

CHAPTER V

CONCLUSION

The multiple linear regression analysis and a computer program SPSS/PC⁺ presented here could be used for analyzing data from potentiometric titration of binary weak acids mixtures with difference in the ΔpK_a value and the initial concentration ratios. In evaluating the accurate results obtained from this method, there were many factors involved. The factors affecting the accuracy and precision of the equivalent volumes of the individual weak acids obtained from the titration of two weak acid mixtures could be summarized as followed :

1. ΔpK_a : The accurate and reproducible results could be obtained if ΔpK_a values were between 0.93 and 5.02 corresponded well with the study of Prachasitthisak,1996 that in the acid mixtures which ΔpK_a was so small, the raw data range of the titration curve being interpreted was in the very high buffer region. In that region ,the measurement of pH was not sensitive enough to the change of titrant volume ; thus, the accurate and reproducible results could not be obtained in that situation.

2. The initial concentration ratios of the acid mixture (X) : The accurate results could be obtained by using the appropriate method for choosing raw data range if the initial concentration ratios of the acid mixtures studied were in the range between 0.1 and 15 or in the acid mixtures which the slope of any point of titration curve did not exceed 1.90. In the acid mixtures which $X = 0.1$ or 15 or the acid mixtures which the slope of titration curve was greater than 1.90, the accurate results could not be obtained since the raw data ranges of the titration curve of these acid mixtures were in the very low buffer capacity region. In this region, the standard errors of pH measurement and volume of base were greater than other regions.

3. Method applicable for suitable titration data ranges : The satisfying results could be obtained if Method B was used for choosing the titration data ranges. The titration data ranges of two-mixed weak acids being interpreted should be within the linearity range of Gran plots of each single acid titrations. Method A and Method C could also be used for choosing the titration data range if the difference between pKa values of the acid mixtures was much more than 2 and the initial concentration ratios were 1 or 0.5.

4. The ionic strength of the solution during titration : For the titration of the acid mixtures which the initial concentration ratio was 15 ($X = V_{eB}/V_{eA} = 30\text{ml}/2\text{ml}$), the equivalent volumes of the individual acid obtained were statistical difference from the equivalent volumes obtained from G plots of each single weak acid titration. Although ΔpKa of these

acids were more than 0.9 and Method B was used for choosing titration data range, accurate and reproducible results could not be obtained. It might be due to the variation of the liquid junction potential of the cell used for pH measurement, probably caused by insufficient ionic strength.

Thus, carefully control ionic strength of the solution during titration was necessary and important, especially in the ionized acid mixtures which X was about 15, the ionic strength would change more than 50 % (from about 0.15 at the beginning of titration to about 0.10 at the second equivalent point). This noticeably change of the ionic strength might cause variation of liquid junction potential and also cause deviation in Davies equation which used to evaluate the activity coefficient of each ion during the course of titration.

5. The standard errors of pH measurement and volume of base

: These random errors affected the precisions of the resulting values of each single acid equivalent volume determination by the way corresponding to the shape of the titration curves. The accurate results could be obtained if the raw data range used to evaluate the equivalent volume of each single weak acid did not in the domain of very high or very low buffer region. In those regions, the standard errors of the measurement of pH and volume of titrant (V_b) did become significant and might greatly outweigh those standard error in the other regions. As presented in this investigation, the acid mixtures which their ΔpK_a was small yielded higher theoretically coefficient variations of equivalent volumes of each single acid (%C.V. V_{eA} and %C.V. V_{eB}). Furthermore,

when the initial concentration ratios (X) increased coefficient variation of V_{eA} increased and coefficient variation of V_{eB} decreased. This might be due to the fact that in the area of V_{eA} or V_{eB} being interpreted, the slope of the raw data of titration curve was in the very low buffering region. Hence, The great standard errors in pH measurement and volume of base was observed, resulting in high coefficient variation of V_{eA} if very low buffer region was in the V_{eA} raw data range. Therefore, the theoretical results corresponded well with the experiment results.

6. Experimental condition : The results of such carefully controlled experiment could yield the accurate result in evaluating the single acid equivalent volume from the acid mixtures. The careful conditions involved selection of the experimental procedure for avoiding variation factors such as temperature reading, pH reading owing to the electronic circuit drift, impurity of trace elements and carbon dioxide. It was important and necessary to calibrate the equipment just prior to use.

ศูนย์วิทยทรัพยากร
จุฬาลงกรณ์มหาวิทยาลัย