Green Composites from Styrene Butadiene Rubber and Chicken feather fiber

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Abstract

Chicken feather fiber was used as reinforcing agent in styrene butadiene rubber (SBR). Fibers of almost similar length and diameter were mixed into SBR using a Two Roll Mixing Mill. The mechanical and thermal properties of the composites were analysed as a function of fiber loading. The results indicate that feather fiber improves the mechanical properties and glass transition temperature of the rubber. Scanning electron microscopy revealed some interaction between the rubbers and feather fiber.

Introduction

- In Kerala, a lot of chicken waste is producing every year - It causes environmental pollution
- Chicken feather fibers are made of a protein - **Keratin.**
- Keratin fibers from feathers are non-abrasive, eco-friendly, biodegradable , low density, insoluble in organic solvents and have good mechanical, thermal and insulating properties.
- Composites reinforced with chicken feather fiber have low density, recyclability, bio-degradability and can be manufactured at low costs.

Objectives of the work

- Development of SBR chicken feather fiber composites in different fiber loadings.
- To study the reinforcing effect of chicken feather fiber.
- To study the mechanical properties and thermal properties of SBR-chicken feather fiber composite.
- To study the surface characteristics of the composites by SEM.

Mixing formulations

Ingredients	Phr
Styrene Butadiene Rubber (SBR)	100
Dicumyl Peroxide (DCP)	2.5
Chicken feather fiber	0, 5,10 ,15,20

EXPERIMENTAL

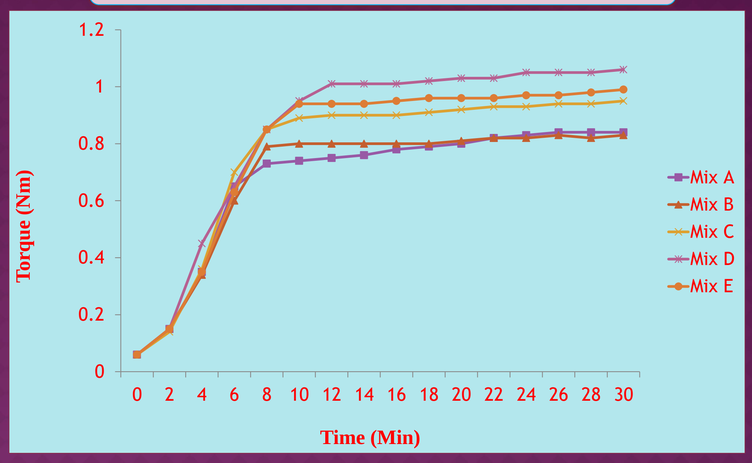
- Mixes were prepared in a laboratory two roll mixing mill.
- The cure characteristics studied by an oscillating disc rheometre (Geottfert elastograph)
- The samples vulcanized at 160°C in a hydraulic press.
- Dum bell shaped tensile (ASTM D.412) and tear ((ASTM D.624) specimens were punched from vulcanized sheets.
- Stress strain measurements were carrried out at a crosshead speed of 500mm/min on Instron model UTM.
- The hardness was measured with a shore A type durometre as per ASTM D-2240.

Results and Discussion

Cure characteristics of CF-SBR composites

Mixes	Minimum torque	Maximum torque	Cure time
Mix A (0 phr)	0.06	0.84	7.16
Mix B (5 phr)	0.05	0.80	8.06
Mix C (10 phr)	0.06	0.96	10.13
Mix D (15 phr)	0.06	1.01	12.37
Mix E (20 phr)	0.06	0.90	10.69

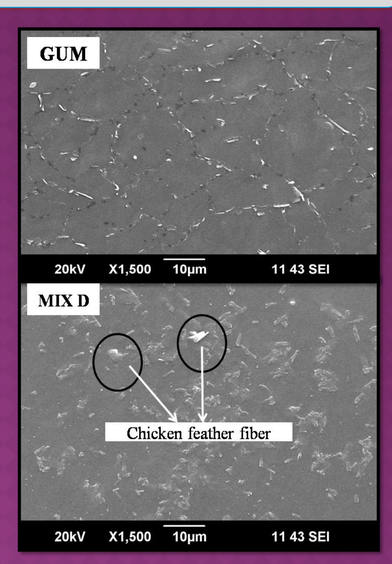
Rheograph of CF-SBR composites



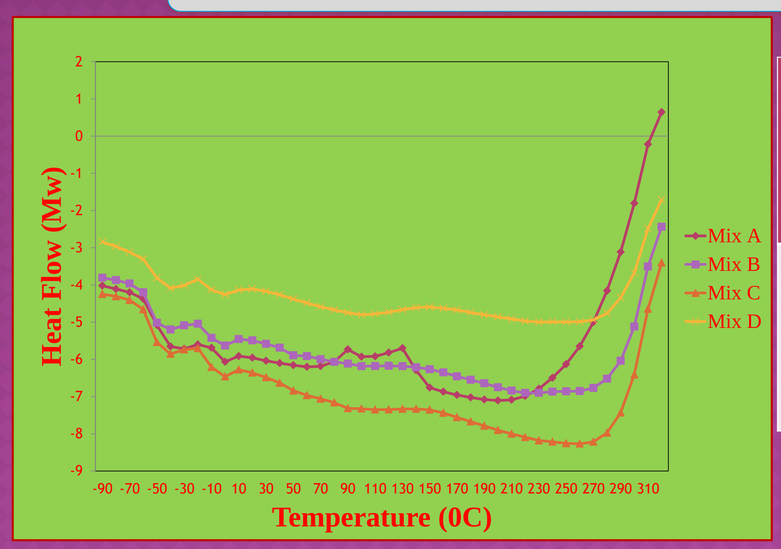
Mechanical Properties of CF-SBR composites

Properties	Mixes				
	A	B	C	D	E
Tensile strength (MPa)	0.74	1.11	1.33	1.64	0.93
Tear strength (kN/m)	2.85	3.35	4.30	5.20	6.10
Elongation at break (%)	131.59	117.38	58.39	19.05	11.29
Hardness (Shore A)	49.3	63.5	75.6	84	96.5

SEM images of samples



Thermal Properties of CF-SBR composites



Property	Fiber loading			
	0 phr	5phr	10 phr	15 phr
Glass transition temperature (T_g)	-49.72°C	-48.56°C	-48.32°C	-48.14°C

Conclusion

- **Mechanical properties of SBR-CF composites show strong interaction between fiber and rubber even without using coupling agent or any chemical treatment of the fibers**
- **The optimum loading of CF in the SBR composites was 15phr for the achievement of good reinforcement**
- **SEM analysis revealed the better adhesion between CF and SBR in the composites.**
- **Differential Scanning Calorimetric studies show that incorporation of feather fiber increases the T_g of the composite material.**
- **The presence of CF in the SBR composites prolonged t_{90}**

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