CONTENTS

Chapter 1: Introduction

1. Nanotechnology 26
   1.1 Nanotechnology-global outlook 26
   1.2 Nanomaterials and nanosized dimensions 30
   1.3 Classification 30
      1.3.1 Nanoparticles 31
      1.3.2 Nano platelets or layered silicates 33
         1.3.2.1 Morphology-crystallography 34
         1.3.2.2 Microstructure 37
         1.3.2.3 Cation exchange 38
            1.3.2.3.1 Cation exchange capacity 38
         1.3.2.4 Surface charge density 39
         1.3.2.5 Compatibilising agents 39
         1.3.2.6 Nanoclay modifications 41
         1.3.2.7 Nanoclay - physical constants 41
      1.3.3 Nanofibres 45
      1.3.4 Nanotubes 47
      1.3.5 Nanofibrils 50
   1.4 Preparation of nanomaterials 52
      1.4.1 Major preparation methods 52
         1.4.1.1 Wet chemical process 52
         1.4.1.2 Mechanical process 53
         1.4.1.3 Gas- phase synthesis 53
         1.4.1.4 Form-in-place process 54
      1.4.2 Micro-emulsion methods 55
      1.4.3 Pyrolysis 57
      1.4.4 Sol - gel processing 58
      1.4.5 Forced hydrolysis and chemical co-precipitation 60
1.9 Properties of polymer-layered silicate nanocomposites

1.9.1 Mechanical properties

1.9.1.1 Modulus
1.9.1.2 Tensile strength
1.9.1.3 Elongation at break

1.10 Barrier properties

1.10.1 Solvent resistance

1.10.1.1 Equilibrium swelling

1.10.2 Permeability

1.11 Thermal properties

1.11.1 Thermal stability
1.11.2 Flammability

1.12 Optical properties

1.13 Natural rubber based nanocomposites

1.13.1 Natural rubber

1.13.1.1 Compounding of natural rubber-dry stage
1.13.1.2 Compounding of natural rubber latex

1.13.2 Natural rubber latex nanocomposites
1.13.3 Nanocomposites from latex blends

1.14 Motivation and objectives of the present work

1.15 References

Chapter 2: Experimental

2.1 Centrifuged natural rubber latex
2.2 Neoprene latex

2.3 Compounding ingredients

2.3.1 Sulphur (Rhombic type)
2.3.2 Zinc diethyldithiocarbomate (ZDC)
2.3.3 Zinc oxide
2.3.4 Dispersol F
2.3.5 Fillers
Chapter 3: Sulphur prevulcanized natural rubber latex-based nanocomposites with layered silicates

3.1 Introduction 172
3.2 Results and discussion 174
  3.2.1 XRD analysis 174
  3.2.2 TEM analysis 175
  3.2.3 Mechanical properties 177
  3.2.4 Sorption behaviour 183
3.3 Conclusion 185
3.4 References 185

Chapter 4: Radiation prevulcanized natural rubber latex-based nanocomposites with layered silicates

4.1 Introduction 190
4.2 Materials and methods 191
4.3 Results and discussion 191
4.4 Conclusion 198
4.5 References 199
Chapter 5: Rheological behavior of layered silicate natural rubber latex nanocomposites

5.1 Introduction 202

5.2 Results and discussion 203
   5.2.1 Rheological measurements 206
   5.2.2 Activation energy ($E_a$) 211
   5.2.3 Zero shear viscosity ($\eta_0$) 213
   5.2.4 Yield stress ($\tau_0$) 214
   5.2.5 Pseudoplasticity index ($n$) 215

5.3 Conclusion 217

5.4 References 217

Chapter 6: Dipping characteristics of layered silicate-natural rubber latex nanocomposites

6.1 Introduction 222

6.2 Experimental 224
   6.2.1 Dipping process 224

6.3 Results and discussion 225
   6.3.1 Viscosity studies 225
   6.3.2 Dipping studies 226
   6.3.3 Tensile properties 232

6.4 Conclusion 233

6.5 References 234

Chapter 7: Degradation behaviour of natural rubber layered silicate nanocomposites

7.1 Introduction 238

7.2 Results and discussion 239
   7.2.1 Characterization of NR nanocomposites 239
      7.2.1.1 XRD analysis 239
Chapter 7: Degradation studies

7.2.1 TEM and SEM analysis
7.2.1.3 TGA analysis

7.2.2 Degradation studies
7.2.2.1 Effect of hot air ageing
7.2.2.2 Heat ageing in autoclave
7.2.2.3 Exposure to γ- radiation
7.2.2.4 Exposure to UV- radiation
7.2.2.5 Effect of chlorination
7.2.2.6 Effect of solvent
7.2.2.7 Exposure to ozone

7.3 Conclusion
7.4 References

Chapter 8: Mechanical and morphological properties of natural/chloroprene rubber latex blends nanocomposites

8.1 Introduction
8.2 Experimental

8.3 Result and discussion
8.3.1 The XRD studies of NR, CR and their blends nanocomposites
8.3.2 FTIR analysis of NR, CR and their blends nanocomposites
8.3.3 Swelling studies of NR, CR and their blends nanocomposites
8.3.4 NR and CR nanocomposites
8.3.5 NR/CR blend nanocomposites

8.4 Conclusion
8.5 References
Chapter 9: Design and development of Foley catheter from natural rubber latex nanocompound

9.1 Introduction

9.2 Result and Discussion

9.2.1 Optimization of catheter

9.2.1.1 Flow properties

9.2.1.2 Optimization of dipping conditions

9.2.1.2.1 Withdrawal rate of former

9.2.1.2.2 Immersion rate of the former

9.2.1.2.3 Dwell time

9.2.1.2.4 Concentration of coagulant

9.2.1.3 Optimization of dipping parameters

9.2.2 Preparation of catheter

9.2.2.1 Process flow chart

9.3 Conclusion

9.4 References

Chapter 10: Conclusions and future outlook

10.1 Conclusions

10.2 Future outlook