PREPARATION AND CHARACTERIZATION OF ETHYLENE VINYL ACETATE/POLYBUTADIENE RUBBER/NATURAL RUBBER (EVA/BR/NR) BASED THERMOPLASTIC ELASTOMER FOR FOOTWEAR APPLICATION

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ABSTRACT

To development of the effective thermoplastic elastomer from ethylene vinyl acetate (18% VA), polybutadiene rubber (cisamer 1220) and natural rubber (RSS 3) material for footwear application. Virgin EVA has poor set, tear and wear properties. BR enhance the lower tension rate, higher tear strength, higher abrasion resistance and low hardness and natural rubber will make economic which is necessary for the footwear application. EVA/BR/NR microcellular foam shows overall properties comparable with commercial EVA/BR microcellular foam. The main uses of this application in the shoes inner sole or the outer-sole of the shoes and also for flip flop and hawaii chappal. This TPE can give the flexible product and reduce the slippage on the wet floor or ground which is the essence of the footwear application. The blends are prepared at 110°C and 25 rpm by batch process in a two roll mill. After the mixing were done compression will takes place for the final foamed sheet with good mechanical properties.

Keyword: - *EVA, Polybutadiene rubber, Natural Rubber and Footwear*

1. INTRODUCTION

The development and growth in the thermoplastic elastomers based footwear are rapidly increasing. TPEs have opened the doors of many aspect and criteria to fulfill the requirement of customer. A huge range of articles using EVA are being produced in the footwear application with range of 18 to 28% for insoles and midsoles. According to reports the elastomers and foams of EVA with different rubber such as polybutadiene rubber (PBR)[1], styrene butadiene rubber (SBR)[5][6], Acrylonitrile – butadiene rubber (NBR) [7], Natural rubber [2][3] has been reported. However, there are a few claims on TPE using EVA as a hard phase and different rubbers as soft-phase.[8] EVA copolymer has dynamic and stable physic - chemical property. [9] World footwear production has crossed 21 billion pairs in 2011 of which EVA (9%), Polyurethane (8%), Rubber (40%), thermoplastic rubber (14%), are being used as a soling material[4].

EVA has poor set, wear and tear property after adding the mixer of NR and BR rubber which are bring good mechanical property, Reduce slippage also gives good compression set. As compare to EVA/BR and EVA/NR EVA/BR/NR has good mechanical and good compression and much reduction of slippage found. Virgin EVA has

not good anti-slippage but after adding the NR/BR has reduce slippage ratio. As increasing the ratio of EVA it has a good tensile strength but it has increased slippage.

1.1 EVA

EVA has a poor tear, wear and poor compression set. The EVA midsole is the most common cushioning material used for modern sports shoes. Used to make running shoes, basketball shoes, and almost any other sport shoe, EVA is light weight, resists compression set, is available in almost any color, and is easily formed. EVA is now the most widely used midsole material for shoes.

1.2 BR

Polybutadiene rubber is expected to enhance the set property and abrasion resistance of EVA. Polybutadiene Rubber (PBR) or simply Butadiene Rubber is one of the oldest offerings of Elastomers. Cisamer 1220, it is an international quality product, with high Cis content, has high elasticity and is resistant to dynamic stress, thus ensuring longer product durability

1.3 NR

Ribbed Smoked Sheets (RSS) are coagulated rubber sheets processed from fresh field latex sourced from well managed rubber plantations adopting modern processing methods. The higher grades RSS 1x to RSS 3 are mainly used for manufacture of products for medical, pharmaceutical and engineering. It will enhance good property also the availability and lower cost makes product economic.

2. Experimental

2.1 Materials

EVA (18%VA) supplied by Kaka polymers, India, and Natural Rubber (RSS 3), Polybutadiene rubber (Cisamer 1220) supplied by Patel rubbers, India.

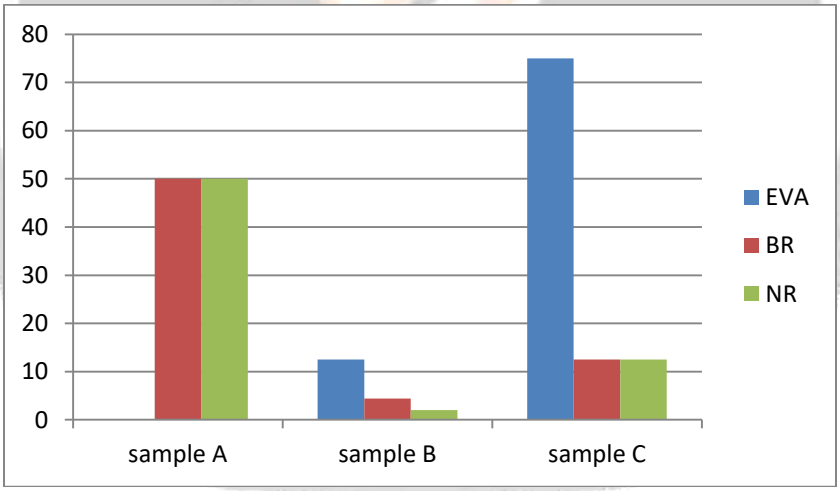

Chart -1: Formulation of EVA:BR:NR

DNPT(Blowing agent) with 60% purity, naphthenic oil (oil), sulfur (curing agent), silica (precipitate silica) (Filler), TMTD (Accelerator) is used for the experimental work.

Fig -1: Model of Hawaii chappal

2.2 Preparation of Blend

All blends are prepared in a Two Roll Mill. The mixing was performed at 110˚C temperature. The formulation EVA/BR/NR were prepared with different ratio without adding any additives.

Primarily two rubbers (BR/NR) were softened and then EVA was charged. The mixing was continued for 5-10 min. The sheet were formed in the two roll and cut. Remixed for 3 min. while it is still in a molten condition remove it and place it into the compression mould for second operation. The sheet was molded in a compression moulding machine at 160˚to 170˚C and 4 to 5 MPa pressure for 25 to 30min. The microcellular foam sheet were formed and cooled it in the same pressure. Then the test specimen were die cut from the molded sheet and was sent for test.

Table -1: formulation of Hawaii chappal

formulation	Phr
EVA (18%)	15
BR	45
NR	40
Blowing agent	6
Oil	10
Curing agent	2.5
Filler	20
Accelerator	1.2

2.3 Test Methods

Tensile test of the sample was carried out according to ASTMD 412 – 98a on dumbbell shaped specimen using servo series 50 kN universal tensile tester at ambient temperature. Compression set was done as per ASTM D 395 – 03. Abrasion test was performed using abrader as per ASTM D 394 – 59. Shore A hardness of each compositions were tested according to ASTM D 2240-97.

- Tensile strength
- Compression set
- Abrasion resistance

3. Results and discussion

3.1 Tensile strength

Result for the tensile strength for B (sample 3) has a good tensile strength then A (sample 1) and C (sample 2).

Sample 3 presents much higher elongation and good tensile strength. Due to high ratio of EVA in the batch three its shows high tensile strength as compare to batch 1 and batch 2.

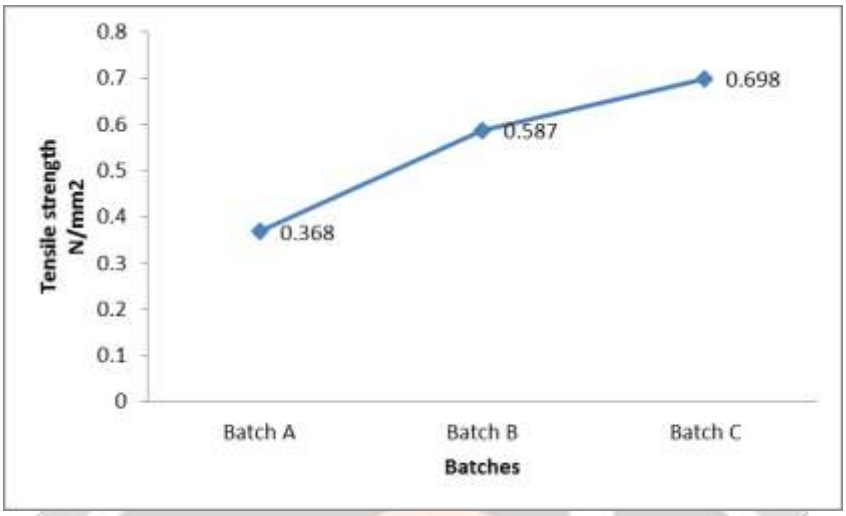

Chart -2: Tensile test graph

Due to high ratio of EVA Batch C shows high tensile strength as compare to other batches.

3.2 Compression set

The results show a good compression set then EVA/BR blends and less compression set then EVA/NR. It shows the EVA/BR/NR has a good compression set about 4.03 % vs EVA/BR blends.

Fig -2: Compression set and sample

3.3 Abrasion resistance

The abrasion results identify the results of the samples from sample 1 to sample 3. Sample 1 has more volume loss compare to other samples. sample 2 and sample 3 has not more loss of volume cm^3 per 10 min and it is about 0.08± 0.002 cm^3 per 10 min.

4. CONCLUSIONS

Compare all the results, we conclude that highly EVA contain batch C shows the highest tensile strength compare other batches due to high quantity content of EVA. Also the compression value is quite compare to other Batches.

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