PROJECTTITLE&ID:**LIGHT RESPONSIVE FILM**

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Light-Activated Materials: Photochromic and Thermochromic Films for Energy Efficiency

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.

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

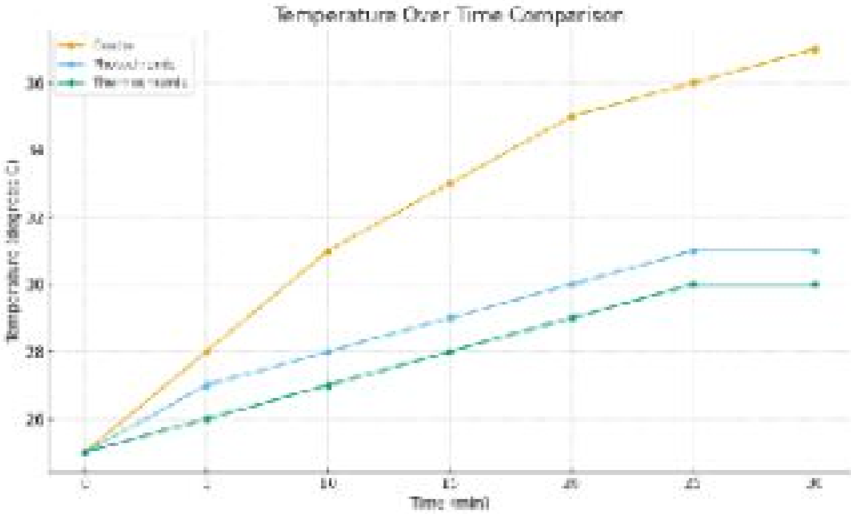


Table 2: Percentage Temperature Reduction

Time (min)	Control Temperature(degrees C)	Photochromic Temperature(degrees C)	% Reduction Photo chromic	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

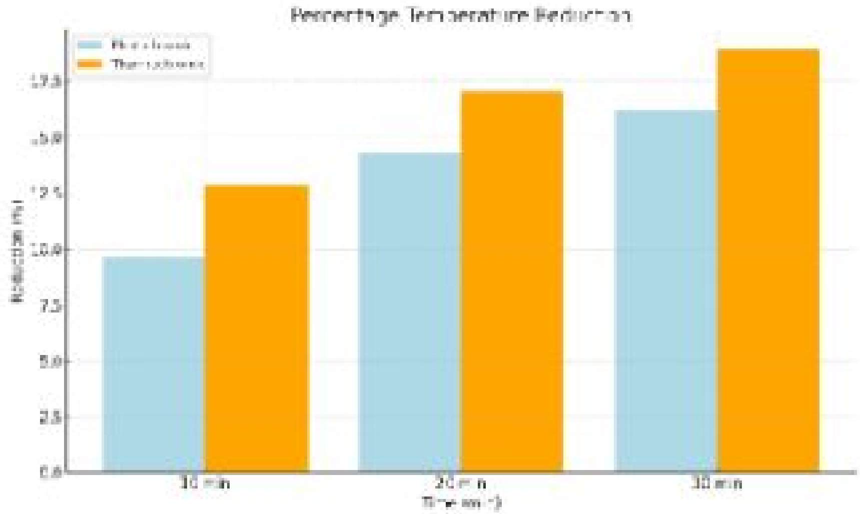


Table 3: User Comfort Survey

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

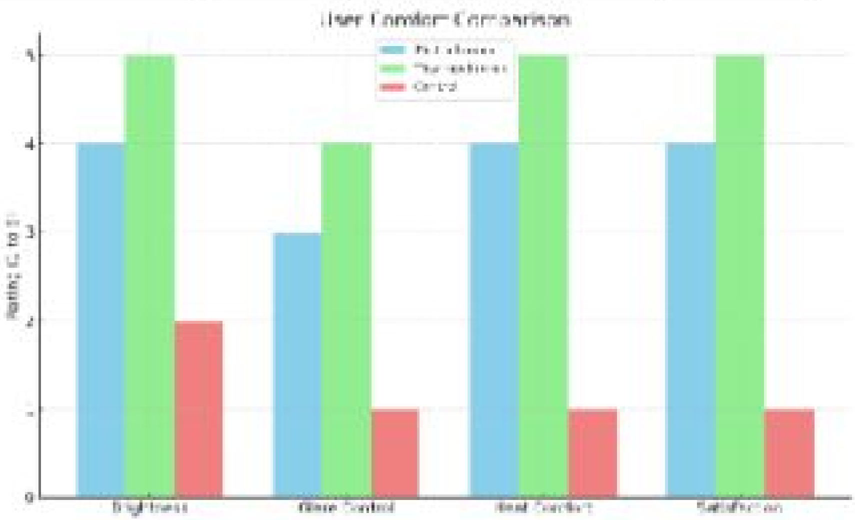
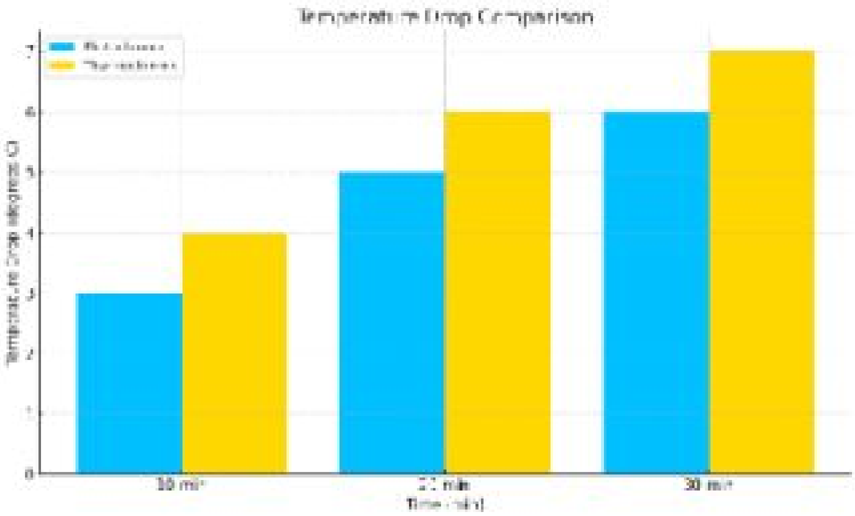


Table 4: Temperature Drop Comparison

Time (min)	Control Temperatu re(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




NO FILM
THERMO CHROMIC FILM


PHOTO CHROMIC FILM


NO FILM
Room Temperature
CELSIU
FAHREN...
KELVIN
INDOOR
31.6°C


THERMO CHROM

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 and Application

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.

References

1.

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