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# PHOTODEGRADATION OF AZO CI ACID RED 131 IN POLYAMIDE 6 FABRIC AND ITS IMPACT ON ULTRAVIOLET PROTECTION FACTOR (UPF)

**Paulo R. Marques (IC)[1], Allan M. Splieter (PQ)[1], Adécio Gamba (PQ)[1].**

**paulo.m@sc.senai.br; paulo.m@sc.senai.br**

[1]*Instituto SENAI de Tecnologia Têxtil, Vestuário e Design.*
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## Highlights

Photodegradation of CI Acid Red 131 improved UPF protection in a polyamide 6 fabric. ISO 105-B02 Xenon arc tests were applied to predict durability of functional textile properties.

## Resumo/Abstract

The photodegradation of textile dyes directly affects color stability and UV-protective performance of polymer-based materials. This process occurs when the dye absorbs radiation and forms reactive species that cleave chemical bonds within both the dye and the polymer matrix, causing optical and mechanical deterioration [1]. The evaluation of photochemical stability is therefore essential to understand not only color fading but also changes in ultraviolet absorption capacity. In this study, the azo dye CI Acid Red 131 applied to polyamide 6 fabric was exposed to controlled xenon-arc irradiation, tests performed on Mesdan 325E XenonLab, under ISO 105-B02:2019: Textiles – Tests for Colour Fastness to Artificial Light: Xenon Arc Fading Lamp Test (B Cycle: 65 ± 3 °C, 30 ± 5 % RH, 42 ± 2 W/m²) to assess variations in Ultraviolet Protection Factor (UPF), measured according to AS/NZS 4399:2017 – Sun Protective Clothing – Evaluation and Classification standards, using an Agilent Cary 100 UV-Vis Spectrophotometer Bundle was employed to measure the UPF of samples subjected to different hours of photodegradation.

After xenon-arc exposure, the five samples (0, 10, 30, 40 and 60h) exhibited a marked increase in the UPF from 45.0 (0 h) to 108.7 (60 h) (Fig 1). This behavior suggests that processes beyond visible fading are enhancing the UV attenuation performance. One plausible explanation arises from the photodegradation of the azo dye, as Qu et al. (2017) reported that during UV irradiation, hydroxyl radicals act as dominant reactive species and that hydroxylated intermediates and low-molecular-weight dicarboxylic acids are formed through oxidative pathways. These reactions yield more polar and partially conjugated fragments that can still absorb in the UV range [2]. Similarly, Roșu et al. (2021) demonstrated that photochemical aging of dyed fabrics leads to surface oxidation and the formation of carbonyl and conjugated chromophoric structures, which contribute to increased UV absorbance even as visible fading occurs [3]. Therefore, the increase in UPF observed here likely results from the combined effects of dye photodegradation and surface oxidation of the polymer, generating new UV-active species that enhance protection against ultraviolet radiation.

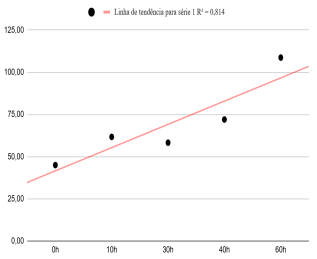


**Fig 1 -** UPF values for each sample.

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