

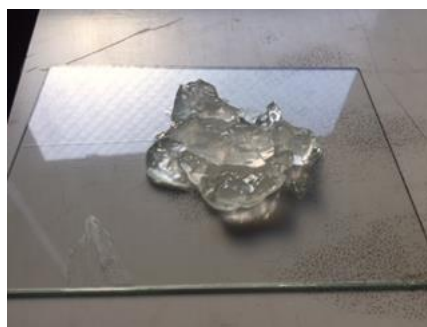
GS *TECHNICAL INFORMATION*

We can supply you in the form of cellulose nanofiber (CNF) in water dispersion. Also, we can make CNF dispersion in various type of organic solvent. Please consult with us which solvent you need such as alcohol, glycol ether based solvent, NMP, MEK, ethyl acetate etc... For example, below table indicates the basic property of CNF dispersion in water.

We also supply CNF composite materials mixed with various type of resin although trying to develop to mix higher CNF concentration.



CNF dispersion in water

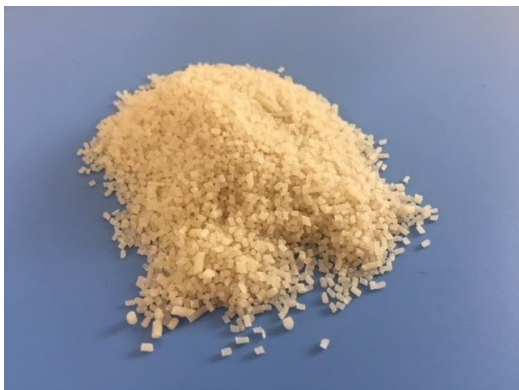


CNF dispersion in Phenyl Glycol

CNF	0.2 - 10 %
Additive and Resin	0.01 - 1 %
Water	89 - 99.9 %
Viscosity	1.0 – 300000 mPa·s/ 25 °C
CNF size	20 - 500 nm

GS *TECHNICAL INFORMATION*

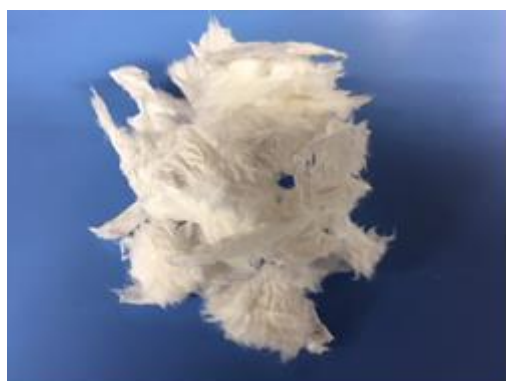
Below table indicates the basic physical properties of our CNF composite masterbatch with various type of resin.



**CNF mixed PLA (Poly Lactic Acid)
Compounds**



CNF mixed Plastic test pieces



Chemically modified Cellulose

Non biodegradable plastic + CNF composite

type of plastic	CNF Concentration (%)	Tensile Strength (MPa)	Tensile Stroke (mm)	Elasticity (MPa)	Bending Strength (MPa)	Bending Stroke (mm)
Polyethylene (PE)	0	10				
PE composite with CNF	23	15 - 17				
PE composite with CNF	33	24 - 25				
Polypropylene (PP)	0	32	6.2	2031	59	9.4
PP composite with CNF	23	38 - 39				
PP composite with CNF	33	41 - 42				
PP composite with CNF	40	48 - 49		3289	83	7.7
Poly Styrene (PS)	0	29				
PS composite with CNF	23	36 - 37				
Polymethyl methacrylate (PMMA)	0	42				
PMMA composite with CNF	23	56 - 57				
Polyamide 6 (PA6)	0	42				
Polyamide 6 (PA6) composite with CNF	13	43				
Poly Vynil Chloride (PVC)	0	12				
PVC composite with CNF	23	22 - 23				
Acrylonitrile butadiene styrene (ABS)	0	43				
ABS composite with CNF	23	50 - 51				
Polycarbonate (PC)	0	44				
PC composite with CNF	23	55 - 56				
polyvinyl butyral (PVB)	0	44				
PVB composite with CNF	23	54 - 55				
Thermoplastic Poly Urethane (TPU)	0	17				
TPU composite with CNF	25	30				
polyacetal, polyoxymethylene (POM)	0	51				
POM composite with CNF	23	61				
Ethylene α Olefin Copolymer	0	7.3		22.7	1.5	
Ethylene α Olefin Copolymer with CNF	33	7		370	6.7	

Biodegradable plastic + CNF composite

type of biodegradable plastic	CNF Concen- tration (%)	Tensile Strength (MPa)	Tensile Stroke (mm)	Elasticity (MPa)	Bending Strength (MPa)	Bending Stroke (mm)
polycaprolactone (PCL)	0	2				
PCL composite with CNF	23	8.5				
starch based plastic	0	8				
starch based plastic composite with CNF	23	19.5				
starch + PBAT based plastic	0	11	198	258.7		
starch + PBAT based plastic composite with CNF	25	24	4.2	1640		
starch + PLA based plastic	0	29	2.4	1869	42.7	4.8
starch + PLA based plastic composite with CNF	23	34	1.3	3567	59	3
Poly buthylene succinate (PBS)	0	38				
PBS composite with CNF	26	48				
Poly Lactic Acid (PLA)	0	62				
PLA composite with CNF	23	69				
poly(butylene adipate-co- terephthalate) (PBAT)	0	12				
PBAT composite with CNF	23	18.5				
polyhydroxyalkanoate (PHA)	0	16				
PHA composite with CNF	30	24.5				

Recycle plastic (Plastic waste) + CNF composite

type of waste plastic (recycle plastic)	CNF Concentration (%)	Tensile Strength (MPa)	Tensile Stroke (mm)	Elasticity (MPa)	Bending Strength (MPa)	Bending Stroke (mm)
polypropylene (PP) from plastic pallet (Black color)	0	21.8	6.4	1304	31.6	8.4
PP composite with CNF	40	32.4	4.1	2851	51.7	7
polyethylene (PE) from diaper (from factory, white color)	0	11.7	5.2	1239	14.3	16.4
PE composite with CNF	30	33.8	4.3	2958	46.3	9.4

Other properties such as thermal expansion coefficient, MFR (Melt Flow Rate), heat stability etc... will be updated soon. We will keep chasing to create CNF composite plastic with higher strength, also with other resins, functional fillers. Please consult with us including technical detail anytime.