



ECOGUARD ***Fluorine-Free Fire-Fighting Foam***

Dr. Thomas J. Martin



ECOGUARD - Background & Introduction



- 🔥 As used in AFFFs in general, fluorinated surfactants are effective and indispensable
- 🔥 Fluorine-Free foams have been around a long time (proteins, etc.)
- 🔥 A present and growing market demand exists for Fluorine-Free Foam Products
- 🔥 ECOGUARD was developed as a “Synthetic” Foam Concentrate (as defined by UL) in response to customer needs
- 🔥 ECOGUARD meets UL 162 and EN 1568 test requirements and is therefore qualified for use in the respective applications
- 🔥 Manufactured under ISO 9001:2000 certified quality program



ECOGUARD - Summary



ECOGUARD Foam is “Environmentally Friendly” in a number of respects:

- 🔥 Key ingredient is a novel hydrocarbon polymer surfactant
- 🔥 Non-fluorinated, ECOGUARD contains no organo-fluorine
- 🔥 Made with low toxicity hydrocarbon surfactants
- 🔥 Primary surfactant is derived from a renewable source
- 🔥 Very low glycol ether content
- 🔥 Optimized formula, synergistic use of ingredients
- 🔥 Readily biodegradable
- 🔥 Low concern for toxicity, by several standards
- 🔥 US EPA “Designed for the Environment” partnership underway

ECOGUARD - Properties



Typical Properties:

pH	8.2
Specific Gravity	1.11
Density	9.3 lbs/gal
Expansion Ratio	7.0-8.0
Quarter Drain Time	4:00-7:00
Viscosity	22 cP
Surface Tension	26-27 dyne/cm

*Expansion & Drain Time at 3%, tap water, 2 gpm nozzle
Surface Tension at 0.1% DI water*



Acute Aquatic Toxicity Ranking



“Chemicals can be also ranked by their hazard concern levels for the aquatic environment.

This ranking can be based upon the acute toxicity values expressed in milligrams per liter (mg/L).

The generally accepted scoring used by OPPT is as follows (Smrchek et al., 1993; Wagner et al., 1995):”

Concern Level	LC50
High Concern	<1 ppm
Moderate (or Medium) Concern	>1 and <100 ppm
Low Concern	>100 ppm

Source: US EPA
 (<http://www.epa.gov/dfe/pubs/pwb/ctsasurf/download/pdf/app-h.pdf>)

“Relative toxicity of substances (adapted from USFWS, 1984; Hunn and Schnick, 1990).”

Toxicity Rating	Aquatic 96-hour LC50
Extremely Toxic	<0.1 mg/L
Highly Toxic	0.1-1.0 mg/L
Moderately Toxic	1-10 mg/L
Slightly Toxic	10-100 mg/L
Practically Non-toxic	100 – 1,000 mg/L

Source: US FWS
 (http://response.restoration.noaa.gov/book_shelf/675_append.pdf)

Aquatic Toxicity and Biodegradation



Commercial Foam Type	Aquatic Toxicity (Concentrates)				Biodegradation
	LC50 96 hr Fathead minnow (pimephales promelas)	LC50 96 hr Rainbow trout (ocorhynchus mykiss)	EC50 24 hr Water flea (Daphnia magna)	EC50 48 hr Water flea (Daphnia magna)	BOD 28 day (%)
1% AFFF	63 ppm			357 ppm	
3% AFFF	233 ppm			1110 ppm	38%
3% AFFF					60%
3% AFFF					60%
3% AFFF			100-1000 ppm		>99.4%*
3% AFFF		390 ppm		147 ppm	
3% AFFF				1016 ppm	
3% FP					100%
3% FP					58%*
3%-3% AR-AFFF				757 ppm	71%
3%-6% AR-AFFF				<500 ppm	
3%-6% AR-AFFF					60%
3%-6% AR-AFFF					65%
3% protein					100%*
3% Synthetic		42 ppm		644 ppm	54%
Class A		130 ppm			55%
Class A					56%
Class A		41 ppm			>90%
Class A		28 ppm			
Class A				47 ppm	
Hi-Ex				22.4 ppm	
Hi-Ex		45 ppm	37 ppm	10 ppm	53%
ECOGUARD	104 ppm	48 ppm	1289 ppm	570 ppm	66%
shampoo				88.8 ppm	

* BOD 20 day (%)

Source: Supplier Material Safety Data Sheets

Ecoguard testing performed by EA Engineering, Science, and Technology, Inc. & Galbraith Laboratories, Inc.

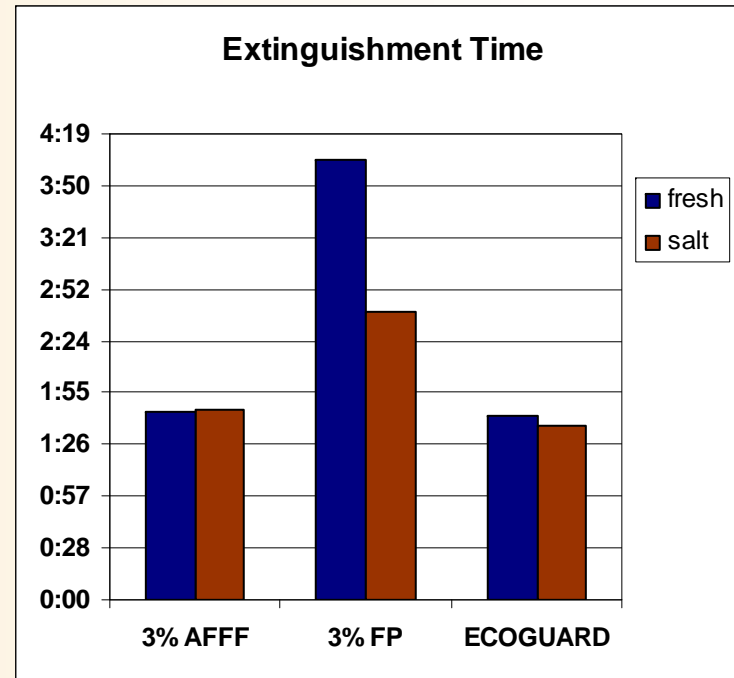
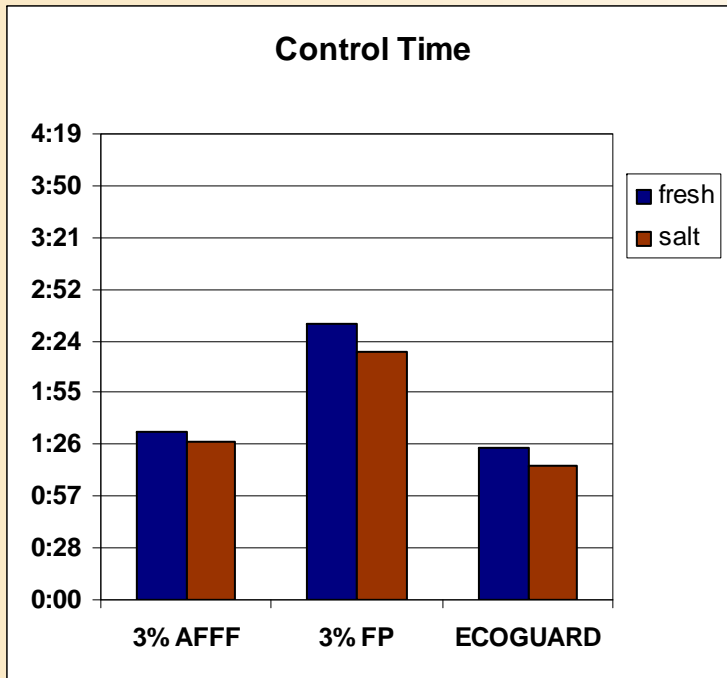
Acute Aquatic Toxicity for Solutions



Commercial Foam Type	Aquatic Toxicity (as used)			
	LC50 96 hr Fathead minnow (pimephales promelas)	LC50 96 hr Rainbow trout (ocorhynchus mykiss)	EC50 24 hr Water flea (Daphnia magna)	EC50 48 hr Water flea (Daphnia magna)
1% AFFF	6300			35700
3% AFFF	7767			37000
3% AFFF				
3% AFFF				
3% AFFF				
3% AFFF		13000		4900
3% AFFF				33867
3% FP				
3% FP				
3%-3% AR-AFFF				25233
3%-6% AR-AFFF				16667
3%-6% AR-AFFF				
3%-6% AR-AFFF				
3% protein				
3% Synthetic		1400		21467
Class A		13000		
Class A				
Class A		4100		
Class A		2800		
Class A				4700
Hi-Ex				1120
Hi-Ex		2250	1850	500
ECOGUARD	3467	1600	42967	19000

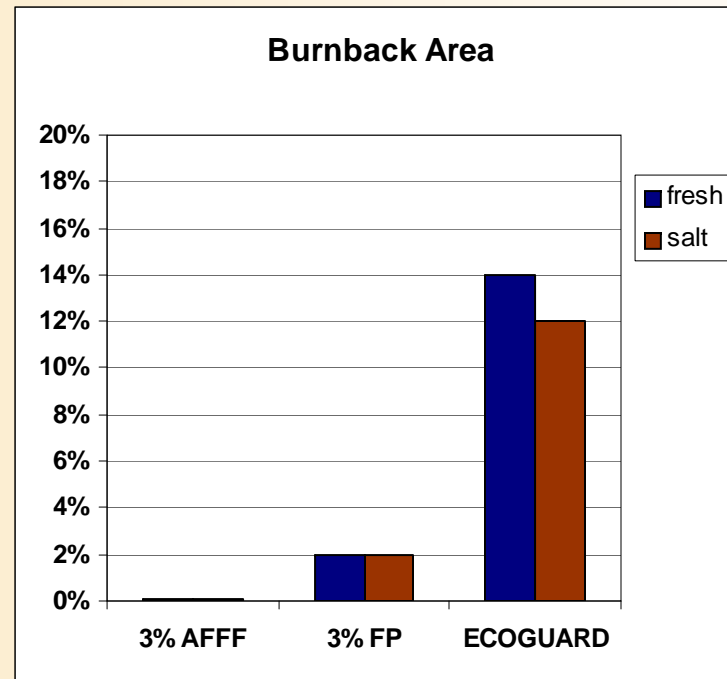
Source: Supplier Material Safety Data Sheets

ECOGUARD - Topside Performance (UL)



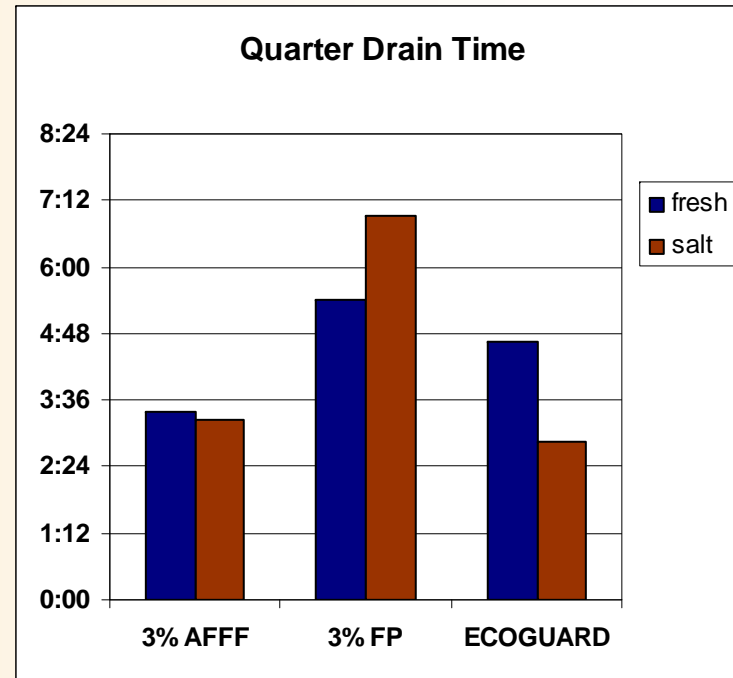
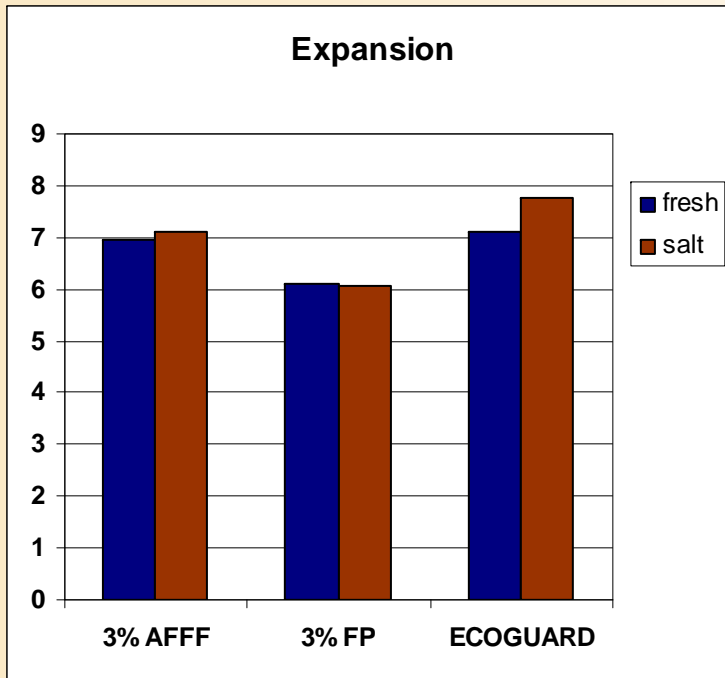
UL 162 §10 Topside Discharge Device
Fluoroproteins and Synthetics
hydrocarbon fuels (heptane)
0.06 gpm/sq. ft. (8/3 design factor), type III application

ECOGUARD - Topside Performance (UL)



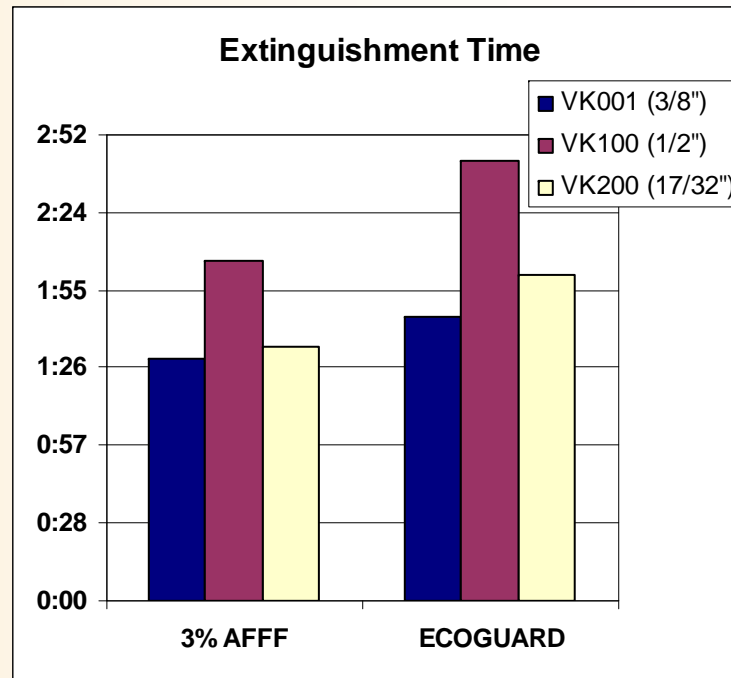
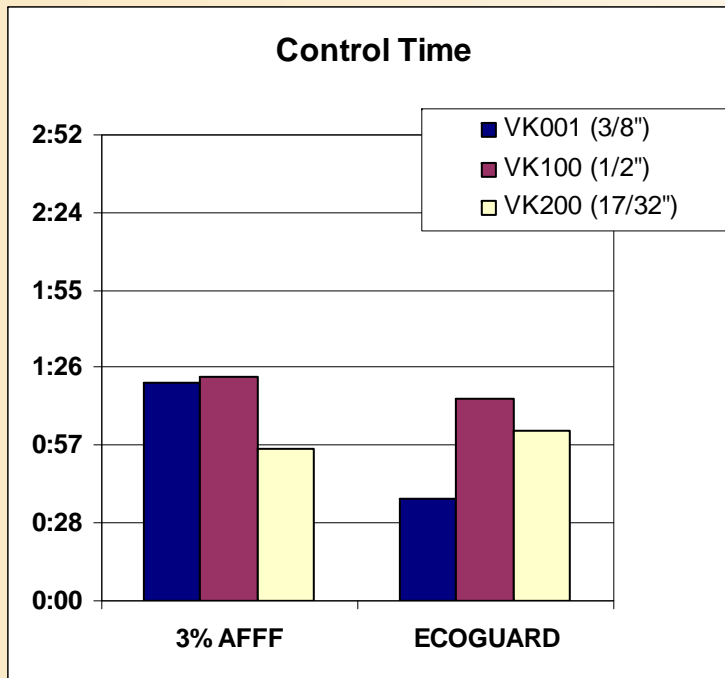
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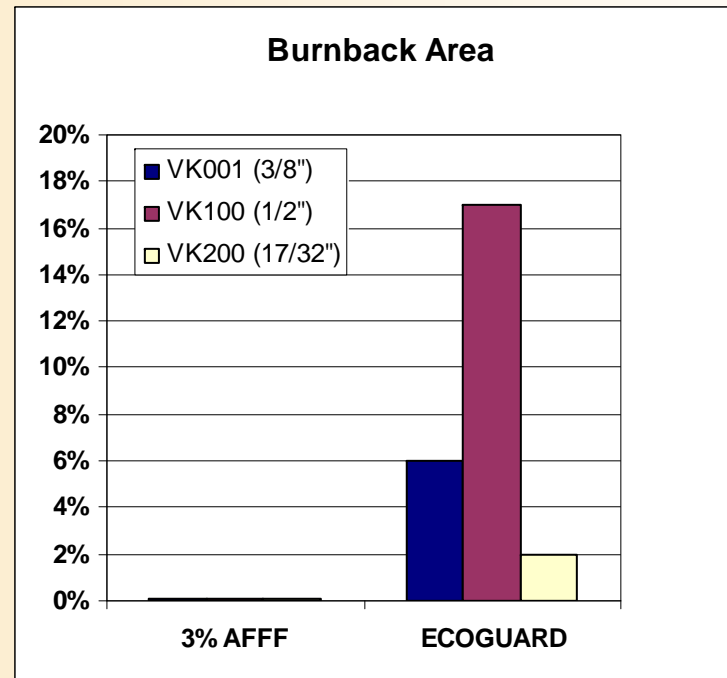
ECOGUARD - Sprinkler Performance (UL)



UL 162 §9 Sprinklers
hydrocarbon fuels (heptane)
(8/5 design factor)

	prop. rate	appl. rate
VK001	3%	0.10 gpm/sq. ft.
VK100	6%	0.10 gpm/sq. ft.
VK200	6%	0.14 gpm/sq. ft.

ECOGUARD - Sprinkler Performance (UL)



UL 162 §9 Sprinklers
hydrocarbon fuels (heptane)
(8/5 design factor)

ECOGUARD - Topside Performance (EN)



	Rating	Extinguishment	Burnback
3% AFFF	IC	<3:00 (forceful)	>10:00 (gentle)
Ecoguard	IIIB	<5:00 (gentle)	>15:00 (gentle)

Table A.1 — Typical performance for various grades of foam concentrate

Grade	Extinguishing performance class	Burn-back resistance level	Film formation
AFFF (not AR)	I	C	Yes
AFFF (AR)	I	A or B	Yes
FFFP (not AR)	I	B	Yes
FFFP (AR)	I	A or B	Yes
FP (not AR)	II	A or B	No
FP (AR)	II	A or B	No
P (not AR)	III	B	No
P (AR)	III	B	No
S (not AR)	III	C	No
S (AR)	III	C	No

achieved

expected

gentle application only

Source: BS EN 1568-3:2008 hydrocarbon fuels (heptane)

ECOGUARD - Conclusions



- 🔥 Fluorinated surfactants are proven and have a long history of effective use in AFFF foams
- 🔥 Fluorine-Free foams is a maturing technology, developed to meet a growing market demand in specific application areas
- 🔥 Performance vs. impact trade-offs exist for all foam types
- 🔥 ECOGUARD passes UL 162 topside and sprinkler test requirements (UL approved)
- 🔥 ECOGUARD meets EN 1568 (IIIB) test requirements (independently verified)
- 🔥 Chemguard continues to develop new chemical technology in both fluorocarbon-surfactant and hydrocarbon-surfactant areas for future foam improvements

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