
Light Responsive
Film

Abstract

This experiment investigates the effectiveness of photochromic and thermochromic films in reducing indoor temperature when applied to window surfaces. As global temperatures rise, maintaining cooler indoor environments has become a major challenge, especially in buildings with large glass areas. Traditional windows allow significant heat and light to enter, increasing the need for artificial cooling. Photochromic films darken when exposed to sunlight, while thermochromic films change color based on temperature. These properties help reduce the transmission of heat and high-intensity light. In this study, both treated and untreated window setups were observed under identical environmental conditions. Temperature measurements were recorded at regular intervals to evaluate the films' performance. The results are expected to show that windows with chromic films maintain a noticeably lower room temperature compared to untreated windows. This reduction occurs due to the films' ability to block infrared radiation, minimize glare, and control light penetration. The experiment aims to demonstrate an energy-efficient, cost-effective method to improve indoor comfort. The findings may support the use of chromic window films in homes, schools, and commercial buildings. Additionally, the project highlights how smart materials can contribute to sustainable architectural practices. Overall, the study provides insight into how chromic films can reduce dependence on cooling appliances and promote energy conservation.

INTRODUCTION:

This project explores how light-activated materials such as photochromic and thermochromic films can improve energy efficiency in buildings. These films automatically adjust their transparency based on light and temperature. By applying them to window panes and observing temperature changes, the experiment demonstrates that such smart materials can reduce heat gain indoors, thus lowering cooling requirements and energy consumption. This study highlights the potential of these materials in developing sustainable, energy-saving buildings.Buildings consume large amounts of energy for heating and cooling. Conventional windows allow uncontrolled light and heat entry, increasing indoor temperatures. Photochromic and thermochromic films provide a smart solution by adjusting their transparency automatically. Photochromic films darken with high light, while thermochromic films react to heat. This project studies their effect on temperature control and energy efficiency.

Statement of the Problem

Can applying photochromic and thermochromic films on windows reduce internal temperature and improve energy efficiency compared to untreated glass?

Hypothesis

If photochromic and thermochromic films are applied to windows, then the room temperature will remain lower than untreated windows due to their ability to block excess heat and light.

Design of the Study

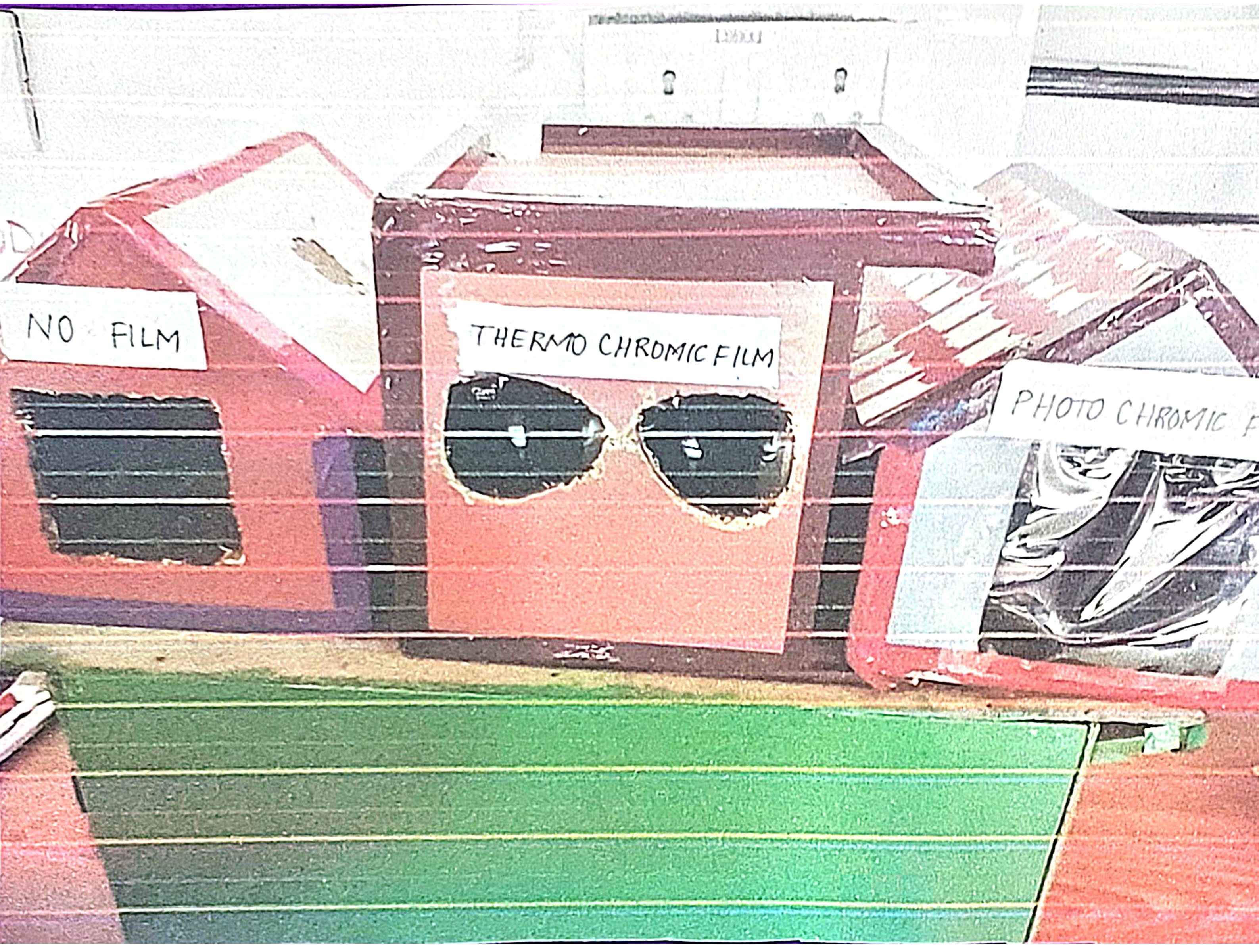
Three glass windows were used: one untreated (control), one with a photochromic film, and one with a thermochromic film. All were exposed to the same light and temperature conditions, and internal temperatures were measured over 30 minutes.

Variables

Independent Variable: Type of film (photochromic or thermochromic)
Dependent Variable: Temperature inside the box (degrees C)
Controlled Variables: Window size, light intensity, ambient temperature, distance from source.

METHODS:

1. Three identical glass windows were prepared: control, photochromic, and thermochromic.
2. All were placed 50 cm from the same LED light source.
3. A temperature sensor recorded readings every 5 minutes for 30 minutes.
4. The experiment was repeated three times for accuracy.
5. The average values were used for analysis.


NO FILM
THERMO CHROMIC FILM
PHOTO CHROMIC F

Data for the Tables

Table 1: Temperature Over Time

Time (min)	Control Temperature(degrees C)	Photochromic Temperature (degrees C)	Thermochromic Temperature (degrees C)
0	25	25	25
5	28	27	26
10	31	28	27
15	33	29	28
20	35	30	29
25	36	31	30
30	37	31	30

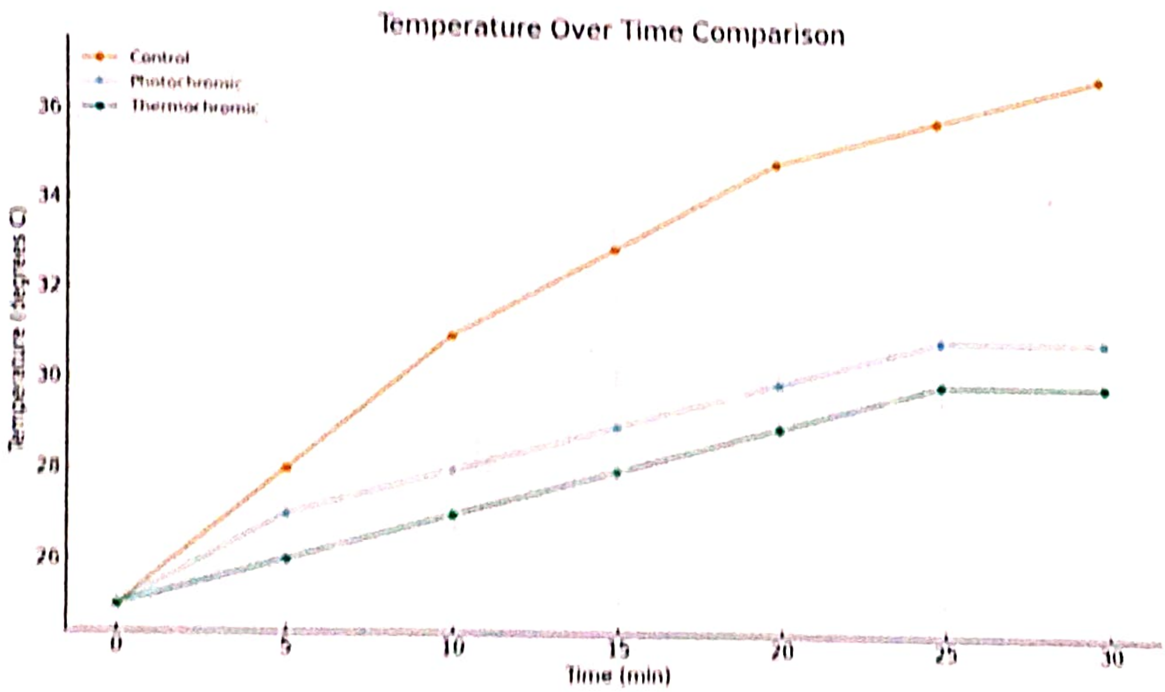


Table [illegible]: Percentage Temperature Reduction

Time (min)	Control Temperature(degrees C)	Photochromic Temperature(degrees C)	% Reduction Photochromic	Thermochromic Temperature(degrees C)	% Reduction Thermochromic
10	31	28	9.6	27	12.9
20	35	30	14.3	29	17.1
30	37	31	16.2	30	18.9

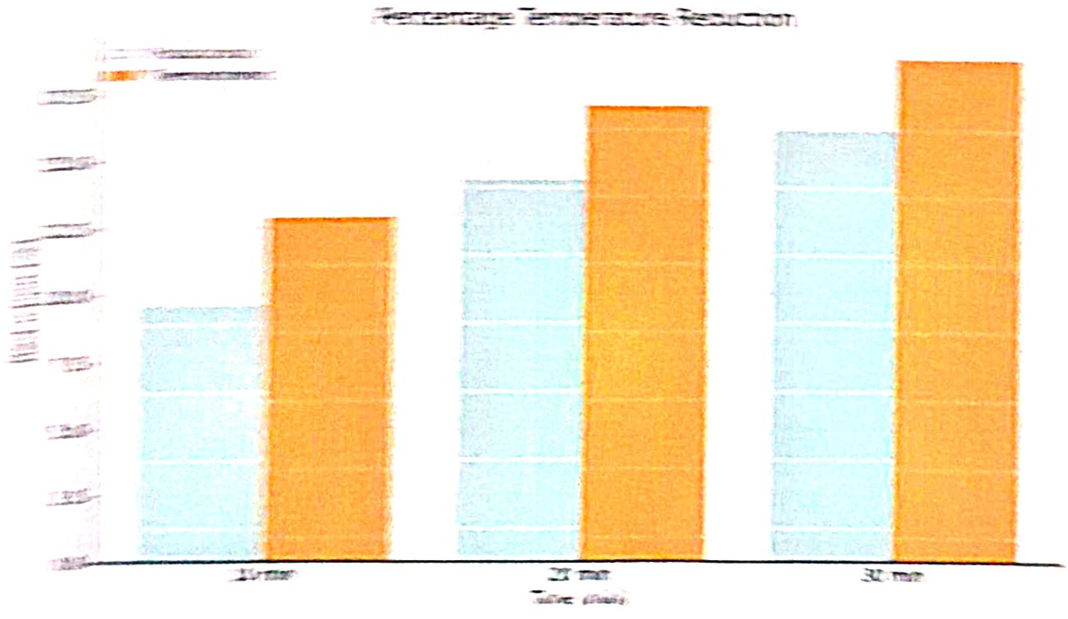


Table 3: User Comfort Survey

Setup	Brightness level	Glare Control	Heat Comfort	Overall Satisfaction
Control	Very Bright	Poor	Uncomfortable	Low
Photochromic	Moderate	Good	Comfortable	High
Thermochromic	Slightly Dim	Very Good	Very Comfortable	Very High

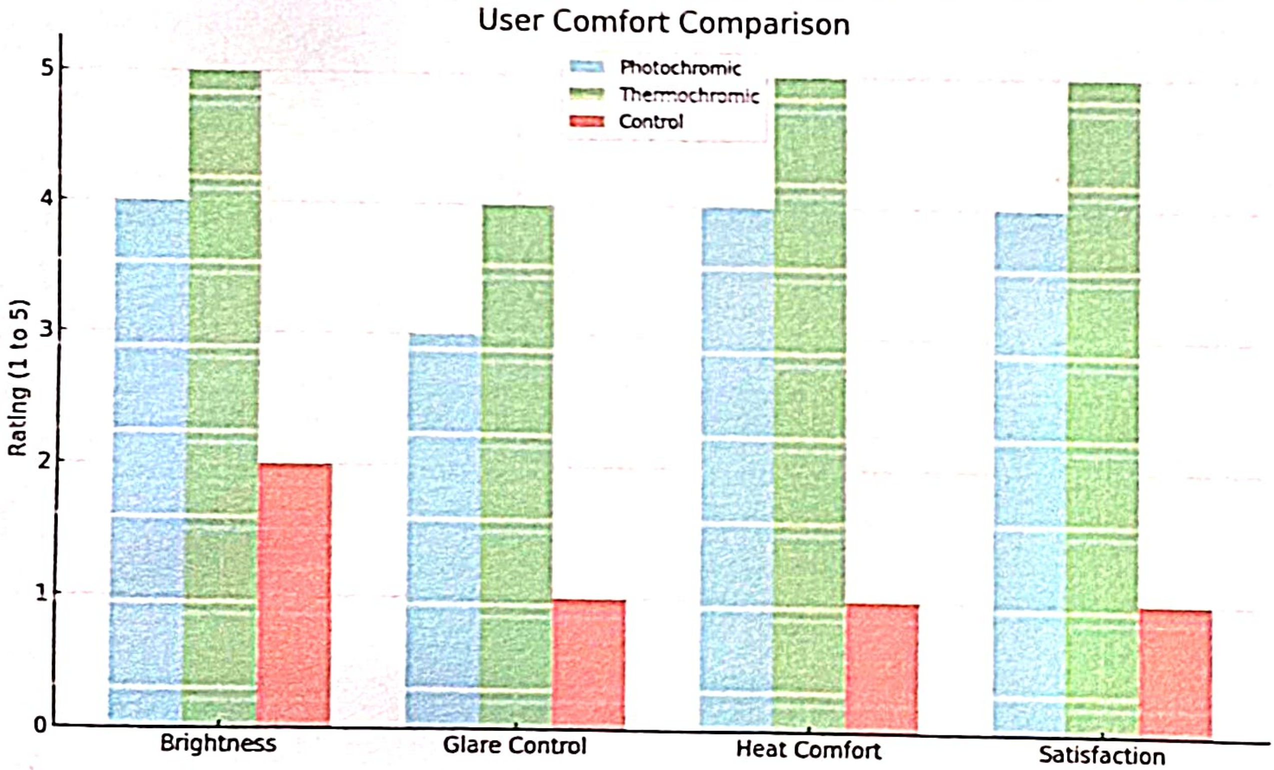
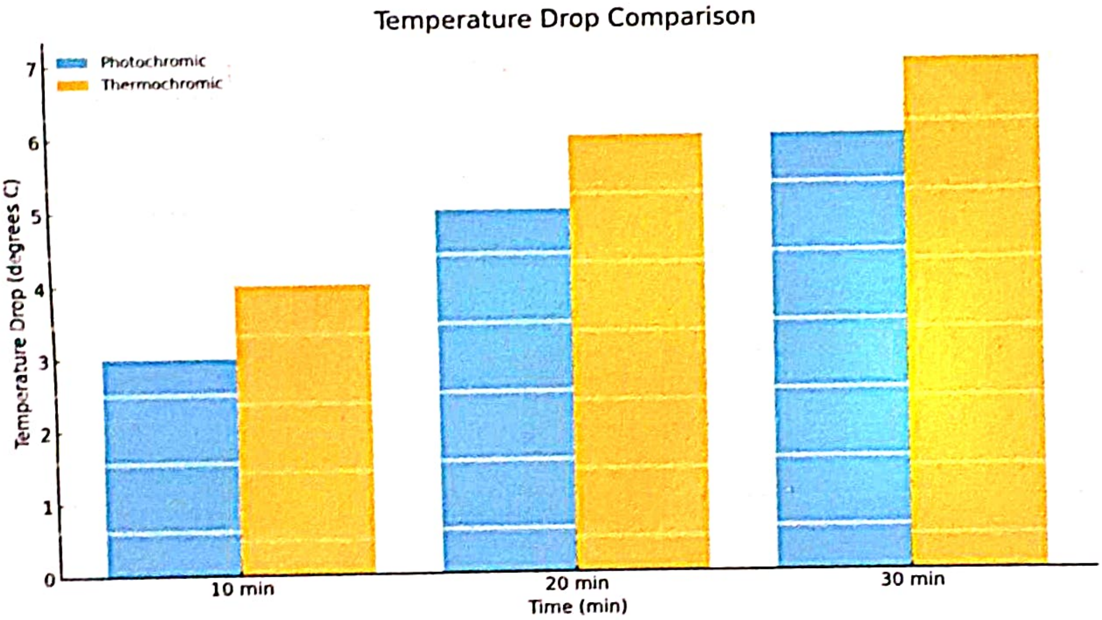


Table 4: Temperature Drop Comparison

Time (min)	Control Temperature(degrees C)	Photochromic Temperature (degrees C)	Temperature Drop Photochromic (degrees C)	Thermochromic Temperature (degrees C)	Temperature Drop Thermochromic (degrees C)
10	31	28	3	27	4
20	35	30	5	29	6
30	37	31	6	30	7

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Room Temperature
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31.6 °C


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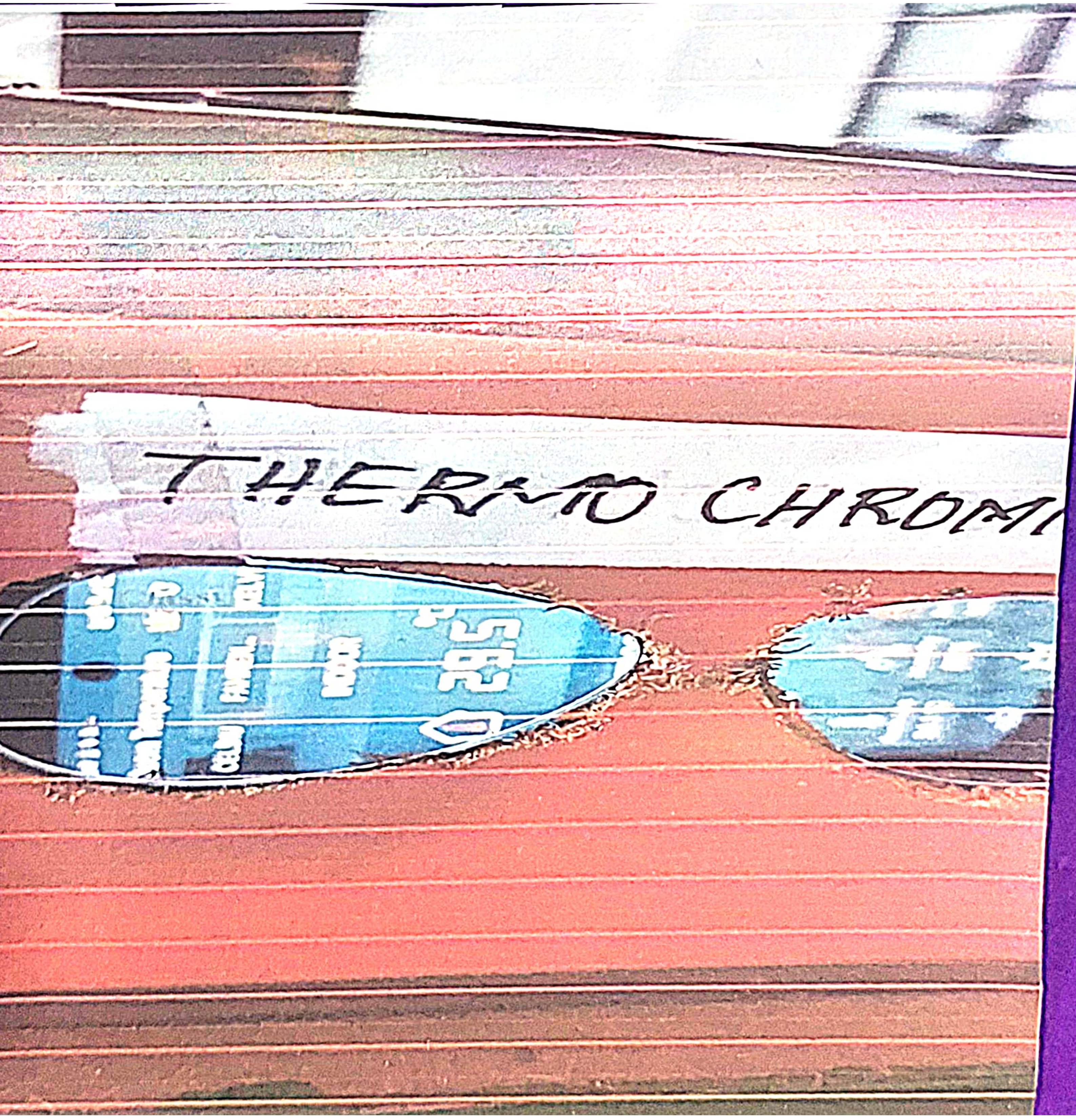
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Results and Discussion

Both photochromic and thermochromic films reduced internal temperatures significantly compared to untreated glass. photo chromic films performed best, maintaining up to 18-19 percent lower heat levels. This confirms their ability to improve comfort and reduce cooling energy needs.

Conclusion :

The experiment proved that photochromic and thermochromic films can maintain cooler indoor environments and improve energy efficiency. Applications include smart windows for homes, vehicles, and commercial buildings to reduce air-conditioning usage.

Future Enhancement

Future studies can explore hybrid films that combine both photochromic and thermochromic properties, long-term outdoor testing, and integration with smart sensors for fully automated energy-saving systems.

Application: Photochromic and thermochromic window films have a wide range of practical applications in modern buildings and energy-efficient systems. These smart films can be used in homes to reduce indoor heat and improve comfort without relying heavily on air conditioners. In schools, they help maintain cooler classrooms, creating a better learning environment for students. Offices and commercial buildings benefit from reduced glare on computer screens and lower electricity costs. Hospitals can use these films to create controlled lighting environments that support patient comfort. In cars and public transport, these films help reduce cabin temperature and protect passengers from harsh sunlight. Greenhouses can use thermochromic films to regulate heat and protect plants from excessive sunlight. Photochromic films are also useful in laboratories where stable temperatures are needed for experiments. These films can be applied in smart homes to integrate with energy-saving technologies. They help reduce UV radiation, protecting furniture, flooring, and displays from fading. Industrial buildings benefit from decreased cooling loads, resulting in lower energy consumption. They are also useful for eco-friendly architectural designs focused on sustainability. Hotels can use them to enhance guest comfort without increasing operational costs. Thermochromic films can be applied in skylights to automatically control sunlight entry. Modern city developers use these films in green buildings to achieve energy-efficiency certifications. They are valuable in regions with hot climates, helping communities reduce heat stress. Overall, these films provide a cost-effective, low-maintenance solution for maintaining cool indoor environments while promoting environmental sustainability.

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