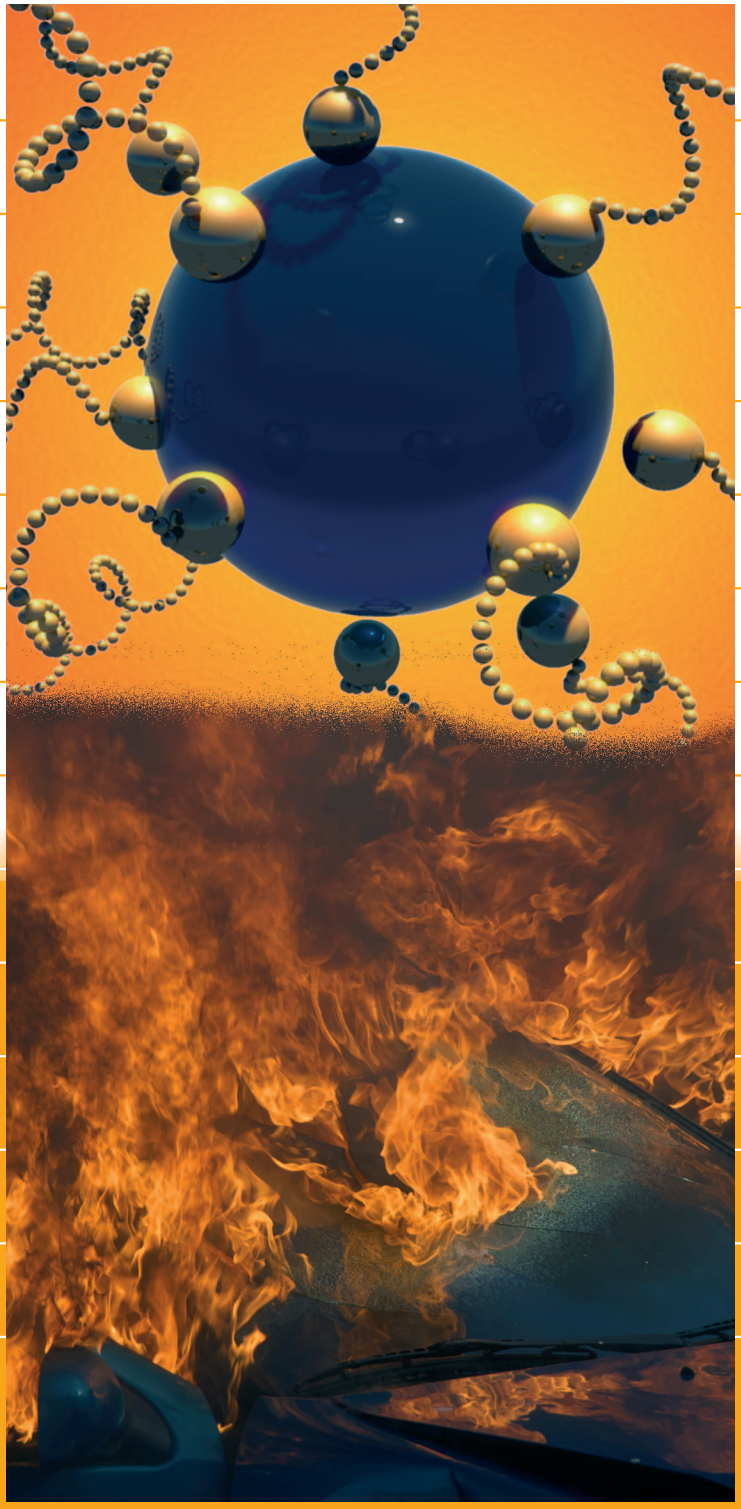
FireAde 2000®

FireAde 2000 Hydrocarbon suspension technology

The new technology for fighting fires

- Non-toxic
- Non-corrosive
- Frost resistant down to –32° C
- Biodegradable
- Extreme heat dissipating capabilities
- Fire class A/B
- Fire class D/F
- Stable foam, free of fluorine
- Eliminates flammable liquids
- Heavy consistency foam with hollow spray head
- Much less consumption of water and extinguishing agent
- Submission of the free radicals
- Less smoke, improved visibility
- Increased safety for fire fighters



OVERVIEW

FireAde 2000 is based on high-tech chemistry with properties that are uniquely suitable for fighting and preventing fires. FireAde 2000 was developed by US scientists and patented as a superior alternative to conventional, foam-based extinguishing agents. FireAde 2000 is a development by one of the pioneers in the field of fire fighting, Mr Ron Thames, who previously became famous during the fires of Kuwaiti and the Gulf fires.

Among other applications, FireAde 2000 is being used by American aircraft carriers and refineries in the Near and Middle East and has now also been approved in Europe. It provides a new technology that offers increased safety for the fire-fighting crews, while at the same time permanently extinguishing the fire at various levels with a previously unknown degree of efficiency.

In the fire classes A, B and F, FireAde 2000 can also be used in sections of fire class D (alkaline earth metals) and does not have the disadvantages of conventional foam extinguishing agents, which also include poisonous fluorine compounds.

FireAde 2000 is biodegradable, non-corrosive and facilitates the immediate dissipation of heat from the burning material by combining a number of different operating mechanisms with previously unknown efficiency. The new technology for separating the hydrocarbon molecules on a molecular basis neutralises flammable liquids; even explosive liquids are extinguished immediately after wetting which in turn largely prevents the reignition effect. An additional, stable foam film that floats on a membrane also reliably separates the oxygen from the burning material and the flammable vapours.

The new extinguishing agent in fire fighting – a profile of the pioneer Ron Thames and his company, Fire Services Plus

Fire Services Plus: *"Here at Fire Service Plus we are committed to saving human lives and protecting our environment by developing and producing an environmentally compatible extinguishing agent.*

Fire Services Plus is one of the world's fastest growing producers of fire-extinguishing agents and has 30 years of experience in research and development that has made a success of an innovative and environmentally compatible technology. Our FireAde 2000 products set new standards. We do not fight fires - we extinguish them.

The registered address of Fire Service Plus is in Fayetteville, Georgia, USA. Fire Service Plus employs a professional team with decades of experience in the sale of extinguishing agents to governments, local authorities and industry. Our business is known worldwide for its high degree of integrity in the production of FireAde products.

Our FireAde products have set a standard; they are suitable for a wide range of applications, are not hazardous or toxic and are biodegradable. These characteristics render FireAde 2000 very effective and universally useful. FireAde products are used in many countries for military, industrial and fire-fighting applications.

We have combined various technologies that were not previously compatible in the history of extinguishing foams, i.e. Class A extinguishing agents, Class B extinguishing agents and wetting agents. This revolutionary breakthrough is possible with FireAde 2000.

Class A extinguishing agents are exactly what they profess to be: extinguishing agents only for Class A fires. The extinguishing agent industry only recognises wetting agents as non-foaming agents. These products work on a different chemical basis from the AFFF media (aqueous film foaming foams). Wetting agents are thus typically used for Class A fires and rarely for flammable liquids, due to the missing foam component.

Foam and AFFF products are generally considered to be standard agents and serve as the "extinguishing foam" for fire-fighting purposes. AFFF products cover the fire to be extinguished with a film that generates a membrane, which in turn suppresses toxic vapours and the fire itself. AFFF products are normally only used for fires in class B.

Their combination has resulted in the unique characteristics of FireAde 2000. Fire Service Plus has combined the "wetting agent technology" with the "AFFF" technology. This has resulted in the first multidimensional extinguishing agent in classes A and B.

FireAde 2000 reliably extinguishes almost any kind of fire."

FireAde 2000 does not require any special equipment and can be used by the fire brigade together with standard equipment such as a hollow spray head, a heavy- and medium-consistency foam pipe and existing mixing systems.

Due to its low viscosity (dry matter < 5%), FireAde 2000 also immediately mixes with the extinguishing water and remains mixed. There is no risk of extinguishing systems becoming blocked or not permanently achieving the desired concentration. Valves and pumps also do not have to be maintained after use, as the product is non-corrosive, just flush with fresh water.

Traditional fire-fighting methods disperse heat by converting water into water vapour or by removing oxygen from the fire as one of the elements of the fire tetrahedron, as well as by temporarily covering toxic vapours with a foam film (foam for fire class B).

The molecular structure of FireAde 2000, on the other hand, forms the basis for a new fire-fighting method, which simultaneously acts on heat, fuel, oxygen and free radicals as parameters of the fire tetrahedron model. It is therefore the ideal medium for fighting fires and neutralising easily flammable liquids.

Accreditations and approvals

- US Defence Ministry
- UL accreditation
- MPA Dresden (European accreditation)
- Hygiene Institute for the Ruhr region

At an admixing rate of 1%, 3% and 6%, FireAde 2000 was approved for applications in fire classes A and B, both according to the United States and the Canadian standards of the UL certification organisation.

FireAde 2000 is available in two variants:

- **FireAde 2000 Fire Fighting Agent**
  frost resistant down to – 4 Grad Celsius
- **FireAde 2000 Climate Control**
  frost resistant down to – 32 Grad Celsius.

The results confirm that FireAde 2000 corresponds to the current requirements of the UL 162 standards for foam extinguishing agents, as well as the NFPA 18 standards for wetting agents.

Note: *Fire Services Plus Inc. does not in any way advocate the improper disposal of neutralised, spilled fuels. Guidelines for appropriate disposal are available from your local council or from the relevant government authorities.*

The chemistry of fire

A basic chemical knowledge of fire is a precondition for understanding how a fire-fighting agent acts on the fire.

From an historical point of view, the chemistry of fire is based on the model of the fire tetrahedron.

A fourth factor, the so-called free radicals, were identified at the beginning of the 1980s. It is since then known that fire chemistry is based on the extended fire tetrahedron model, which consists of the parameters of oxygen, fuel, heat and free radicals.

Lately, the free radicals have been given increased significance. All four factors of the fire tetrahedron must be present for a fire to spread.

APPLICATIONS

Fire fighting

Applications in fire class A	■ Wood ■ Coal ■ Paper ■ Coconut ■ Cotton ■ Fibre glass ■ Hay / Straw / Crops ■ Rubber tyres
Applications in fire class B [polar]	■ Isopropyl alcohol ■ Ethanol ■ E-85 ■ Methanol ■ Methylethylketon ■ Methyl tertiary butyl ether
Applications in fire class B [non-polar]	■ Petrol ■ Diesel ■ Jet A (kerosene) ■ military fuels / JP5 / JP8 ■ Crude oils
Applications in parts of fire class D	■ Alkaline earth metals such as magnesium, titanium, aluminium, etc.

The absorption of spilled liquids

Flammable hydrocarbon liquids are neutralised by using a 3% admixing rate.

This opens up the following fields of application:

- Neutralisation of spilled fuel
- Neutralisation of spilled liquids in refineries, in the chemical and industrial areas
- Neutralisation of fuels in drainage pits

One of the most significant advantages of FireAde 2000 over conventional foam is that the fuel remains neutralised during the cleaning phase and the subsequent disposal of the hazardous substances.

FIRE-FIGHTING METHODS

A fire is extinguished by removing one of the factors of the expanded fire tetrahedron model. There are basic differences between the fire-extinguishing methods using wetting agents (NFPA 18), foam in fire classes A and B (NFPA P 1150 or NFPA P 11) and the fire-fighting method using separation, for example the chemical medium FireAde 2000 (new NFPA project). These basic differences are explained below:

Wetting agent

The method of fighting fires with the aid of wetting agents is based on one main operating principle:

1. Reducing the surface tension

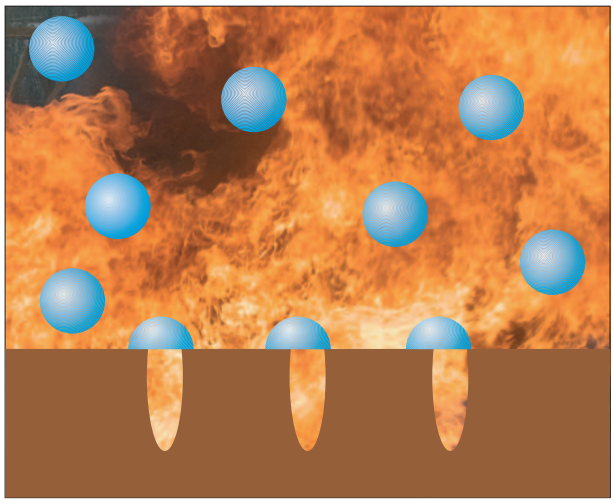
The surface tension of the water is reduced from 72 dyn/cm^2 to less than 22 to 26 dyn/cm^2.

This reduced surface tension has several decisive advantages over normal water during fire fighting. By reducing the surface tension, the size of the individual water droplets is reduced. The heat of

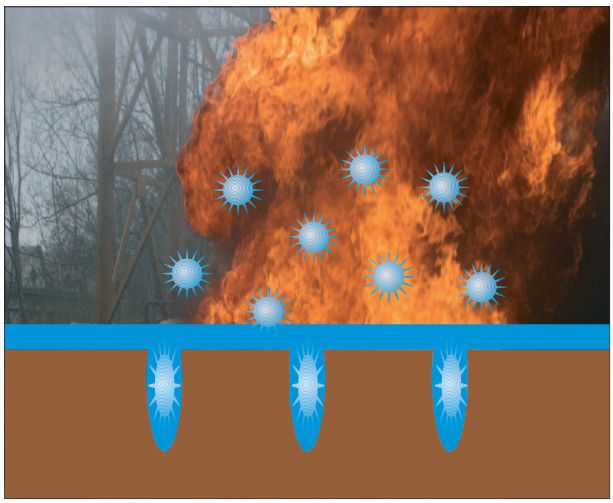
a fire is reduced by the fact that the energy is mainly absorbed by changing the state from liquid to gas. Small water droplets result in a larger surface area relative to the volume, which means that the fire comes into contact with a larger water surface, thus increasing the conversion of water into water vapour.

In addition, the water is distributed more rapidly as a result of the reduced surface tension, so that it can penetrate deeper into the pores and the burning material.

Note: *Wetting agents cannot form foam films or separate Hydro Carbon molecules.*



Normal water: ***The diagram illustrates how the expansion capacity of the water is limited by its high surface tension (72 dyn/cm_), with bridges being formed via the pores, which in turn prevents water penetration.***



Wetting agent: ***The diagram shows how the surface tension is reduced by the wetting agent, so that a larger surface is covered and the water can penetrate the pores of the thermal loads.***

Foams in fire classes A and B

The foam method of fighting a fire is based on two operating principles:

1. Reducing the surface tension

As is the case with the wetting agents, foam also reduces the surface tension of the water. This characteristic supports the formation of bubbles and the expansion of the foam film over the surface of the thermal load.

2. The formation and maintenance of a foam film

The distinctive difference with wetting agents lies in the fact that foam is able to form bubbles that last longer (i.e. formation of a foam film over the thermal load). This isolates the thermal load from oxygen, cutting off the supply of oxygen required for the fire to burn.

The covering capacity of the foams in fire classes A and B isolates the thermal load, which subsequently emits heat at a slower rate.

The technically mature alternative

FireAde 2000 – fighting fires with suspension technology

The method of fighting fires by separation is based on **five** basic operating principles:

1. Reducing the surface tension of the water
2. Rapid heat reduction
3. Interrupting the chain reaction of the free radicals
4. Formation of a foam film
5. Neutralisation of the Hydro Carbon molecules

On 1) Reducing the surface tension of the water

As is the case with the wetting agent, the surface tension of the water is reduced from 72 dyn/cm^2 to less than 22 to 26 dyn/cm^2, depending on the water used. During fire fighting, this effect has the same advantages as the use of a wetting agent in comparison with ordinary water.

By reducing the surface tension, the size of the individual water droplets is reduced. A smaller water droplet size means a larger surface area relative to the volume. Heat dissipation is achieved by allowing the fire to come into contact with the water surface and removing energy by changing the state from liquid to gas.

A larger surface area in proportion to the volume enables greater contact with the fire so that thermal energy is more rapidly absorbed even if the water volume remains constant. FireAde 2000 chemically reacts with the water, causing normal water to become up to 15 times "softer", with the individual droplets becoming significantly smaller. The surface tension is significantly reduced.

In addition, the water can be distributed more rapidly due to the reduced surface tension, so that a greater surface is dampened and the water can penetrate more deeply into the burning material.

On 2) Rapid heat reduction

Fire Ade 2000 improves the way in which the heat is channelled into the water droplets, thus resulting in a significantly higher evaporation rate. In addition, existing Hydro Carbon molecules are attracted to this FireAde 2000 / water compound by its electrical charge. These characteristics of the FireAde 2000 / water mixture result in the mixture being almost entirely converted into water vapour which produces a very great cooling effect. These water vapour molecules combine with the adjoining water molecules and the water vapour condenses back into water. This cyclical change in the state within the water droplet, i.e. between evaporation and condensation, absorbs a great deal of heat energy, thus rapidly reducing the heat while at the same time creating little water vapour.

In addition to the reduced surface tension, and thus to the increase in the surface/volume ratio, the

Surface tension test

According to US norm NFPA 18

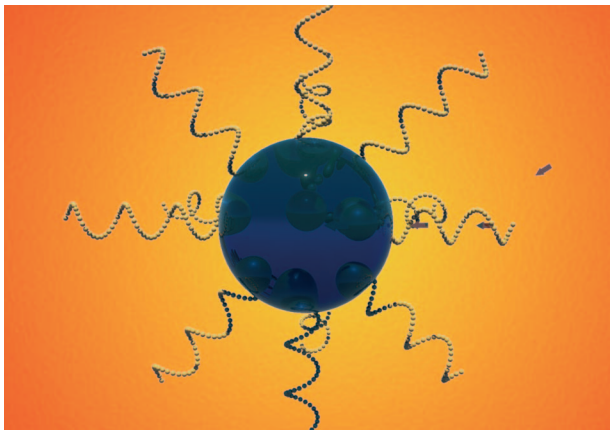
FireAde 2000 fulfils all the NFPA 18 directives for tests for class A and class B fires.

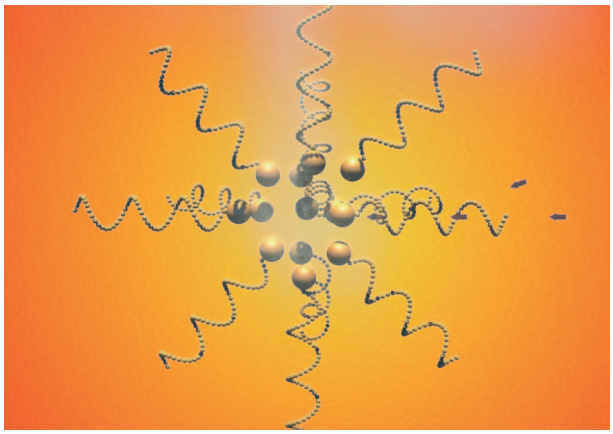
Practical tests

A simple test demonstrates how FireAde 2000 improves the wetting and penetration capacity of water.

10 cm^3 water are applied to blotting paper in a fixed position. The surface tension causes it to form a pool of approximately 50 mm^2.

When a 3% mixture of water and FireAde 2000 is used and 10 cm^3 water are applied in the same way, the surface tension of the water is reduced to such an extent that the dampened surface immediately expands to more than 600 mm^2 as the smaller droplet size causes the mixture to penetrate the paper instead of forming a pool.





FireAde 2000 allows for the absorption of about ten times as much heat energy as ordinary water.

covalent ends of the FireAde 2000 molecules project from the water droplets. The all-round channelling of heat into the droplets prevents the droplets from "shooting off" as a result of asymmetrical water vapour formation when they are heated from one side only.

The droplets of the FireAde 2000/water mixture look like pin-cushions with projecting pins. As these droplets come closer to a fire, the FireAde 2000 molecule acts as a heat conductor that channels the heat to the inside of the droplet.

FireAde 2000 was developed in such a way that not only the outer surface of the water droplets but also their inner volume is effectively used. The following could be proven, both during experimental studies and during design calculations:

- FireAde 2000 allows for the absorption of about ten times as much energy as ordinary water.
- Heat reduction using FireAde 2000 is more efficient than using of foam, which isolates the thermal load.

Unlike the foam in fire class B, which isolates the thermal load, FireAde 2000 rapidly reduces the temperature of the thermal load (as well as of the adjoining infrastructure) to below the self-ignition temperature. A very short extinguishing time is achieved in combination with the foam film.

The rapid heat reduction of FireAde 2000, together with its separation effect, considerably reduces spontaneous reignition, as the vapours are separated, while simultaneously rapidly reducing the temperatures to below the self-ignition temperature.

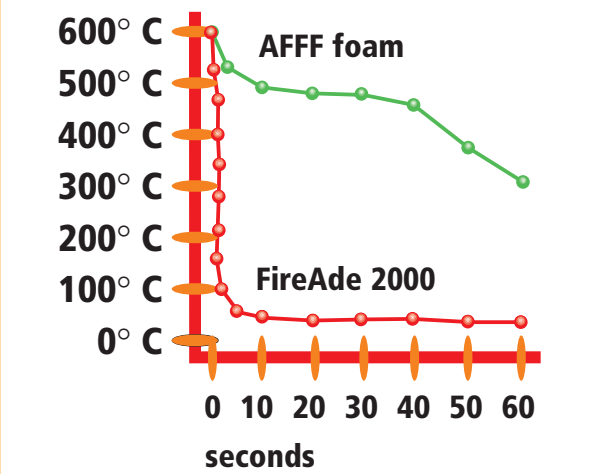
When simulating "flash over", the fire fighters usually crouch down in the vicinity of the simulator. Burns may occur as a result of the considerable formation of water vapour. When simulating "flash over" situations, the use of FireAde 2000 leads to a low risk of burns as a result of its rapid cooling and minimal water vapour formation effect.

Temperature reduction

Method in comparison to AFFF foam

This test shows the marked difference in the cooling efficiency between FireAde 2000 and traditional foam.

The test objects were two steel plates with a thickness of 2 cm and an edge length of 15 cm. Both plates were continuously exposed to a extinguishing stream. The initial temperature was over 600 degrees centigrade. The test period amounted to 60 seconds of cooling. Immediately after this period, the plate cooled with FireAde 2000 had a temperature that prevented reignition.
Foam cooled the plate far more slowly and a significantly greater amount of cooling liquid was required.

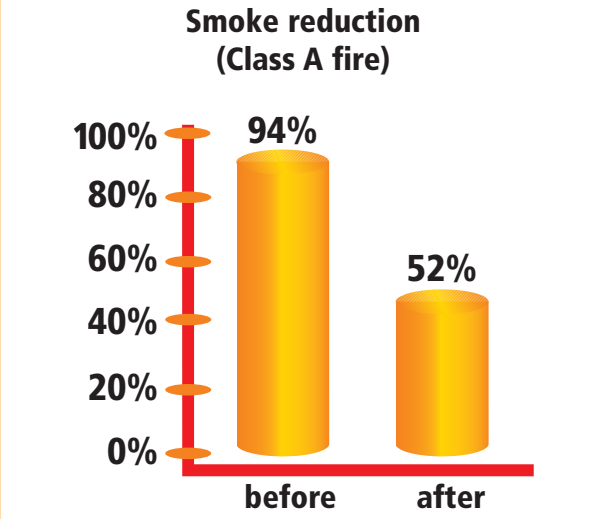


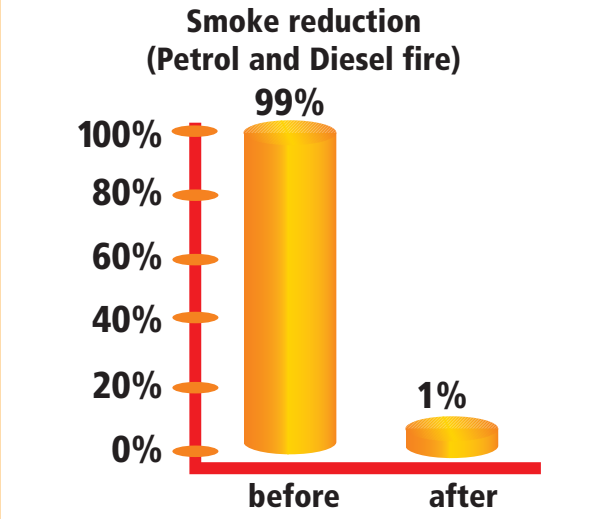
Smoke reduction when using FireAde 2000

For the fire-fighting crew, good visibility has a major safety advantage, resulting in a lower risk to human life and property.

The diagrams show that smoke development is significantly suppressed immediately after using FireAde 2000, even more strongly in the case of flammable liquids than for Class A fires, where smoke development was reduced by almost half. In the case of petrol and diesel fires, the application of FireAde 2000 as a 3% additive almost entirely eliminated the reduction in visibility caused by smoke after about 30 seconds.

FireAde 2000 not only accelerates the improvement in visibility but also combats the formation of toxic substances often found in dense smoke.





On 3) Interrupting the chain reaction of the free radicals

Free radicals are uncharged molecular components with high reactivity. They collide with fuel sources in Class A or B at high speed. This causes heat and even more free radicals to be released, triggering a chain reaction which in turn accelerates the combustion process. Due to its high molecular mass, FireAde 2000 inhibits the radical chain reaction by absorbing the energy of the free radicals released during these collisions and channelling it into the water.

As the energy of the combustion system decreases as a result of the absorption of the high energy from the free radicals, the fire is extinguished.

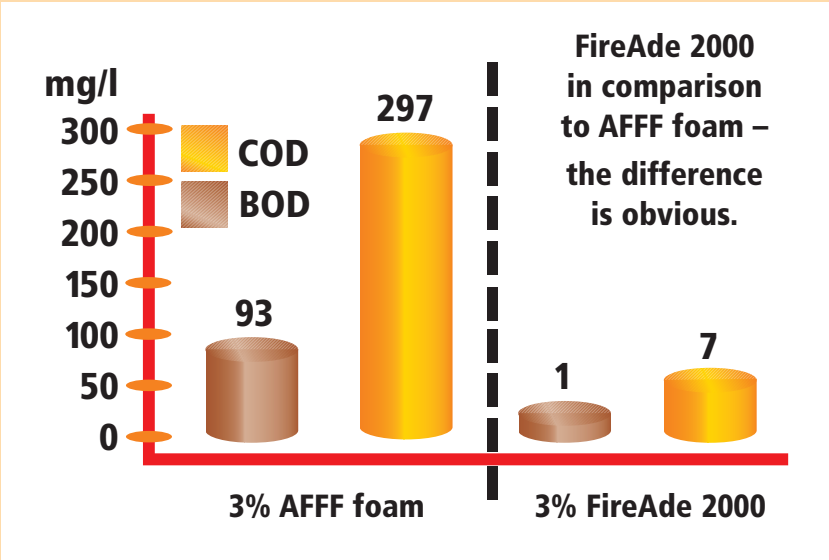
When the free radicals collide, soot and smoke are formed. In fact, soot is the third purest form of carbon.

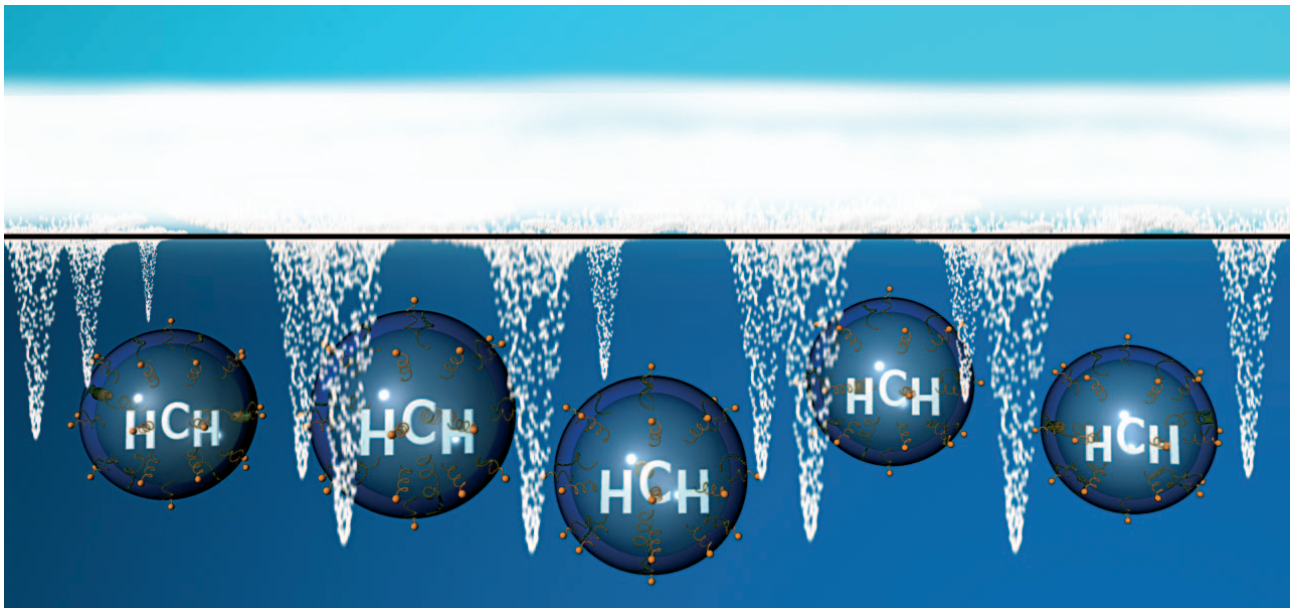
Biochemical and chemical oxygen consumption (BOD and COD)

Oxygen consumption is a standardised measure for determining the degree of contamination of water reserves, especially in the case of polluted waste water or industrial waste.

Chemical oxygen consumption refers to the amount of oxygen, in particles per million (ppm), that can be measured during the oxidation of organic material in the waste water.

FireAde 2000 is fully biologically degradable and the results shown in the diagram show that FireAde 2000 is far less harmful to the environment than traditional foam.





By admixing of 3% of FireAde 2000 heat is instantly being dissipated and the surface of combustible liquids is being separated by the FireAde 2000 molecules. After the dissipation of heat and the separation of the Hydro Carbon molecules a thick membrane and a tight structure (no large bubbles) foam blanket is built.

FireAde 2000 interrupts the chain reaction of the free radicals by strongly reducing the collision with new thermal loads.

The prevention of radical reactions by reducing the smoke was determined before, during and after the application of FireAde 2000.

On 4) Formation of a foam film

Moreover, FireAde 2000 is designed to build a heavy or medium consistency foam. In case of heavy consistency foam one can choose between a hollow spray pipe or a heavy foam pipe. The crews can act more flexible with the hollow spray pipe. FireAde 2000 develops a very stable and dense foam blanket which does not exceed 3 cm in height in case of heavy consistency foam.

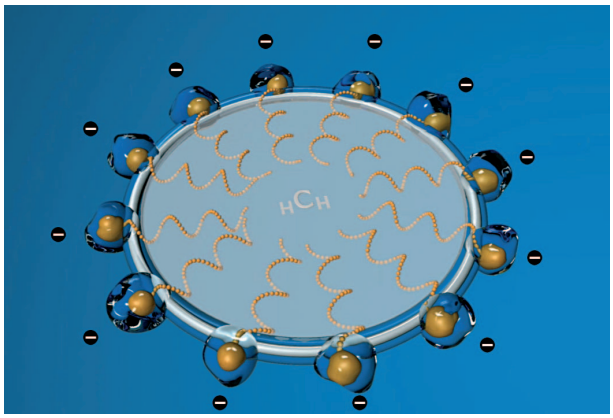
The foam blanket is floating on a thick membrane, which also separates the oxygene from the burning material and combustible vapours

On 5) Separation of the Hydro Carbon molecules

As soon as the FireAde 2000 / water mixture comes into contact with hydrocarbon molecules, a new chemical reaction takes place. This provides the Hydro Carbon molecular groups on the surface with a negative charge, causing them to repel each other. At the same time, they attract the positively charged water, so that they are separated from each other but surrounded by water, which they retain.

As is shown in the diagram on the right, the chemistry of FireAde 2000, by changing the electrical charge, ensures that the Hydro Carbon molecular groups repel each other and thus separate and attract the surrounding water, not allowing any flammable Hydro Carbon vapours to be formed.

This new approach to the molecular separation of the fuel has numerous advantages for the fire-fighting crews. The FireAde 2000 chemistry separates the fuel in a liquid state and binds it with water, thus resulting in the liquids no longer being flammable and explosive.



Groups of Hydro Carbon molecules separated by FireAde 2000

Five litres of burning cooking oil: even self-combustible edible fats and thermic oils are reliably extinguished by a ten percent admixture of FireAde 2000.

Applications of FireAde 2000

Practical fire-extinguishing tests with FireAde 2000

A large number of tests were carried out with numerous fires. Two examples are given below:

Transformer fire

A major American energy generator carried out tests on transformers with a cooling liquid volume of 40,000 litres of hydraulic oil. These tests compared the extinguishing effect of FireAde 2000 and AFFF foam.

The heat emanating from the fire was so intense that five crews had problems applying a foam film before it evaporated. During the AFFF foam test, five groups had to spray foam continuously at the site of the fire for a period of more than 12 hours before the fire had been completely extinguished.

After applying FireAde 2000 for only 30 minutes, the heat sensors showed a temperature drop of 426 degrees and the crew could be withdrawn after only 40 minutes.

In both cases, the original explosion completely destroyed the transformers.

Transformer fire	FireAde 2000	AFFF foam
Total time spent at site	< 40 minutes	12.5 hours
Total consumption of extinguishing agent	38 litres	470 litres
Actual time until fire is extinguished	1 minute, 24 seconds	28 minutes
Labour costs	$ 250 for a two-man crew	$ 5,200 for a four-man crew

Brushwod fire

These tests were carried out by fully qualified members of a voluntary fire brigade in the USA.

Approximately 4 hectares of dry brushwood were set alight under controlled conditions to obtain a comparison between FireAde 2000 and AFFF foam.

Brushwood fire	FireAde 2000	AFFF foam
Admixing rate	0.25 %	1.0 %
Water consumption	860 litres	8.140 litres
Product consumption	3.7 litrs	83 litres
Manpower and hardware	Two-man crew 1 tanker vehicle	Four-man crew 2 tanker vehicles 1 water storage tanker
Total time spent at site	28 minutes	4.5 hours

EUROPA

Fire Services GmbH
Hallplatz 15
D-90402 Nuremberg

Telefon: +49 (0) 911-234299-0
Telefax: +49 (0) 911-234299-55
Website: www.fireservices.de
E-Mail: info@fireservices.de

USA

Fire Services Plus Inc.
180 Etowah Trace
Fayetteville, Georgia 30214, USA

The specifications and information provided on the mechanical and physical characteristics or chemical analyses refer only to the chemical analysis of samples taken from substances at specific sites when manufacturing the products, in accordance with the regulations governing sampling. Documentation about the exact sales and delivery conditions is available from Fire Services GmbH.