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# Fire Extinguishing Concepts for Recycling Plants

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**This fire extinguishing concept analyses problems that may occur with fires in recycling plants and shows improved procedures for safe and economical automatic fire fighting.**

## 1 Fire Extinguishing Concepts for Recycling Plants

### 1.1 Problem Outline

In view of growing piles of waste and the related problems of disposal, the importance of recycling companies in the economy is increasing. Objective-oriented waste treatment and recycling of raw materials make an important contribution to the protection of earth's resources. Solid fractions used for interim storage, e.g. paper, cardboard, or plastics, may have calorific values of over 14 MJ/Kg with corresponding fire load and thus bear a major risk potential for human beings as well as for buildings. After evaluating the type, amount and configuration of combustibles, those agents and methods should be chosen that have the most effect on the scope of the specific fire potential. We know from a study by the Düsseldorf Institut für Abfallwirtschaft [Institute for Waste Management] that even spontaneous ignition of recycling products is possible under certain storage circumstances.

### 1.2 Fire Risk

Fires may spread at a high speed and are thus a major risk for staff working nearby and for material assets. Firefighters often do not have much time to bring a spreading fire under control. As we find in the media, fires in recycling plants often result in a total loss. In a number of cases, people have been injured or lives lost. On top of that, combustion products (dioxines, furans) pose an extreme threat to the environment. In order to use storage facilities and sorting equipment for a longer period of time, improved fire detecting and extinguishing systems for key areas are needed. In extreme cases, firefighters either cannot, or can hardly reach the source of fire. The fire detecting and extinguishing system must be able to determine the fire early, extinguish it in the respective dump, bunker, container or shredder and stop it from spreading. The

required method hence must both insulate and cool the building, equipment or stored material on fire, and extinguish the fire.

## 2 Choice of Extinction Method

### 2.1 Possible Extinction Methods

For the extinction of fires in recycling plants, conventional methods like low expansion foam or deluge systems with a 1% foaming agent have been used so far. Medium expansion foam is another means that has been used for combating fires in recycling or incineration plants – sometimes with more success, sometimes with less success.

### 2.2 Assessment of Fire Extinction Methods

Choosing a fire extinction system based on safety, economics, and loss prevention (secondary damage) requires an evaluation of all possible automatic fire extinction methods. Regulations and guidelines as well as experiments and insights were used for this evaluation.

Characteristics/type	Low expansion foam	Deluge System 1%	Medium expansion foam	ONE-SEVEN
Fire classification	A-B	A-B	A-B	A-B-C
Water demand	60%	100%	30%	15%
Cooling effect	40%	80%	10%	100%
Suppression effect	80%	10% (steam)	60%	100%
Wetting ability	good	good	low	very good
Floor load	very high	very high	very high	low
Foaming agent	5%	1%	3%	0.5%

### 2.3 Choice of Method

Since the fire extinction methods described above are either not efficient or too costly, we would like to introduce a system that masters fire risk and is economically sensible. This system is the ONE-SEVEN Compressed Air Foam System.

It can be described as follows:

### 3. ONE-SEVEN Compressed Air Foam Extinction System

This compressed air foam extinction system has been used in fire fighting for decades. Now it is a state-of-the-art procedure which is regulated by German standard DIN 14430. For insurance reasons the system is currently being checked at the testing and certification institution VdS in Cologne. A timely authorisation is likely, as the procedure is in the last stage at FM Global (potential authorisation by the first quarter of 2009). With the help of this system, the foam produced (with a consistent bubble diameter of 0.5 mm) can be transported over long pipe distances (1,000 m length, 400 m height) and dispersed through the applicable nozzles (throwing range up to 30 meters). Because of its quenching effect, which is many times higher than conventional water-based fire extinction methods, its extremely moderate water consumption and minimum secondary damage, this method is a convenient solution for high fire loads. A comparison of extinction by water and the ONE-SEVEN system at the research centre in Karlsruhe resulted in the following data for the same fire situation:

#### ONE SEVEN® test at Forschungsstelle für Brandschutztechnik in Karlsruhe

##### Test with DIN-C pipe at 100 l/min

	Water	Compressed air foam
Cooling capacity	0.83°/sec	10.3°/sec
Water consumption for extinction	800 litres	175 litres
Water consumption for ultimate extinction	600 litres	235 litres
Foaming agent consumption	0	1.24 litres
Water residue	Large amounts of residue	no non-vaporized water 200 litres vaporized 200 litres in burnt materials

Fire extinction with ONE SEVEN enabled a cooling capacity 12 times higher than extinction by water alone. The compact foam mainly stays on the fire source and can be removed with a wet vacuum cleaner. At the fire source, about 50% of the water used is vaporized and 50% remains in the burnt materials, reducing water damage to a minimum. Extinction is achieved by a foam layer that suppresses the fire and strongly cools its source. In this respect, the high cooling capacity of compressed air foam is crucial. Another advantage is fast suppression or insulation of toxic gases and smoke particles. The alcohol resistant foaming agent ONE-SEVEN Class B-AR is classified as water danger class 1.

Stationary ONE-SEVEN compressed air foam extinction units offer a number of important and in some cases decisive advantages for the use and application of this system for automatic and semi-automatic fire fighting:

- By using a special “class B” foaming agent that requires only a 0.6% additive to the water, it is possible to produce a compressed air foam that effectively combats fires of plastics and other recycling materials.
- The consistency of this compressed air foam can be varied from wet and fluid to dry and sticky by using different pressures of compressed air for the water/foaming agent mixture. Because of fire extinction, side effects (cooling, separating, suppressing and wetting effect) and flow properties of the compressed air foam, up to 80% of the extinguishing agent come into effect (compared to 25-30% for sprinkler/water spray systems).
- In this way, fires can be extinguished a lot quicker and with less extinguishing agent compared to other extinguishing methods or agents – some of which might not even be suitable for automatic fire fighting of recycling materials at all. Because of its penetrating and strong cooling capacity, the vast majority of hot spots can be reached and extinguished.
- In contrast to conventional foam extinguishing methods, the foam created by the ONE SEVEN compressed air foam system is produced by a central foaming unit (foam generator or foaming module) which is located outside the danger area and thus is independent of ambient air. This is an advantage for plastics on fire since flue and conflagration gas that develop in large amounts and spread quickly in this type of fire cannot influence or damage foam production.
- Further spreading of the fire is prevented through early detection and very fast fire suppression and extinction.

- The foam can be transported via pipes to special rotors which sufficiently impinge on the burnt material. With one unit and special rotors, areas of 100 to 200 square meters can easily be impinged with foam. This drastically reduces necessary pipe installations compared to water extinction systems with full coverage.



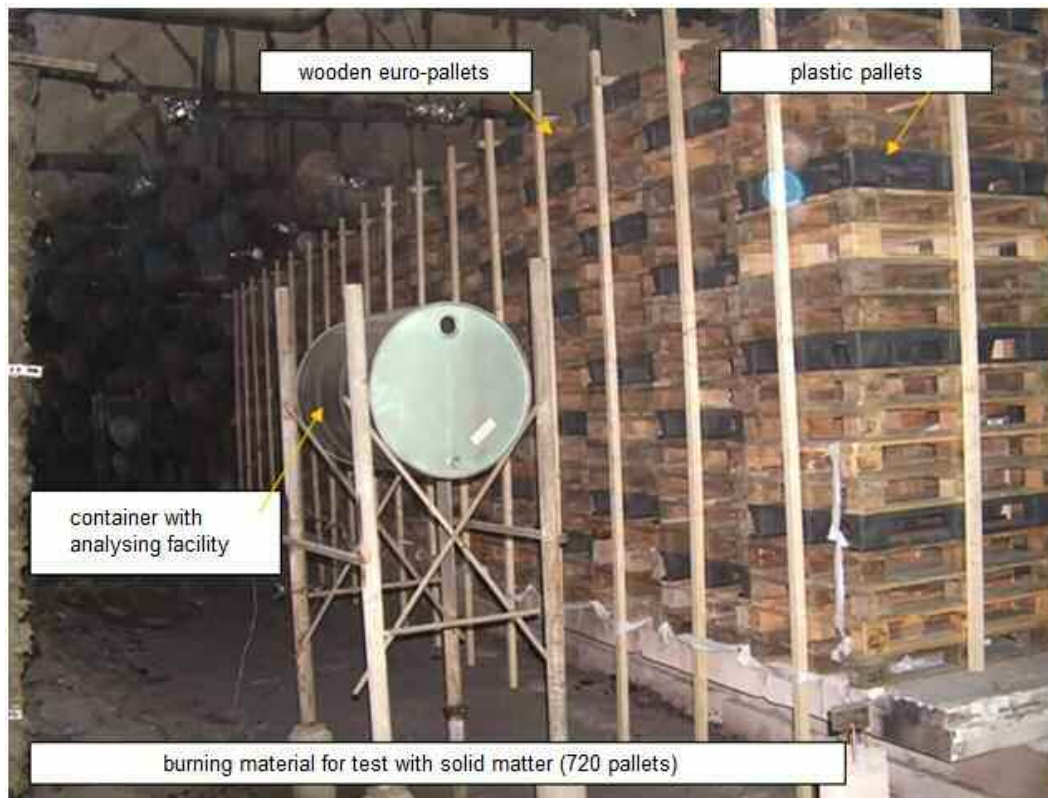
**Figure 4: Compressed air foam ONE SEVEN (wet):**  
*Water 14.22%; Foam concentrate 0.07%; Compressed air 85.71%;  
 Compressed air foam 100%*

### 3.1 Extinguishing Capacity

In 2005, the producer of this system in cooperation with E sting and Research Institute carried out comprehensive tests on major fires in the Runehamar tunnel of Norway. These tests were monitored and documented by three internationally reputable test institutes:

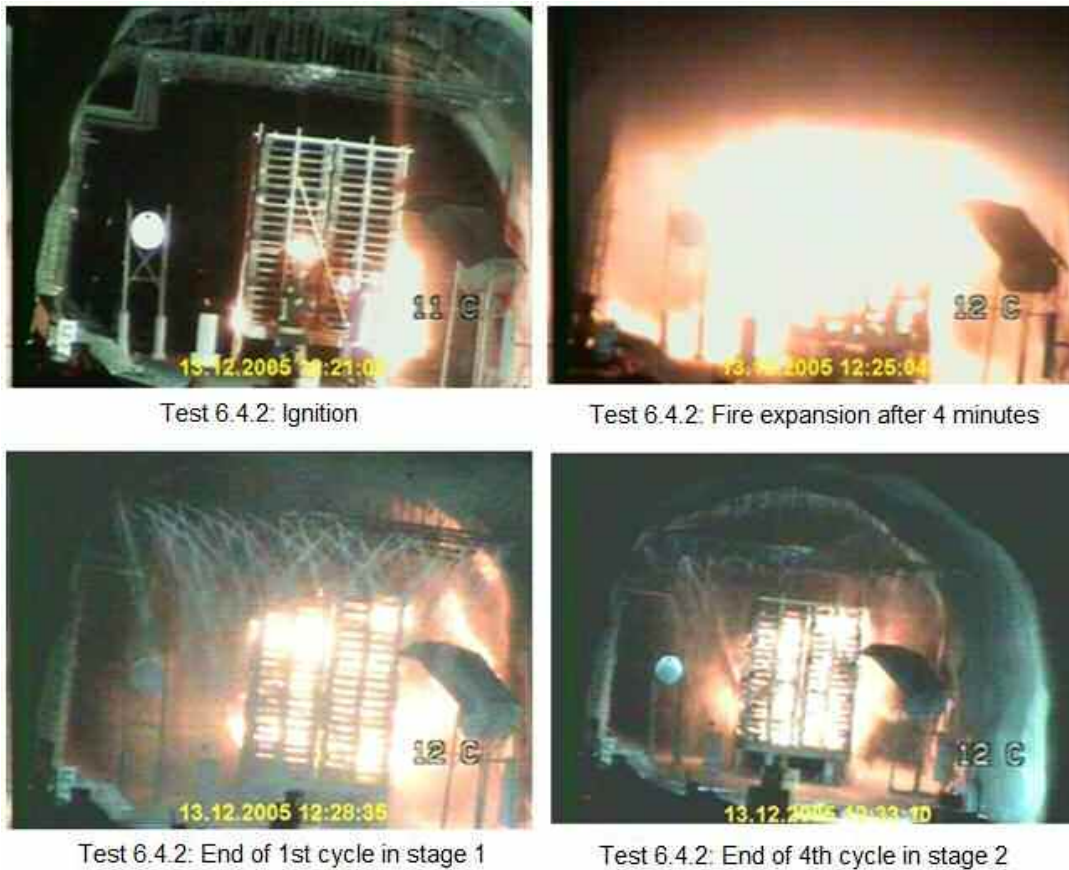
1. TNO from the Netherlands
2. NBL Sintef from Norway
3. NRC from Canada

The goal of these tests was to prove the performance of ONE SEVEN fire extinguishing systems for the extinction of different kinds of blazing fires.



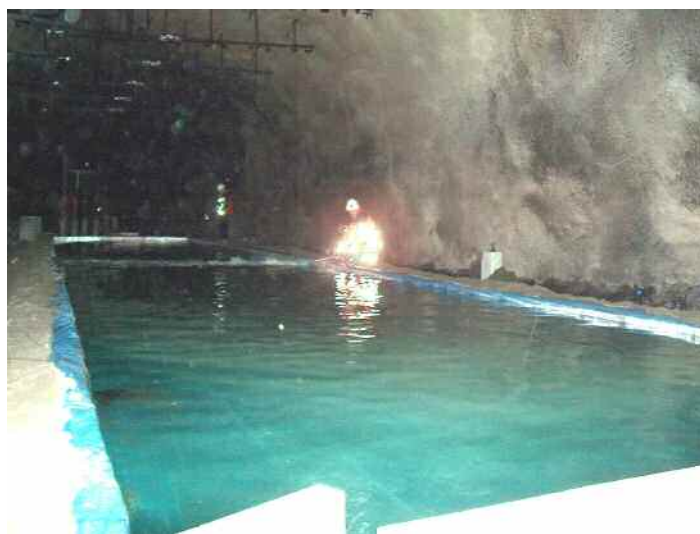
**Figure 6: Test 1 (solid matter)**

A fire on a fully loaded truck was simulated. For this test, 720 euro-pallets (80% wood, 20% polypropylene) were piled up to 14.4 m length, 3 m height and 2.4 m width.



**Figure 7: Test series – solid matter**

The One Seven system was able to control this extreme scenario. Despite heat production above 160 MW and temperatures over 1,000°C (1,832°F) the fire was brought under control within less than 7 minutes. It was fully extinguished after less than 22 minutes.



**Figure 8: Test 2 (liquids)**

For the second test, a 25 m x 4 m tank was filled with 5,000 litres of diesel fuel. Immediately after ignition, temperatures rose dramatically and smoke emission was extreme. Test results show that this blazing fire, with a heat production of 140 MW and temperatures of up to 1,200°C (2,192°F), was extinguished within 2 minutes.

### 3.2 System Suitability and Use

Because of its extraordinary extinguishing properties for recycling facilities, recycling company Lober in Bavaria has equipped each of their halls and storage areas with ONE SEVEN compressed air foam system.



ONE SEVEN Extinction system for automatic fire fighting in a storage hall for recycling products

Additional real-world results can be found in Oranienburg, where 13 tyre yards which were set on fire by arson were extinguished by a One-Seven unit within 6 hours after burning for one and a half days. One-Seven units have since been installed in secondary material storage areas in the Bremen and Bitterfeld power plants.



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