

## CHAPTER V

### CONCLUSIONS AND RECOMMENDATIONS

#### 5.1 Conclusions

For the modification part, the solubility of chitosan was enhanced upon modifying by high amounts of GTMAC (cationic chemical), a mole ratio 1:4 of chitosan to GTMAC was sufficient to dissolve chitosan in neutral condition. It was found that the modified chitosans possessed high charge density of 6.5 meq/g and 4.5 meq/g for modified low molecular weight chitosan and modified medium molecular weight chitosan, respectively.

In mechanical and optical properties of paper part, the 5 effects of variables have been studied. Begin with the washing stage of chemical adsorption on pulp, having the washing stage of chitosan and CMC additions has significant impact on mechanical and optical properties of papers in the way that decreasing in mechanical properties, on the other hand, enhancing the optical properties of paper. The second effect, which is the effect of drying method, mechanical improvement of chitosan-CMC complex is more profound by using the instant drying method even though it has some drawback in brightness. In addition, complex of modified low molecular weight chitosan and high molecular weight CMC25 has more pronounced influence on mechanical and optical properties of paper than complex of other alternatives. Ratio of CMC adding to form the complex with modified chitosan has positive effect by increasing in both mechanical and optical properties of paper when ratio of CMC increasing but the light scattering coefficient and the apparent density of paper were reduced to some degree before starting to perform oppositely.

Modified chitosan has the influence on the antimicrobial activity of paper even though the low amount of CMC has marginal effect on antimicrobial performance of modified chitosan. Around 90% of bacteria amount has been reduce by modified chitosan.

## 5.2 Recommendations

It would be interesting to find the optimum amount of chitosan-CMC complexes to develop the paper with highest efficiency in both mechanical and optical paper properties and antimicrobial efficiency. Moreover, the chitosan-CMC complexes should be investigated with AFM to study the layer-by-layer complex forming.