Technical Information

(vol.18)

Nippon Kayaku (Thailand) CO., LTD.
Technical Service Center

[Kayacion CF-COMJ color fastness to natural sunlight]

- We received an inquiry from a reader of our monthly technical information releases, who is currently using our KCN CF-COMJ trichromatic color series. The question was regarding considerable fading of fabric dyed with KCN CF-COMJ trichroma after being left for a while by the window with exposure to sunlight.
  (*KCN CF-COMJ is KCN CF-COM series sold in Japan.)
- The answer is that considerable fading can be expected. Even CDP-dyed fabrics show fading in a few days of sunlight, so cotton-dyed fabrics may fade faster. For reference, please see our Technical Information Vol. 1.
- However, we did not have actual sunlight exposure data for KCN CF-COMJ series, so with this opportunity, we set out to conduct this test.
- As we conducted the test for both summer sunlight and winter sunlight, a considerable amount of time was used in producing the results for this test.

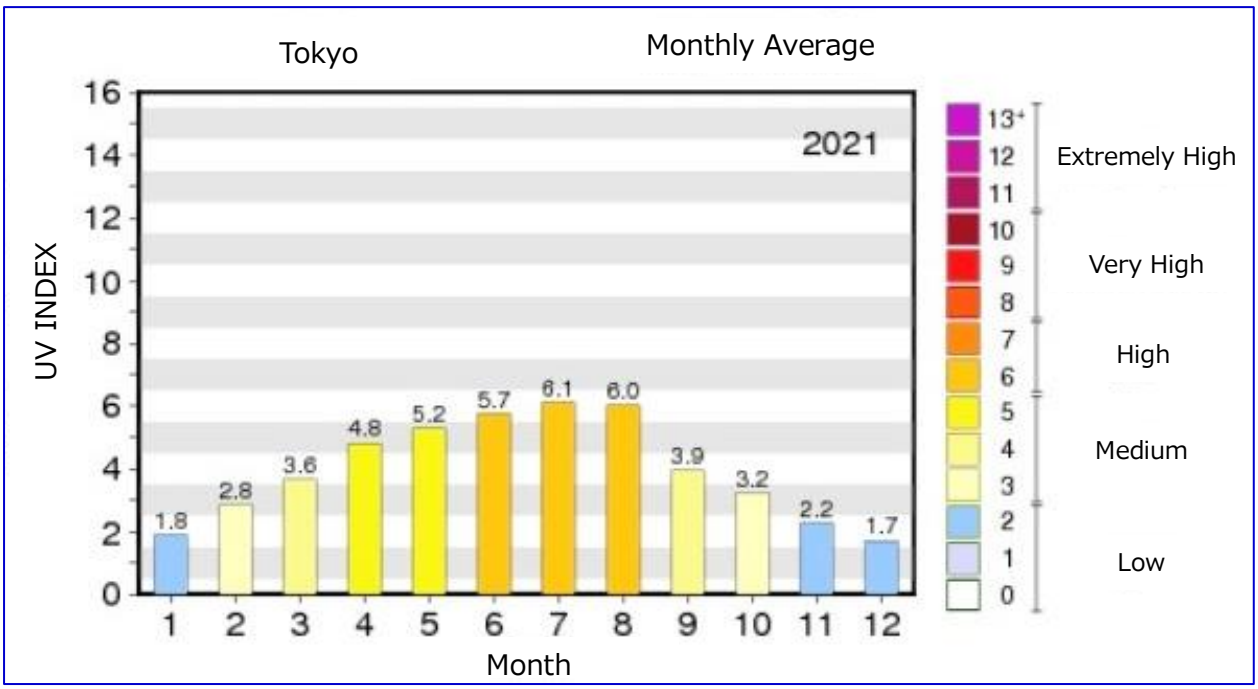
Side note: Surprisingly, there were only a few days where the sun was not hidden behind clouds.

Results: Light fastness of fabric dyed with KCN CF-COMJ trichroma after exposure to natural sunlight

Exposure conditions

Winter Sun Exposure Date	Weather	Wind	Maximum Temperature (Alcohol thermometer)	
2021/12/21	Clear	None ~ slight breeze	28℃ (11:30)	
2021/12/22	Clear	None ~ slight winds	22℃ (12:30)	
2021/12/27	Clear	None ~ slight winds	21℃ (13:00)	Completed 3 days of exposure
2021/12/28	Clear	None ~ slight winds	20℃ (14:00)	
2022/01/12	Clear	Slight winds	19℃ (12:00)	Completed 5 days of exposure
2022/01/14	Clear	Slight winds	17℃ (13:00)	
2022/02/02	Clear	Slight winds	21℃ (13:00)	Completed 7 days of exposure
Summer Sun Exposure Date	Weather	Wind	Maximum Temperature (Alcohol thermometer)	
2022/06/27	Sunny	None ~ slight winds	48℃ (13:30)	
2022/06/30	Sunny	None ~ slight winds	49℃ (10:30)	
2022/07/01	Clear-Sunny	None ~ slight winds	51℃ (12:15)	Completed 3 days of exposure
2022/07/25	Sunny	Slight winds	44℃ (11:00)	
2022/07/28	Sunny	Slight winds	47℃ (12:00)	Completed 5 days of exposure
2022/08/03	Sunny	Slight winds	50℃ (13:00)	
2022/08/09	Sunny	Strong winds	45℃ (13:45)	Completed 7 days of exposure

Exposure time 07:30 AM -> 15:00 PM (7.5 h exposure)



Reference: Data from Japan Meteorological Agency

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- The test was conducted in Akabane, Tokyo Prefecture. The monthly UV index data in 2021 for Tokyo Prefecture is shown.
- It has been nearly 20 years since the Kayacion CF trichroma has been introduced and sold, but both the CF-J dyes and the CF-COMJ dyes have never received complaints from the market regarding light fastness to date. In other words, it may be that the current test results of sunlight irradiation are at a "level that is acceptable by the market".
- Our understanding is that the cotton dyed fabric fading problem caused by light is usually due to Reactive Black 5 or dyes which use Reactive Black 5 as the main component. This problem may also be caused by the rare case of [Dyeing -> Fix -> Reduction decolorization -> Re-dyeing].

- Light fastness tests conducted in this test:

ISO Xenon-arc Grade 4 Irradiation	JIS Xenon-arc Grade 4 Irradiation	JIS Carbon-arc Grade 4 Irradiation
Winter Sunlight 7.5 h x 3 days	Winter Sunlight 7.5 h x 5 days	Winter Sunlight 7.5 h x 7 days (1 week)
Summer Sunlight 7.5 h x 3 days	Summer Sunlight 7.5 h x 5 days	Summer Sunlight 7.5 h x 7 days (1 week)

Recipe

	Brown	Grey
KCN Yellow CF-COMJ	0.496	0.236
KCN Red CF-COMJ	0.343	0.197
KCN Blue CF-COMJ	0.184	0.641

Dyeing conditions

Liquor ratio	12:1
Na_2SO_4/Soda Ash	24/20 g/L
Kayatector E	1 g/L
Dyeing time & temperature	60℃×50min.

Light fastness values were judged with grey scale.

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Brown	ISO Xenon-Arc Grade 4	JIS Xenon-Arc Grade 4	JIS Carbon-Arc Grade 4
Light Fastness Machine (SUGA)	3-4	3-4	4

Brown	Winter Sunlight 7.5 h x 3 days	Winter Sunlight 7.5 h x 5 days	Winter Sunlight 7.5 h x 7 days
Winter Sunlight Exposure	4	2-3	1-2

Brown	Summer Sunlight 7.5 h x 3 days	Summer Sunlight 7.5 h x 5 days	Summer Sunlight 7.5 h x 7 days
Summer Sunlight Exposure	2-3	1-2	1

Grey	ISO Xenon-Arc Grade 4	JIS Xenon-Arc Grade 4	JIS Carbon-Arc Grade 4
Light Fastness Machine (SUGA)	4-5	4-5	4

Grey	Winter Sunlight 7.5 h x 3 days	Winter Sunlight 7.5 h x 5 days	Winter Sunlight 7.5 h x 7 days
Winter Sunlight Exposure	4-5	3-4	2-3

Grey	Summer Sunlight 7.5 h x 3 days	Summer Sunlight 7.5 h x 5 days	Summer Sunlight 7.5 h x 7 days
Summer Sunlight Exposure	3-4	2	1

- Exposure to natural sunlight displays similar fading trend to exposure to ISO Xenon-Arc irradiation.
- Summer sunlight is around 1 to 1.5 grade worse compared to winter sunlight, due to the difference in temperature and UV intensity.
- Color measurement values are attached on the next page for your reference.
- [value] in the tables below refers to the concentration ratio after exposure with reference to unexposed dyed fabric.

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Recipe

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Dyeing conditions

Liquor ratio	12:1
Na_2SO_4/Soda Ash	24/20 g/L
Kayatector E	1 g/L
Dyeing time & temperature	60℃×50min.

Brown	ISO Xenon-Arc Grade 4	JIS Xenon-Arc Grade 4	JIS Carbon-Arc Grade 4
Light fastness machine (SUGA)	ΔE 2.74 ΔL* 1.86 Δa* -1.94 Δb* 0.55 value **89.2**	ΔE 2.20 ΔL* 1.42 Δa* -1.61 Δb* 0.47 value **91.7**	ΔE 1.27 ΔL* 0.95 Δa* -0.77 Δb* -0.33 value **93.1**

Brown	Winter Sunlight 7.5 h x 3 days	Winter Sunlight 7.5 h x 5 days	Winter Sunlight 7.5 h x 7 days
Winter Sunlight Exposure	ΔE 1.58 ΔL* 0.57 Δa* -1.29 Δb* 0.72 value 97.6	ΔE 2.97 ΔL* 1.40 Δa* -2.29 Δb* 1.18 value 94.6	ΔE 3.63 ΔL* 1.51 Δa* -3.06 Δb* 1.24 value 93.1

Brown	Summer Sunlight 7.5 h x 3 days	Summer Sunlight 7.5 h x 5 days	Summer Sunlight 7.5 h x 7 days
Summer Sunlight Exposure	ΔE 3.47 ΔL* 2.40 Δa* -2.17 Δb* 1.26 value 87.4	ΔE 4.34 ΔL* 2.57 Δa* -3.12 Δb* 1.58 value 86.9	ΔE 5.47 ΔL* 3.55 Δa* -3.78 Δb* 1.75 value 81.7

Grey	ISO Xenon-arc Grade 4	JIS Xenon-arc Grade 4	JIS Carbon-arc Grade 4
Light fastness machine (SUGA)	ΔE 1.66 ΔL* 1.37 Δa* -0.80 Δb* 0.51 value 92.2	ΔE 1.74 ΔL* 1.31 Δa* -0.88 Δb* 0.76 value 92.9	ΔE 0.81 ΔL* 0.71 Δa* -0.33 Δb* 0.21 value 95.7

Grey	Winter Sunlight 7.5 h x 3 days	Winter Sunlight 7.5 h x 5 days	Winter Sunlight 7.5 h x 7 days
Winter Sunlight Exposure	ΔE 0.99 ΔL* 0.57 Δa* -0.66 Δb* 0.47 value 97.1	ΔE 2.11 ΔL* 1.49 Δa* -1.21 Δb* 0.89 value 92.0	ΔE 2.78 ΔL* 1.88 Δa* -1.63 Δb* 1.24 value 90.2

Grey	Summer Sunlight 7.5 h x 3 days	Summer Sunlight 7.5 h x 5 days	Summer Sunlight 7.5 h x 7 days
Summer Sunlight Exposure	ΔE 2.31 ΔL* 1.66 Δa* -0.99 Δb* 1.27 value 91.2	ΔE 3.16 ΔL* 2.57 Δa* -1.40 Δb* 1.20 value 86.0	ΔE 3.90 ΔL* 3.18 Δa* -1.74 Δb* 1.43 value 82.9

- The sunlight irradiation test was performed such that the test cloth always faced the sun.
- As a result, we approximate that the light fastness machine grade 4 irradiation is about 7.5 hours of sunlight for 3 days (intermediate value between winter and summer).
- In addition, Xenon light is more similar to fading in sunlight, but we recognize that there are more Carbon-arc standards for apparels in Japan.

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- The standards used are decided by apparel manufacturer, so we are not in a position to say anything about them, but overseas, Carbon-arc results are completely ignored. The standard for Japanese car seats is now the Xenon-arc standard.
- Recently, there have been increasing number of cases where Xenon-arc ISO or AATCC standards with irradiation for 20 or 40 hours and a minimum fastness level of grade 3-4 or higher is required with grey-scale.
- Please refer to the next two pages for the irradiation results using Bluescale Grade 3 standard fabric and Bluescale Grade 4 standard fabric.

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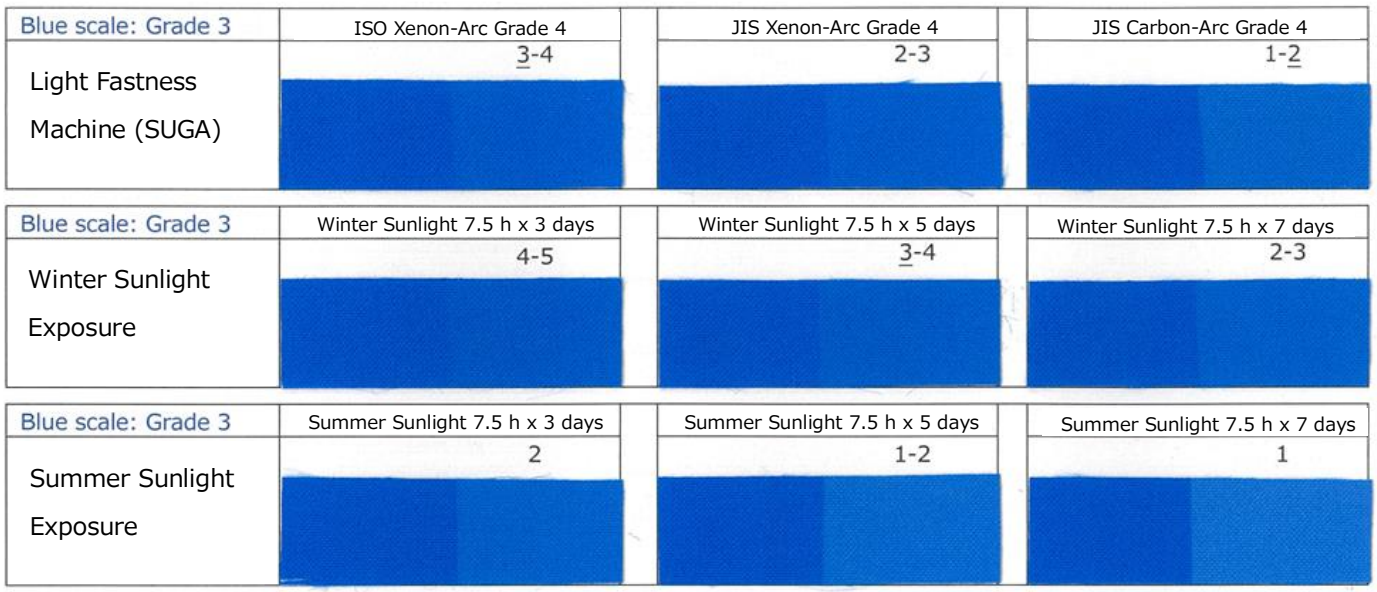
Light Fastness: Bluescale: Grade 3 (Judged with Greyscale)

Blue scale: Grade 3	ISO Xenon-Arc Grade 4	JIS Xenon-Arc Grade 4	JIS Carbon-Arc Grade 4
Light Fastness Machine (SUGA)	3-4	2-3	1-2
Blue scale: Grade 3	Winter Sunlight 7.5 h x 3 days	Winter Sunlight 7.5 h x 5 days	Winter Sunlight 7.5 h x 7 days
Winter Sunlight Exposure	4-5	3-4	2-3
Blue scale: Grade 3	Summer Sunlight 7.5 h x 3 days	Summer Sunlight 7.5 h x 5 days	Summer Sunlight 7.5 h x 7 days
Summer Sunlight Exposure	2	1-2	1



Blue scale: Grade 3	ISO Xenon-Arc Grade 4	JIS Xenon-Arc Grade 4	JIS Carbon-Arc Grade 4
Light Fastness Machine (SUGA)	ΔE 5.99 ΔL* 2.48 Δa* -4.61 Δb* 2.92 value 82.6	ΔE 6.16 ΔL* 2.74 Δa* -4.81 Δb* 2.70 value 82.4	ΔE 12.33 ΔL* 4.76 Δa* - 8.92 Δb* 7.07 value 67.1
Blue scale: Grade 3	Winter Sunlight 7.5 h x 3 days	Winter Sunlight 7.5 h x 5 days	Winter Sunlight 7.5 h x 7 days
Winter Sunlight Exposure	ΔE 4.90 ΔL* 1.43 Δa* -3.74 Δb* 2.83 value 88.8	ΔE 7.43 ΔL* 2.52 Δa* -5.67 Δb* 4.09 value 81.8	ΔE 9.42 ΔL* 3.45 Δa* -7.10 Δb* 5.14 value 75.7
Blue scale: Grade 3	Summer Sunlight 7.5 h x 3 days	Summer Sunlight 7.5 h x 5 days	Summer Sunlight 7.5 h x 7 days
Summer Sunlight Exposure	ΔE 10.07 ΔL* 4.49 Δa* -6.80 Δb* 5.92 value 66.9	ΔE 14.14 ΔL* 6.83 Δa* -8.82 Δb* 8.69 value 53.2	ΔE 17.43 ΔL* 9.05 Δa* -10.19 Δb* 10.86 value 43.5

Exposure conditions

Winter Sun Exposure			Maximum Temperature	
Date	Weather	Wind	(Alcohol thermometer)	
2021/12/21	Clear	None ~ slight breeze	28℃ (11:30)	
2021/12/22	Clear	None ~ slight winds	22℃ (12:30)	
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2022/01/14	Clear	Slight winds	17℃ (13:00)	
2022/02/02	Clear	Slight winds	21℃ (13:00)	Completed 7 days of exposure
Summer Sun Exposure			Maximum Temperature	
Date	Weather	Wind	(Alcohol thermometer)	
2022/06/27	Sunny	None ~ slight winds	48℃ (13:30)	
2022/06/30	Sunny	None ~ slight winds	49℃ (10:30)	
2022/07/01	Clear-Sunny	None ~ slight winds	51℃ (12:15)	Completed 3 days of exposure
2022/07/25	Sunny	Slight winds	44℃ (11:00)	
2022/07/28	Sunny	Slight winds	47℃ (12:00)	Completed 5 days of exposure
2022/08/03	Sunny	Slight winds	50℃ (13:00)	
2022/08/09	Sunny	Strong winds	45℃ (13:45)	Completed 7 days of exposure

Exposure time 07:30 AM -> 15:00 PM (7.5 h exposure)

Light Fastness: Bluescale: Grade 4 (Judged with Greyscale)

Blue scale: Grade 4	ISO Xenon-Arc Grade 4	JIS Xenon-Arc Grade 4	JIS Carbon-Arc Grade 4
Light Fastness Machine (SUGA)	4-5	4-5	4

Blue scale: Grade 4	Winter Sunlight 7.5 h x 3 days	Winter Sunlight 7.5 h x 5 days	Winter Sunlight 7.5 h x 7 days
Winter Sunlight Exposure	4-5	4-5	4-5

Blue scale: Grade 4	Summer Sunlight 7.5 h x 3 days	Summer Sunlight 7.5 h x 5 days	Summer Sunlight 7.5 h x 7 days
Summer Sunlight Exposure	3-4	2-3	1-2

Blue scale: Grade 4	ISO Xenon Arc Grade 4	JIS Xenon Arc Grade 4	JIS Carbon Arc Grade 4
Light Fastness Machine (SUGA)	ΔE 1.46 ΔL* 0.75 Δa* -1.15 Δb* 0.50 value 95.9	ΔE 2.02 ΔL* 1.33 Δa* -1.48 Δb* 0.35 value 92.5	ΔE 2.32 ΔL* 1.24 Δa* -1.62 Δb* 1.10 value 91.7

Blue scale: Grade 4	Winter Sunlight 7.5 h x 3 days	Winter Sunlight 7.5 h x 5 days	Winter Sunlight 7.5 h x 7 days
Winter Sunlight Exposure	ΔE 1.12 ΔL* 0.59 Δa* -0.82 Δb* 0.50 value 96.1	ΔE 1.31 ΔL* 0.77 Δa* -0.98 Δb* 0.38 value 95.6	ΔE 2.03 ΔL* 1.20 Δa* -1.55 Δb* 0.54 value 93.3

Blue scale: Grade 4	Summer Sunlight 7.5 h x 3 days	Summer Sunlight 7.5 h x 5 days	Summer Sunlight 7.5 h x 7 days
Summer Sunlight Exposure	ΔE 3.30 ΔL* 1.88 Δa* -2.33 Δb* 1.39 value 88.3	ΔE 5.08 ΔL* 3.14 Δa* -3.24 Δb* 2.34 value 79.9	ΔE 6.40 ΔL* 4.09 Δa* -3.90 Δb* 3.00 value 74.4

Exposure conditions

Winter Sun Exposure			Maximum Temperature	
Date	Weather	Wind	(Alcohol thermometer)	
2021/12/21	Clear	None ~ slight breeze	28℃ (11:30)	
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