REINFORCEMENT OF CARBOXYLATED ACRYLONITRILE-BUTADIENE RUBBER LATEX FILMS BY SURFACE MODIFIED FILLERS

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Declaration

I declare that this is my own work and this thesis with the title "**Reinforcement of carboxylated acrylonitrile-butadiene rubber latex films by surface modified fillers**" does not incorporate without acknowledgement any material previously submitted for a Degree or Diploma in any other University or Institute of higher learning and to the best of my knowledge and belief it does not contain any material previously published or written or orally communicated by another person except where due reference is made in the text.

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Dr. (Mrs.) N.M.V.K. Liyanage

Abstract

Carboxylated acrylonitrile butadiene rubber (XNBR) latex is a widely used synthetic copolymer of acrylonitrile and butadiene with a small amount of a third monomer containing carboxylic groups. Some of the mechanical properties of XNBR latex are not adequate for certain applications and should be enhanced. Incorporation of reinforcing fillers is most widely used technique for that purpose. Silica filler is used in dry rubber industry as a reinforcement agent, but difficult to use in latex applications due to some problems associated with dispersing silica resulted by its surface chemistry. Surface of silica should be modified in order to use as a reinforcing filler in latex applications.

In the present investigation, XNBR latex was filled with a series of surface modified precipitated silica. Surface modification of silica was affected by two methods i.e. non aqueous medium modification and aqueous medium modification, with the use of some synthetic polymers (SP). Three types of SPs, containing hydrophillic and hydrophobic groups that are methacrylic acid and 2-ethyl hexyl acrylate, respectively in different ratios were synthesized and used at a concentration of 3 % by weight of silica for the modification. The effectiveness of the SPs in enhancing reinforcing ability of silica in XNBR latex films was evaluated through investigation of mechanical properties of a range of vulcanized films cast from filled XNBR latex compounds containing modified filler in different concentrations in the range of 5 to 20 phr loadings. One of the well known non-sulphur vulcanization systems of XNBR, crosslinking with zinc oxide was used during the study. Latex films were cast from filled latex by several routes with different process sequences in order to investigate the importance of each step of the process to find out the most suitable step for filler addition.

Some of the mechanical properties important for rubber latex applications, such as tear strength, of modified silica filled cast films improved over unmodified silica filled cast films. Optimum tear strength of cast films filled with modified fillers was observed at 20 phr filler loading, while films containing 15 phr filler loading gave optimum tensile properties. Morphological studies done by scanning electron microscopy illustrated improved distribution and lower size of modified filler particles within the XNBR matrix indicating surface modification has reduced filler aggregation.

SPs used for the modification are capable of enhancing reinforcing action of silica fillller in XNBR latex films. The extent of enhancement of physical properties of filled cast films depends on the hydrophillic/hydrophobic ratio of SPs used for surface modification of silica. Highest physical properties were observed for the vulcanizates containing silica modified with the most hydrophobic SP, which is thought to be the result of better rubber filler interactions created by the entanglement of rubber chains with hydrophobic side groups present in this particular SP.

Keywords— Carboxylated acrylonitrile butadiene rubber, synthetic polymer, silica filler

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L.A.D.A. Liyanaarachchi

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List of Terms, Abbreviations and Symbols

AM	Aqueous medium
BCW	Bacterial cellulose whisker
CB	Carbon black
CN	Polar nitrile group
COOH	Carboxylic group
EHA	2-ethylhexyl acrylate
FTIR	Fourier Transform Infrared Spectroscopy
KOH	Potassium hydroxide
MAA	Methacrylic acid
MF	Modified filler
MWCNT	Multiwalled carbon nanotube
NAM	Non aqueous medium
NBR	Acrylonitrile butadiene rubber
PVC	Polyvinyl chloride
SDBS	Sodium dodecyl benzene sulphonate
SEM	Scanning electron microscopy
SP	Synthetic polymer
TGA	Thermogravimetry Analysis
THF	Tetrahydrofuran
UMF	Unmodified filler
w/w	Weight/Weight
XNBR	Carboxylated acrylonitrile butadiene rubber

ZDEC	Zinc diethyldithiocarbamate
ZnO	Zinc oxide