CHAPTER 6

Conclusions and Recommendations

6.1 Conclusions

6.1.1 Equation of mercerization

The important equations of mercerization were derived and tested with the experimental results, they fit very well with the experimental results. These equation are the equations of $r_1/r_{1,i}$, the equation of conversion and the equation of rate as shown below

$$t = \left(\frac{\rho}{M}\right)_{GLuONa} \frac{r_s^2}{4 D_e (C_{Na^+})_b} \left[1-\left(\frac{r_1}{r_{1,i}}\right)^2\left(1-\ln\left(\frac{r_1}{r_{1,i}}\right)^2\right)\right] \qquad (3.32)$$

$$t = \left(\frac{\rho}{M}\right)_{GLuONa} \frac{r_s^2}{4 D_e (C_{Na^+})_b} \left(x+(1-x)\ln(1-x)\right) \qquad (3.40)$$

and

$$-\frac{dN_{Na^+}}{dt} = \frac{2\pi D_e (C_{Na^+})_b}{\ln \frac{r_1}{r_{1,i}}} \qquad (3.47)$$

These three equations are in terms of the variables which can be obtained directly such as bulk concentration of sodium ions and internal radius of cotton fibre (r_1). The only variable has to

be evaluated in order to determine the reaction rate is the effective diffusivity which is a function of tension, bulk concentration of sodium hydroxide and temperature.

6.1.2 Equation of Effective Diffusivity

It can be noted that D_e appears in every equation of mercerization so that it is very useful to know the equation of D_e. From the experiments, D_e depends on S, T and $(C_{Na^+})_b$ as shown below

$$D_e = 1.6267 \times 10^{-10} (1-1.5437\times10^{-6}S) \quad (5.3)$$

$$D_e = 1.7058 \times 10^{-13} e^{0.0217T} \quad (5.5)$$

$$D_e = 4.1012 \times 10^{-10} (C_{Na^+})_b e^{0.227} \quad (5.7)$$

Combining Eqs. (5.3), (5.5) and (5.7) gives

$$D_e = 7.8167\times10^{-13}(1-1.5437\times10^{-6}S)\ e^{0.0217T}(C_{Na^+})_b^{0.227} \quad (5.10)$$

Eq. (5.10) is very useful in calculating the internal effective diffusivity of sodium ions at various conditions of mercerization. From D_e, the conversion and the rate can be calculated from Eqs. (3.40) and (3.47) respectively. Fig 6.1 shows the graph between time and conversion. Fig 6.2 shows the graph between time and rate.

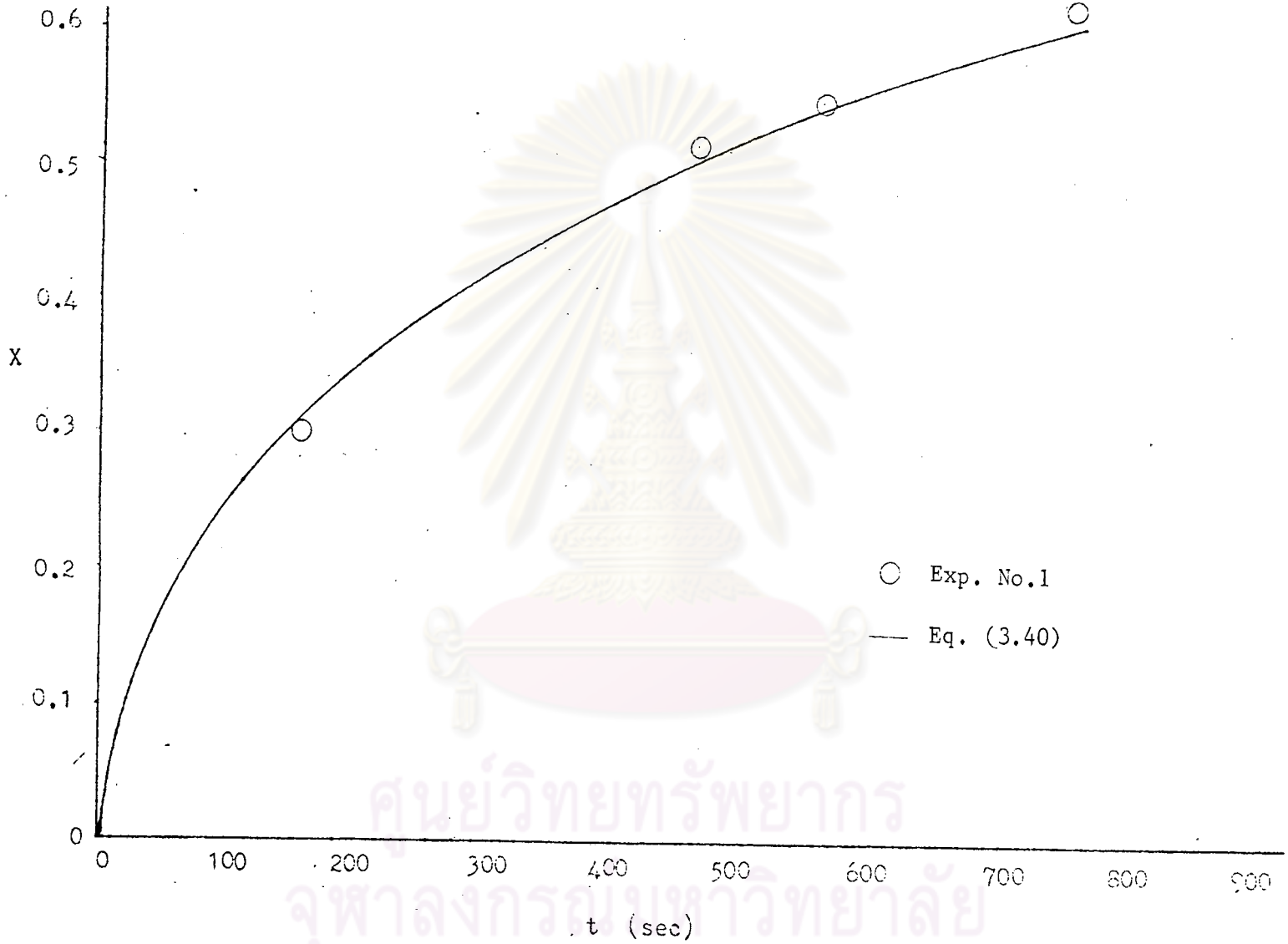

Fig. 6.1 Relationship between t and X

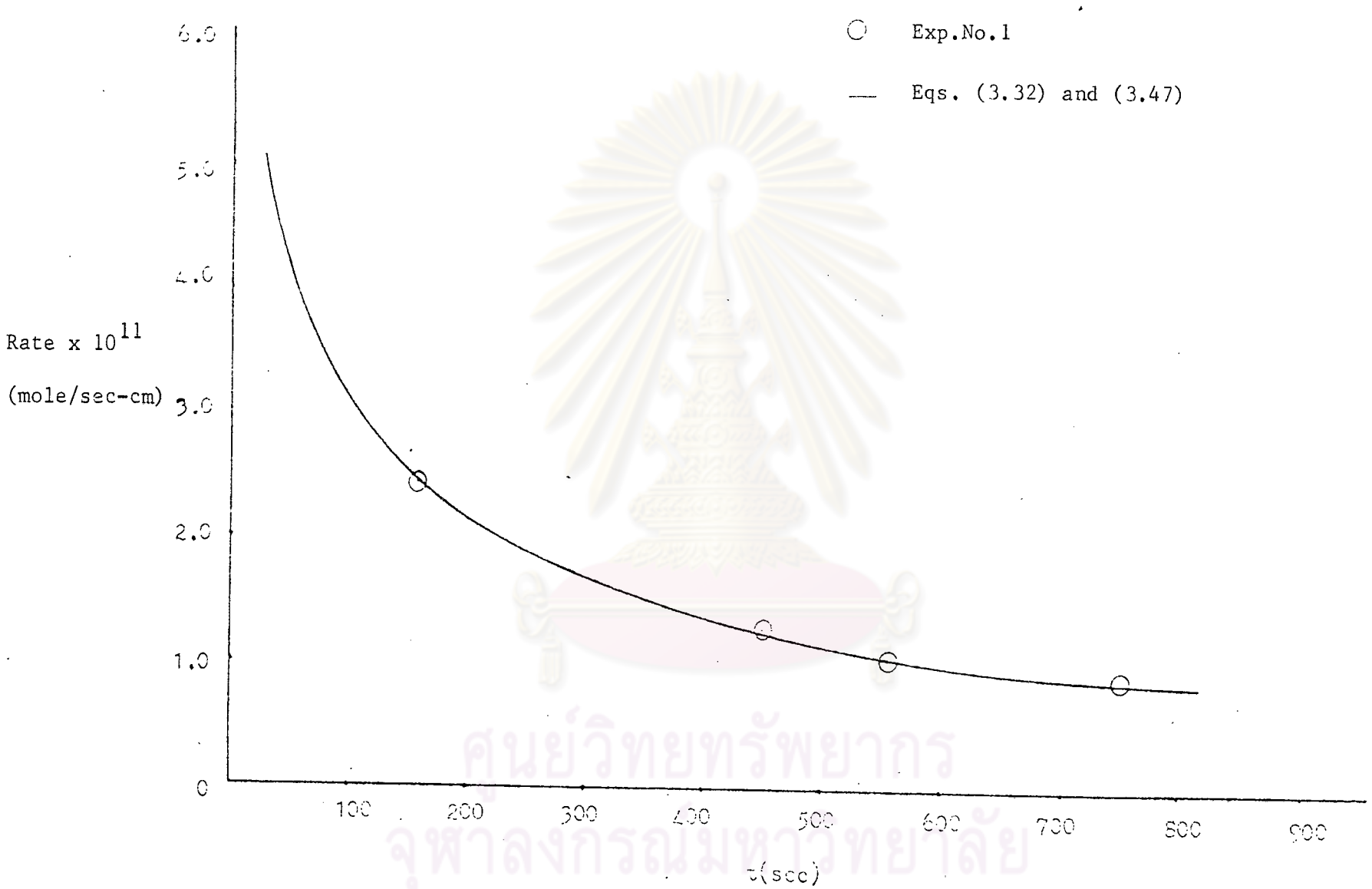

Fig. 6.2 Relationship between t and rate

6.2 Recommendations

6.2.1 Further study should be made to find other methods in increasing the effective diffusivity of sodium ions through alkali-cellulose such as adding other ions into sodium hydroxide solution to reduce influence of hydroxyl group or adding some wetting agent to reduce surface tension between sodium hydroxide solution and cotton fibre.

6.2.2 Physical properties of mercerized cotton fibre should be studied such as tensile strength, light reflection to find the optimum point of mercerization.

6.2.3 Chemical properties of mercerized cotton should be studied such as rate of dying, percentage of exhaustion, colour fastness. These properties also can be used in determining optimum point of mercerization.