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The use of modified asphalt binder for asphalt mixtures is becoming common to provide a more durable and better performance for flexible pavement surfacing. This study presents the viability of nanopolyacrylate (NP) and natural rubber latex (NRL) as a modifier in asphalt binder and asphalt mixture. The objective of this study is to investigate the properties of asphalt binder mixtures containing NP and NC modifiers and their effect on the asphalt mixture performance of densely-graded (AC) and gap graded-stone mastic asphalt (SMA) according to Marshall mix design method. The study investigates fourteen different asphalt mixes consists of NP and NC modified asphalt binder formulations. NP polymer modified asphalt binder was prepared by mixing penetration grade PEN 80/100 asphalt binder with 2, 4 and 6 percent NP by weight of asphalt binder at mixing temperature 140°C, mixing time 60 minutes and mixing speed 1650 revolution per minute. While, Nanocomposite (NC) polymer modified asphalt binder was prepared by mixing penetration grade PEN 80/100 asphalt binder with optimum 6 percent NP with NR at several percentages ranging from 0 to 6 percent by weight of asphalt binder. The physical and rheological asphalt binder characterization and mechanical properties of asphalt mixture were assessed and evaluated with the laboratory tests. Physical asphalt binder tests result using penetration, softening point, storage stability and viscosity indicated that both NP and NC polymer modification improved the asphalt binder physical properties and temperature susceptibility. Rheological test using Dynamic Shear Rheometer also showed that addition of NP and NC to the asphalt binder may enhances the properties of modified asphalt binder. It was found that an increase in the percentage of NP and NC causes an increase in rutting factor (G*sin 5) and decrease in fatigue factor (G*sin 5) indicating higher resistance against rutting and fatigue cracking. Therefore, it can be concluded that both polymers considerably improve elastic properties and rutting resistance of asphalt binder and thus could be used to enhance the asphalt mixture performance. The asphalt mixture performance of the NP and NC modifiers were investigated by resilient modulus, wheel tracking, dynamic modulus and moisture susceptibility test. The results show that the addition of NP and NC polymer into the mixture has a significant positive effect on the properties of AC14 and SMA14 which could improve the mixture’s resistance against permanent deformation (rutting), stripping resistance and increase the stiffness of the mix. It was observed that the addition of NP and NC polymer gave better overall performance in the asphalt mixture. Two statistical models were developed in this study to evaluate a statistical relationship between resilient modulus with viscosity and G*sin5 of asphalt binder. The tests revealed that the models have been successfully developed and validated thus could be effectively used to predict the asphalt mixture performance according to asphalt binder properties. Therefore, it can be concluded that NP and NC polymer is feasible to be used as asphalt modifier and 6 percent NC is the most effective proportion that could gave better asphalt binders and asphalt mixture performance compared to others.

Oil palm residue has a good potential as an alternative raw material for wood-panel industry especially plywood industry in Malaysia due to the shortage of wood supply. The oil palm residue which is abundant and left to rot in plantation mill necessitated the study into development of high quality for structural material from oil palm stem as an alternative sources and to verify its properties (physical and mechanical). Research had shown that the moisture content is the bottleneck of oil palm stem and requires suitable drying method to improve the properties of plywood products. Oil palm (Elaeisguineensis Jacq) trunk was used due to its availability in Malaysia as well as the environmental conditions. The effect of different drying methods using roller pressing (gap setting, speed), steam dryer (temperature, speed and time) and platen press (temperature and time) on oil palm stem veneer were assessed. The drying method with and without the use of roller pressing methods were also compared. This was done to search for the optimum drying process and recommend the best drying method. The results revealed that the used of roller pressing machine successfully remove the moisture content in the oil palm stem veneer using gap setting such as trial 9 with gap of 3.5mm, 2.8mm and 2.8mm and speed of the roller 8.0 rpm with highest moisture reduction to 5.9% as compared to the specimen without pre­press. Accordingly, the 100% OPS plywood were later steam dry for 45 minutes before partially cured under high hot pressing pressure at 140°C for 9 minutes. The results revealed that the mean value of moisture for 100% OPS plywood after gluing process was respectively in the range of 6% to 20%. Results showed that the drying process using this combination successfully reduced on the moisture content of the veneer and in the same time increase on the plywood production. The 100% OPS plywood was also found successfully improved on the physical properties as compared to commercial-plywood. The modulus of rupture and modulus of elasticity in perpendicular and parallel direction significantly showed the improvement of strength properties. Similar trend was also observed in shear in wet and dry conditioned where it showed that 100% OPS plywood improved on the properties compared to commercial-plywood. The improvement of plywood by the resin system were also found in compression strength, panel shear, charpy impact notched, and charpy impact unnotched properties where it showed that 100% OPS plywood had higher mean value of 27.54 N/mm2, 8.53 N/mm2, 376.65 (J/m), and 449.41 (J/m), approximately. The plane strain and strain energy release for 100% OPS plywood also showed higher value approximately of 129.88 MNm2 and 57.55 KJm-2. Generally, the pre-pressing method to remove moisture content in the oil palm stem veneer using rolling pressing machine and gluing of OPS veneer with medium molecular weight phenol formaldehyde (MMwPF) resin improved the physical and mechanical properties of plywood, hence it is suitable to promote as a structural products such as concrete foam, light weight partitions, wall panel and floor slabs.