Development of High visibility visual determination based on Eye-Microplate method

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Keywords: Visual determination, Microplate, Number of changing color

1. Introduction

The visual determination based on clorimetry could be rapidly on site analysis without expensive instrument, becouse of measurement of the concentration by the color light and shade. Therefore, this analytical method has been widely used not only as screening method in several field but also as class of experiment of analytical chemistry at several school.However, the analytical technique has been had problem that the individual variation of the analysis result grows. Moreover, it is difficult to treat this technique for the measurer of slight color blindness.

In this study, the new type visual determination that doesn't depend on color vision was developed (called Eye-Microplate method), and the performance of the proposed method was examined by comparing the current technology. The principal of this method was shown in Fig.1. The microplate which was the several concentration of reagent was added to the well in each row was prepared. When sample solution is added to microplate by each row, the number of changing color of well was changed with the sample concentration. For this reason, the concentration could be visibly determined by the number of discoloring well. Some measurement examples by this measurement principle was intrduced.

Fig.1 Principal of the proposed method

2. Visual determination using autocatalytic reaction

The oxidative reaction with sulfite ion and hydrogen peroxide is autocatalytic reaction which the product of proton promote the own reactin. Therefor, the reaction discrive the charactristic S-shape pH ver. Time curve. The induced period of this reaction was changed with the concentration of hydrogen peroxide, and the reaction curve is not shown on the borderline of the concentration. The borderline concentration is decided when the density ratio of sulfite ion and hydrogen peroxide is 1:1.

For this reason, the microplate which several kind of concentration of sulfite ion with bromothymolblue were added with each row was prepared, and the sample solution was added at each row. As a results, the number of discoloring (blue to yellow) was changed. Based on these findings, the visual determination for hydrogen peroxide was developed. The outline of this proposed method was shown in Fig.2.

Fig.2 Visual determination for H₂O₂

2. Visual determination using chelate titration

This analytical technique was used not only special reaction such as autocatalytic reaction, but also general discoloration reaction such as the reaction for titration. For example, the visual determination for water hardness using the reaction for chelate titration was developed (Fig.3). The microplate which was the several concentration of EDTA solution with eriochrome blac T (EBT ) as indicator was added to the well in each row was prepared. When sample solution including calcium(magnesium) is added to microplate by each row, the color of well which the sample concentration is higher than EDTA was changed. This fact implies the measurement of hardness becomes possible by the number of well that discolors continuously. Based on these findings, the purpose of this study was the development of the visual analysis of hardness using visual microplate analysis.

Fig.3 Analytical result of water hardness

Hardness = 1:300, 2:180, 3:120, 4:60, 5:30 mg/L
6: distilled water
7: tap water(70mg/L) 8: drinking water(310mg/L)