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Supplementary Material

Synthesis and Application of a Low Dye Absorption Water-borne Polyurethane for Microfiber Synthetic Leather

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1. SEM Results of Microfiber Leather After Alkali Reduction

SEM images of microfiber synthetic leather with different HTPB contents are shown in Figure 1.

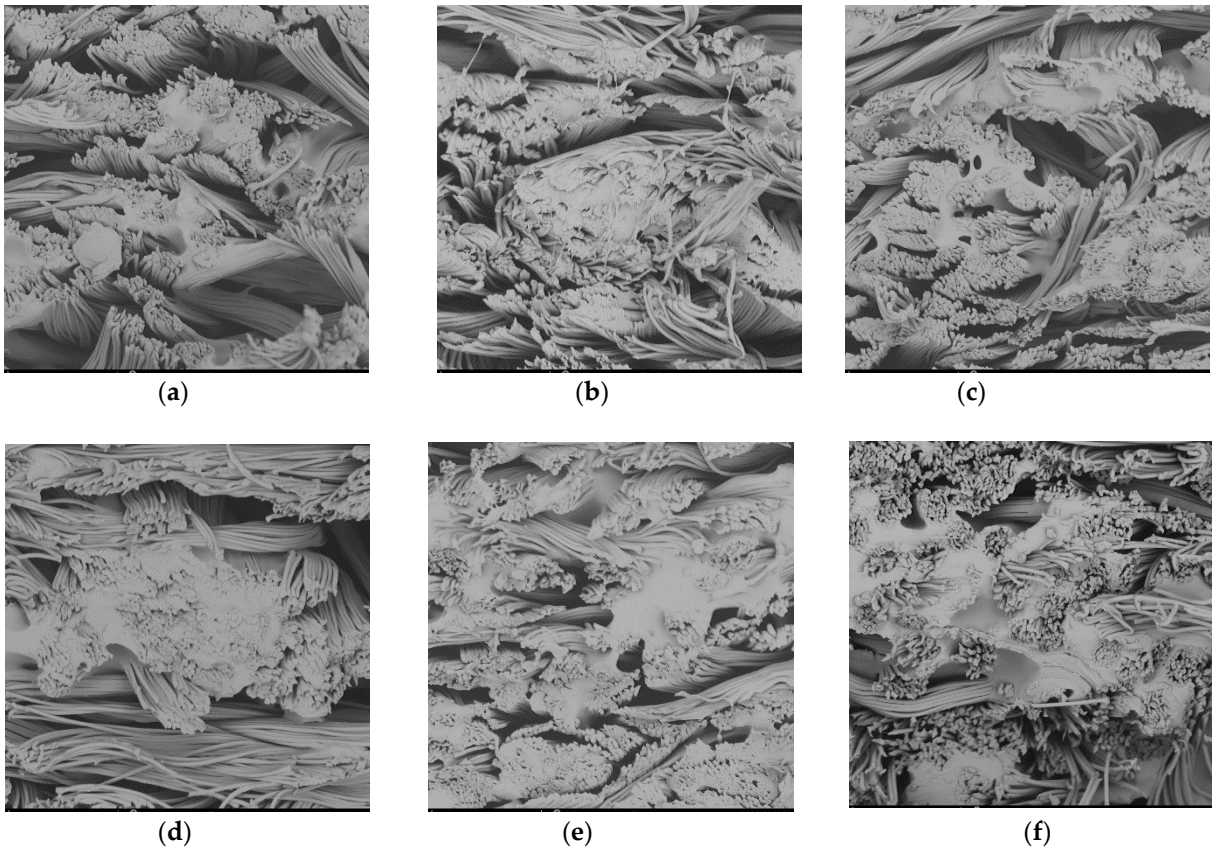

Figure S1. SEM images for microfiber synthetic leather: (a) 0% HTPB content; (b) 10% HTPB content; (c) 20% HTPB content; (d) 30% HTPB content; (e)40% HTPB content; (f) 50% HTPB content.

Comparing the results shows that with the increase in HTPB content, the WPU composition decreased after the alkali reduction process, and the impregnated WPU with 40% HTPB coated more WPU on the surface of the superfine fiber than the impregnated WPU without HTPB added. However, when the addition amount of HTPB increased to 50%, the alkali reduction ratio exhibited an increasing trend, which was consistent with the previous data. The reason is that with the increase in HTPB content, the cross-linking's progress between the double bonds was promoted, the overall degree of cross-linking and

the density of cross-linking were improved, and the infiltration of the corrosive ions was hindered.

2. Standard Curve for S-5BL

S-5BL dispersing red with different concentrations of 0, 50, 150, 200, 250 and 300 mg/L were configured with the concentration difference dilution method and the UV absorbance results are shown in Table 1, the S-5BL dispersive dye standard curve is shown in Figure 2.

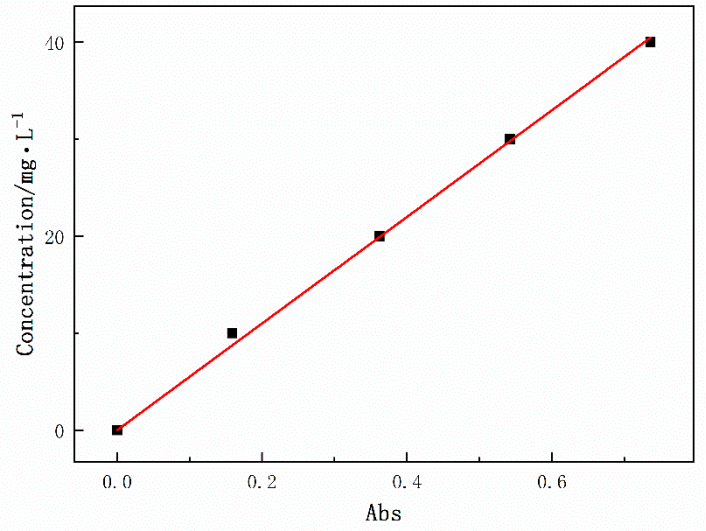

Figure S2. Standard curve of disperse dye S-5BL.

Table S1. UV absorbance of standard solutions with different S-5BL dispersed red content.

Concentration (mg/L)	0	50	100	150	200
Absorbance (A)	0	0.159	0.362	0.542	0.736

The regression parameters related to the standard curve of S-5BL dispersed dye are shown in Table 2. After adjustment, the regression coefficient R^2=0.97665. At the level of 0.05, the slope is significantly different from 0. The independent variable has a significant predictive effect on the dependent variable

Table S2. Regression equation parameters of S-5BL disperse dye.

Equation	Y-intercept	Slope	Pearson's R	R^2	R^2 after Adjustment
Y = a * x + b	0	54.98267 ± 0.68375	0.99969	0.99938	0.99923

3. Statistical Analyses for Alkali Reduction Ratio

The microfiber leather prepared from the same modified water-based polyurethane was prepared three times, and the statistics of the alkali reduction rate data were carried out. The results are shown in Table 3. The between-group T-test was carried out for the three parallel data within the group. It can be seen from the T-test results that the one-tail p values between the groups are all less than 0.05, can be considered that the difference between adjacent groups is significant, and the data trend is statistically significant

Table S3. Regression equation parameters of S-5BL disperse dye.

Sample	M1WPU-0-a	M1WPU-1-a	M1WPU-2-a	M1WPU-3-a	M1WPU-4-a	M1WPU-5-a
Weight of Nonwovens /g	16.00	16.00	16.00	16.00	16.00	16.00
Wet weight /g	32.74	32.68	31.46	32.08	32.06	31.88
Dry weight /g	20.98	20.75	21.04	21.03	20.89	20.68

Gain ratio /%	31.10	29.66	31.50	31.43	30.54	29.25
Weight after alkali reduction /g	15.59	15.45	15.76	15.84	15.76	15.36
Alkali reduction ratio /%	33.67	33.12	32.99	32.45	32.01	33.27

Sample	**M1WPU-0-b**	**M1WPU-1-b**	**M1WPU-2-b**	**M1WPU-3-b**	**M1WPU-4-b**	**M1WPU-5-b**
Weight of Nonwovens /g	16.00	16.00	16.00	16.00	16.00	16.00
Wet weight /g	32.51	32.46	31.96	31.88	32.35	32.43
Dry weight /g	20.82	20.79	20.80	20.77	20.78	20.81
Gain ratio /%	30.13	29.94	30.00	29.81	29.88	30.06
Weight after alkali reduction /g	13.79	13.86	13.95	14.07	14.17	13.75
Alkali reduction ratio /%	33.78	33.33	32.95	32.28	31.80	33.92

Sample	**M1WPU-0-c**	**M1WPU-1-c**	**M1WPU-2-c**	**M1WPU-3-c**	**M1WPU-4-c**	**M1WPU-5-c**
Weight of Nonwovens /g	16.00	16.00	16.00	16.00	16.00	16.00
Wet weight /g	31.78	32.04	31.79	31.94	32.05	32.07
Dry weight /g	20.74	20.79	20.69	20.81	20.78	20.77
Gain ratio /%	29.62	29.94	29.31	30.06	29.88	29.81
Weight after alkali reduction /g	13.65	13.83	13.83	14.01	14.09	13.64
Alkali reduction ratio /%	34.19	33.49	33.18	32.68	32.20	34.31

Sample	**M1WPU-0**	**M1WPU-1**	**M1WPU-2**	**M1WPU-3**	**M1WPU-4**	**M1WPU-5**
Alkali reduction ratio (a) /%	33.67	33.12	32.99	32.45	32.01	33.27
Alkali reduction ratio (b) /%	33.78	33.33	32.95	32.28	31.80	33.92
Alkali reduction ratio (c) /%	34.19	33.49	33.18	32.68	32.20	34.31

a, b and c means three leather samples for same WPU

Table S4. T-test results for alkali reduction.

Sample	**M1WPU-0**	**M1WPU-1**
Mean	33.88	33.31333
Variance	0.0751	0.034433
Observations	3	3
pooled variance	0.054767	
df	4	
t Stat	2.965618	
P(T<=t) one-tail	0.020662	
t Critical one-tail	2.131847	

Sample	**M1WPU-1**	**M1WPU-2**
Mean	33.31333	33.04
Variance	0.034433	0.0151
Observations	3	3
pooled variance	0.024767	
df	4	
t Stat	2.127181	
P(T<=t) one-tail	0.050263	
t Critical one-tail	2.131847	

Sample	**M1WPU-2**	**M1WPU-3**
Mean	33.04	32.47
Variance	0.0151	0.0403
Observations	3	3
pooled variance	0.0277	
df	4	
t Stat	4.194504	
P(T<=t) one-tail	0.006878	
t Critical one-tail	2.131847	

Sample	**M1WPU-3**	**M1WPU-4**
Mean	32.47	32.00333
Variance	0.0403	0.040033
Observations	3	3
pooled variance	0.040167	
df	4	
t Stat	2.851803	
P(T<=t) one-tail	0.023156	
t Critical one-tail	2.131847	

Sample	M1WPU-4	M1WPU-5
Mean	32.00333	33.83333
Variance	0.040033	0.276033
Observations	3	3
pooled variance	0.158033	
df	4	
t Stat	-5.63796	
P(T<=t) one-tail	0.002436	
t Critical one-tail	2.131847	