Fire safety in the recycling of end-of-life tyres

Approximately 2.5 billion tyres are produced globally each year. It is estimated that only 40 to 50 per cent of discarded tyres are recycled. In many countries, a well-organised system for collecting and processing this waste stream is lacking. As a result, old tyres are illegally dumped, stored in the open air, or burned to recover metal. This releases harmful substances that pollute air, soil, and water.

The growing volume of tyre waste calls for new, industrial solutions for circular processing. The Circtec plant in Delfzijl is a concrete example of this. At the same time, processing this waste stream on an industrial scale also brings new safety challenges.

Precisely because Circtec works on a large scale with flammable substances, high temperatures, and complex installations, fire safety is central to the factory's design. This article describes how Circtec has developed its fire safety policies and how Kenbri has translated this into effective detection and suppression provisions.

Stockpile of end-of-life tyres, highlighting the growing challenge of tyre waste.

Old tyres, new raw materials: Circtec's circular approach

Circtec focuses on the circular processing of discarded car tyres into new raw materials. The plant in Delfzijl was officially opened in January 2026 in the presence of His Majesty the King, underscoring the importance of circular chemistry and innovative waste processing. The core of the process is pyrolysis: a technique in which rubber is heated at high temperatures without oxygen, causing the material to break down into various components.

In this process, old tyres are converted into recovered carbon black, pyrolysis oil (from which, among other things, naphtha can be extracted), steel, and process gases. Part of these gases are used to heat the process itself, making the system largely self-sufficient. The remaining products can be used as raw materials for new rubber products, chemicals, and fuels.

What makes Circtec special is the scale at which this occurs. The plant in Delfzijl is designed to process approximately ▸

Fire hydrant in front of the Circtec facility, part of the site's integrated fire protection system.

'The fire suppression installations at Circtec demonstrate how safety is an integral part of the circular industry: the systems are not only designed to combat incidents, but above all to prevent escalation at an early stage'

Circtec's industrial facility in Delfzijl, where end-of-life tyres are transformed into valuable raw materials.
Photo courtesy of Rob Jastrzebski

180,000 tonnes of discarded tyres per year. This represents an estimated 6% of the total volume of available tyres in Europe. As the capacity exceeds the volume of available tyres in the Netherlands, tyres are imported from across Europe and shipped in over water.

The plant thereby contributes to a CO_2 reduction of nearly 230,000 tonnes per year and to closing raw material cycles in the chemical industry.

Circtec thus demonstrates how a complex waste stream can be transformed into valuable raw materials, making it an important example of circular chemistry on an industrial scale.

The risk profile of Circtec

The scale and complexity of the Circtec plant also entails an elevated risk profile. The plant has therefore been designated as a SEVESO (or COMAH) upper-tier establishment. This means that hazardous substances are present within the plant in such quantities that an incident could have major consequences for people, the environment, and the surrounding area. As a result, strict requirements apply with regard to safety and risk management and emergency response.

SEVESO establishments are often required to have an industrial fire brigade. At Circtec, this requirement has been waived, because the fire scenarios – through the deployment of modern detection and suppression systems – are sufficiently controllable that incidents can be brought and kept under control at an early stage.

The risks within the plant can be broadly divided into process, storage, and escalation risks. Process risk arises primarily from the pyrolysis process itself. Tyres are heated at temperatures of approximately 400 degrees Celsius in an oxygen-poor environment. The reactor in which this takes place is therefore a critical component within the installation.

Storage risks also play an important role. Within the plant, tyre chips, pyrolysis oil, and recovered carbon black are stored and transported. These materials are flammable and, if stored improperly, can lead to leakage, fire, or explosion hazards.

Finally, there are environmental and escalation risks. The combination of process installations, storage facilities, and transport movements creates an environment in which various risk sources are simultaneously present and can reinforce each other. ATEX zones are also present in various parts of the plant, where flammable substances can lead to explosion hazards when exposed to an ignition source such as a spark. This combination of factors makes effective fire protection essential.

Fire protection: Policy by Circtec, Vision by Kenbri

Circtec's fire safety policy is based on the following principles:

- The likelihood of fire-starting must be minimised through an inherently safe process.
- If a fire nonetheless threatens, detection systems must identify it extremely quickly.
- If a fire does occur, small containment systems must be able to keep it contained.
- If there is a fire, it must be controlled and fought by technical suppression systems on site.
- Suppression systems must be able to operate automatically, without human intervention (other than verification upon detection).
- The structural layout of the plant is such that no more than one process unit can ever be damaged by fire.

Kenbri has based the fire safety, fire water systems, and foam requirements for the site on these principles. Systems operate according to a fixed chain of detection, assessment, and activation. The operation is set out in a basis of design (BOD). This describes the requirements and principles for fire protection based on international

standards such as NFPA, Dutch guidelines like PGS and European directives, including Directive 2012/18/EU. These standards determine, among other things, the performance the system must deliver to effectively combat an incident.

Field signals first arrive at the fire alarm control panel and will be managed in the control room. Various detection methods are applied on site, including infrared flame detection (IR3), smoke detection, linear detection, gas detection and manual call points. This combination of detection techniques makes it possible to detect various types of hazard scenarios in a timely manner and forms the basis for further assessment and follow-up of alarms.

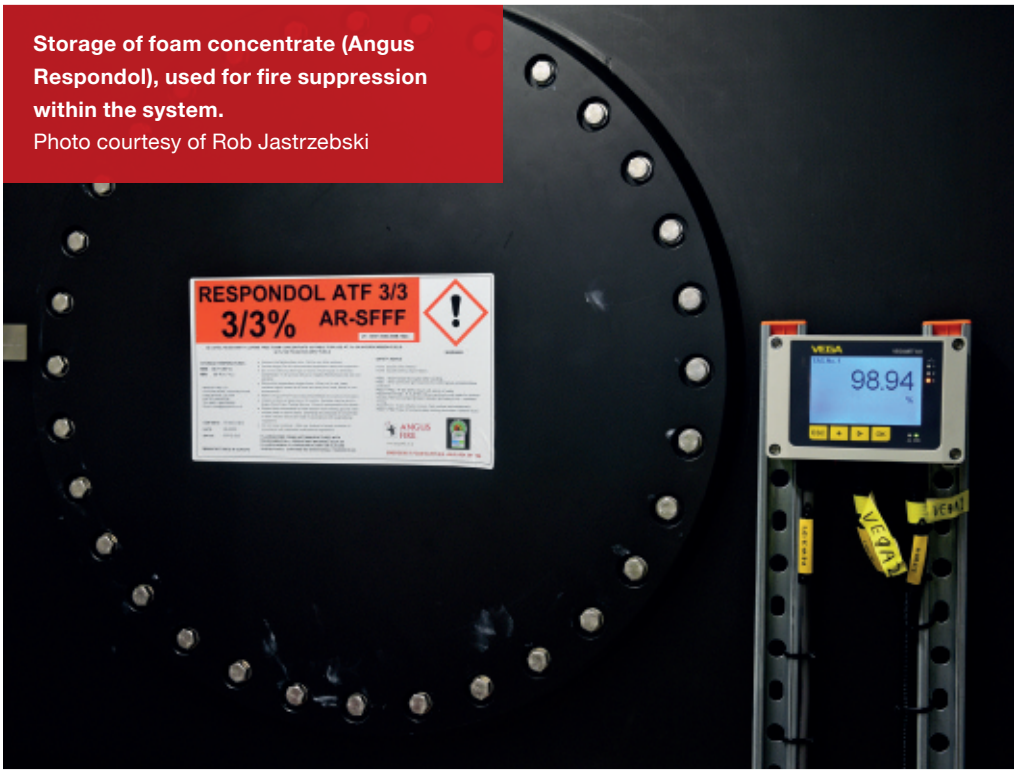
Two detector dependency for stability

To prevent unwanted activation, Circtec has not opted for a single uniform strategy, but for a combination of automatic and manual activation. In parts of the system, two-detector dependency is used, where activation only occurs when two independent detectors signal a fire. This reduces the likelihood of unwanted alarms and unintended activation. In other cases, a verification step is applied first: field signals are forwarded via the fire alarm panel to the control room, where they are assessed based on camera images or a physical check on site. Once an incident has been confirmed, the relevant suppression system is activated manually.

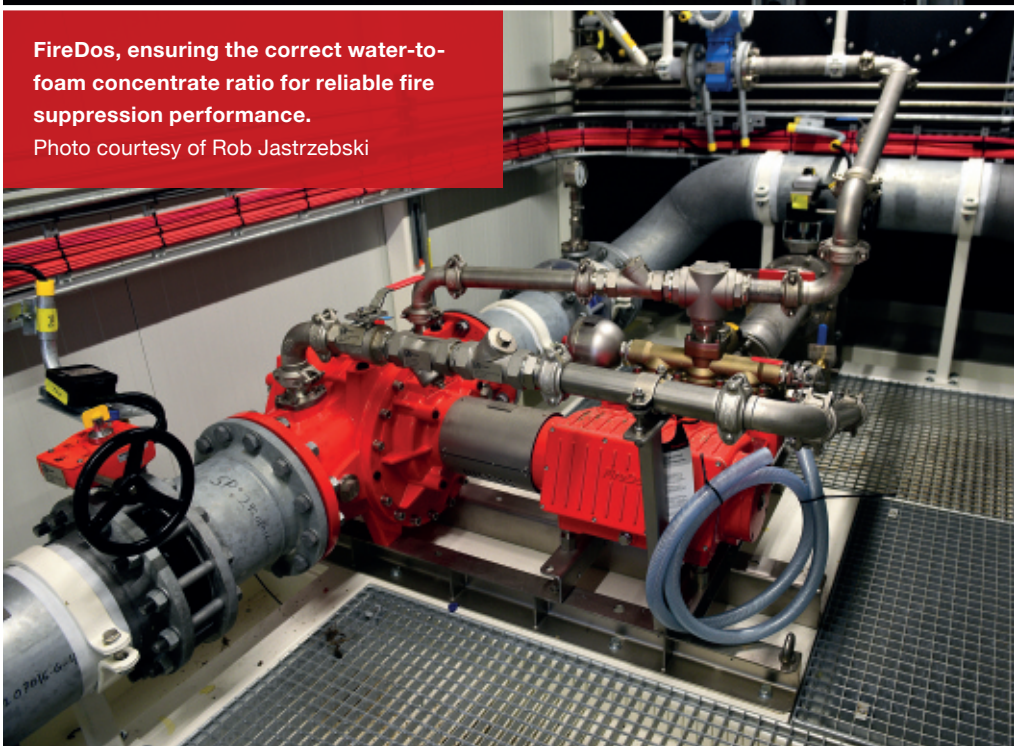
The foundation of the suppression system is formed by the water supply tank and pump room, which act as the beating heart of the installation. From the water tank, the pump room pumps water under pressure into the fire water network. The fire water pumps are redundantly configured, so that if one pump fails, an automatic switchover to a second pump occurs. In addition, the pumps have a redundant power supply, enabling a switchover to an alternative power source if the primary supply fails. Emergency power is also provided for the control and alarm systems, ensuring they remain operational for a limited period in the event of a power failure.

From the fire water network, water is led to the valve station where foam is blended in. The volume of water and foam required is calculated based on the size of the area to be protected and the required application rate. For the substances naphtha and crude oil present, an application rate of four litres per minute per m² applies. These minimum values ▸

Fire suppression lines installed in a bund area, ready to deliver foam in case of fire.
Photo courtesy of Rob Jastrzebski



Storage of foam concentrate (Angus Respondol), used for fire suppression within the system.
Photo courtesy of Rob Jastrzebski



FireDos, ensuring the correct water-to-foam concentrate ratio for reliable fire suppression performance.
Photo courtesy of Rob Jastrzebski

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are set out in the standards and are used as the basis for the design. In practice, an additional safety margin is applied to increase reliability. The foam suppression systems protect, among other things, the pump sump, tank bund, and mix tanks, where flammable substances are present. For electrical rooms, an aerosol gas suppression system has been chosen, which interrupts the combustion reaction without posing a suffocation hazard to those present.

Foam: Dependable, certified and no PFAS

The foam-forming agent used is Angus Respondol ATF 3/3, a synthetic fluorine-free concentrate (F3) with certifications according to EN 1568 (parts 3 & 4), UL 162, LASTFIRE, and GreenScreen. Independent selection tests by the Joint Industrial Fire Service Rotterdam showed this agent to perform best in terms of fire suppression quality.

The agent is stored in a tank of approximately 10 m³, in a conditioned room. During dispensing, dry air is drawn into the tank to prevent condensation, as moisture negatively affects the agent's performance.

The foam system is variably adjustable for flow and pressure and can be tested without the addition of foam-forming agent. Sensors for temperature, volume, pressure, and flow continuously monitor system status and report deviations immediately, ensuring the system is always ready for deployment. The choice of the best available fluorine-free agent ensures that suppression performance and environmental friendliness go hand in hand.

To ensure the system actually operates as designed, it is inspected in accordance with the Dutch CCV inspection and certification schedule. An independent party verifies whether the installation meets the specified requirements. During these inspections, detection, water flow in relation to the minimum required and expected pressures, and foam blending are tested in practice.

Fire safety that grows with the plant

The realisation of the fire suppression installations also brought practical challenges. Design, procurement, and construction had to be completed in a short time, while parts of the plant were not yet ready. This required close coordination between various parties and flexibility in project execution.

During realisation, work was carried out while the factory design was not yet fully developed, with various disciplines operating in parallel and influencing each other. This introduced additional risks, as design changes in one discipline could have direct consequences for other parts of the project, and vice versa. To keep this complexity manageable, extensive focus was placed on detailed engineering and intensive coordination between disciplines. In addition, critical components such as the pump room and valve station were prefabricated to ensure quality and limit on-site lead times, allowing flexible handling of design changes.

Furthermore, future expansion was already taken into account in the design of the fire protection systems. The pump room, water supply tank, and valve station are configured so that additional installations can be connected in a subsequent phase. This allows the fire protection to grow alongside the further development of the plant.

Fire safety as an integral concept

The fire suppression installations at Circtec demonstrate how safety is an integral part of the circular industry: the systems are not only designed to combat incidents, but above all to prevent escalation at an early stage.

According to Joost van Hagen (technical manager projects & engineering at Kenbri Fire Fighting), the future of fire protection in the chemical industry is focused on stationary systems that prevent and control fires at an early stage, so that emergency services arrive in a safer scenario.

At the same time, human decision-making remains an essential element, as a balance between automation and human action.

Circtec and Kenbri thereby demonstrate that circular industry and professional fire safety go hand in hand, with prevention, control, and the protection of people and the environment at the centre.

For more information, go to www.kappetijn.eu

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