Composite Belts (KF) UV Resistance Test

Introduction: Why Testing Composite Strapping?

Polyester Composite Belts are usually manufactured using parallel layers of single polyester threads laminated together with polypropylene. For industrial uses, polypropylene and polyester have very different characteristics that make them suitable for different environmental stresses including sunlight exposure.

With the name Polyester it is usually indicated a family of plastics that share a similar structure. Thus different polyester can have different characteristics but the overall performance of these plastics compared to others (e.g. polypropylene) is much greater concerning UV resistance. Typically, polyester has uses in clothing, high-strength ropes, shatterproof bottles, and insulation.

Polypropylene is a simple chain polymer. Because of the chemical structure of polypropylene, it has a high degradation rate when exposed to UV light like the Sun. The light causes the bonds holding the polymer together to break and consequently weakens the plastic. For this reason, the polypropylene is usually unsuitable for uses that require long-term exposure to sunlight.

In the case of the composites products, nevertheless the UV radiation cannot easily damage Polyester Yarn, it is still able to penetrate into a Belt damaging the Polypropylene coating. A degraded coating surface could present cracks, that can influence the yarn binding and compromise the structure of the composites belt, e.g. peeling off the yarn. Also, UV light and weathering effects can reduce the overall strength and ductility of the material after very long exposure.

Weathering and UV penetration cannot be stopped completely, but it can be slowed down by proper material selection and the use of additives to improve the photo stability of materials.

Methods

The OEMSERV testing facilities allows to perform the following international recognised testing procedures: *ASTM D4329, ISO4892, ISO 11507, SAE J2020.*

To test the UV resistance of the composites belt by means of a Fluorescent UV Lamp, the ISO 4892:2006 Cycle 1 method was taken as reference. Details are reported in Table 1.

Samples analysed: GW105KF and GW40KF

Total Cycles completed: 86

Total Irradiance Exposure Time: 688 hrs

Table 1

ISO4892:2006 Part 3, Method A				
Cycle N	**Exposure Period**	**Lamp Type**	**Irradiance**	**Black-standard temperature**
1	8h Dry 4h Condensation	Type 1A(UVA-340)	1.0 W/m^2 @ 340nm No light	60 ˚C ± 3 ˚C 50 ˚C ± 3 ˚C

Testing Machine used:

Sample prepartion photos:

Approximately 3 meters of Oemserv's GW105KF and GW40KF were lightly tensioned on the Test Grid.

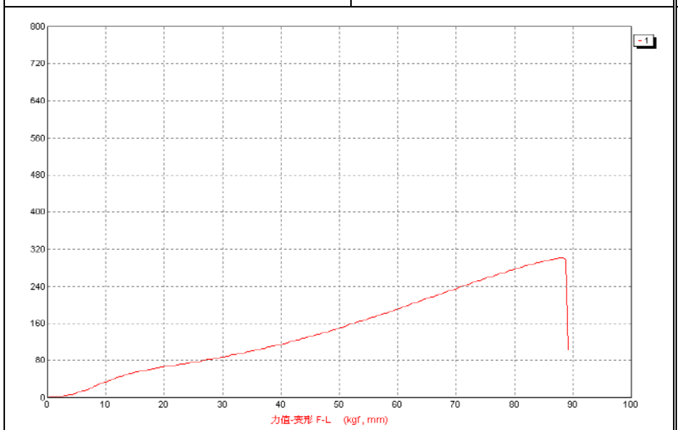
Results

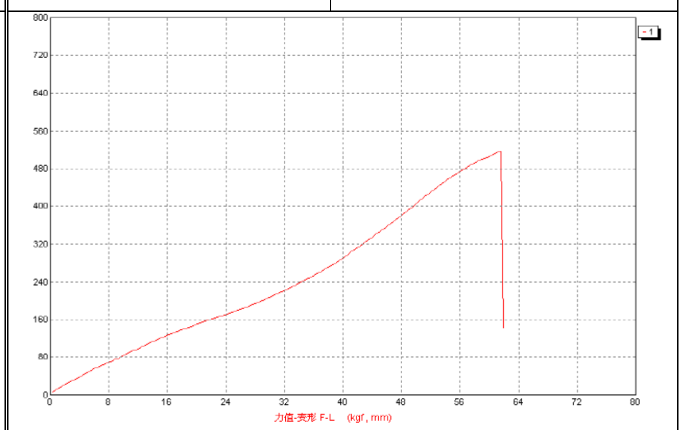
From the Photo Set reported below, it is evident that in OemServ composites strapping:

1. The appearance of the belt has remained unchanged.
2. No evident damages of polyester were caused by UV effect.
3. The PP coating kept integrity with small surface changes caused by UV effect.

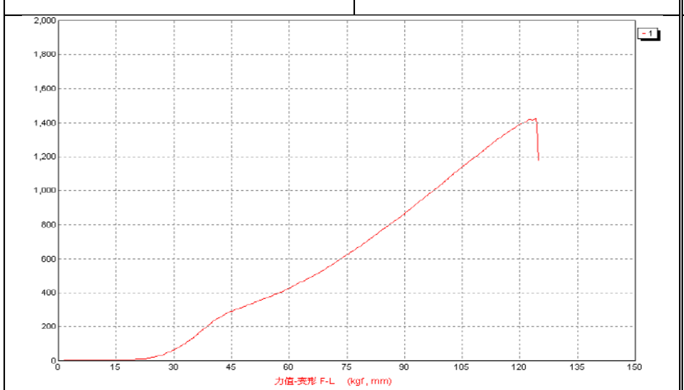
After the test, the Belts have been tested both for Linear and System's Strength. Results as follow:

GW40KF			
Linear Strength	**Linear Strength Standard**	**System's**	**System's Standard with B4**
295 daN	300 daN	506 daN	510 daN





GW105KF			
Linear Strength	**Linear Strength Standard**	**System's**	**System's Standard with B10**
1349 daN	1500 daN	2449 daN	2400 daN



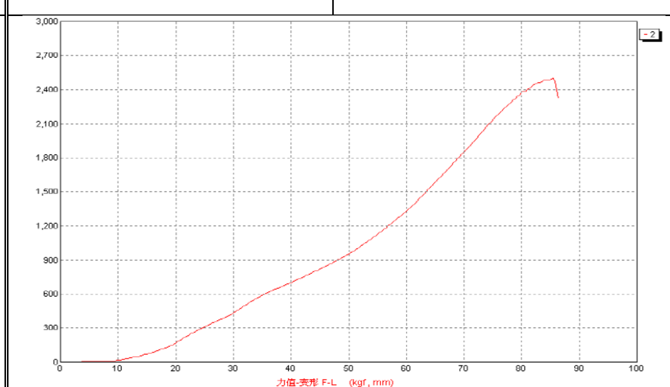


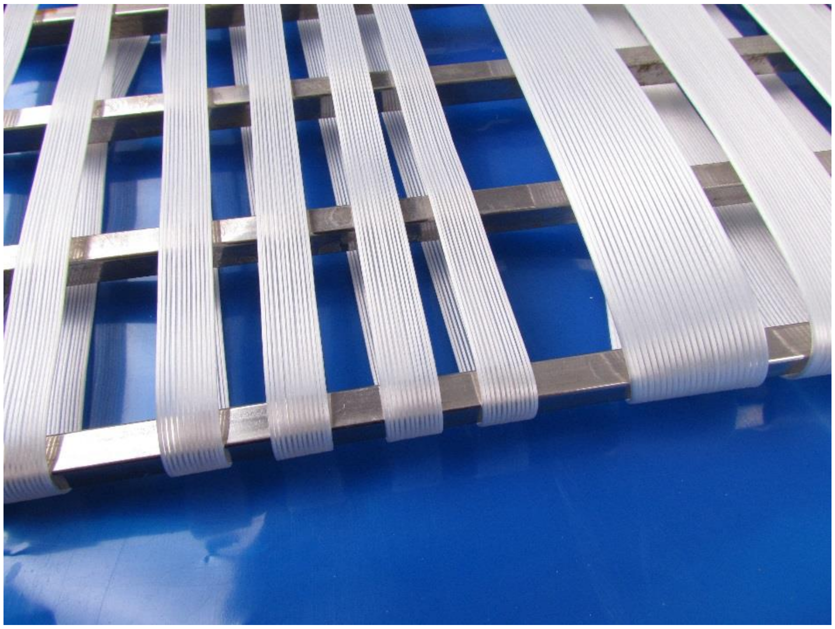
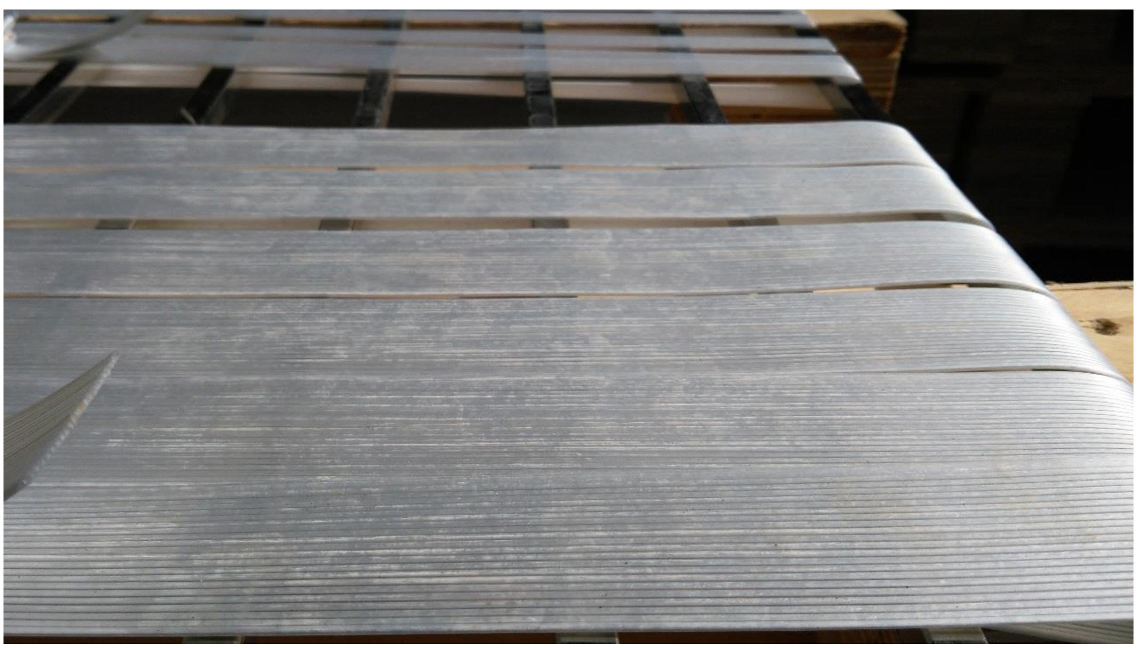
Photo Set 1
Before 
After 

Photo Set 2
Before

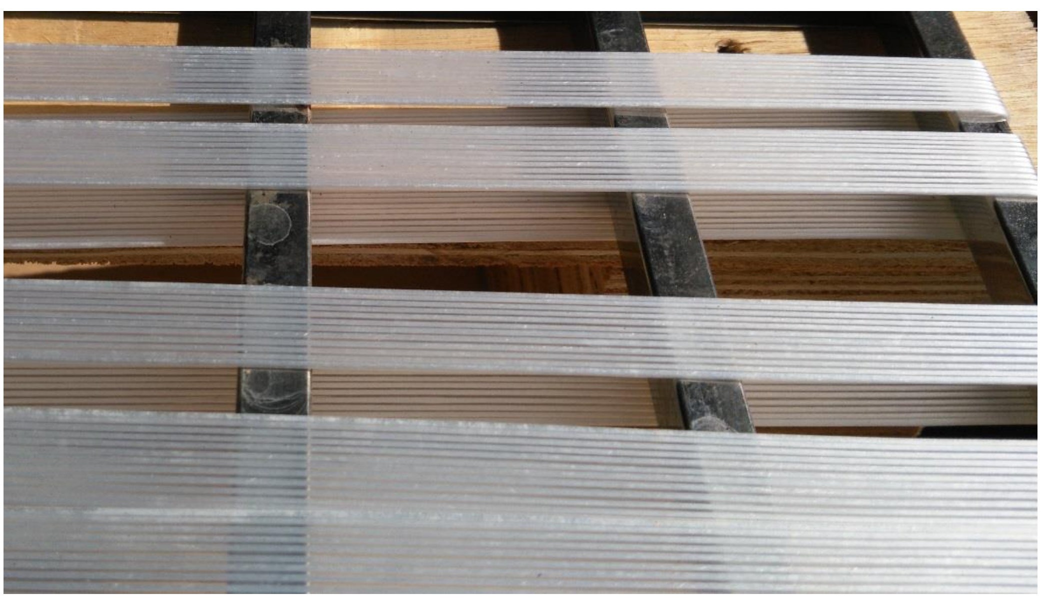
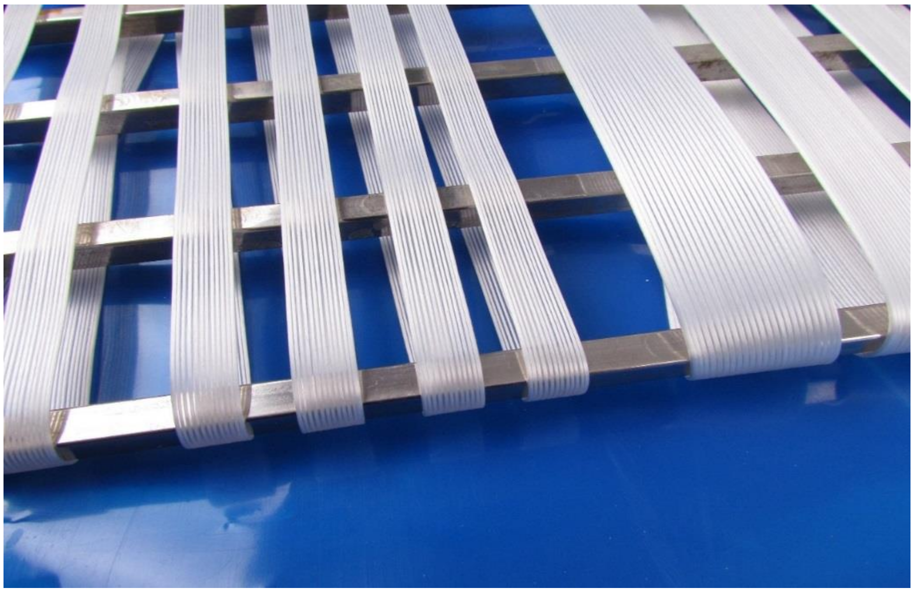
After


Photo Set 3
Before 
After 

Simulation / Real time Correlation

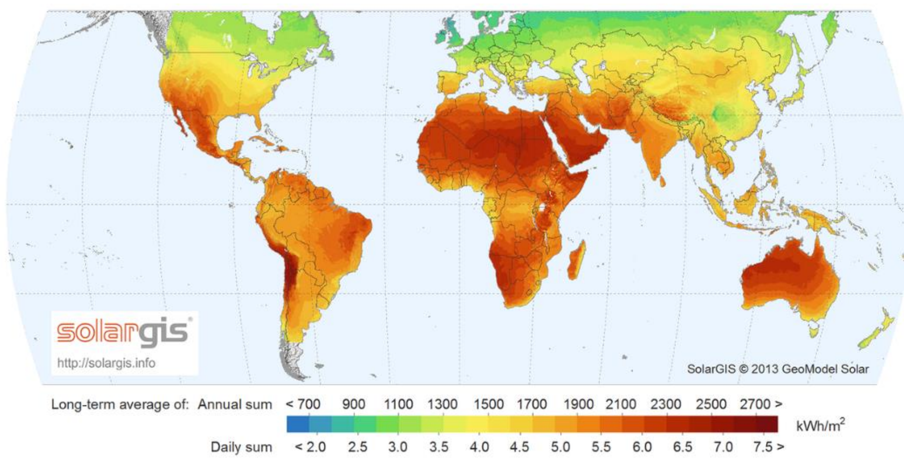
An approximate correlation factor between accelerated tests and natural weathering is given for ISO 4892 part 2/A and SAE J1960. Without going too much into details, the following equation can be used to approximate a correlation between UV exposures in the accelerated test time against UV exposure in natural environment.

$$UV\ Test\ Hours = \frac{Area\ Solar\ Irradiance\ (kJ/m^2)\ at\ 340nm}{Radiant\ Exposure\ (W/m^2)\ at\ 340nm\ x\ 3.6}$$

Where:

Area Solar Irradiance: Total amount of solar radiation in a certain area and latitude over time (annual, daily, etc.) considering only contribute of a certain solar irradiance passband at a particular UV wavelength, e.g. 340 nm.

Radiant Exposure: Radiant exposure controlled by the UV Machine at a certain wave length, e.g. 340 nm



Then, it is possible to calculate with an accuracy of ± 10% a correlation between accelerate time of testing and equivalent solar time in a particular geographical area using Solar Spectral Irradiance data. For instance, the CIE 085-1989 is internationally recognised as the most complete work regarding Solar Irradiance on the earth and provides useful average solar irradiance tables for all the solar spectrum and sorted for latitude and/or geographical position.

Real Time Correlation South Florida Miami

In our case, 688 Hours of UV Testing Cycle can be compared to any real geographical area taking in account its Annual mean UV exposure (295-385 nm):

We simulate 1 year solar irradiation in South Florida Miami (Area Solar Irradiance = 280 MJ/m2 a year and Equivalent Natural Sunlight Exposure = 721 hrs ± 10%.) using 86 cycles of 8hrs UV at power of 1W/m2.

The UV test result is equivalent to 10.8 months Real Time in Miami.

Examples of real geographical area UV irradiance

Area	Total UV/year 295-385 nm	Equivalent Natural Sunlight Exposure	Equivalent Days of light
San Paulo	330 MJ/m^2	611 hrs ± 10%	26
New Delhi	300 MJ/m^2	671 hrs ± 10%	28
Miami	280 MJ/m^2	721 hrs ± 10%	30
Rome	230 MJ/m^2	877 hrs ± 10%	36
Tokyo	190 MJ/m^2	1062 hrs ± 10%	44
London	180 MJ/m^2	1121 hrs ± 10%	47
Moscow	150 MJ/m^2	1345 hrs ± 10%	56