re: Chevron
3369 C.V. Bl.

PACIFIC
ENVIRONMENTAL
GROUP, INC.

FACSIMILE TRANSMITTAL

DATE: January 31, 1996 PROJECT #: 320-156.1A

TO: Scott Seery FAX: 510/337-9335

Alameda County Department of
Environmental Health

FROM: Mark Sullivan

IF YOU HAVE ANY PROBLEMS RECEIVING THIS FACSIMILE, PLEASE CALL (408) 441-7500

SHEETS TO FOLLOW COVER PAGE

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COMMENTS:

Scott, I have attached the information that you requested regarding the liners used at the Castro Valley Blvd. and Wilbeam Ave. Chevron site. It appears that Geoprobe conducted their own analysis of the liners and determined that the loss of VOCs during a 40 hour period at elevated temperatures was insignificant (less than 2%). Additionally, I have included information from Eastman Chemical Co. (the liner manufacturers) that provides the chemical and mechanical properties. The "Effect of Various Chemicals and Reagents..." table indicates that submersing the liners in 100% gasoline for one year is not recommended. Consider this information and give me a call to discuss; my number is 408/441-7500.

2025 Gateway Place, Suite 440, San Jose, California 95110 (408) 441-7500 FAX (408) 441-7539

CELLULOSE ACETATE BUTYRATE LINER INFORMATION

The most widely-used type of liner in the Geoprobe Systems Large Bore Soil Sampler is composed of a cellulose acetate butyrate (CAB) supplied by Eastman under the band name of "TENITE". This CAB is a cellulose thermoplastic widely used in many injection-molding and extrusion applications. Since this substance is a cellulose based polymer, it has no exact formula and likely has an average molecular weight in excess of a million atomic mass units.

The method of CAB (Tenite) production by Eastman is unknown, but this polymer can be produced in a lab by the esterification of cellulose with acetic anhydride in the presence of butyric acid. Eastman has added special formulation substances to the CAB that inhibit ultraviolet radiation, mask odors, and increase the plastic nature of the polymer. This butyrate is a useful combination of toughness, hardness, and strength, which through the proper choice of formulation and flow, provides a very good material of composition for soil sample liners.

Testing of the CAB liner material has been performed at Geoprobe Systems. These tests related to Tenite CAB stability and permeability (for a single set of parameters). A mixture of unidentified volatile organic compounds (VOC) in a soil sample was used. At an elevated temperature level (similar to being exposed to direct sunlight in a closed vehicle), there was no evidence of sample contamination. At the same elevated temperature, there was less than a 2 % loss of VOC through the CAB liner in a 40 hour storage period. Extended storage periods or higher temperatures would likely result in greater loss.

A table of the effect of various chemicals and reagents on "TENITE" CAB is available from Eastman Chemical Company, P.O. Box 431, Kingsport, Tn. 37662-5280.

GEOPROBE SYSTEMS
04/17/95

L.B. 24"

Table 1 Formulas Guide

	Basic Formula	Basic Plus Odor Mask	Basic Plus UVI	Basic Plus Odor Mask and UVI
TENITE Acetate (Specific gravity approximately 1.29)	038 105 ▲108 ■110			485 567 ■576
TENITE Butyrate (Specific gravity approximately 1.18)	264 525 568	285 530 550 565 566 ■575 438 ●562	460 527 503 205 554 571 307 ▲307	461 462 465 505 ●513 528
TENITE Propionate (Specific gravity approximately 1.18)	358 350 311 363 361 ▲370 364 ▲369 360 ▲371 ■375 ■377		351 366 353 ▲357 362 372 ■376	

THIS FORMULA FOR 24" LB LINERS

Bold Numbers = Meets FDA requirements when supplied in FDA color numbers (For Propionate 350, only flows of 112 or harder meet FDA requirements.)

● = Contains lubricant for extrusion
▲ = Contains mold release
■ = Standard inventory clears

Table 2 Typical Properties

Property	Units	ASTM Method	Acetate 105-MS	Butyrate 264-MH	Propionate 360-H2
Specific Gravity		D 792	1.26	1.19	1.20
Tensile Strength at Yield (50 mm/min [2 in./min])	MPa	D 638	22.8	33.1	31.7
	psi		3000	4800	4800
Elongation at Break (50 mm/min [2 in./min])	%	D 638	30	50	45
Modulus of Elasticity in Bending (127 mm/min [0.05 in./min])	MPa	D 790	1310	1379	1448
	10^5 psi		1.9	2.00	2.10
Flexural Strength (1.27 mm/min [0.05 in./min])	MPa	D 790	33.1	45.5	41.4
	psi		4800	6600	6000
Izod Impact Strength at 23°C (−40°C) (3.2 mm x 12.7 mm [⅛ in. x ½ in.] specimen)	J/m	D 256	235 (59)	240 (96)	416 (107)
	ft-lbf/in.		4.4 (1.1)	4.5 (1.8)	7.8 (2.0)
Deflection Temperature (conditioned 4 h @ 70°C)					
at 1.82 MPa (264 psi)	°C (°F)	D 648	57 (135)	74 (165)	75 (167)
at 0.455 MPa (66 psi)	°C (°F)		70 (158)	85 (185)	83 (181)
Light Transmission (1.52 mm [0.060 in.] thickness	%	E 308	>90	>90	>90
UV Light Screening (>99% Absorbed)	%	F 308	— Formulations Available Upon Request —		
Haze (1.52 mm [0.060 in.] thickness)	%	D 1003	<8.5	<8.5	<8.5
Coefficient of Linear Thermal Expansion	°C⁻¹	D 696	12×10^{-5}	12×10^{-5}	11×10^{-5}
	°F⁻¹		7×10^{-5}	7×10^{-5}	6×10^{-5}
Dielectric Strength	kV/mm	D 149	14.5	16.6	15.9
	V/mil		368	422	404
Dielectric Constant	@ 10^6 Hz	D 150	3.5	3.3	3.3
Dissipation Factor	@ 10^6 Hz	D 150	0.05	0.02	0.03
Volume Resistivity	ohm-cm	D 257	1.6×10^{13}	1.8×10^{15}	2.6×10^{15}
Surface Resistivity	ohm/sq	D 257	6.8×10^{14}	1.4×10^{16}	3.9×10^{16}

This is the material for the 2 foot sampler

TENITE Butyrate Formulas 264, 285, 485, 530, 550, 565, 566, 575, 576

575E 3700-10

Property*	Unit	ASTM Method								
Plasticizer	%	—	1	3	5	8	10	13	16	20
Flow Designation		D 569	H4	H3	H2	H	MH	M	MS	S
Flow Temperature	°C	D 569	170	165	160	155	150	145	140	13[illegible]
	°F		338	329	320	311	302	293	284	27[illegible]
Specific Gravity		D 792	1.22	1.21	1.20	1.20	1.19	1.15	1.17	1.1[illegible]
MECHANICAL										
Tensile Strength at Yield 50 mm/min (2 in./min)	MPa	D 638	49.6	45.5	40.7	37.2	33.1	29.0	25.5	21.[illegible]
	psi		7200	6600	5900	5400	4800	4200	3700	31[illegible]
Tensile Strength at Break 50 mm/min (2 in./min)	MPa	D 638	55.8	53.8	51.0	47.6	43.4	39.3	33.8	27.[illegible]
	psi		8100	7800	7400	6900	6300	5700	4900	40[illegible]
Elongation at Break 50 mm/min (2 in./min)	%	D 638	55	55	55	50	50	50	50	50
Modulus of Elasticity in Bending 1.27 mm/min (0.05 in./min)	MPa	D 790	1999	1862	1724	1596	1379	1241	1103	96[illegible]
	10^5 psi		2.90	2.70	2.50	2.30	2.00	1.80	1.60	1.4[illegible]
Flexural Strength 1.27 mm/min (0.05 in./min)	MPa	D 790	69.6	63.4	57.2	51.0	45.5	39.3	33.1	27.[illegible]
	psi		10100	9200	8300	7400	6600	5700	4800	40[illegible]
Rockwell Hardness	R Scale	D 785	106	102	94	88	78	59	40	12[illegible]
Izod Impact Strength 3.2 mm x 12.7 mm at 23°C	J/m	D 256	117	139	165	198	240	283	331	38[illegible]
	ft·lbf/in.		2.2	2.6	3.1	3.7	4.5	5.3	5.2	7.2
	[illegible]		[illegible]	[illegible]	[illegible]	[illegible]	96	101	107	11[illegible]

Effect of Various Chemicals and Reagents on TENITE® Butyrate

Material Tested	Time Exposed	Percent Increase Weight	Percent Increase Thickness	Observed Condition of Plastic
Miscellaneous Chemicals and Gases (Cont.)				
Hydrogen Sulfide, saturated solution	2 months	5.87	2.34	Unchanged
Hydroquinone, 20 g per gallon	1 week	2.39	0.99	Slightly stained yellow
*Methyl Methacrylate Monomer				Dissolved
*Nitrobenzene				Dissolved
Ozone, 0.05-0.15 ppm	45 days (outdoors)			Unchanged
Ozone, 0.7 ppm	45 days (49°C, 120°F)			Yellowed
*Phenol	1 week			Decomposed
*Styrene Monomer				Dissolved
Sulfur, solid	1 week			Unchanged
*Sulfur Dioxide, dry	2 months	19.40	8.60	Swollen, slightly warped
*Sulfur Dioxide, moist	2 months	31.90	10.20	Considerably swollen and warped
*Sulfur Dioxide, saturated solution	2 months	23.20	18.10	Swollen and warped
*Sulfur Dioxide in Hydrocarbons				Dissolved
*Sulfur Dioxide and Hydrocarbon Vapor	2 months	19.20	11.50	Swollen
*Titanium Tetrachloride	3 days			Very brittle
Trinitrotoluene (TNT), water slurry	4 weeks			Stained
COMMERCIAL AND NATURAL PRODUCTS				
Aeronautical and Automotive Items				
Dane Head Radiator Sealer	3 weeks (50°C, 122°F)			Unchanged
Gasolines:				
*Amoco Regular	1 year	7.7	5.5	Swollen and stained yellow
*Amoco Premium	1 year	18.4	9.5	Swollen
Aviation 100 Octane (Standard Oil Company)	1 year	3.03	3.20	Slightly discolored
*Aviation 115-145 Octane (Socony Vacuum Oil Company)	1 year	5.21	6.06	Slightly stained
*Exxon Extra	1 year	13.9	9.8	Swollen and stained pink
*Exxon Regular	1 year	5.19	5.77	Swollen and stained pink
*Shell High-Test	1 year	11.9	7.5	Swollen and stained pink
*Shell Regular	1 year	9.9	8.1	Swollen and stained yellow

**Indicates that material is generally unsatisfactory for use in contact with TENITE Butyrate under the conditions of this test.*

Effect of Various Chemicals and Reagents on TENITE® Butyrate

Material Tested	Time Exposed	Percent Increase		Observed Condition of Plastic
		Weight	Thickness	
Aeronautical and Automotive Items (Cont.)				
*Texaco Fire Chief	1 year	9.7	7.0	Swollen and stained yellow
*Texaco Sky Chief	1 year	15.0	12.1	Swollen and stained pink
Hydraulic Fluids:				
*Delco Super 9 Brake Fluid	1 week			Swollen and softened
*Du Pont No. 7 Heavy-Duty Brake Fluid (VV-B-860)	Screwdriver handle dipped in fluid and allowed to stand 3 days passed torsional requirement of Federal Specification GGG-S-121d			Dissolved
*Indian Head Brake Fluid	1 week			Swollen and stained
*Skydrol Hydraulic Fluid				Dissolved
*Skydrol 500 Hydraulic Fluid				Dissolved
*Wagner 21-B Brake Fluid	1 week			Swollen and softened
Jet Propulsion Fuel 1A	8 months	3.42	3.01	Unchanged
Jet Propulsion Fuel 3	8 months	3.87	3.22	Unchanged
Jet Propulsion Fuel 4	8 months	3.39	3.22	Unchanged
Jet Propulsion Fuel 5	8 months	0.29	0.32	Unchanged
Kerosene	1 week	0.41	1.32	Unchanged
Oils:				
Aeroshell No. 2	2 months	0.27	0.00	Unchanged
Aeroshell No. 12	1 year	0.60	0.34	Unchanged
Aeroshell Turbine Oil No 300	3 days (49°C, 120°F)	0	0	
Bearing Guard Oil	4 weeks	0.04		Unchanged
Duo-Drive Oil	4 weeks (50°C, 122°F)			Unchanged
Houghton Safe 1120 Lubricating Oil	1 week	<1	<1	Unchanged
MIL-L-7808 Oil	Screwdriver handle dipped in oil and allowed to stand 3 days passed torsional requirement of Federal Specification GGG-S-121d.			

**Indicates that material is generally unsatisfactory for use in contact with TENITE Butyrate under the conditions of this test.*