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Development of Thermoplastic elastomer in Automobile application: high heat resistant and low oil-swell

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Abstract

The main objective of review is to develop thermoplastic elastomer for the automobile application. Automobile sector plays a major part in consumptions of rubber in world. There are many application of rubber in automobile, and there are many critical application of rubber in this sector. In this era of technology there is some very sensitive and critical application of rubber such as high heat resistant and high strength. There is application in oil also; in that case there should be low oil swell. Now day's cars and vehicles are meant to be light for the more fuel economy. Weight of rubber part is also important. For that thermoplastic elastomer have low specific gravity than that of conventional rubber, so aim of thesis is to fulfill the requirement of automobile sector with TPE having high heat resistant and low oil swell. And thermoplastic elastomer have reprocessebility same as plastics . and thermoplastic elastomer have high production rate and good processing characteristics . there is also a major advantage of using plastic processing machinery . I will work on research based on thermoplastic elastomer having high heat resistant and low oil swell. I will consider two basic thermoplastic blends and compare it with each other properties. From that I will suggest best option for automobile application in TPE . which will improve quality and service life of the product.

Keywords*- TPE, Automobile Application, Heat Resistant, Swelling, polyamide.*

I. INTRODUCTION

Thermoplastic elastomer also referred as thermoplastic rubber. Material with thermo reversible crosslink can be prossesd as a thermoplastic. Thermoplastic elastomers are one of the most versatile plastics in today's market. Thermoplastic elastomeric materials are a physical mixture of polymers (a plastic and a rubber). They exhibit the properties of both plastics and rubbers. The unique properties of both materials exist because TPE materials are created only by physical mixing of a thermoplastics and elastomer and no chemical or covalent bonding exists between the two. This behavior has opened a new field of polymer science. TPE are significant part of the rubber industry. They are used in many applications like adhesive, footwear, medical devices, automobile parts, house hold good. Nevertheless, from experiences, mankind has found that rubber can only be used after curing with suitable cross-linking agents, such as the invention of sulfur vulcanization by Charles Goodyear in 1839 opened a new door for various potential applications of natural rubber. The formation of covalent cross-links between the chain molecules prevents melt (re)processing, which gives cross-linked rubbers a distinct disadvantage compared to thermoplastics.

II. EXPERIMENTAL MATERIALS

Polyamide :-PA-l: Capron 8202NL NYLON 6 from Allied-Signal; PA-lC: Capron 8202C NYLON 6 from Allied-Signal; PA-2: Rilsan BMNO NYLON 11 from Rilsan Corp.; PA-3: Grilamid L20G NYLON 12 from Emser Indus tries; PA-4: Zytel 101 NYLON 6,6 from DuPont; **Acrylate Rubbers**: **R-l**: VAMAC-G neat terpolymer of about 73 mole percent of ethylene, about 26 mole percent of methyl acrylate and about one mole percent of carboxylic acid from DuPont; R-2: VAMAC-123 masterbatch of 100 parts of VAMAC-G 20 parts of fumed silica and 3 parts of stabilizers and processing aids. **Cross linking agent**:-Crosslinking agents: **XL-l**: tris(hydroxymethyl)amino methane from Angus Chemical Company; **XL-2**: LICA-44 neoalkoxy tri[N-ethylaminoethy lamino] titanite from Kenrich Petrochemical; **XL-3**: 4,4'-methylene dianiline from Olin Chemicals; **XL-4**: 4,4'-methylenebis(cyclohexylamine) from Ald rich Chemical Company; **XL-5**: N-(2-aminoethyl)-piperazine from Aldrich Chemical Company; **XL-6**: Maglite D magnesium oxide from Merck; XL-7: Mondur E-501 isocyanate-terminated polyester prepolymer from Mobay, about 19 percent NCO. **Stabilizers**: **S-l**: mixture of 0.4 pbw Irganox MD 1024 and 0.3 pbw Chimassorb 944LD and 0.2 pbw Irganox 1425 anti oxidants from Ciba—Geigy; **S-2**: mixture of 0.4 pbw Ethanox 330 from Ethyl Corp., 0.3 pbw calcium stearate, and 0.2 pbw Carbstab distearylthiodipropionate from Cincinnati Milacron.

III. EXPERIMENTAL

Mixing equipment

- Brabender Mixer.
- Mixing extruder such as a twin screw continuous mixing extruder
- Two roll mill

Brabender mixer: - brabender plasticoder is a machine to produce master batches for rubber, plastic, TPE. In this TPE the vamac and nylon is mixed above melting temperature of nylon. That is above 220^0c. in this machine the desire ratio of nylon and vamac is mixed at 240 ^{0}c and at 100 rpm for 3-4 min. then curing agent is added after that and mixed it for more 1-2 min. this is a process for mixing of TPE in brabender plasticoder. The mixture will be in dump form. And the mixing of vamac and rubber will be done in absence of air. In brabender they provide nitrogen atmosphere for inert atmosphere.
Twin screw extruder: - twin screw extruder is used for mixing of plastic material and for mixing of TPE also. In this machine there are two screws rotating in parallel axis. The advantage of twin screw is there is extra shear developed in the martial due to shear between two screw as well as screw and barrel wall. Dynamic vulcanization can also be done with this twin screw extruder.
Two Roll mill:- two roll mill is essential mixing machine for rubber industries. It is also known as heart of rubber

industries. The mixing of vamac and nylon on two roll mill is quite difficult. Because nylon will melt above 200 ^{0}c. It is not possible to achieve this much temperature in rubber two roll mill. It can be achieved in plastics two roll mill.
In plastic two roll mill when we melt nylon on to the mill and make band of nylon on to the roll the temp is about 200^{0}c. After melting of nylon we add rubber in to the mill.

IV. RESULTS

A. Experiment -1

This example serves to illustrate thermoplastic elastomer compositions of TPE comprising polyamide PA-l, acrylic ester copolymer rubber R-1 and varying amounts of tris(hydroxymethyl) amino methane crosslinking agent XL-l.

TABLE :-1 properties comparision with respect to different crosslinking agent PHR.

R-1	**60**	**60**	**60**	**60**
PA-1	**40**	**40**	**40**	**40**
XL-1	**0**	**0.15**	**0.3**	**0.45**
S-1	**0.54**	**0.54**	**0.54**	**0.54**
UTS	**0.3**	**6.4**	**14**	**20**
M100	**0.8**	**3.8**	**11**	**16**
UE	**2320**	**250**	**170**	**180**
H	**42A**	**60A**	**80A**	**89A**
TS	**40**	**16**	**18**	**28**
OS(125)	**45**	**54**	**43**	**34**
OS(150)	**75**	**73**	**50**	**39**
OS(175)	**50**	**57**	**52**	**48**
Extract	**95**	**65**	**95**	**15**

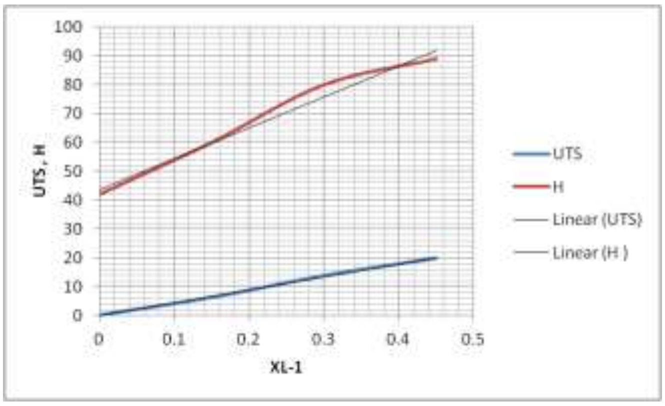

Figure 1:- Graphical Representation of Properties vs crosslinking agent

B. Experiment -2

In this experiment the rubber to polyamide reisn ratio is kept 9:1 and different crosslinking agent is used and properties are checked **.**

TABLE :- 2 Experiments With Different Crosslinking Agents And Compariosion.

R-1	**90**	**90**	**90**
PA-1	**10**	**10**	**10**
XL-1	**0**	**0**	**0.36**
Xl-6	**0**	**0.9**	**0**
Mgs	**0**	**0.45**	**0**
S-2	**0.81**	**0.81**	**0.81**
UTS	**0.3**	**11**	**6.7**
M100	**0.3**	**1.6**	**0.8**
UE	**370**	**640**	**580**
H	**18A**	**44A**	**32A**
TS	**40**	**3**	**6**
OS(125)	**-**	**94**	**90**
OS(150)	**-**	**137**	**125**
OS(175)	**-**	**153**	**179**
Extract	**101**	**16**	**33**

CONCLUSION

This invention provides thermoplastic elastomer compo sitions comprising blends of polyamide resin and covalently-crosslinked acrylate rubber. Such blends are pref erably in a weight ratio of rubber to polyamide of about 9:1 to about 4:6. Such thermoplastic elastomer compositions exhibit excellent high temperature dimensional stability and exceptional resistance to solvent swelling. rubber is advantageously a functional ized ole?n/acrylic ester copolymer rubber that is dynami cally vulcanized, e.g. by a polyfunctional, covalently crosslinking agent. the polyamide is advantageously a polycaprolactam (NYLON 6), polyhex amethyleneadiparnide (NYLON 66), or mixtures or copoly mers thereof. As used herein the term "elastomeric" refers to thermoplastic compositions which exhibit rubber-like elas ticity, i.e. have a tension set of less than about 60 percent, preferably less than about 50 percent.

REFERENCES

1. TPE maerials and Their use in out door Electrical Insulation: Salman Amin &Mohammad Amin,University of Taxila Pakistan
2. Semon W.L, U.S Patent 1929453 (1933 to B.F Goodrich co.)
3. Synder ,M.D U.S Patent 2632031,1952, to Dupont
4. U.S Patent 2629873 (1954, To Dupont)
5. Hoolzer R , U.S Patnet 3262,992 (1967 to Hercules Inc.)
6. Fisher W.K ,U.S Patent 3806558
7. Reader C.P Handbook of thermoplasric elastomer (second edition),chapter 7 (Waker B.M And Rader)
8. Vanderbilt Rubber Handbook, Ed., R. F. Ohm, R. T. Vanderbilt Co., Norwalk, Connecticut, 1990.
9. Rubber Technologist's Handbook , Edited by Sadhan K. De and Jim R. White
10. G. Holden in Encyclopedia of Polymer Science and Engineering, 2nd Edn., Volume 5, Ed., J. I. Kroschwitz, John Wiley and Sons, New York, 1996, 416.
11. Handbook of Thermoplastic Elastomers, Ed., B. M. Walker, Van Nostrand Reinhold, New York, 1979.
12. N. R. Legge, G. Holden and H. E. Schroeder, Thermoplastic Elastomers - A Comprehensive Review, Hanser Publishers, Munich, 1987.
13. G. Holden in Rubber Technology, 3rd Edition, Ed., M. Morton, Van Nostrand Reinhold, New York, 1987, Chapter 16, 465.

14. W. Hofmann, Rubber Technology Handbook, Hanser Publishers, Munich, 1989.
15. R. D. Lundberg, C. M. Alsys and B. M. Walker in Handbook of Thermoplastic Elastomers, Ed., B. M. Walker, Van Nostrand Reinhold, New York, 1979

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