Fire fighting foam

Taiwan juni 2013

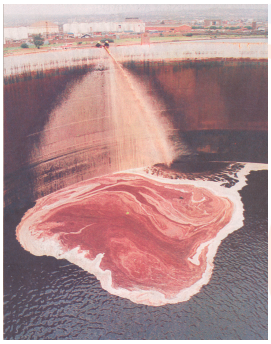
Dry Foam Technology

Trelleborg Dryfoam; Fire Suppression Spheres

- Spheres 3 to 5 mm
- No water necessary to put out fires
- Thermal resistance
- Polar and non-polar fuels
- Oil phobic
- Anti static
- Sub-surface injection

- US and international patents pending

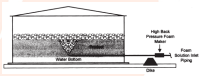
Preventive measure



Fire Suppression Spheres

Applications

- Passive protection as floating roof
- Sub-surface injection
- Spheres mixed with fire fighting foam applied to fire through existing infrastructure



Granules

Heat flux

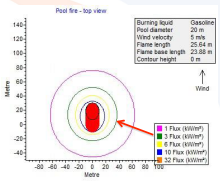
Heat flux

kW/m²

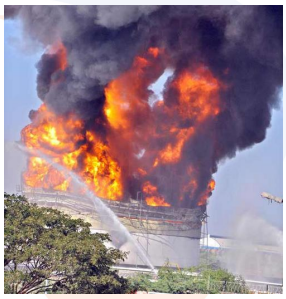
2	Nomex-overall (temp. 100°-150°)
6	Full protection
8	Auto-ignition temperature of paint and wood
12,5	Corrective cooling is necessary
200-250	Radiation from a pool fire
300	Radiation from an impingement fire

8

Flux



Hydrocarbon fires?



Priority?

Stable situation?

Sloping floor

2013; Australie

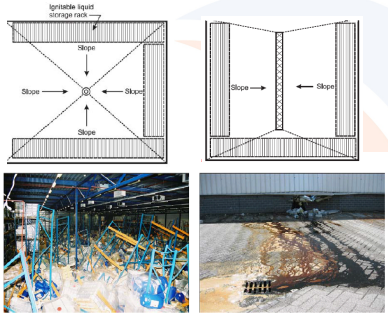
Rapid fire spread!

Chemiepack, Moerdijk; June 5, 2011

Fire spread

Waxahachie, Texas; October 3, 2011

Containment



Abeelding 10A:
Domino-effect omgevallen stelling

Afbeelding 10B:
Brandcompartiment is beschadigd door omgevallen stellingen

Poolfires

- Burning rate
- Surface

"thick stuff" 8 cm* (high viscosity)
"thin stuff" 2 cm* (low viscosity)

*Rule of thump

Viscosity

Overturned truck containing heated asphalt; Highway A67, 2005

Burning rates

Product	Grow heatwave mm/hr	Kg/m²/sec
Light oils		152-305
Medium oils		127-203
Heavy oils	76-508	76-127
Light crude	381-889	102-457
Heavy crude	76-508	76-127

Burning rates

Product	mm/min.	Kg/m²/sec	Density kg/m³
LNG	14	0,11	460
LPG	13	0,13	585
Gasoline	5	0,055	740
MEK	4	0,05	800
Kerosene	3	0,06	820
Fuel Oil	2	0,05	900

Poolformation

- Boiling pool
- Evaporating pool
- Non-evaporating pool

Chemical fires are polar solvents fires

Chemical fires are **polar solvents** fires.
Polar solvents include O or N atoms or halogenes : Cl, Br, F or I.
Their characteristic is their affinity for water.

We can identify some large families :
Alcohols: méthanol, éthanol, isopropanol…
Ketones and aldehydes: acetone, acetaldehyde, methylethylKetone, MIBK…
Esters: Ethyl acetate…
Ethers: diethylether, MTBE, THF…
Glycols: combination 'alcohol + ether' : MEG, MPG, Butoxyethanol, butylcarbitol…
Amines: trimethylamine…
Acids: acetic acid, propionic acid…

Being "water lovers", they can only be extinguished with Alcohol Resistant foams.

Bio fuels

The two most common types of bio fuels in use today are ethanol and biodiesel

E-5
E-10
E-85

Gasoline

Ethanol is mostly used as blending agent with gasoline to increase octane and cut down carbon monoxide and other smog-causing emissions. Some vehicles are designed to run on E85, an alternative fuel with much higher ethanol content than regular gasoline.

Biodiesel

Biodiesel is made by combining alcohol (usually methanol) with vegetable oil, animal fat, or recycled cooking grease. It can be used as an additive (typically 20%) to reduce vehicle emissions or in its pure form as a renewable alternative fuel for diesel engines. Flashpoint >61°C

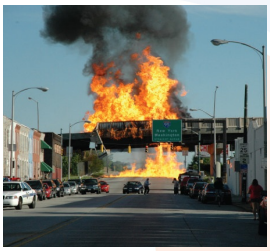
Ethanol fires

2004; Port Kembla, Australie

Methanol fire

EERC

Ethanol Emergency Response Coalition



Testresults:
AR foam recommended choice for all fuel fires involving gasoline- / ethanol-blended fuels

UL Fire tests

Type II Application
- Indirect appication

Type III Application
- Direct applicatie

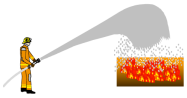
Sprinkler Application
- Air-aspirated and non-aspirated

Type II en III applicatie are classified as a 'top side' fire test

Application techniques

- Roll-on method

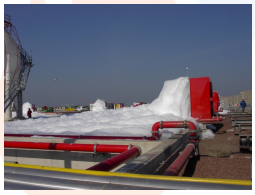
- Indirecte apllication



- Direct application

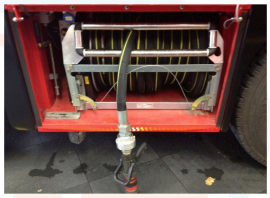
Aerating foam

Expansion rates
- Non-aspirated 3-5
- Low expansion 5-20
- Medium expansion 20-200
- High expansion >200

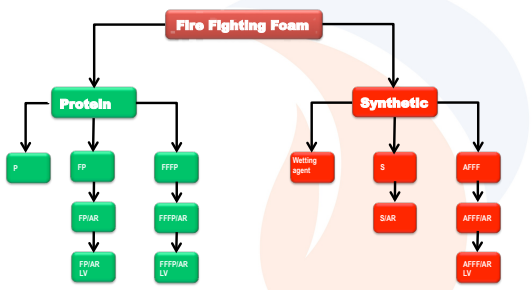


Aspirated

Aerating foam



Foam concentrates



C6 Fluorinated Surfactants

Major foam manufacturer's replace C8 foam concentrates for C6 foam concentrates

- By degration of C8 formation of PFOA
- Existing dat shows that shorter-chain compounds (C6 and below) have a lower potential for toxicity and boiaccumulation

Fluorine Free Foam (FFF-types)

No fluorsurfactants

RE-HEALING FOAM
AUTHENTIC FLUORO-FREE

Foam concentrates

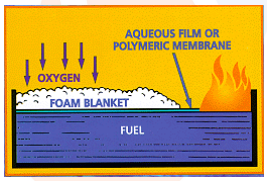
Fluorinated foam concentrate	Fluorine-free foam concentrate
AFFF Aqueous film forming foams	**P** Protein foam
AFFF (AR) Alcohol resistant AFFF	**P (AR)** Alcohol resistant P
FP Fluor protein foam	**S** Synthetisch schuim
FP (AR) Alcohol resistant FP	**S (AR)** Alcohol resistant S
FFFP Film forming FP	
FFFP (AR) Alcohol resistant FFFP	

AFFF

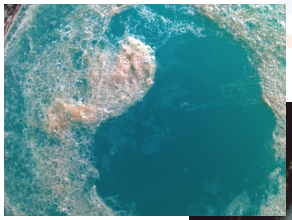
AR AFFF

Alcohol resistant foam

- Expansionrate > 5
- Indirect application method



Polymeric membrame



Foam concentrate

- **Product**
  - Vapour pressure
  - Cryogenic
  - Toxic/ corrosive
- **Type of application**
- **Scenario**

Applicationrates

Lijst van producten met application rates bij inzet van Moussol APS 3x3

Product groep	Product	CAS nr (indien bekend)	Application rate
Acetalen/Esters	n-Propylacetaat	109-60-4	6 l/min
	Ethylacetaat	141-78-6	4 l/min
	Vinylacetaat	108-05	7 l/min
Alcoholen	Methanol	67-56-1	6 l/min
	Ethanol	64-17-5	6 l/min
	n-Butanol	71-36-1	6 l/min
	Isobutanol	75-83-1	6 l/min
	t-Butylalcohol	75-65-0	6 l/min
	Ethylol 75/75	64-17-5 (75%)	6 l/min
	n-Propanol	71-23-8	6 l/min
	Isopropanol		6 l/min
	Blend Ethanol	64-17-5	6 l/min
Acrylonitril	Acrylonitril	107-13-1	5 l/min
Aromaten	Alfa-Methylstyreen	98-83-9	3 l/min
	Styreen	100-42-5	6 l/min
	Tolueen	108-88-3	3 l/min
	Xyleen	1330-20-27	3 l/min
Glycolen	Butylglycol		6 l/min
	Butyldiglycol		6 l/min
	Butyltriglycol	143-22-6	6 l/min
	Ethylglycol		5 l/min
	Ethyleenglycol		3 l/min
	Propyleenglycol	57-55-6	3 l/min
Fenolen	Orthocresol	95-48-7	3 l/min
Ketonen	Aceton	67-64-1	7 l/min
	Methylisobutylketon	108-10-1	6 l/min
	Cyclohexanon	108-94-1	4 l/min
	Methylethylketon	78-93-3	7 l/min

Applicationrates

Lijst van producten met application rates bij inzet van Moussol APS 3x3

Productgroep	Product	CAS nr (indien bekend)	Application rate
Alkenen	Octeen	111-66-0	4 l/min
	Hexeen	592-41-6	4 l/min
Alifaten	Diisobutyleen	107-39-1	3 l/min
	Cyclohexaan	110-82-7	4 l/min
	Hexaan	110-54-3	4 l/min
	Heptaan	142-82-5	3 l/min
Propyleen oxide	Propyleen oxide	75-56-9	8 l/min
Ethers	Methyl t-Butylether	1634-04-4	6 l/min
	Ethyl t-Buthylether	637-92-3	6 l/min
	Tetrahydrofuraan	109-99-9	6 l/min
Amines	Kerocom Piba	64771-72-8	3 l/min
	Polyisobutalamine	64742-45-9	3 l/min
Methacrylaten	Methyl-methacrylaat	80-62-6	4 l/min
Phtalaten	Dioctylphaltaat	117-81-7	3 l/min

*) Op dit moment geen application rate van bekend (juni 2009).

Even rekenen

Gegevens:

- Plasbrand 250 vierkante meter
- Applicationrate 6,5l/min./m²
- Blusduur 30 minuten
- Schuimstraalpijpen van 800L/min.

Vragen

- Hoeveel straalpijpen nodig?
- Hoeveel schuimconcentraat nodig voor 30 min. blussing

Application rates

National Fire Protection Association

Fixed systems	4,1	l./min/m^2
Mobile systems	6,5	l./min/m^2
Large surface*	10,4	l./min/m^2

* Tankdiameter >40 mtr.