



## Preparation

Four methods

- exfoliation adsorption
  - nanocomposites based on water soluble polymers
- in situ intercalation
  - polymer layered thermoplastic nanocomposites
- melt intercalation

-silicon based nanocomposites

- template synthesis
  - double layer hydroxide-based nanocomposites

## Objectives Preparation of NR- nanocomposites by melt intercalation process evaluation of mechanical properties Comparison of properties - layered and non layered silicates dispersion of layered silicates - XRD and TEM



Natural rubber – ISNR 5         Characteristics       Spec         Dirt content, % by mass. max.       0         Volatile matter, % by mass. max.       0         Ash content, % by mass. max.       0         Nitrogen %by mass. max.       0         Initial plasticity, Po. min       0	
CharacteristicsSpecDirt content, % by mass. max.0Volatile matter, % by mass. max.0Ash content, % by mass. max.0Nitrogen % by mass. max.0Initial plasticity, Po. min0	
Dirt content, % by mass. max.0Volatile matter, % by mass. max.0Ash content, % by mass. max.0Nitrogen %by mass. max.0Initial plasticity, Po. min0	fication
Volatile matter, % by mass. max.0Ash content, % by mass. max.0Nitrogen %by mass. max.0Initial plasticity, Po. min0	.05
Ash content, % by mass. max.0Nitrogen %by mass. max.0Initial plasticity, Po. min0	.80
Nitrogen %by mass. max.0Initial plasticity, Po. min	.60
Initial plasticity, Po. min	.60
	30
Plasticity retention index (PRI). min	30
Mooney viscosity, ML (1+4) at 100 ° C 60	) ± 5
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Material	Grade/supplier	Characteristics			
Sodium bentonite (EXM)	EXM 757, Sud Chemie, Germany	Purified natural layered silicate, CEC: 80 meg/100g, interlayer distance 1.24 mm			
MMT-ODA Nanomer 1.30 P, (ODA) Nanomer Inc., USA		Octadecylamine (ODA) modified montmorillonite, specific gravity 1.9 g/cm <sup>3</sup> , particle size 16-20 microns, interlayer distance 2.10 nm			
MMT-TMDA (TMDA)	Cloisite 30B, Southern Clay Products Inc., USA	Methyltallow <i>bis</i> -2-hydroxyethyl quaternary ammonium (TMDA), modified montmorillonite, specific gravity 1.5 to 1.7 g/cm <sup>3</sup> , interlayer distance 1.85 nm.			
English Indian clay (Commercial clay)	English Indian Clays,Trivandrum, India	Amorphous nonlayered clay			

Ingredients	A	В	С	D	E	F	G	Н
Natural rubber	100	100	100	100	100	100	100	100
English Indian clay	0	10	30	0	0	0	0	0
Bentonite	0	0	0	10	0	0	0	0
MMT-ODA	0	0	0	0	5	10	0	0
MMT-TMDA	0	0	0	0	0	0	5	10
Zinc oxide	5	5	5	5	5	5	5	5
Stearic acid	2	2	2	2	2	2	2	2
CBS*	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6
Sulphur	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.5
* N-cvclohexvlbenzo	thiazole-	2-sulph	enamic	le				





Parameters	GUM	EIC 10	EIC 30	Bentonite 10	MMT- ODA 5
Cure time, t <sub>90,</sub> min	11.41	13.14	14.52	11.32	8.41
Mooney viscosity, 120°C, Min	37.8	38	45.3	37.1	41.7
Mooney Scorch Time, 120ºC, Min	42.42	40.21	32.46	30.40	12.59
M <sub>H</sub>	8.32	9.03	13.84	8.58	11.98
ML	0.66	0.66	1.02	0.67	0.87
M <sub>H</sub> -M <sub>L</sub>	6.62	8.41	11.0	7.07	11.1
ts <sub>2</sub>	8.55	8.59	9.16	6.04	2.59





















