CHAPTER 4

Conclusion

4.1 Summary

Palm kernel oil was successfully converted into polyester polyol. The palm oil based polyester polyol was reacted with methylene diphenyl diisocyanate (MDI) to form polyurethane (PU) binder. The palm fiber was converted into palm fiberboard by using PU binder. The (–NCO) and (–OH) from PU binder would react with (–OH) group of palm fiber to form urethane linkage and hence crosslinks between the polymer chains of PU binder. The densities of the fiberboards prepared were in the range of 0.94 g/cm^3 to 1.26 g/cm^3. As the binder content increased from 10% to 30%, the tensile strength, modulus of elasticity, flexural strength and impact strength of the fiberboard increased significantly. This might be due to more urethane linkages formed and more crosslinks between the polymer chains of PU binder. Thus, the mechanical properties increased as the binder content was increased. The water absorption and swelling thickness reduced as the binder content was increased. This is because of the crosslinks present in the fiberboard, reducing the available (–OH) of the fiberboard that can react with (–OH) of water.

Besides that, increase in NCO/OH ratio would increase the mechanical properties of the fiberboard progressively. This might be due to the increase of the formation of urethane linkage. The urethane linkage made the fiberboard more rigid and thus increased the mechanical properties of the fiberboard. However, as the NCO/OH increased, the binder became brittle and resulted in reduced mechanical properties of the fiberboard.

Furthermore, increased curing temperature, curing pressure and curing time also increased the mechanical properties of the fiberboard due to the even stress transfer from the fiber matrix. As the temperature was increased from 60ºC to 100ºC, the higher temperature increased the heat distribution efficiently in the fiber mat and hence accelerated the formation of urethane linkage. This improved the fiberboard resistance to deformation when external load is applied. The tensile strength, flexural strength and impact strength also increased as the pressure increased.

Moreover, the fiber orientation and the length of fiber also played vital role in enhancing the mechanical properties of the fiberboard. The fiber of the fiberboard in the fiber direction increased the mechanical properties compared to undirected fiber in the fiberboard. Besides that, the fine fiber displayed higher strength than long fiber. This is because fine fiber gives a larger surface area for interaction of hydroxyl (–OH) groups from palm fiber with isocyanate (–NCO) groups. That is why the fiberboards made from fine palm fiber have higher mechanical properties than the fiberboards made from palm fiber mat.

4.2 Suggestions for future works

Recently, many attempts have been made to convert the agriculture wastes or biomass resources into particleboards and fiberboards and hence there are many interesting areas for future investigations.

1. Palm oil based polyester polyol can replace other polyols such as polyethylene glycol (PEG) or polyether polyol to be combined with isocyanate to form polyurethane binder
2. In this study, the only isocyanate used was MDI. It would be interesting to investigate the mechanical properties of the fiberboards by using hexamethylene diisocyanate (HDMI) and toluene diisocyanate (TDI).
3. Instead of palm fiber, the future works can investigate the use of other biomass such as coconut fiber and rice husk.

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