Available online at **www.joac.info**

ISSN: 2278-1862

Journal of Applicable Chemistry

2019, 8 (3): 1302-1307

(International Peer Reviewed Journal)

The Effects of Salt Spray on Mechanical Properties of Wood-Plastic Composite, Polypropylene and Neem Wood Flour

Manoj Kumar[1], Mukta Rathore[1], Vikas Gupta[1]* and Animesh Agarwal[2]

1. Department of Chemistry, School of Sciences, IFTM University, Moradabad, UP, **INDIA**
2. Department of Applied Sciences and Humanities, Moradabad Institute of Technology, Ram Ganga Vihar, Phase-2 Moradabad, U.P., **INDIA**

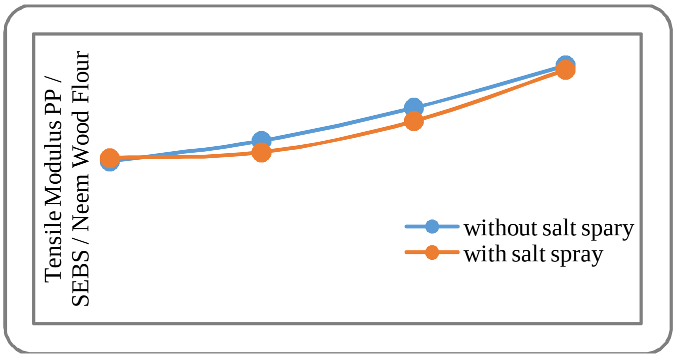
Email: vikasgupta@iftmuniversity.ac.in

Accepted on 31st March, 2019

ABSTRACT

In the present study various mechanical parameters were examined on fabricated wood plastic composite as per the specific standards. Wood plastic composite properties tested against properties of polypropylene (PP), Styrene-ethylene-butylene-styrene (SEBS), Neem wood flour. The mechanical properties of wood plastic composite have been compared with polypropylene, SEBS and Neem wood flour. The PP-SEBS blend with 10% wt of copolymer is further modified up to 10%, 15%, 30% and 50% wt of Neem wood. The tensile properties such as modulus, strength and impact strength were examined and the effect of spray on these properties is also the part of study.

Graphical Abstract



Dependence of Tensile modulus of PP/SEBS/Neem wood flour content (%).

Keywords: Polypropylene, Neem wood flour, SEBS, Salt spray.

INTRODUCTION

Wood Plastic Composites (WPCs) is a general term referring to wood–based elements such as veneer, fibers, flour or particles that are combined with polymer to create a composite material. Wood plastic composites can be of both thermosetting and thermoplastic polymer and are often categorized as separate type of material [1]. The WPC is now widely used in both composite and plastic industries and world is now looking towards the newly generated composites materials as per the demand of customer. The WPCs have emerged as an important family of engineering materials such as building application like docks, landscaping timbers, fencing etc. WPCs are also used in wide variety of many applications in automobiles, building, outdoor furniture, window parts, door panels and construction other commercial products in which creep resistance and some toughness are demanded in addition to weight and cost saving.

Polypropylene (PP), a semi crystalline polymer has become especially important due to its properties such as low density, high melting temperature and good chemical inertness which make it particularly suitable for wide range of application. The use of polypropylene is limited due to lack of good impact resistance and inability to create sufficient interfacial adhesion with other phases such as ceramic fillers or polar, rubbers, materials like urethanes, epoxies or melamine [2, 3].

Styrene-Ethylene-Butylene-Styrene (SEBS) copolymer is extensively used as thermoplastic elastomer with less dense nature, nontoxic and excellent resistance to acid and base. Many research scholars previously studied that SEBS affects the crystallinity of polypropylene when a composite is formed. In the present study the effect of maleic anhydride can be studied on the properties profile of PP, SEBS and Wood flour composites [4-7].

MATERIALS AND METHODS

Materials: Styrene-Ethylene-Butylene-Styrene (SEBS). The elastomer SEBS, Kraton FG 1901 MFI 4.6 g 10 min^{-1} (230ºC, 2.16 kg), is purchased from Shell chemical Co., USA [8].

Polypropylene: Polypropylene (PP), H110MA, with MFI 11g $10min^{-1}$ (230ºC, 2.16 kg) is purchased from Reliance polymers, Vadodara, India [9].

Neem wood flour: Neem wood flour is purchased from local suppliers and sieved. The Specific gravity 0.68 (g/cm^3) of wood particles were evaluated using density gravity bottle and mesh size below 180 µm (BSS-85).

Preparation of polypropylene and neem wood flour composites: The elastomer SEBS and the Neem wood flour were per dried at 70 to 80ºC for 3-5 h to remove the moisture. The blends of PP-SEBS with different concentration of SEBS up to 10% by weight were prepared by using dry blending followed by mixing of melt using a co rotating twin screw compounder(Model PTC/TH/40 (L/D=40, diameter D=21 mm) at rotation speed of 600 rpm and allowed to pelletize. The barrel temperatures were kept 50ºC to 240ºC from the feed zone to die zone and the mold was maintained at 30±2ºC.

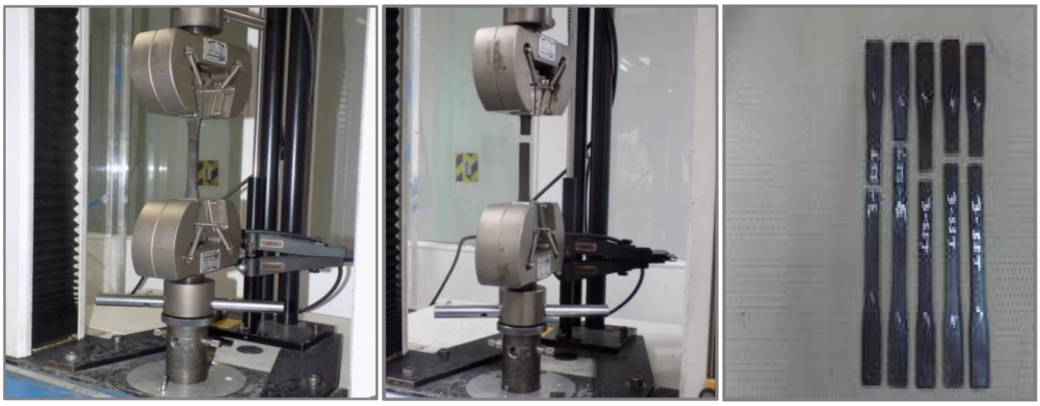


Figure 1. The Dumble shape Tensile Specimen of PP/SEBS/Neem wood flour after test.

The tensile tests were performed using dumbbell specimens (Figure 1) on In stron [Model 3369, UK], at pre condition at 23±2ºC and 50±10% RH for 40 h and crosshead separation 50 mm and with the speed of 50 mm min^{-1} as per standard ASTM D 638:2010.

The Izod impact strength of notched specimens (Figure 2) were also obtained on a Ceast [Model Resil Impactor (Italy)] at pre condition at 23±2ºC and 50±10% RH for 40 h and Hammer used 2.75J as per standard ASTM D 256:2010. A set of five specimens of the each composition are tested and nean value is reported. All the tests are performed at room temperature of 23±2ºC and 50±10%RH.

The salt Spray test are performed in salt chamber [Weiss Umwelttechnik (Germany)] according to the ASTM B 117:2010/ASTM D638:2010 and water specification ASTM D1193 and ASTM E 93 test method of for pH aqueous solution . The samples were tested for 72 h with 5% by weight sodium chloride environment. After 72 h the samples were dried at room temperature 23±2ºC and 50±10% RH for 24 h and again tensile and impact tests were performed.

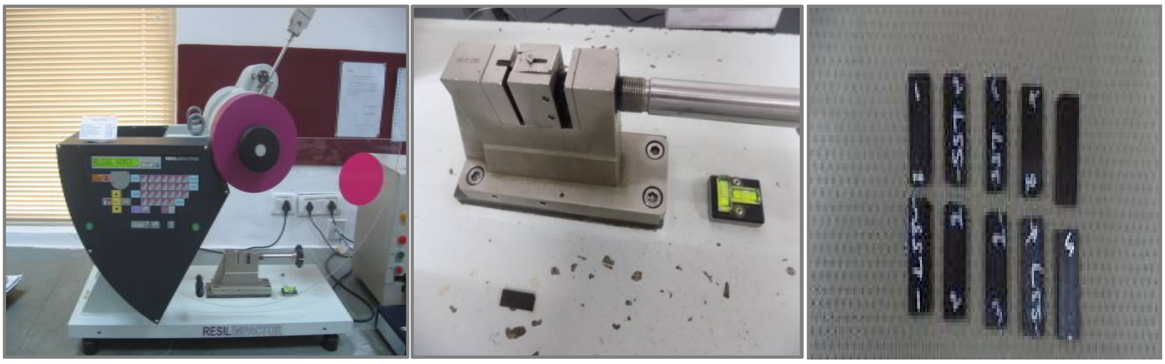


Figure 2. The Impact Specimen of PP/SEBS/Neem wood flour after test.

Table 1. The salt Spray condition on below

S.No.	Parameter	Condition
1	Salt Solution concentration	5 % wt
2	Chamber Temperatures	35±2ºC
3	Fog collection	1.2 ml/hour
4	pH of fog solution	6.5 to 7.2

Preparation of Wood Plastic Composition: The granulated Polypropylene/SEBS was as matrix for WPCs. According the table 2 the wood flour, SEBS were performed along with Polypropylene in twin –screw extruder were prepared with different combinations of fixed SEBS 10% by weight.

Table 2. The composition percentage of PP/SEBS/Neem Wood Flour composites

S.No.	Composition	PP (% wt.)	SEBS (% wt.)	Neem wood flour (% wt.)
1	10	80	10	10
2	15	75	10	15
3	30	60	10	30
4	50	40	10	50

RESULTS AND DISCUSSION

The specimen were prepared with different combination of fixed SEBS (10% wt), as well as varied wood flour (0-50 % wt) contents. Tensile and Impact properties were studies on these specimens. Effect of salt spray was also studies and presented in table 3.

Table 3. Polypropylene and SEBS with Different % wt of Neem wood flour

S. No	Wood flour (%) With fixed SEBS-10 %wt	Tensile Strength (MPa) Before Salt spray	Tensile Strength (MPa) After Salt spray	Tensile Modulus (MPa) Before Salt spray	Tensile Modulus (MPa) After Salt spray	Impact Strength (kJ/m²) Before Salt spray	Impact Strength (kJ/m²) After Salt spray
1	Pure PP	35.58	35.59	1765	1727	2.51	2.26
2	10	28.38	28.33	1121.23	1142.43	4.04	3.82
3	15	28.87	29.41	1261.31	1182.20	3.95	4.12
4	30	29.47	29.00	1489.9	1398.55	3.84	3.48
5	50	27.42	26.84	1783.82	1753.65	3.85	3.97

Tensile Strength

Before salt spray: It is observed from the result reported in table 3 and figure 3, due to mixing of 10 % wt of elastomer SEBS, the tensile strength get decreased in comparison to pure PP. It is also observed that after addition 30% wt tensile strength higher in comparison of 10% wt, 15% wt and 50% wt.

After salt spray: The results are summarized in table 3. The tensile strength gets decreased due to mixing of 10% wt of ealstomer SEBS in comparison to pure PP. It is also observed that after addition 15% wt of ealstomer SEBS shows better tensile strength in comparison 10% wt, 15% wt and 50% wt. The effect of salt spray can also be observed from results as it shows that properties got degraded. Hence it is observed that before and after salt spray 30% wt it shows better tensile strength in comparison to 10% wt, 15% wt and 50% wt (Figure 3)

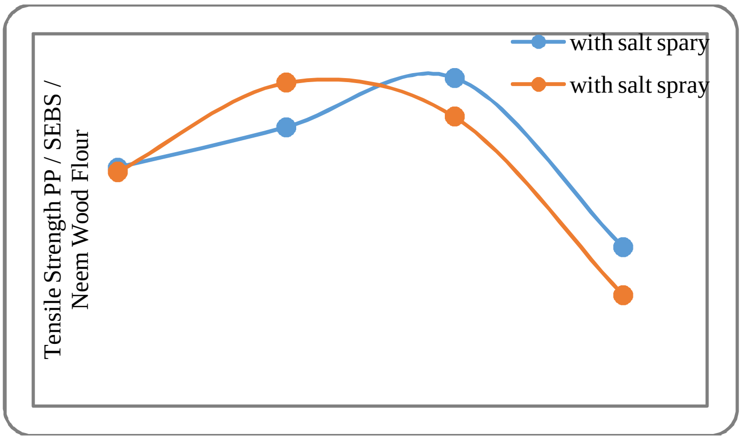


Figure 3. Dependence of Tensile Strength of PP/SEBS/Neem wood flour content (%).

Tensile Modulus

Before salt spray: It is observed from the result reported in table 3 that due to mixing of 10% wt of elastomer SEBS, the tensile Modulus get decreased in comparison to pure PP. Addition of wood flour enhances the tensile modulus in comparison to 10% wt of SEBS and PP. It also observed that after addition 50% wt it shows better tensile modulus in comparison 10% wt, 15% wt and 30% wt (Figure 3).

After salt spray: It is observed from the result reported in table 3, due to mixing of 10% wt of ealstomer SEBS, the tensile Modulus get decreased in comparison to pure PP. Addition of wood flour enhances the tensile modulus in comparison to 10% wt of SEBS and PP. It is also observed that after addition 50% wt it shows better tensile modulus in comparison 10% wt, 15% wt and 30% wt. A maximum degradation is also observed for the addition of 10% wt and 15% wt after salt spray. Hence it is observed that before and after salt spray 50% wt it shows better tensile strength in comparison to 10% wt, 15% wt and 50% wt (Figure 4).

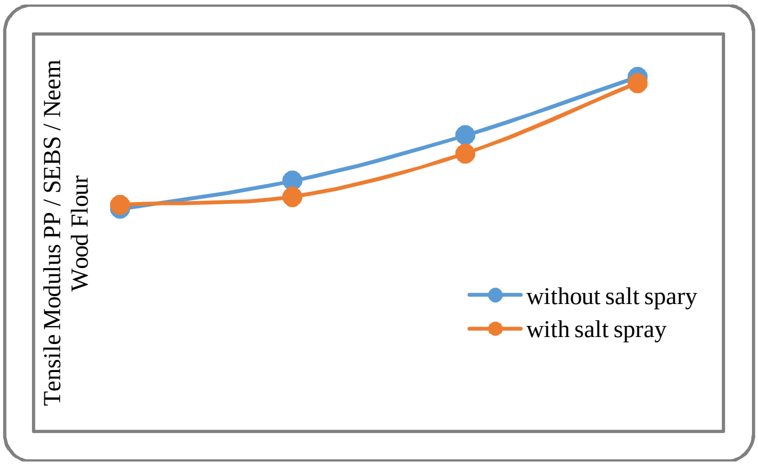


Figure 4. Dependence of Tensile modulus of PP/SEBS/Neem wood flour content (%).

Impact Strength

Before salt spray: It is observed from the result reported in table 3, due to mixing of 10% wt of elastomer SEBS, the Impact strength get increase in comparison to pure PP. Addition of wood flour decreases the impact strength in comparison up to from 0% wt of wood flour 15% wt of wood flour then increase (Figure 5).

After salt spray: It is observed from the result reported in table 3, due to mixing of 10% wt of elastomer SEBS, the Impact strength get increase in comparison to pure PP. Minimum degradation was observed of 30% wt of wood flour with PP and 10% wt SEBS elastomer. It was also observed that impact strength was improved by 18% for the addition of 15% wt of wood flour (Figure 5). Hence from observation, it is found that 15% wt of may be the better combination if the material is used where impact properties is concern.

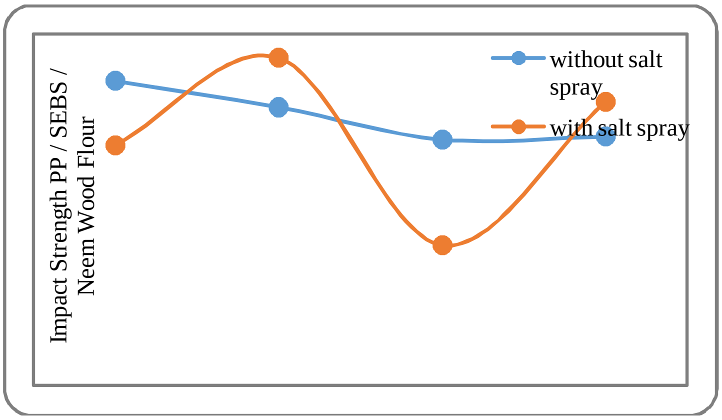


Figure 5. Dependence of Impact Strength of PP/SEBS/Neem wood flour with wood content (%).

APPLICATION

This study is useful to the shipping engineers during design of specific components using these materials.

CONCLUSION

The study examined of properties would be important to the shipping engineers during design of specific components using these materials. The tensile strength was found to be degraded while impact strength was found to be improved with 15% wt of wood flour and tensile modulus was found to slit improved with 50% wt of wood flour. The present study clearly indicates the importance of variation of percentage composition of material on the impact strength and also tensile strength.

REFERENCES

[1]. Forest Product Laboratory. Wood hand book-wood as an engineering material. General Technical Report FPL-GTR-190. Madison: department of Agiculture, Forest Service, Forest Product Laboratory; **2010**.p.508.

[2]. J. Jacar, A.Dianselmo, A. T. DiBenedetto, J. Kucera, *Polymer*, **1993**, 34, 1684.

[3]. T. T. M. Phan, A. J. Jr. De Nicola, S. L.Schadler, *J. Appl Polym Sci*., **1998**,68,1451.

[4]. M. Denac, V. Musil, M. Makarovic, Modification of isotatic polypropylene with styrene block copolymers, *Mater. Technol*., **2001**, 35, 245-249.

[5]. D. Halvata, Z. Horak, Waxs and saxs investigation of polypropylene crystalline phases in blends with high-impact polystyrene and compati-bilizers, *Eur.Poly.J.*, **1990**, 30, 597-600.

[6]. A. K. Gupat, S. N. Purwar, Melt rheological properties of polypropylene/SEBS blends, *J.Appl.Polym.Sci.*, **1984**, 29.1079-1093.

[7]. Z. Vuluga, D. M. Panaitescu, C. Radovici, C.Nicolae, M. D. Iorga, Effect of SEBS on morphology, thermal and mechanical properties of PP/ organoclay nanocomposites, *Polym.Bull.*, **2012**, 69,1073-1091.

[8]. S. Wong, R. Shanks, A. Hodzic "Interfacial improvements in poly(3- hydroxybutyrate)-flax fibre composites with hydrogen bonding additives, *Composites Science and Technology*, **2004**, 64, 1321-1330.

[9]. I. V. Weyenberg, J. Ivens, A. D. Coster, B. Kino, E. Baetens, I. Verpoest, Influence of processing and chemical treatment of flax fibres on their composites, *Composites Science and Technology*, **2003**, 63, 1241-1246.