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**REINFORCEMENT OF
CARBOXYLATED NITRILE RUBBER LATEX
FILMS BY SURFACE MODIFIED NANOSILICA**

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Thesis submitted in partial fulfillment of the requirements for the degree
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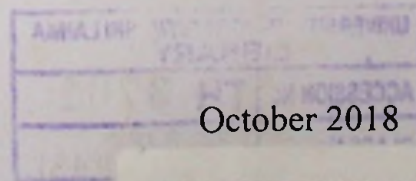
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DECLARATION

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Abstract

Carboxylated acrylonitrile butadiene rubber (XNBR) is synthetic elastomer which inherent number of physical and chemical properties such as comparable barrier protection, good puncture and chemical resistance and high durability under storage.

Although that there is a problem associated with synthetic elastomers that they are typically not self-reinforcing elastomers. Therefore, reinforcing fillers are incorporated to improve the properties of the compounds.

Silica is extensively used for latex products. Nanofillers can impart more advanced properties to the final nanocomposite than micro fillers. Surface modification has been introduced to avoid the incompatibility between inorganic filler silica and organic XNBR matrix.

Role of surface modifiers in this study play dual role, as a capping agent: to control the size of nanoparticles & as a coupling agent: to develop compatibility between rubber and filler. Synthetic surface modifiers i.e. Polymethacrylic acid & Polymethacrylic acid ethyl hexyl acrylate and natural surface modifiers i.e. cellulose, collagen, chitosan & gelatin were used in this study.

The FTIR analysis confirm that the surface of nanosilica particles has been successfully modified with acrylic polymers, forming ester bonds between carboxylic groups of acrylic polymers and surface silanol groups of nanosilica. TGA confirms the successful surface modification resulting lower weight loss; indicating small number of free surface silanols groups are present on the silica surface. XRD analysis revealed the amorphous nature of unmodified and all modified nanosilica particles. SEM results help to monitor the particle shape, size and agglomerations of synthesized particles.

Evaluation of XNBR vulcanizate properties of micro silica, unmodified nanosilica, acrylic polymer modified nanosilica and natural polymer modified nanosilica filled vulcanizates was carried out. The results show that addition of small quantities of nanosilica causes an increase of mechanical properties of XNBR vulcanizates, while high filler loading of nanosilica appear to decrease the mechanical properties due to the aggregation of nanosilica particles. 2% PMAA and 2% cellulose modified nanosilica filled vulcanizates show balance strength with stretch & comfort properties for the glove manufacturing.

TABLE OF CONTENT

DECLARATION	i
Abstract	ii
TABLE OF CONTENT	iii
LIST OF FIGURES	vii
LIST OF TABLES	xii
LIST OF ABBREVIATIONS	xiv
ACKNOWLEDGEMENT	xvi
1 INTRODUCTION	1
2 LITERATURE REVIEW.....	4
2.1 XNBR.....	4
2.2 Fillers	4
2.2.1 Filler characteristics	5
2.2.1.1 Cost.....	5
2.2.1.2 Chemical composition	5
2.2.1.3 Specific gravity.....	5
2.2.1.4 Hardness	6
2.2.1.5 Thermal properties	6
2.2.1.6 Optical properties	6
2.2.1.7 Morphology	6
2.2.1.8 Particle size.....	7
2.2.1.9 Particle shape.....	8
2.2.2 Types of fillers	9
2.2.2.1 Filler classification	9
2.2.2.2 Silica.....	10
2.2.2.3 Surface chemistry of silica	10
2.2.3 Nano fillers	11
2.2.4 Sol-gel process	12
2.2.4.1 Theory for sol-gel process of silicates.....	12
2.2.4.2 Theory for synthesis of nanosilica.....	18
2.3 Nanocomposite.....	18

2.4	Filler surface modification	19
2.4.1	Role of surface modifiers in present investigation	20
2.4.2	Types of surface modifiers	22
2.4.2.1	Synthetic polymers	22
2.4.2.2	NPs	23
2.4.2.2.1	Protein-origin polymers.....	23
2.4.2.2.2	Polysaccharide polymers	24
2.4.3	Methods for silica surface modification	25
2.5	Previous activities of synthesis of silica particles using metal alkoxides	26
2.6	Synthesis of silica particles using sodium metasilicate.....	27
2.7	Reinforcement of latex by organic/inorganic fillers	28
3	EXPERIMENTAL	32
3.1	Materials.....	32
3.2	Methodology	32
3.2.1	Characterization of latex	32
3.2.1.1	pH of latex	32
3.2.1.2	Dry rubber content of latex.....	32
3.3	Synthesis of polymers	33
3.4	Synthesis of surface modified nanosilica particles	34
3.4.1	Trial-01	37
3.4.2	Trial-02	37
3.4.3	Trial-03	38
3.4.4	Trial-04	39
3.4.5	Trial-05	39
3.4.6	Trial-06	39
3.5	Characterization of synthesized unmodified and acrylic polymer modified nanosilica.....	42
3.5.1	Fourier transform infrared (FTIR) spectroscopy	42
3.5.2	Thermogravimetry analysis (TGA)	42
3.5.3	Powder X-ray diffraction analysis (XRD).....	43
3.5.4	Scanning Electron Microscopy (SEM)	43
3.6	Preparation of silica dispersions.....	43

3.6.1	Preparation of dispersions of unmodified and acrylic polymer modified nanosilica.....	43
3.6.2	Preparation of dispersions of nanosilica modified with acrylic and NPs	44
3.6.3	Preparation of dispersions of micro silica modified with NPs	44
3.7	Characterization of NPs modified commercial nanosilica dispersions.....	45
3.8	Preparation of dispersions of compounding ingredients.....	45
3.9	Latex compounding, film casting, drying and vulcanization.....	46
3.10	Evaluation of vulcanizate properties.....	48
3.10.1	Measurement of physical properties of vulcanized latex films.....	48
3.10.2	Swelling properties of vulcanized latex films.....	50
3.10.3	Morphology of vulcanized latex films	51
4	RESULTS AND DISCUSSION	52
4.1	Surface modification of nanosilica particles using acrylic surface modifiers	52
4.1.1	Yield extracted from synthesis of surface modified nanosilica particles	52
4.1.2	Characteristics of synthesized unmodified and acrylic polymer modified nanosilica.....	53
4.1.2.1	Results of FTIR analysis of unmodified and acrylic polymer modified nanosilica	53
4.1.2.2	Results of TGA of unmodified and acrylic polymer modified nanosilica	56
4.1.2.3	Results of XRD analysis of unmodified and acrylic polymer modified nanosilica	65
4.1.2.4	Morphology and particle size distribution of unmodified and acrylic polymer modified nanosilica.....	67
4.1.3	Properties of XNBR latex vulcanizates filled with acrylic polymer modified nanosilica	76
4.1.3.1	Results of FTIR analysis of XNBR latex vulcanizates	76
4.1.3.2	Results of physical properties of XNBR latex vulcanizates filled with acrylic polymer modified nanosilica.....	78
4.1.3.3	Swelling properties.....	92
4.1.4	Characterization of unmodified and NPs modified nanosilica	97
4.1.4.1	Surface modification of silica particles using NPs as surface modifiers	97
4.1.4.2	Results of FTIR analysis of NPs modified nanosilica.....	97
4.1.4.3	Results of TGA of NPs modified nanosilica	100

4.1.5 Properties of XNBR latex vulcanizates filled with NPs modified nanosilica.....	103
4.1.5.1 Results of physical properties of XNBR latex vulcanizates filled with NPs modified nanosilica	103
4.1.5.2 Swelling properties.....	111
4.1.5.3 Morphology	116
CONCLUSIONS.....	118
RECOMMENDATIONS FOR FUTURE WORKS	119
REFERENCES.....	120

LIST OF FIGURES

Figure 2.1: Monomers of XNBR	4
Figure 2.2: Characteristic sizes of fillers (a) Primary particles (b) Aggregates (c) Agglomerates	7
Figure 2.3: Particle sizes of different types of fillers (C. Brinker, 1988)	8
Figure 2.4: Idealized shapes of typical fillers (Rothon, 2002).....	8
Figure 2.5: Classification of fillers based on particle size (Skelhorn, 2003)	9
Figure 2.6: Classification of fillers based on origin (Skelhorn, 2003).....	10
Figure 2.7: Types of hydroxyl species on silica surface (C. J. Brinker & Scherer, 2013)	11
Figure 2.8: Polymerization behavior of aqueous silica (C. J. Brinker, 1994).....	15
Figure 2.9: Schematic representation of the interphase in a polymer nanocomposite (Rallini & Kenny, 2017)	19
Figure 2.10: The two main types of filler surface modifiers (Rothon, 2002)	20
Figure 2.11: Structure of (a) PMAA homopolymer and (b) P(MAA-EHA) copolymer	23
Figure 2.12: Structure of gelatin	24
Figure 2.13: Structure of cellulose	25
Figure 2.14: Structure of chitosan.....	25
Figure 3.1: Diagram of polymerization setup	33
Figure 3.2: Hydrolysis reaction of sodium metasilicate	34
Figure 3.3: Reaction Scheme of anchored surface modifier on nanosilica particles .	35
Figure 3.4: Schematic diagram of Trial-01	37
Figure 3.5: Schematic diagram of Trial-02.....	38
Figure 3.6: Schematic diagram of Trial-03	38
Figure 3.7: Photograph of a dispersion of nanosilica particles	40
Figure 3.8: Extraction of PMAA modified nanosilica particles (a) MNS_{M2} in n-butanol and MNS_{M2} aqueous dispersion, (b) n-butanol solvent layer and UMNS in water, (c) n-butanol solvent layer and PMAA aqueous solution	41
Figure 3.9: Extraction of P(MAA-EHA) copolymer modified nanosilica particles (a) $MNS_{M/E1.5}$ in tetrahydrofuran and $MNS_{M/E1.5}$ aqueous dispersion, (b) tetrahydrofuran	

solvent layer and UMNS in water, (c) tetrahydrofuran solvent layer and P(MAA-EHA) copolymer aqueous solution	42
Figure 3.10: Latex film casting	48
Figure 3.11: Latex film air drying	48
Figure 3.12: Tensile test samples	49
Figure 3.13: Tear resistance test sample	49
Figure 4.1: FTIR spectra of UMNS, PMAA homopolymer and PMAA modified nanosilica at different concentrations of PMAA.....	53
Figure 4.2: FTIR spectra of UMNS, PMAA –EHA copolymer and P(MAA-EHA) modified nanosilica	55
Figure 4.3: (a) TGA curves of UMNS, VN ₃ , MNS _{M1} , MNS _{M1.5} , MNS _{M2} , MNS _{M2.5} and PMAA homopolymer, (b) Enlarged version of (a) except PMAA curve	58
Figure 4.4: (a) TGA curves of UMNS, VN ₃ , MNS _{M/E1} , MNS _{M/E1.5} , MNS _{M/E2} and P(MAA-EHA), (b) Enlarged version of (a) except P(MAA-EHA) curve	61
Figure 4.5: Variation of extracted yield (%) and weight loss (%) with level of surface modifier PMAA homopolymer	63
Figure 4.6: Variation of extracted yield (%) and weight loss (%) with level of surface modifier P(MAA-EHA)	64
Figure 4.7: XRD of UMNS	65
Figure 4.8: XRD of PMAA polymer	66
Figure 4.9: XRD of MNS _{M2}	66
Figure 4.10: XRD of MNS _{M/E1.5}	67
Figure 4.11: SEM of micro silica.....	68
Figure 4.12: SEM of UMNS	68
Figure 4.13: SEM of MNS _{M1}	69
Figure 4.14: SEM of MNS _{M1.5}	69
Figure 4.15: SEM of MNS _{M2}	69
Figure 4.16: SEM of MNS _{M2.5}	69
Figure 4.17: SEM of MNS _{M/E1}	70
Figure 4.18: SEM of MNS _{M/E1.5}	70
Figure 4.19: SEM of MNS _{M/E2}	70
Figure 4.20: Particle size distribution of (a) UMNS, (b) MNS _{M1} , (c) MNS _{M1.5} , (d) MNS _{M2} and (e) MNS _{M2.5}	72
Figure 4.21: Variation of average particle size with level of surface modifier PMAA	73

Figure 4.22: Particle size distributions of (a) $MNS_{M/E1}$, (b) $MNS_{M/E1.5}$ and (c) $MNS_{M/E2}$	74
Figure 4.23: Variation of average particle size with level of surface modifier P(MAA-EHA)	75
Figure 4.24: FTIR spectrum of unfilled XNBR latex vulcanizate	77
Figure 4.25: FTIR spectrum of UMNS filled XNBR latex vulcanizate	77
Figure 4.26: F/F interactions	78
Figure 4.27: F/R interactions	79
Figure 4.28: F/M interactions	80
Figure 4.29: M/R interactions	80
Figure 4.30: R/V interactions	81
Figure 4.31: M/V interactions	81
Figure 4.32: Bound rubber model [Mihara, 2009]	82
Figure 4.33: Variation of TS of XNBR latex vulcanizates with MNS_{M2} and $MNS_{M/E1.5}$ at different levels of filler loading	83
Figure 4.34: Variation of EB of XNBR latex vulcanizates with MNS_{M2} and $MNS_{M/E1.5}$ at different levels of filler loading	83
Figure 4.35: Variation of M300 of XNBR latex vulcanizates with MNS_{M2} and $MNS_{M/E1.5}$ at different levels of filler loading	84
Figure 4.36: Variation of TRS of XNBR latex vulcanizates with MNS_{M2} and $MNS_{M/E1.5}$ at different levels of filler loading	84
Figure 4.37: Variation of TS of XNBR latex vulcanizates with $*MNS_{M2}$ and $*MNS_{M/E1.5}$ at different levels of filler loading	89
Figure 4.38: Variation of EB of XNBR latex vulcanizates with $*MNS_{M2}$ and $*MNS_{M/E1.5}$ at different levels of filler loading	89
Figure 4.39: Variation of M300 of XNBR latex vulcanizates with $*MNS_{M2}$ and $*MNS_{M/E1.5}$ at different levels of filler loading	90
Figure 4.40: Variation of TRS of XNBR latex vulcanizates with $*MNS_{M2}$ and $*MNS_{M/E1.5}$ at different levels of filler loading	90
Figure 4.41: Variation of Swelling (%) of XNBR latex vulcanizates with MNS_{M2} and $MNS_{M/E1.5}$ at different levels of filler loading	94

Figure 4.42: Variation of Crosslink density of XNBR latex vulcanizates with MNS_{M2} and $MNS_{M/E1.5}$ at different levels of filler loading	94
Figure 4.43: Variation of Rubber filler interactions of XNBR latex vulcanizates with MNS_{M2} and $MNS_{M/E1.5}$ at different levels of filler loading	95
Figure 4.44: Variation of Swelling (%) of XNBR latex vulcanizates with $*MNS_{M2}$ and $*MNS_{M/E1.5}$ at different levels of filler loading	96
Figure 4.45: Variation of Crosslink density of XNBR latex vulcanizates with $*MNS_{M2}$ and $*MNS_{M/E1.5}$ at different levels of filler loading	96
Figure 4.46: Variation of Rubber filler interactions of XNBR latex vulcanizates with $*MNS_{M2}$ and $*MNS_{M/E1.5}$ at different levels of filler loading.....	97
Figure 4.47: FTIR spectra of UMNS, $*MNS_{CE2}$ and CE.....	98
Figure 4.48: FTIR spectra of UMNS, $*MNS_{CO2}$ and CO	99
Figure 4.49: FTIR spectra of UMNS, $*MNS_{CHO2}$ and CHO	99
Figure 4.50: FTIR spectra of UMNS, $*MNS_{GE2}$ and GE.....	100
Figure 4.51: TGA of $*UMNS$, $*MNS_{CE2}$ and CE.....	101
Figure 4.52: TGA of $*UMNS$, $*MNS_{CO2}$ and CO	101
Figure 4.53: TGA of $*UMNS$, $*MNS_{CHO2}$ and CHO	102
Figure 4.54: TGA of $*UMNS$ and $*MNS_{GE2}$	102
Figure 4.55: Variation of TS of XNBR latex vulcanizates filled with VN_3 , MMS_{CE2} , MMS_{CO2} , MMS_{CHO2} and MMS_{GE2} at different levels of filler loading	104
Figure 4.56: Variation of TS of XNBR latex vulcanizates filled with $*UMNS$, VN_3 , $*MNS_{CE2}$, $*MNS_{CO2}$, $*MNS_{CHO2}$ and $*MNS_{GE2}$ at different levels of filler loading	104
Figure 4.57: Variation of EB of XNBR latex vulcanizates filled with VN_3 , MMS_{CE2} , MMS_{CO2} , MMS_{CHO2} and MMS_{GE2} at different levels of filler loading	106
Figure 4.58: Variation of EB of XNBR latex vulcanizates filled with $*UMNS$, VN_3 , $*MNS_{CE2}$, $*MNS_{CO2}$, $*MNS_{CHO2}$ and $*MNS_{GE2}$ at different levels of filler loading	106
Figure 4.59: Variation of M300 of XNBR latex vulcanizates filled with VN_3 , MMS_{CE2} , MMS_{CO2} , MMS_{CHO2} and MMS_{GE2} at different levels of filler loading....	108

Figure 4.60: Variation of M300 of XNBR latex vulcanizates filled with *UMNS, VN ₃ , *MNS _{CE2} , *MNS _{CO2} , *MNS _{CHO2} and *MNS _{GE2} at different levels of filler loading.....	108
Figure 4.61: Variation of TRS of XNBR latex vulcanizates filled with VN ₃ , MMS _{CE2} , MMS _{CO2} , MMS _{CHO2} and MMS _{GE2} at different levels of filler loading....	110
Figure 4.62: Variation of TRS of XNBR latex vulcanizates filled with *UMNS, VN ₃ , *MNS _{CE2} , *MNS _{CO2} , *MNS _{CHO2} and *MNS _{GE2} at different levels of filler loading	110
Figure 4.63: Variation of swelling (%) of XNBR latex vulcanizates filled with VN ₃ , MMS _{CE2} , MMS _{CO2} , MMS _{CHO2} and MMS _{GE2} at different levels of filler loading....	111
Figure 4.64: Variation of swelling (%) of XNBR latex vulcanizates filled with *UMNS, VN ₃ , *MNS _{CE2} , *MNS _{CO2} , *MNS _{CHO2} and *MNS _{GE2} at different levels of filler loading	112
Figure 4.65: Variation of crosslink density of XNBR latex vulcanizates filled with VN ₃ , MMS _{CE2} , MMS _{CO2} , MMS _{CHO2} and MMS _{GE2} at different levels of filler loading	113
Figure 4.66: Variation of crosslink density of XNBR latex vulcanizates filled with *UMNS, VN ₃ , *MNS _{CE2} , *MNS _{CO2} , *MNS _{CHO2} and *MNS _{GE2} at different levels of filler loading	113
Figure 4.67: Variation of Qf/Qg of XNBR latex vulcanizates filled with VN ₃ , MMS _{CE2} , MMS _{CO2} , MMS _{CHO2} and MMS _{GE2} at different levels of filler loading....	115
Figure 4.68: Variation of Qf/Qg of XNBR latex vulcanizates filled with *UMNS, VN ₃ , *MNS _{CE2} , *MNS _{CO2} , *MNS _{CHO2} and *MNS _{GE2} at different levels of filler loading.....	115
Figure 4.69: Morphology of (a) VN ₃ (b) *MNS _{CE2} (c) *MNS _{CO2} (d) *MNS _{CHO2} (e) *MNS _{GE2} filled XNBR latex vulcanizates at 10 phr level of filler addition.....	117

LIST OF TABLES

Table 2.1: A comparison of the pre-coating and in situ methods of filler treatment (Rothon, 2002)	25
Table 3.1: Details of identification codes of silica samples.....	36
Table 3.2: Formulation used for the preparation of 15 % unmodified and acrylic polymer modified nanosilica dispersions.....	43
Table 3.3: Formulation used for 15% acrylic polymers modified silica dispersions.	44
Table 3.4: Formulation used for 15% NPs modified silica dispersions.....	45
Table 3.5: Formulation used for preparation of 33 % (w/w) ZnO dispersion	46
Table 3.6: Formulation used for preparation of 25 % (w/w) ZDC dispersion.....	46
Table 3.7: Formulation for XNBR latex compounding	46
Table 3.8: Operating conditions for tensile testing	49
Table 3.9: Operating conditions for tear resistance testing.....	49
Table 4.1: Extracted yield (%) of PMAA modified nanosilica.....	52
Table 4.2: Extracted yield (%) of P(MAA-EHA) modified nanosilica	52
Table 4.3: Characteristic group frequencies of silica.....	54
Table 4.4: Weight loss % of UMNS, VN ₃ and PMAA modified nanosilica at different levels of modification.....	58
Table 4.5: Degradation temperatures of PMAA and PMAA modified nanosilica at different levels of modification.....	59
Table 4.6: Weight loss (%) UMNS, VN ₃ and P(MAA-EHA) modified nanosilica at different levels of modification.....	62
Table 4.7: Degradation temperatures of P(MAA-EHA) and P(MAA-EHA) modified nanosilica at different levels of modification.....	62
Table 4.8: Variation of weight loss (%) and yield (%) with PMAA level of modification of nanosilica.....	63
Table 4.9: Variation of weight loss (%) and extracted yield (%) with P(MAA-EHA) level of modification of nanosilica.....	64
Table 4.10: Variation of weight loss (%), extracted yield (%) and average particle size with PMAA level of modification of nanosilica.....	73

Table 4.11: Variation of weight loss (%), extracted yield (%) and average particle size with P(MAA-EHA) level of modification of nanosilica.....	74
Table 4.12: Characteristic Group Frequencies of the unfilled XNBR latex vulcanizate (Ain & Azura, 2011)	78
Table 4.13: Weight loss (%) less than 150° C of UMNS and natural polymer modified nanosilica	103
Table 4.14: Increase in TS of vulcanizates filled with surface modified nanosilica over equivalent vulcanizates filled with surface modified micro silica.....	105
Table 4.15: Increase in EB of vulcanizates filled with surface modified nanosilica over equivalent vulcanizates filled with surface modified micro silica.....	107
Table 4.16: Increase in M300 of vulcanizates filled with surface modified nanosilica over equivalent vulcanizates filled with surface modified micro silica.....	109
Table 4.17: Increase in TRS of vulcanizates filled with surface modified nanosilica over equivalent vulcanizates filled with surface modified micro silica.....	111

LIST OF ABBREVIATIONS

XNBR	Carboxylated acrylonitrile butadiene rubber
PMAA	Polymethacrylic acid homopolymer
P(MAA-EHA)	Polymethacrylic acid ethylhexyl acrylate copolymer
PEG	Poly ethylene glycol
ZDEC	Zinc diethyldithiocarbamate
KOH	Potassium hydroxide
MAA	Methacrylic acid
FTIR	Fourier transform infrared
TGA	Thermogravimetric analysis
SEM	Scanning electron microscopy
ZnO	Zinc oxide
SP	Styrenated phenol
UMNS	Unmodified nanosilica
VN ₃	Ball milled micro silica
MNS _{M1}	1% Polymethacrylic acid modified nanosilica
MNS _{M1.5}	1.5% Polymethacrylic acid modified nanosilica
MNS _{M2}	2% Polymethacrylic acid modified nanosilica
MNS _{M2.5}	2.5% Polymethacrylic acid modified nanosilica
MNS _{M/E1}	1% Polymethacrylic acid ethylhexyl acrylate modified nanosilica
MNS _{M/E1.5}	1.5% Polymethacrylic acid ethylhexyl acrylate modified nanosilica
MNS _{M/E2}	2% Polymethacrylic acid ethylhexyl acrylate modified nanosilica
*MNS _{M2}	2% Polymethacrylic acid modified commercial nanosilica
*MNS _{M/E1.5}	1.5% Polymethacrylic acid ethylhexyl acrylate modified commercial nanosilica
CE	Cellulose

CO	Collagen
CHO	Chitosan
GE	Gelatin
*MNS _{CE2}	2% cellulose modified nanosilica
*MNS _{CO2}	2% collagen modified nanosilica
*MNS _{CHO2}	2% chitosan modified nanosilica
*MNS _{GE2}	2% gelatin modified nanosilica
MMS _{CE2}	2% cellulose modified microsilica
MMS _{CO2}	2% collagen modified microsilica
MMS _{CHO2}	2% chitosan modified microsilica
MMS _{GE2}	2% gelatin modified microsilica
TS	Tensile strength
EB (%)	Elongation at break (%)
M300	Modulus at 300% elongation
TRS	Tear strength

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