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More Than Just Cleaning: Long-Term Effects on Blue-Control Lens Transmission

PIOTR BIAŁUCHA*[1], AGNIESZKA JÓŹWIK [2]
[1]*Wroclaw University of Science and Technology, Faculty of Fundamental Problems of Technology / Politechnika Wrocławska, Wydział Podstawowych Problemów Techniki*
[2]*Wroclaw University of Science and Technology, Department of Optics and Photonics/ Politechnika Wrocławska, Katerda Optyki i Fotoniki*
* *Corresponding author: 268203@student.pwr.edu.pl*

Summary: The method of cleaning spectacle lenses can significantly and imperceptibly affect visual quality. Routine wiping may cause micro-damage to precise, multi-layered lenses, gradually degrading their optical properties. This study investigated the long-term impact of common cleaning methods on the light transmittance of blue light–filtering lenses. Six lens types from three manufacturers were cleaned daily using three popular methods and analyzed every two months with a UV5100 spectrophotometer (200–900 nm). Certain methods caused measurable transmission losses, particularly when the filter layer was surface-mounted, while integrated filters showed the highest durability.

Keywords: blue light, UV radiation, glasses lenses, protective filters, optical technology,

INTRODUCTION

The modern lifestyle, inherently associated with the extensive utilization of digital devices, has been demonstrated to result in elevated daily exposure to blue light (380-500 nm), which can exert detrimental effects on the human visual system [1]. In response to these risks, the development of optical technologies such as blue light filtering lenses has been undertaken [2] . Their effectiveness is dependent , among other factors, on the method of implementing the protective layer and the durability of these coatings under everyday usage conditions.

METHODS

The objective of this study was to investigate the impact of three commonly used cleaning methods on the light transmission properties of blue light-filtering lenses. Different filtration technologies were analyzed: lens 1 (filter integrated into the lens bulk material, manufactory 1), lens 2 (filtering layer applied on top of the anti-reflective coating, manufacturer 2), lens 3 (filter embedded within the material structure, manufacturer 2). The study was conducted in the Thin Film Physics Laboratory at Wroclaw University of Science and Technology using a UV5100 spectrophotometer over the course of a six-month measurement cycle.

RESULTS

Each lens was subjected to one of the following cleaning methods: material? and paper towel (method 1), microfiber cloth (method 2) and glass cleaner and paper towel (method 3). The findings indicated that cleaning could result in substantial alterations in light transmission, particularly within the 380-450 nm range. The most substantial effect was observed in lenses with an external filtering layer (lens 2), where transmission increased by up to 10%, which may indicate a reduction in filtration efficiency (Fig. 1). In contact, lenses with a filter integrated into the lens material (lenses 1 and 3) only minor changes were exhibited, suggesting higher resistance.

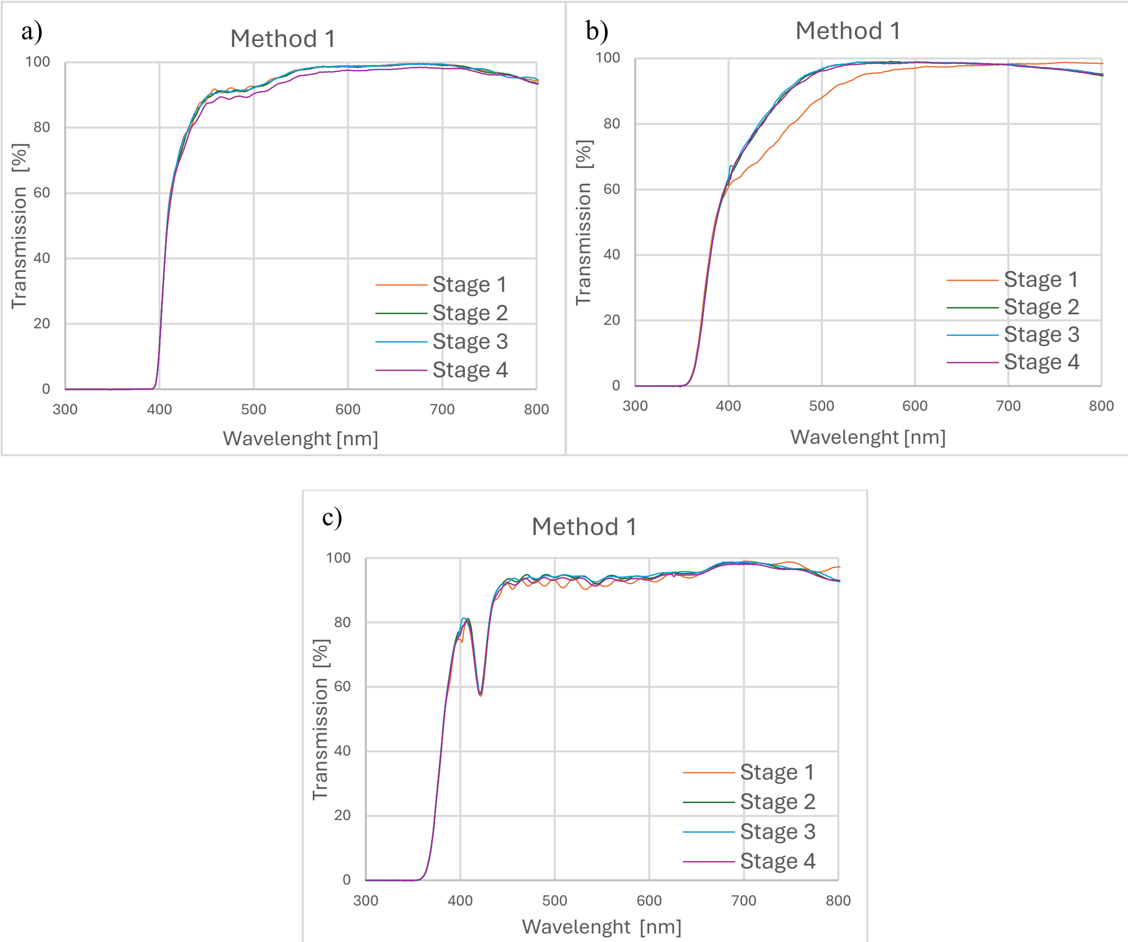

Figure. 1. Results of the six-moth measurements for lenses 1-3, (a) filter integrated into the lens bulk material, manufactory 1, (b) filtering layer applied on top of the anti-reflective coating, manufacturer 2, (c) filter embedded within the material structure, manufacturer 2

Table 1. Averaged transmittance measurement results for all lenses in the 380–450 nm and 450–500 nm ranges, divided by the three cleaning methods

	450 – 500 nm	*380 – 450 nm*
	Method 1	
Stage 1	89,9 ± 4,7	49,7 ± 15,4
Stage 2	92,7 ± 1,8	51,4 ± 16,6
Stage 3	91,7 ± 3,3	51,0 ± 17,2
Stage 4	91,8 ± 1,8	50,8 ± 16,8
p- volue	**<0,005**	0.093
	Method 2	
Stage 1	89,7 ± 4,6	49,6 ± 15,2
Stage 2	93,2 ± 2,3	51,8 ± 16,1
Stage 3	93,3 ± 1,8	52,1 ± 16,8
Stage 4	93,1 ± 1,9	52, 0 ± 16,5
p- volue	0.58	0.34
	Method 3	
Stage 1	89,8 ± 4,8	49,8 ± 15,3
Stage 2	93,6 ± 1,7	52,3 ± 16,4
Stage 3	93,6 ± 1,5	52,2 ± 16,6
Stage 4	92,9 ± 2,9	52,0 ± 17,1
p- volue	0.15	0,21

CONCLUSIONS

The results showed that the cleaning method involving water and a paper towel caused a statistically significant increase in light transmittance in the 450–500 nm range. The remaining methods did not produce statistically significant changes, although a slight increasing trend was observed. These findings indicate that the cleaning procedure may affect the durability of protective coatings and the effectiveness of blue-light filtration.

Most of the examined lenses maintained their filtering efficiency after six months of use, confirming good stability of their optical properties. However, the use of aggressive cleaning agents may lead to damage of protective layers and a reduction in filtration performance. Future studies should employ an integrating sphere to enable a more accurate assessment of lens optical properties.

REFERENCES

[1] International Commission on Non-Ionizing Radiation Protection. (2013). *Guidelines on limits of exposure to incoherent visible and infrared radiation*. **Health Physics**, 105(1), 74–96. https://doi.org/10.1097/HP.0b013e318289a61

[2] Leung, T. W., Li, R. W., & Kee, C. S. (2017). *Blue-light filtering spectacle lenses: Optical and clinical performances*. **PLoS ONE**, 12(1), e0169114. https://doi.org/10.1371/journal.pone.0169114