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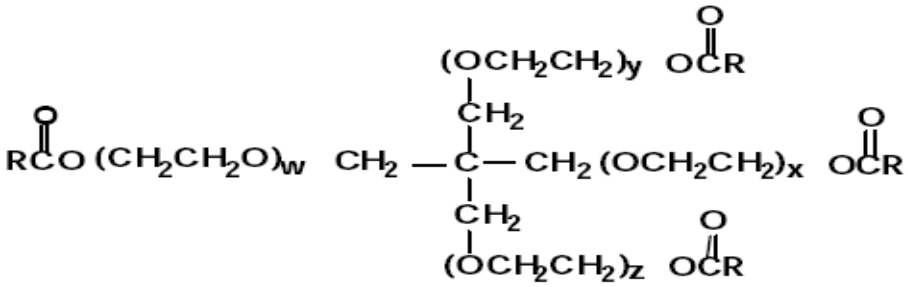
INCI Name: PEG-150 Pentaerythrityl Tetrastearate

CROTHIX* is a patented high performance thickener developed for aqueous surfactant systems. As a complex high molecular weight ester, **CROTHIX** is truly multi-functional. Not only is it superior as a thickener, but it is also effective as a diethanolamide (DEA) replacement and a mitigator of irritation. As a thickener, **CROTHIX** is efficient as well as effective, producing substantial viscosity even at low levels. As a (DEA) replacement, the product is a safe alternative providing similar viscosity and foam stabilization. As a mitigator of irritation, it is a viable means of lowering the irritancy potential of the surfactant system itself. What's more—**CROTHIX** requires no neutralization, forms no nitrosamine byproducts, and works especially well in clear systems.

Structure of CROTHIX



Where R is the stearic acid fatty moiety and (w+x+y+z) = 150

With **CROTHIX**, formulators can create mild, rheologically balanced shampoos, body washes, shower gels, liquid soaps or other soap based systems and offer products that are free of DEA and substantially less irritating. As a pastille, **CROTHIX** also allows you to formulate problem-free without the handling hassles or dusting hazards some materials cause. **CROTHIX** is approved for use in Japan as *Polyoxyethylene Pentaerythritol Tetrastearate (150EO)* and is suitable for shampoo products you market globally.

- *The use of **CROTHIX** in cosmetic and other formulations is covered under U.S. Patent # 5,192,462.*

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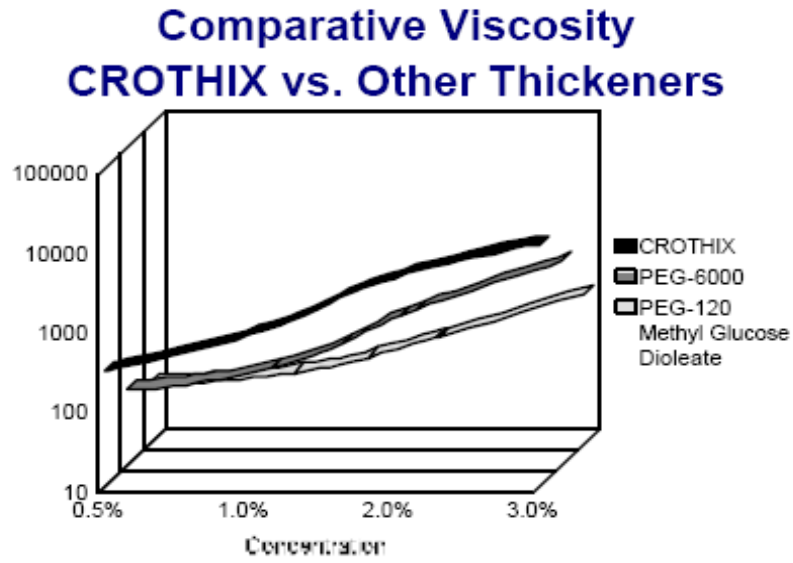
Thickening Performance

As the graph indicates, **CROTHIX** provides higher viscosity from an ALS shampoo base at all concentrations, compared to PEG-6000 Distearate or to PEG-120 Methyl Glucose Dioleate. Such dramatic viscosity-modifying effects demonstrate both the effectiveness and the efficiency with which **CROTHIX** thickens surfactant systems.



CROTHIX can be used to thicken shampoos, conditioners, soaps and other liquid

bath products or to bolster the viscosity of gels and is able to do so at levels as much as 40% below those of conventional thickeners. Because it produces increasing viscosity with increasing concentration, **CROTHIX** is also a more reliable and consistent means of thickening than salt, with none of its undesirable characteristics or its tendency to salt-out. Such unpredictable behavior can be observed by running a salt curve.

CROTHIX is extremely effective as a thickener for clear systems (including clear conditioners) and for hard-to-thicken systems (even iodine-based pet shampoos). For instance, it has successfully thickened a clear, acid-balanced (pH 5.7) shampoo containing sodium lauroyl sarcosinate (viscosity: 2000cps).[1] In a published paper **CROTHIX** was cited for its viscosity increasing effects on sarcosine surfactants.[2]

CROTHIX also works well with INCRODET TD-7 C, provided the pH of the system remains between 5.0-8.5. INCRODET TD-7 C is a carboxylated surfactant that lends itself well to acid-balanced shampoos.

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DEA Replacement Data
Formulators can use **CROTHIX** to thicken systems that are being reformulated without DEA. Our Applications Laboratory has found that blends containing **CROTHIX** and CROSULTAINE C-50 *(Cocamidopropyl Hydroxysultaine)* in various ratios work well as functional equivalents to Lauramide DEA in terms of both viscosity and foam height. CROSULTAINE C-50 was used specifically because of its ability to produce flash foam. *(See chart below; also refer to the Alkanolamide Replacement Guide, DS-132-1.)* Precise use levels, viscosity data, and foam heights allow formulators to calculate a ratio that is specific to their own formula. Testing was conducted using single surfactants alone, *i.e.,* Ammonium Laureth Sulfate (*ALES)* and Ammonium Lauryl Sulfate *(ALS),* as well as surfactant blend systems of the two and of Sodium Laureth Sulfate/Sodium Lauryl Sulfate *(SLES/SLS)*.

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			ALES (2 mol, 10% Active)	
	If you use…		*Replace with…*	*Or…*
	Lauramide DEA: 5%		CROSULTAINE C-50: 2.5% CROTHIX: 3.1%	CROSULTAINE C-50: 8.12% CROTHIX: 0.01%
*Viscosity, cps Foam Height, ml	9,600 1,033		8,800 883	9,200 820
			ALS (10% Active)	
	If you use…		*Replace with…*	
	Lauramide DEA: 5%		CROSULTAINE C-50: 2.5% CROTHIX: 2.0%	
*Viscosity, cps Foam Height, ml	9,400 863		10,200 833	
			ALS/ALES (2:1, 10% Active)	
	If you use…		*Replace with…*	
	Lauramide DEA: 5%		CROSULTAINE C-50: 4.0 CROTHIX: 2.0%	
*Viscosity, cps Foam Height, ml	14,800 847		13,000 923	
			SLS/SLES (2:1, 10% Active)	
	If you use…		*Replace with…*	
	Lauramide DEA: 5%		CROSULTAINE C-50: 2.5% CROTHIX: 0.3%	
**Viscosity, cps Foam Height, ml	80 883		60 973	

Counter-Irritancy Data

Given the Industry's focus on mildness, **CROTHIX** can be of great benefit in both skin care and hair care, in that the product has been shown to actually lower the potential for skin irritation in surfactant-based systems. New data we have generated suggests that **CROTHIX** has mitigating effects that help reduce the irritation potential of surfactant or surfactant blend systems.

In one *in vitro* study evaluating the effects of various **CROTHIX** concentrations on SLS-induced cell death, our Cell Biology Laboratory found that **CROTHIX** acts as a counter-irritant to decrease SLS mediated cell death and does so at an optimum

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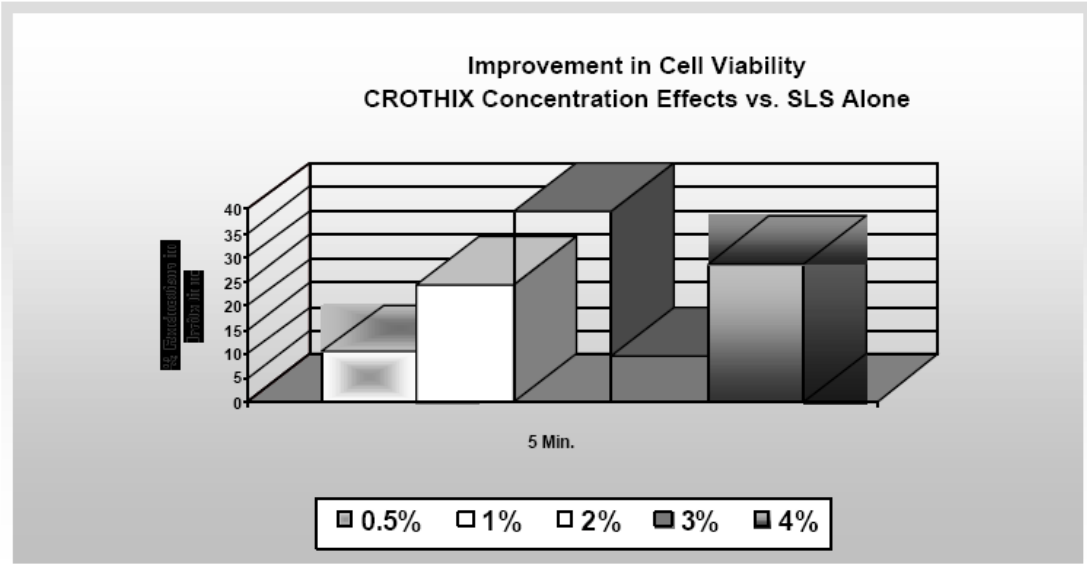
concentration of 2%. During testing, changes in cell viability were evaluated over time at one, five, and ten minutes after exposure to 10% SLS with and without **CROTHIX**.

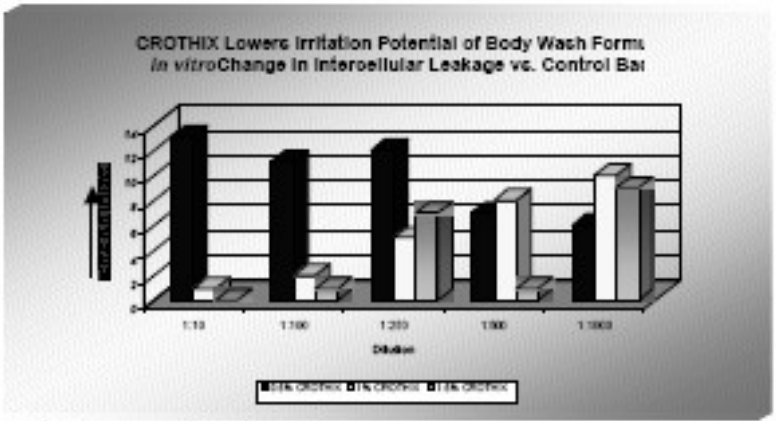


Control represented by the baseline

*The ability of **CROTHIX** to mitigate irritation may be due in part to the product's high molecular weight and complex branched structure.*

The study was conducted using the EpiOcular™ Tissue Model (MatTek Corporation, Ashland MA). Cell survival rates were measured using the MTT Assay which is an accepted method of assessing cell viability. Values given represent changes in cell viability as compared to the 10% SLS positive control.

A second study evaluated **CROTHIX** in a body wash at normal use dilution strengths and found that the product's mitigating effects on irritation also hold true under these real-use conditions *(see graph on the following page)*. The study was conducted using the Trans-Epithelial Permeability (TEP) assay which is an *in vitro* replacement for the Draize Eye Irritation Assay. TEP is a very sensitive and highly reproducible means of assessing surfactant cleanser systems at use dilution levels and is considered a more reliable method than the MTT assay.[3] In healthy skin, cell membranes composed of lipid bilayers and proteins hold the stratum corneum intact and prevent fluid from leaking through. When the skin experiences insult, the lipid bilayer is perturbed, causing cells to pull apart and leave gaps where cellular leakage can occur. With TEP, layers of cultured kidney cells are grown on tissue culture inserts modeling the non-keratinized epiderm and are treated with test material and controls. Na-fluorescein is added directly onto the cell monolayer. Whatever Nafluorescein accumulates in the wells below the filter is measured and used as a marker for intercellular leakage.



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***CROTHIX** reduces irritation at all concentrations over the use dilution range. Optimum irritation mitigation is seen with 0.5% **CROTHIX**.*

Base formula:
SLES (3) 20% active, Crosultaine C-50 12% active, Germaben II 1%, q.s distilled deionized water, **CROTHIX** at 0.5%, 1.0%, or 1.5% (pH 6-7).

CROTHIX Stabilizes Foam Height:
The effect of varying concentrations of **CROTHIX** on the foam height of the body wash formula was determined using the ASTM Standard Method of Test for Foaming Properties of Surface-Active Agents. All foam heights were measured at 1:100 dilution in distilled deionized water. The results show that **CROTHIX** has a stabilizing effect on the foam. Values are expressed as centimeters.

Formula	Foam Height (cm)	
	T=0 min	T=5 min
Base	13	12
0.5% **CROTHIX**	12	11.5
1.0% **CROTHIX**	12	11.9
1.5% **CROTHIX**	12	11.8

CROTHIX is freely soluble in anionic, nonionic or amphoteric surfactant systems and is compatible with cationic salts. As a surfactant-based thickener, **CROTHIX** s*hould first be premixed with the surfactant or surfactant blend*, preferably with an emulsifier that is nonionic, such as Oleth-20 (VOLPO 20), Polysorbate 80 (CRILLET 4), PPG-5 Ceteth 20 (PROCETYL AWS) or one of the higher ethoxylated vegetable oils (CROVOL 70 series). Using a blend of **CROTHIX** and any one of these materials in a ratio of 2:5 (***CROTHIX**:nonionic emulsifier*) works well and yields a surfactant base that is extremely effective in thickening a variety of formulations. Once this surfactant solution is heated to around 60-70°C, the mixture can be added to the oil phase. **CROTHIX** is best used at a pH between 5.0 and 9.0, tolerates salt well and unlike carbomers, does not need to be neutralized. Recommended use levels: 0.25-5%.

Typical Analysis

APPEARANCE	Pastille
COLOR	White to off-white
ODOR	Mild, characteristic
ACID VALUE	5.0 max.
HYDROXYL VALUE	10 max.
MOISTURE CONTENT	1.0% max.

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The data submitted in this publication are based on our current knowledge and experience. They do not constitute a guarantee in the legal sense of the term and, in view of the manifold factors that may affect processing andapplication, do not relieve those to whom we supply our products from the responsibility of carrying out their own tests and experiments. Any relevantpatent rights and existing legislation and regulations must be observed.

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