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Analysis of Various Properties of Textile Tarpaulins Made From High Density Polythylene Woven Fabric

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***Abstract* - There are lot of plastic materials and products being used in various application and sometimes it requires knowing the life time of the products used in some critical application. These predictions of service life enable to understand and benchmark product life cycles in the application field.In this project work I have studied the Mass and Breaking Strength of tarpaulin as a function of time with the constant exposure to the plastic product at 70^o c for 23 week .The above mentioned properties were studied periodically as per is 7903.The life time prediction studies were carried out as per ASTM D3045 from the studies it has been observed that 5-20% property determination is taking place during exposure.**

I. INTRODUCTION

To study of life time prediction of Tarpaulin 450 GSM Ageing Property, Thermal Behavior and Physical Properties of Plastic Product.

History of HDPE:- At the very close of the 19th century, German chemist Hans von Pitchman noted a precipitate while working with a form of methane in ether. In 1900, German chemists Eugene Bamberger and Friedrich Tschirner identified this compound as polyethylene, a very close cousin to polyethylene. Thirty years later, a high-density residue was created by an American chemist at E.I. du Pont de Nemours & Company, Inc., Carl Shipp Marvel, by subjecting ethylene to a large amount of pressure. Working with ethylene at high pressures, British chemists Eric Fawcett and Reginald Gibson created a solid form of polyethylene in 1935. Its first commercial application came during World War II, when the British used it to insulate radar cables. In 1953, Karl Ziegler of the Kaiser Wilhelm Institute (renamed the Max Planck Institute) and Erhard Holzkamp invented high-density polyethylene (HDPE). The process included the use of catalysts and low pressure, which is the basis for the formulation of many varieties of polyethylene compounds. Two years later, in 1955, HDPE was produced as pipe. For his successful invention of HDPE, Ziegler was awarded the 1963 Nobel Prize for Chemistry.

Physical Chemistry and Mechanical Properties of HDPE

High-density polyethylene (HDPE) ($0.941 < \text{density} < 0.965$) is a thermoplastic material composed of carbon and hydrogen atoms joined together forming high molecular weight products as shown in Figure 1-1c. Methane gas (Figure 1-1a) is converted into ethylene (Figure 1-1b), then, with the application of heat and pressure, into polyethylene (Figure 1-1c). The polymer chain may be 500,000 to 1,000,000 carbon units long. Short and/or long side chain molecules exist with the polymer's long main chain molecules.

PROPERTIES OF HDPE

Density : 0.94 – 0.96 g/cc
M.P. : 130 C

- Milky Transparency
- Good Strength
- Good Heat Resistance
- Water Resistance
- Chemical Resistance
- Good chemical resistance
- Very good ESCR
- High Gas permeability
- Good electrical resistance
- Moderate mechanical properties.

LOW DENSITY POLYETHYLENE (LDPE) PROPERTIES

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Density: 0.91 – 0.92 g/cc
M.P.: 108 – 132 C

- Very good chemical resistance
- Non-polar
- Free from odour & toxicity
- Easy processability
- Mod.ESCR
- High impact
- Reasonable clarity

Many HDPE and LDPE sheets are used in for a wide range of purposes like agriculture, camping, construction, poultry curtain, farming and so on. These sheets are light in weight and easy to carry and tear resistant they find variety of use in our day today life. This sheets are tarpaulin mulch film, vermibed and geomembran have economical, light in weight, no microbial attack, inert to chemicals and acids, unaffected by plain or salt water, very strong, water proof and unaffected by UV rays.

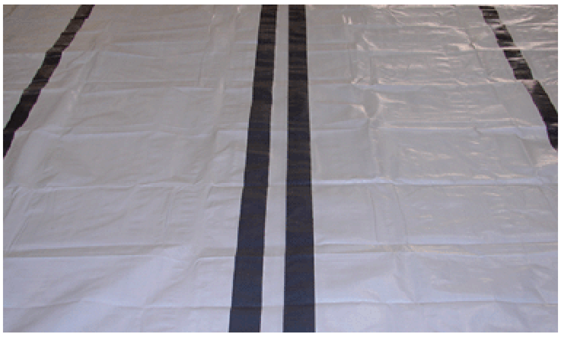

Fig.1.1 - Tarpaulin sheet

A **tarpaulin**, colloquially **tarp**, is a large sheet of strong, flexible, water-resistant or waterproof material, often cloth such as canvas or polyester coated with urethane, or made of plastics such as polyethylene.

II. METHODOLOGY

The objective of the proposal is to evaluate the predicted life of the plastic products used in field applications. Predicting service life enables to understand and benchmark product life cycles in the field. Plastic materials exposed to heat may be subject to ay types of physical and chemical changes. The severity of the exposures in both time and temperature determines the extent and type of change that takes place. A plastic material is not necessarily degraded by exposure to elevated temperatures, but may be unchanged or improved. However, extended periods of exposure of plastics to elevated temperatures will generally cause some degradation, with progressive change in physical properties. Generally, short exposures at elevated temperatures may drive out volatiles such as moisture, solvents, or plasticizers, relieve molding stresses, advance the cure of thermosets, and may cause some change in color of the plastic or coloring agent, or both. Normally, additional shrinkage should be expected with loss of volatiles or advance in polymerization. Some plastic materials may become brittle due to loss of plasticizers after exposure at elevated temperatures. Other types of plastics may become soft and sticky, either due to sorption of volatilized plasticizer or due to breakdown of the polymer. These studies contain material aging and properties evaluation and product aging and properties evaluation. Generally, the changes in properties are investigated by means of mechanical, thermal and physical properties. The test is complete once the property. Use regression analysis to determine the relationship between the logarithm of exposure time and measured property. Use the regression equation to determine the exposure time necessary to produce a predetermined level of property change. An acceptable regression equation must have an r^2 of at least 80%.

Fig.2.1 – Sheet in the oven

III. EXPERIMENTAL PROCEDURE

The properties evaluated using the guideline **ASTM D 3045-1992** (Reapproved 2003). The various properties were evaluated with the heat exposure to **70°C** for **23 Weeks.** The Dimensions, Mass, Breaking Strength, Tear Strength, Puncture Resistance to Materials To Artificial Light, UV Resistance Test was observed before and after heat aging. The sample was drawn in the B-1,3,6,12,15,23 Weeks interval to evaluate the above properties.

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Suggested Exposure Temperature °C	Reciprocal Temperature Degrees Absolute 1/TX 10^3	Estimated Limiting Temperature ^{A} t1, °C										
		40	55	70	85	100	115	135	155	180	210	240
50	3.09	A										
70	2.91	B	A									
90	275.	C	B	A								
105	2.64	D	C	B	A							
120	2.54		D	C	B	A						
130	2.48			D	C	B	A					
155	2.34				D	C	B	A				
180	2.21					D	C	B	A			
200	2.11						D	C	B	A		
225	2.01							D	C	B	A	
250	1.91								D	C	B	A
275	1.82									D	C	B
300	1.74										D	C
325	1.67											D

Table 3.1

S.No.	Name Of The Property Evaluated	ASTM /IS Method	1 week	3 weeks	6 weeks	12 weeks	24 weeks
1.	DIMENSIONS	IS-7903	✓	✓	✓	✓	✓
2.	MASS	IS-1964:2001	✓	✓	✓	✓	✓
3.	BREAKING STRENGTH	IS-1969:1985	✓	✓	✓	✓	✓

Table 3.2

Properties Performance Evaluation and schedule

Mass

The mass was done in accordance with the IS 1964 (2001).GSM in tarpaulin means grams per square meter it refers to the quality of material used in production. This can be calculated with average of five results.
Following equation is used to calculate the "GSM".

GSM = Mass Area Sample size: 200×200 (Unit:- mm)

Breaking strength

The mass was done in accordance with the IS 1969 (1985). The greatest stress especially in tension that a material is capable of withstanding without rupture. Tensile strength measures the force required to pull something such as rope, wire, or a structural beam to the point where it breaks. Sample size: 450×50 (mm).

IV. RESULTS AND DISCUSSION

In the present investigation the GSM, Breaking Strength ,mass was determined as a function of time with the constant exposure to the plastic product at 70°C for 24 week.

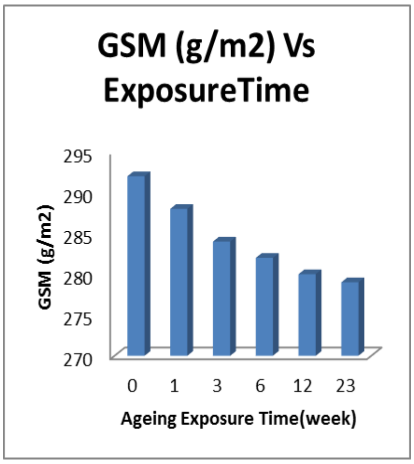

Fig. 4.1 – GSM Vs Ageing Exposure Time

The regression analysis was conducted on the above test data and the prediction of the life span of the products was made as per ASTM. Use the regression equation to determine the exposure time necessary to produce a predetermined level of property change. An acceptable regression equation must have an r^2 of at least 80%.

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The sample was initially determined the above properties and considered as 0 days sample or base property of the material. The sample was drawn in the interval of B-1,3,6,12,24 Weeks.

Breaking Strength : The following Properties were measured in the interval time duration of 0 to 23 weeks. The test values obtained as follows.

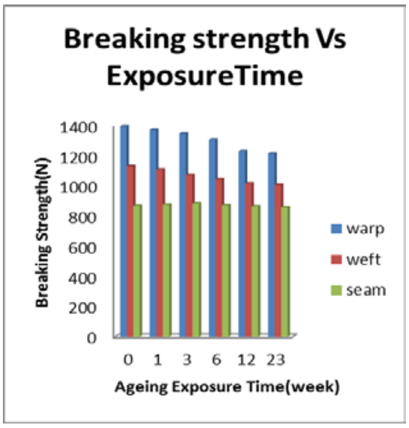

Fig. 4.2 – Breaking Strength Vs Exposure Time

V. REFERENCED DOCUMENTS

ASTM STANDARDS

- **ASTM D** 3045 Test Method Standard Practice for Heat Aging of Plastics Without Load
- **ASTM** D 573 Test Method for Rubber—Deterioration in an Air Oven.
- **ASTM** D 618 Practice for Conditioning Plastics for Testing.
- **ASTM** D 883 Terminology Relating to Plastics.
- **ASTM** D 1870 Practice for Elevated Temperature Aging Using a Tubular Oven3.
- **ASTM** D 1898 Practice for Sampling of Plastics3.
- **ASTM** E 145 Specifications for Gravity-Convection and Forced-Ventilation Ovens.**ASTM** E 456 Terminology Relating to Quality and Statistics.

ISO STANDARD:

- **ISO 2578 (1974)** Determination of Time-Temperature Limits After Exposure to Prolonged Action of Heat.

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- **IS 7903 (2011):** Textiles - Tarpaulines Made From High Density Polyethylene Woven Fabric [TXD 23: Textile Materials made from Polyolefins].
- **IS 1964 (2001):** Methods for Determination of Mass per Unit Lenght and Mass per Unit Area of Fabrics [TXD 1: Physical Methods of Tests].
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- **IS 1969 (1985):** Methods for Determination of Breaking load and Elongation of Woven Textile Fabrics [TXD 1: Physical Methods of Tests].
- **IS 13162-2 (1991):** Geotextiles - Methods of test, Part 2:Determination of resistance to exposure of ultra-violet light and water (Xenonarc type apparatus) [TXD 30:Geotextiles and Industrial Fabrics].
- **IS 14293 (1995):** Geotextiles - Method of test for trapezoid tearing strength [TXD 30:Geotextiles and IndustrialFabrics].

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