HFP 1:1

LOW-MODULUS, 1:1 RATIO, HIGH FRICTION SURFACE POLYMER

DESCRIPTION
HFP 1:1 is a moisture-insensitive, low-modulus, two-component high friction surface polymer.

APPLICATIONS
HFP 1:1 is designed for binding High Friction Surfacing Aggregates to asphalt and concrete on grade and elevated surfaces. Specific applications include:
- Asphalt roadways
- Bridge decks
- Roadway departure areas
- Horizontal curves
- Stop zones / Intersections
- High grade roadways
- Parking structures

ADVANTAGES
- Excellent bond strength
- Moisture insensitive to minimize contaminants
- High early strength
- High tensile elongation allows for non-linear expansion and contraction (move with the roadway)
- High tensile strength for superior retention of aggregates
- High range of flexibility
- Easy to mix - 1:1 ratio
- Fast set time for quick return to traffic
- Designed for automated pump or hand mix application
- Non-regulated, hazmat certification or placards not required for transport.

COMPLIANCES
- Tested to AASHTO PP79 standards [Title: *High Friction Surface Treatment for Asphalt and Concrete Pavements*]
- Transportation within the United States is non-regulated by the DOT

PACKAGING
10-gallon unit
- Component A: (1) 5-gallon pail
- Component B: (1) 5-gallon pail

110-gallon unit
- Component A: (1) 55-gallon drum
- Component B: (1) 55-gallon drum

500-gallon unit
- Component A: (1) 250-gallon tote
- Component B: (1) 250-gallon tote

Appearance of Components: A - Clear, B - Amber
Shelf Life: 2 years in original unopened container
Storage: 50°F to 95°F in dry and dark conditions
Temperature Considerations: IMPORTANT! Epoxy resins are temperature sensitive and care should be taken to condition all components to between 65°F to 95°F for a minimum of 24 hrs. prior to mixing and placement. Temperatures colder than stated range increase viscosity of resins and inhibit mixing and flow of materials. Temperatures warmer than stated range decrease viscosity of resins, hasten the cure and reduce the working time. Mixing and curing at less than ideal temperatures, <60°F or >95°F, will require special considerations.

Special considerations include heating epoxy & mechanical placement, both of which we have. See E-Chem email.

COVERAGE
Minimum Coverage Rates:

	Epoxy	Aggregate
Asphalt Road	1 gallon/26-32 sq. ft.	14-20 lbs./sq. yd.

CURE TIME
Use the table below to determine minimum cure times based on the temperature of the materials and substrate.

	Average Temperature of Materials & Substrate (°F)					
Cure Temp	60-64	65-69	70-74	75-79	80-84	85+
Cure Time	3 hrs	2.5 hrs	2 hrs	1.5 hrs	1 hr	1 hr

*Set times are merely averages, site conditions will dictate actual cure response for sweeping as well as open to traffic time.

INSTALLATION
Surface Preparation: Remove all traffic control markings from roadway, if required. CONCRETE: For concrete surfaces, clean surface by shot-blasting to remove all contaminants. Concrete surface should be at a minimum ICRI CSP 5 for surface roughness. Remove dust and debris by blowing off with oil-free compressed air. Prefill cracks larger than 1/4" with premixed resin, add aggregate to larger voids. ASPHALT: For asphalt surfaces, clean pavement using mechanical sweepers and blow down with oil-free compressed air to remove all dirt, debris and surface contaminants. Prefill cracks larger than 1/4" with premixed resin, add aggregate to larger voids. Asphalt surfaces should be at least 45 days old prior to applying HFP 1:1.

Mixing: Mechanically mix Component A with Component B 1:1 by volume with Jiffy type mixer and low-speed variable drill at 300 rpm for a minimum of 3 minutes. Mix only the quantity that can be used within its gel time. BULK: For bulk mixing, a positive displacement pump, incorporating a static mixing wand and meter, is recommended.

Placement: Apply neat HFP 1:1 by pouring the material on the surface. Distribute material evenly with a ¼" notched squeegee or other approved placement method. Epoxy resin should be uniform in coverage, no puddles, sags or rippled areas. Broadcast select aggregate to properly cover liquid resin to refusal. The aggregate should be moisture free and free of dirt, clay, etc., and manufactured for HFST applications. After cure, remove excess aggregate prior to opening to traffic. Please consult with E-Chem for Project Specification Guidance.

LIMITATIONS
- For professional use only
- Do not thin with solvents
- Compressed air equipment must have an oil/air separator.
- Minimum age of concrete must be 28 days before applying as a HFST.
- HFP 1:1 is a vapor barrier after curing.

Epoxy will be stored in a heated trailer prior to use. Once loaded onto our truck, it will be kept warm by our heated tanks.

E-Chem, LLC | 4102 El Rey Rd. SE | Albuquerque, NM 87105 | Phone: 505-217-2121 | Fax: 505-217-3721
www.e-chem.net

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- Substrate temperatures must be 50°F and rising prior to installation: 50°F minimum must be maintained during stated cure period. See E-Chem email.
- Consult E-Chem representative when mixing or placing outside of the temperature recommendations listed.

CLEAN UP

EQUIPMENT: Uncured material can be removed with C-Clean 100 or approved solvent. Cured material can only be removed mechanically.

MATERIAL: Collect with absorbent material. Flush area with water. Dispose of in accordance with local, state and federal disposal regulations.

CAUTIONS

READ SDS PRIOR TO USING PRODUCT!

- Component A: Irritant
- Component B: Irritant
- Product is a strong sensitizer. Use of safety goggles and chemical resistant gloves are recommended.
- Use in a well-ventilated area and avoid breathing vapors
- Use of a NIOSH/MSHA organic vapor respirator is recommended if ventilation is inadequate.
- Avoid skin contact

FIRST AID

EYE CONTACT: Flush immediately with water for at least 15 minutes. Contact physician immediately.

RESPIRATORY CONTACT: Remove person to fresh air.

SKIN CONTACT: Remove any contaminated clothing.

Remove epoxy immediately with a dry cloth or paper towel. Solvents should not be used as they carry the irritant into the skin. Wash skin thoroughly with soap and water.

IF INGESTED: Do not induce vomiting. If swallowed give water to drink. Seek medical treatment immediately.

GENERAL: Remove contaminated soaked clothing immediately. In the event of persistent symptoms receive medical treatment.

CURED EPOXY RESINS ARE INNOCUOUS.

WARRANTY

This product is warranted and guaranteed to be of good quality. Manufacturer, as its sole and exclusive liability hereunder, will replace material if proved defective. This warranty and guarantee are expressly in lieu of all others, express or implied, including any implied warranty of merchantability or fitness for a particular purpose and may not be extended by representatives or any persons, written sales information, or drawing in any manner whatsoever. While the manufacturer recommends uses for the product based on tests believed reliable, no warranties, express or implied, or guarantees can be given as to particular methods of use or application, nor can performance be warranted, expressly or impliedly, or guaranteed under special conditions. Distributors, salespersons or company representatives are not authorized to extend or vary any warranties or guarantees beyond those outlined herein, nor may the manufacturer's or seller's limitation of liability be waived or altered in any manner whatsoever.

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TEC Services
Testing • Engineering • Consulting

January 16, 2019

Mr. James High
E-Chem, LLC
4102 El Rey Rd SE
Albuquerque, NM 87105

Email: James@e-chem.net
Phone: 505-554-0659

Subject: **Report of Product Testing – AASHTO PP79**
Product: HFP 1:1
TEC Project No: 16-1306
TEC Laboratory No: 18-1407-1

Dear Mr. High:

Testing Engineering & Consulting Services, Inc. (TEC Services) is an AASHTO R18, ANS/IEC/ISO 17025:2005, and Army Corps of Engineers accredited laboratory. TEC Services is pleased to present this report of testing on the subject product submitted to our laboratory on December 10, 2018. Testing was performed in accordance with the terms and conditions of our Service Agreement (TEC-PRO-16-1306). These test results pertain only to the sample tested. The purpose of the testing was to evaluate the submitted product in accordance with the below referenced standards. Mix proportions are reported in Table 1. Summary test results are reported in Table 2. Complete test results are reported in Tables 3-6.

- ASTM D570-10 *Standard Test Method for Water Absorption of Plastics*
- ASTM D638-10 *Standard Specification for Tensile Properties of Plastics*
- ASTM D2240-10 *Standard Test Method for Rubber Property—Durometer Hardness*
- AASHTO M235 *Standard Specification for Epoxy-Resin Bonding Systems for Concrete*
- ASTM C579-12 *Standard Test Methods for Compressive Strength of Chemical-Resistant Mortars, Grouts, Monolithic Surfacings, and Polymer Concretes*
- ASTM E1252-13 *Standard Practice for General Techniques for Obtaining Infrared Spectra for Qualitative Analysis*
- ASTM D4541-17 *Standard Test Method for Pull-Off Strength of Coatings Using Portable Adhesion Testers*
- ASTM D1640-14 *Standard Test Methods for Drying, Curing, or Film Formation of Organic Coatings*
- AASTHO PP79 *Standard Practice for High-Friction Surface Treatment for Asphalt and Concrete Pavements*
- ASTM C881-15 *Standard Specification for Epoxy-Resin Bonding Systems for Concrete*
- ASTM C1583-13 *Standard Test Method for Tensile Strength of Concrete Surfaces and the Bond Strength or Tensile Strength of Concrete Repair and Overlay Materials by Direct Tension (Pull-off Method)*
- ASTM D2556-14 *Standard Test Method for Apparent Viscosity of Adhesives Having Shear-Rate-Dependent Flow Properties Using Rotational Viscometry*
- ASTM D1084-16 *Standard Test Methods for Viscosity of Adhesives*
- ASTM D2196-18 *Standard Test Methods for Rheological Properties of Non-Newtonian Materials by Rotational Viscountess*

AASHTO M235/ASTM C881 – Gel Time - Neat

The components and equipment were conditioned to 75 ± 2°F prior to and during testing. Gel time was measured by placing approximately 60g of the mixed epoxy into an 8oz paper cup at the referenced temperature. The material was probed with a wooden tongue depressor every two minutes until a soft gelatinous mass formed in the center of the sample.

ASTM D2196/ D2556/ D1084 – Viscosity - Neat

The Brookfield DV-E Viscometer was leveled prior to testing, and the subject product was transferred to a 350 mL plastic cup capable of accommodating the viscometer spindle. The spindle was submerged in the material up to the reference mark and adjusted to the highest spindle speed capable of achieving a reading between 20% and 80% of torque. Viscosity was recorded in centipoise and is reported with spindle size, motor speed, and percent torque in Table 2.

ASTM D638 - Tensile Properties - Neat

Tensile strength and elongation were performed in accordance with ASTM D638 using Type I specimens. Five test specimens were cast and cured at 75 ± 2°F until the time of testing at an age of 7 days. The rate of testing was 0.2 in./min of crosshead displacement. Elongation was determined using a 2.00 inch gage length.

ASTM D570 – Water Absorption - Neat

Water absorption was determined in accordance with ASTM D570. Three test specimens were prepared and cured at laboratory temperature until the date of testing. After curing for 7 days the disks were submerged in water for 24 hours. The initial and final weights were used to calculate the percent absorption.

ASTM D4541/C1583 – Bond Strength to Concrete - Neat

The subject material was applied to a 18" x 18" x 1.75" concrete substrate with an ICRI CSP-3 finish at a wet film thickness of 55-60 mils applied in a single coat. The specimen was allowed to cure at ambient laboratory conditions for 24 hrs. The specimen was wet cored in three areas to a depth of 0.5" and bond test fixtures were adhered to the cored areas and allowed to cure prior to testing. Testing was performed using a Prosec DY-216 pull off tester at a loading rate of 5 psi/sec until failure.

ASTM C579 – Method B – Loading Rate II - Compressive Strength – Extended

Compressive properties were determined in accordance with C579 Method B – Loading Rate II. The epoxy was mixed and extended with ASTM C778 20-30 sand using the proportions shown in Table 1. The mold was filled approximately 1/2 full with the extended mixture. The layer was then rodded to ensure sufficient distribution. This was repeated to obtain a single specimen. Nine extended 2" x 2" cubes were prepared and cured at laboratory temperature until the time of testing at ages of 3 hrs, 24 hrs, and 7 days. The specimens were loaded at a rate of 0.25 in./min of crosshead displacement until failure.

ASTM E1252 – FTIR of Components

Infrared spectra of the two components were collected with a PerkinElmer Spectrum 2 FT-IR spectrometer, fitted with a UATR (Single Reflection Diamond) Accessory; spectra were recorded over the range 4000-450 cm-1, with a resolution of 4 cm-1 and 16 accumulations and the sample positioned parallel at a nominal origin of 0° to the ATR crystal. Information pertaining to the product is reported in Table 1. The scans for each component and identified peaks are attached to this report.

Table 1 – Product Information & Mix Proportions

Product Name	HFP 1:1
Lot #	A - 2.181010 | B – 2.180810
Lot Size	Unknown
Conditioning Temperature	75 ± 2°F
Curing Temperature	75 ± 2°F specials say 73+/-2 & 50+/-2
Test Temperature	75 ± 2°F specials say 73+/-2
Components	2 Component
Mix Proportions A:B	1.000 | 0.835 by weight
Extended Mix Proportions	2.75 Sand | 1.00 Combined Epoxy by volume
Part A	218 g
Part B	182 g
Part C (C778 20-30 Sand)*	1877g
Mixing Time	3 minutes
Mixer Type	Drill Paddle – Extended | Hand Mix - Neat

See E-Chem email.

*Extended specimens only

Table 2 – Summary Test Results

ASTM	Test Property	Age	Average Test Result	AASHTO PP79 Polymeric Requirements
D2196/D2556/D1084	Viscosity (Ps)	Plastic	**15.5**	7 - 30
AASHTO M235/ ASTM C881	Gel Time – 60g (min.)	Plastic	**18**	10 minutes (min.)
D1640	Drying Time – 50-55 wet mils (min.)	Plastic	**92**	180 minutes (max.)
D570	Water Absorption 24 hr Immersion (%)	7 days	**0.15**	1% (max)
D2240	Shore D Hardness	7 days	**78**	60 - 80
D4541/C1583 (Neat)	Tensile Bond Strength to Concrete (psi)	24 hrs	**480 100 % Substrate Failure**	250 psi or 100% Substrate Failure
C579 (Extended)	Compressive Strength (psi)	3 hrs	**1,630**	1,000 (min.)
		24 hrs	**5,095**	NA
		7 days	**6,780**	5,000 (min.)
D638 (Neat)	Tensile Strength (psi)	7 days	**4,100**	2,500 – 5,000
	% Elongation		**33.6**	30 - 70

Table 3 – ASTM D638 – Tensile Properties – Neat – Type I Specimens - 7 days

ID	Width (in.)	Thickness (in.)	Area (in^2)	Peak Load (lbf.)	Tensile Strength (psi)	% Elongation
1	0.499	0.148	0.0735	333	4,530	34.2
2	0.498	0.164	0.0817	308	3,770	32.6
3	0.502	0.121	0.0607	241	3,970	29.5
4	0.501	0.112	0.0559	242	4,330	35.6
5	0.500	0.170	0.0847	332	3,920	36.0
				Average	**4,100**	**33.6**

Table 4 – ASTM C579 – Compressive Properties - Extended

Age	ID	Width (in.)	Length (in.)	Area (in^2)	Peak Load (lbf.)	Peak Stress (psi)
3 hrs	1	2.00	2.00	4.00	6,555	1,640
	2	2.00	2.00	4.00	6,556	1,640
	3	2.00	2.00	4.00	6,432	1,610
	Average					**1,630**
24 hrs	1	2.00	2.00	4.00	20,350	5,090
	2	2.00	2.00	4.00	20,279	5,070
	3	2.00	2.00	4.00	20,500	5,125
	Average					**5,095**
7 days	1	2.00	2.00	4.00	27,181	6,800
	2	2.00	2.00	4.00	28,243	7,060
	3	2.00	2.00	4.00	25,952	6,480
	Average					**6,780**

Table 5 – ASTM D570 – Absorption - Neat

Specimen #	Diameter (in.)	Thickness (in.)	Initial Weight (g)	Weight After 24hr Soak (g)	Difference (g)	% Absorption
1	2.00	0.1640	8.3509	8.3638	0.0129	0.15
2	2.00	0.1500	7.5185	7.5289	0.0104	0.14
3	2.00	0.1520	7.9513	7.9639	0.0126	0.16
					Average	**0.15**

Table 6 - ASTM D4541/C1583 – Direct Tensile Bond Strength to Concrete – Neat – 24 hrs

Specimen	Sample Diameter (in.)	Bond Area (in^2)	Peak Pull Off Load (lbf)	Bond Strength (psi)	Material Where Failure Occurred	Avg Bond Strength (psi)
1	2.00	3.14	1,550	494	Concrete Substrate	**480**
2	2.00	3.14	1,478	471	Concrete Substrate	
3	2.00	3.14	1,496	476	Concrete Substrate	

Summary

Based on results to date the submitted product meets the requirements of AASTHO PP79 Standard *Practice for High-Friction Surface Treatment for Asphalt and Concrete Pavements* for a Polymeric Resin.

We appreciate the opportunity to provide our services to you on this project. Please do not hesitate to contact us at your convenience if you have any questions about this report or if we may be of further assistance.

Sincerely,

TESTING, ENGINEERING & CONSULTING SERVICES, INC.

James G. McCants III
Laboratory Manager, Chemist

Shawn P. McCormick
Laboratory Principal

Attachments: ASTM E1252 – FTIR Scans of Component A & B

Figure 1 – Component A – FTIR

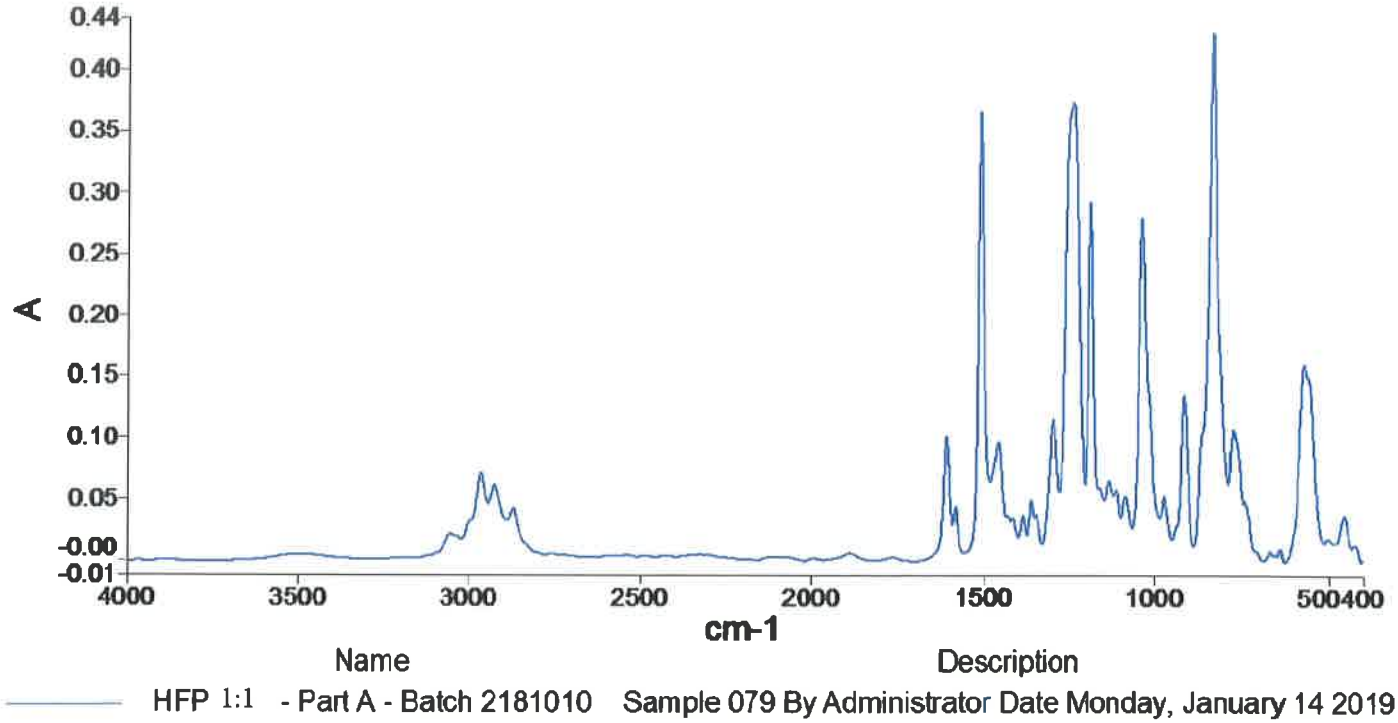

Figure 2 – Component A – Relative Peaks

Peak Number	Height (A)	Start	End	X (cm-1)	Y (A)
1	0.0711	4000	2946.32	2965.62	0.0711
2	0.0619	2946.32	2890.76	2926.45	0.0619
3	0.0423	2890.76	2019.62	2871.89	0.0423
4	0.1014	2019.62	1590.67	1606.88	0.1014
5	0.0438	1590.67	1554.93	1581.71	0.0438
6	0.3674	1554.93	1479.32	1507.22	0.3674
7	0.0962	1479.32	1397.92	1456.02	0.0962
8	0.0364	1397.92	1373.74	1384.5	0.0364
9	0.0489	1373.74	1328.37	1361.67	0.0489
10	0.1147	1328.37	1275.93	1295.55	0.1147
11	0.375	1275.93	1200.53	1231.93	0.375
12	0.2935	1200.53	1144.45	1182.6	0.2935
13	0.0649	1144.45	1095.22	1131.74	0.0649
14	0.0517	1095.22	1063.67	1082.78	0.0517
15	0.28	1063.67	983.6	1032.69	0.28
16	0.0518	983.6	947.77	969.95	0.0518
17	0.1345	947.77	883.86	913.31	0.1345
18	0.4315	883.86	784.42	827.56	0.4315
19	0.1066	784.42	685.66	769.89	0.1066
20	0.1603	627.22	483.74	571.03	0.1603

Figure 3 - Component B – FTIR

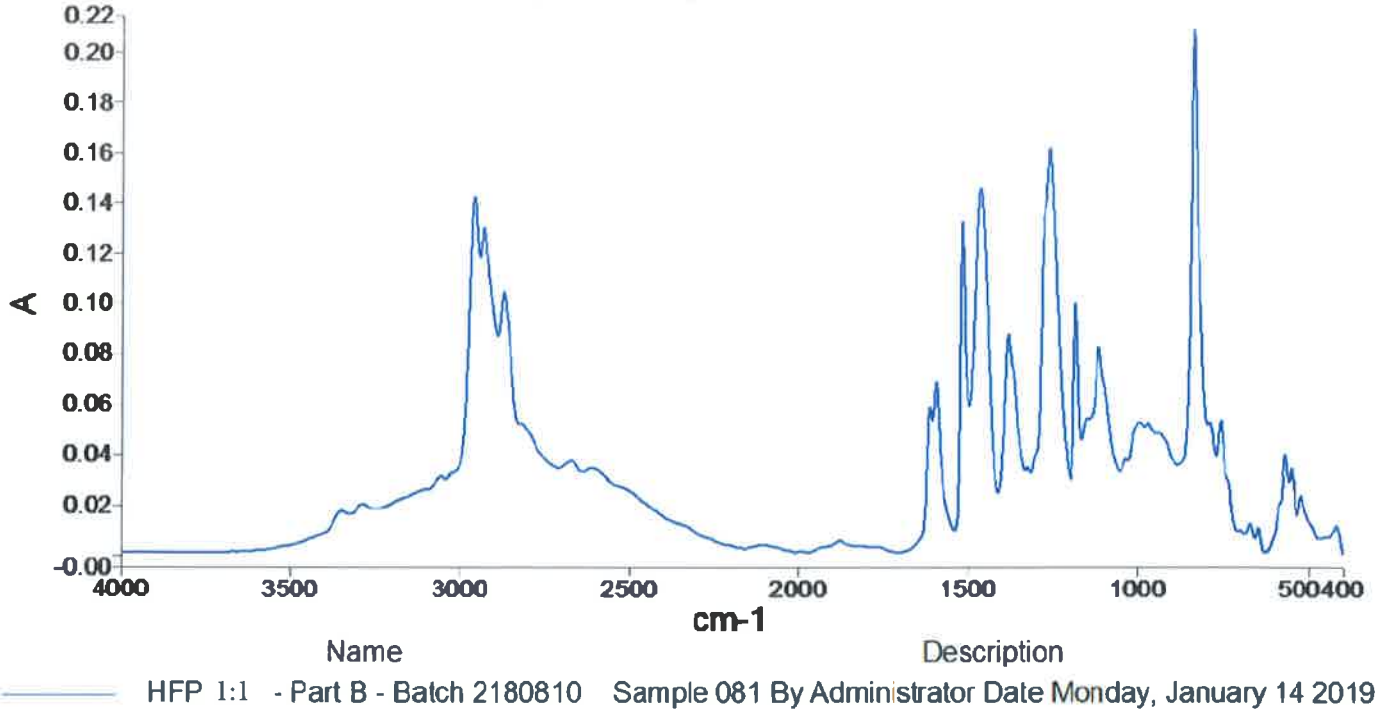

Figure 4 - Component B – Relative Peaks

Peak Number	Height (A)	Start	End	X (cm-1)	Y (A)
1	0.1432	4000	2941.66	2956.81	0.1432
2	0.1306	2941.66	2887.68	2928.68	0.1306
3	0.105	2887.68	1971.35	2870.95	0.105
4	0.0691	1971.35	1537.51	1591.18	0.0691
5	0.1333	1537.51	1492.88	1513.21	0.1333
6	0.1465	1492.88	1408.93	1457.7	0.1465
7	0.088	1408.93	1312.4	1377.17	0.088
8	0.163	1312.4	1195.67	1252.67	0.163
9	0.1006	1195.67	1162.61	1179.07	0.1006
10	0.0831	1162.61	1050.86	1112.18	0.0831

Peak Number	Height (A)	Start	End	X (cm-1)	Y (A)
11	0.0529	1050.86	879.89	993.64	0.0529
12	0.2098	879.89	766.83	827.93	0.2098
13	0.0538	766.83	626.89	752.74	0.0538
14	0.0404	626.89	400	568.56	0.0404