steel belts. At the center of the press the impulse nozzles are usually arranged on two levels. Here the geometry of the frame construction is particularly relevant.

Large areas of protection are usually sub divided into several extinguishing zones, each with deluge valve sets so that the water can be directed as specifically as possible. With continuous presses the subdivision of the extinguishing zones corresponds to the division of the press into sections. To protect the entire press, you therefore require five extinguishing zones.

The Minifog system is usually released automatically via flame detectors, so that fast fire fighting is guaranteed. If the ambient temperature is particularly high, e.g. in the heat tunnels or in covered areas around the press outlet, special flame detectors are used. These detectors are thermally isolated from the hot area via flexible, heat-resistant fiber optics. The latter have proven their worth for many years in the thermal isolation of spark detectors in Minimax spark extinguishing systems.

The flame detectors are arranged in such a way that each extinguishing zone is entirely monitored (Figure 3). The Minifog fine water spray system can also be released manually. Usually a break glass unit is installed for each extinguishing zone, both in the immediate vicinity of the press and in the control room, which is almost continuously manned.

In case of fire, the fire detection and ex tinguishing control panel picks up the detector signals and controls the release solenoid valve of the deluge valve set that matches the extinguishing zone affected by the fire. The extinguishing water, which is available at the deluge valve set, is now released and flows into the pipework to the open nozzles. At the same time both visual and acoustic alarms are triggered, and an electrical alarm is sent to the fire station, the control room or some other place that is continuously manned.

SUCCESSFUL USE

The Minifog system was developed on the basis of numerous test series at the Minimax Fire Protection Research Center, including tests which involved flammable liquid fires at a turbine mock-up.

The suitability of Minifog for the protection of machinery was also proven in realistic fire tests on a press section model. For these tests the lower press inlet of an MDF press was imitated. One of the test fires chosen was a 3.5 m2 (38 sq. ft.) diesel pool fire which was partially covered by pipes, sheets of metal and other components, so that the obstructions to the spraying were realistic.

The Minifog system used for this purpose included 10 impulse nozzles, arranged horizontally on two levels.

Two tests were conducted with this setup:

Test 1: no additives in the extinguishing water

Test 2: a film-forming foam compound in the extinguishing water (3% AFFF)

The pre-burning time was approximately 30 seconds in both tests. In the first test the fire was controlled within five seconds. All that was left was a small residual fire in the area of the obstructions, extinguished 30 seconds later.

In the second test the film formed on the diesel pool by the foam compound led to a noticeable reduction of the extinguishing time to approximately eight seconds. There was no residual fire in this test, so that just a small amount of water was needed.

Both tests confirmed the suitability of the Minifog system for the protection of continuous presses. They also showed that if there is a pool or surface fire with obstructions to the spraying, the effectiveness of such a system can be increased by adding a film-forming foam compound.

The results of the tests were taken into account when designing a fire-fighting concept for chip board and MDF presses. Whether the admixture of a film-forming foam compound is appropriate needs to be decided from case to case, as it depends on the geometry of a given object.

Since then, the Minifog system has proven its worth not only in tests but also in practice, with a number of fires that occurred on continuous presses. The Minifog fine water spray system has been installed at approximately 20 board plants in Europe, with several systems expected to start up during the first half of this year.

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The paper, "Fine Water Spray Systems for the Protection of Chip Board and MDF Presses," was read by Tim Strieder at the VdS conference: Fire Protection for the Woodworking Industry. Contact Flamex Inc., 4365 Federal Drive, Greensboro, NC 27410/336-299-2933; fax: 336-299-2944; web site: www.flamexinc.com