CHAPTER VIII
CONCLUSIONS AND RECOMMENDATIONS

8.1 Conclusions

The sericin-g-PLA clay aerogel with acrylic acid, the new foam like material, was successfully developed via freeze-drying technique. Due to the limitation of neat clay aerogel, the fragility of neat clay aerogel restricted the augmentation of its applications. To overcome this problem, sericin-g-PLA and acrylic acid were applied to improve the mechanical properties via using plasma treatment to initiate cross-linked reaction. The properties of the aerogels mainly depended on acrylic acid and clay contents and plasma treatment times. The increment of clay contents exhibited the improvement of mechanical properties owing to the high reinforcing efficiency and aspect ratio of clay bentonite which introduce the stiffness structure for the biocomposites. The presence of ferric ion (Fe^{3+}) in the octahedral sheet of bentonite was the main factor to accelerate the thermal decomposition of the sericin-g-PLA clay aerogel resulted in reducing of thermal stability. At 8 wt% of clay, the clay loading was excess leading to the inhomogeneous structure with more power to accelerate decomposition causing the inferior mechanical and thermal properties. The mechanical properties of the clay aerogels can be improved by increasing of acrylic acid content and plasma treatment time due to the cross-linked network can dissipated energy efficiently under apply load. In the case of 6 and 8 wt% of acrylic acid and 60 s and 120 s of plasma treatment times, the mobility of molecules was strongly reduced by the chemical bond in the structure. The viscosity of the clay gel precursor was increased causing bubbles defect in the sample result in reducing of the mechanical properties.

The influences of sericin and PLA contents in sericin-g-PLA were significantly affected to the mechanical and thermal properties of the clay aerogels. Increasing PLA content in sericin-g-PLA results in increased of the decomposition onset temperature which depended on the polymer's molecular weight. The higher of molecular weight showed the higher of decomposition temperature. Moreover, increasing of PLA content from 92 to 98 wt% in sericin-g-PLA, the Young's

modulus increased from 116 to 296 kPa. These indicate that PLA presents a high modulus that affects to the Young's modulus of the aerogel.

Sericin-g-PLA was cooperated with clay aerogel on account of the efficiency to adsorb the ethylene gas. The SEM micrographs of sericin-g-PLA clay aerogel with acrylic acid showed the high porosity and large pore size. The sericin content in sericin-g-PLA was affected to the surface area and ethylene adsorption ability but not affected on the density of the aerogels. Increasing of sericin content, the surface area and ethylene adsorption ability of the aerogels were enhanced significantly. Addition of sericin-g-PLA to the clay aerogels can be enhanced the ethylene adsorption ability due to the amino groups in sericin-g-PLA effectively bind to ethylene similar to amine adsorption of carbon dioxide. This indicates that raising sericin content in sericin-g-PLA results in the increase of amino groups leading to greater ethylene adsorption ability.

The optimum condition was found in aerogel with the composition of clay 6 wt%, sericin-g-PLA with sericin 8 wt% and PLA 92 wt%, acrylic acid 4 wt% and plasma treatment time 30 s. Because in this composition presented the optimum in mechanical, thermal properties and ethylene adsorption. The most suitable ethylene adsorption material should be clay aerogel with sericin-g-PLA synthesized from sericin 8 wt% and LA monomer 92 wt% due to the high ability to adsorb ethylene gas.

8.2 Recommendations

a) In this research, the inhomogeneous structure of aerogel still observed because of the high viscous clay gel precursor. The suitable clay content should be equal or lower than 6 wt% of clay.

b) The freezing method is another factor to obtain the homogenous structure. To used ethylene adsorption material, the freezing by using the solid CO_2 in water under the oscillation using the shaker bath is the effective way to obtain the suitable pore dispersion.

c) Beside the ethylene adsorption material, sericin-g-PLA clay aerogel with acrylic acid can expand the application to another field. For example, the insulation material, smart package, scaffold for tissue engineering, etc.