Industry Day Theme # Emerging Nano and Advanced Materials

Material Designing for Aerostat: Laminated Fabric based on Spectra (HPPE) for Inflatables

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Abstract

- Multilayered laminated structure was fabricated for a lighter than air (LTA) system
- Gas barrier film and protective layer film were laminated on high strength Spectra fabric by using adhesive along with UV additives
- The gas barrier and tensile strength property were measured by different characterizations including helium permeability test and lap shear test

Introduction

Aerostat is mainly used in defense applications including military surveillance, detecting aerial threats, broadcasting, weather forecasting, and telecommunication relay

Working Atmosphere

- Temp (-50 to 50 °C)
- Pressure (110 to 5475 Pa)
- UV & cosmic radiations
- Concentrated ozone

Inflatable Requirements

- Light weight
- Lower gas permeability
- High flexibility
- Weather resistance

Fibre	Density (g/cc)	Tensile strength (Gpa)	Tensile modulus (Gpa)	Breaking extension (%)	Moisture regain (%)	Decomposition temp (ºC)
UHMWPE	0.97	3.1	105	2.5	-	150
PET	1.38	1	15	20	0.4	260

UHMWPE fibre (Spectra)

- High strength-to-weight ratio
- Light and chemical stability
- High impact strength
- Low moisture regain
- High abrasion resistance

PU Nanocomposites

- Gas barrier
- UV screener
- Tortuous diffusion path
- High deflection temp
- Mechanical properties

Materials and Methods

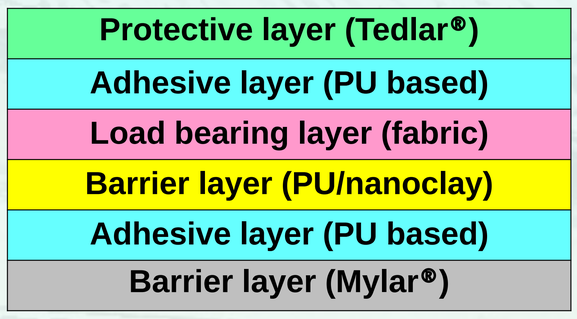
Materials

- BOPET film (Mylar®)
- PVF film (Tedlar®)
- PU (aliphatic)
- Nano-clay
- Adhesive (PLS500)
- UV additives

Methods

- Plain weave Spectra fabric
- One side coated by PU/clay
- PVF film on the upper side
- BOPET film on the bottom side
- Laminated by compression moulding (120 ºC, 110 bar)

Sample paste



Spectra laminated fabric (PAUNAB)

Conclusions

PU-nanocomposite based laminated fabric was successfully developed with excellent gas barrier and good tensile property with a medium aerial density material

Industrial Significance

This work is a preliminary study. More progress is required for commercialization with industry collaboration

Types of Laminated Specimens

S. No	Sample	Code	GSM
1	PVF + UHMWPE + BOPET	PUB	260
2	PVF + Adhesive + PVF + Adhesive + UHMWPE + PU/nanoclay	PAPAUN	380
3	PVF + Adhesive + UHMWPE + Adhesive + BOPET	PAUAB	280
4	PVF + Adhesive + PVF + Adhesive + UHMWPE +Adhesive + BOPET	PAPAUAB	330
5	PVF + Adhesive + BOPET + Adhesive + UHMWPE + PU/nanoclay	PABAUN	360
6	PVF + Adhesive + UHMWPE + PU/nanoclay + Adhesive + BOPET	PAUNAB	360

GSM of individual layers was also calculated where GSM of Tedlar (50), Mylar (30) and Spectra (180) was fixed.

Result

The performance of laminated fabrics was evaluated in terms of gas permeability, tensile strength, tearing strength and UV resistance property.

Code	He permeability ($L/m^2/day$)	Breaking strength (N)	Breaking extension (%)	Young's Modulus (MPa)
PUB	0.48	3462	11.8	827.8
PAPAUN	0.32	4401	8.3	1104.5
PAUAB	0.25	4458	8.1	1121.4
PAPAUAB	0.19	4515	7.5	1152.6
PABAUN	0.07	4569	7.2	1160.1
PAUNAB	0.05	4597	7.1	1168.2

PAUNAB becomes better laminated sample in terms of low helium gas permeability and improved tensile property.

References

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