INVESTIGATION OF MECHANICAL PROPERTIES OF PVC BASED ROOFING MATERIAL UNDER EXPOSURE TO ACCELERATED AND NATURAL WEATHERING CONDITIONS

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Mr. V. S. C. Weragoda

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ABSTRACT

Polyvinyl chloride (PVC) stands out as a versatile thermoplastic polymer with widespread usage. However, prolonged exposure to outdoor UV radiation can trigger photodegradation in PVC, resulting in diminished longevity and alterations in its physical and chemical characteristics.

This study aims to comprehensively examine how natural and artificial (UV) weathering affect the chemical and mechanical attributes of PVC-based roofing sheets. The research employs a non-linear square fitting technique to ascertain the correlation between degradation rates in tensile strength, impact resistance, hardness, and water absorption properties over time. Furthermore, Fourier-transform infrared spectroscopy (FTIR) is employed to detect any associated chemical alterations.

Specimens designated for UV exposure and natural weathering undergo preparation under standard conditions. These samples are subjected to field and UV chamber environments, and evaluations are conducted at intervals of 0, 336, 672, 1008, 1344, 1680, 2016, and 2352 (Hours) for field exposure and 200, 400, 600, 800, 1000, 1200, and 1400 (Hours) for UV chamber exposure. The properties of irradiated samples are compared against a reference sample across various exposure durations and conditions.

Initially, the samples exhibit a hardness of 70.8 (Shore D). Following exposure to UV radiation for 1400 and 2352 (Hours), the hardness increases by 6% and 7%, respectively. However, tensile and impact properties decline under both natural and UV weathering. Intriguingly, elongation at break increases by 2% under UV irradiation. Moreover, treated samples demonstrate a significant 92% reduction in water absorption.

A correlation is established between weathering data for hardness, water absorption, and tensile properties. Polynomial equations derived from artificial (UV) weathering data accurately predict natural weathering outcomes. While artificial (UV) weathering tests offer insights into degradation behavior, particularly in the initial degradation stages, certain factors unique to natural weathering may not be entirely replicated in artificial (UV) settings, potentially leading to deviations in observed trends. Notably, no significant color changes are observed in either natural or artificial (UV) weathering test samples.

Keywords: Polyvinyl chloride (PVC), degradation, weathering.

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LIST OF ABBREVIATIONS

Abbreviation	Description
eV	Electron volts
FTIR	Fourier Transform-Infrared Spectroscopy
IR	Infrared
LMA	Levenberg-Marquardt algorithm
PVC	Polyvinyl chloride
SLP	Service Life Prediction
UV	Ultra Violet