CHAPTER V
CONCLUSION

Twenty azo dyes were synthesized using two methods. The first method was a coupling reaction of linear alkylaniline, which was obtained from nitration and reduction reactions of linear alkylbenzene, with diazonium salt of seven aniline derivatives, including *p*-nitro aniline, *o*-nitro aniline, 4-chloro-2-nitroaniline, 4-chloro-3-nitroaniline, 2-chloro-4-nitroaniline, 2-chloro-5-nitroaniline, and 2-methoxy-4-nitroaniline. The second method was a coupling reaction of diazonium salt of linear alkylaniline, with above seven aniline derivatives and six phenol derivatives, including phenol, resorcinol, catechol, 2,6-di-*tert*-butylphenol, α-naphthol, and β-naphthol. All synthesized compounds were fully characterized by spectroscopic evidences, including IR, ^{1}H-NMR, and ^{13}C-NMR. Moreover, some compounds that were considered to be excellent markers were characterized by mass spectroscopic evidence. Seven synthesized compounds could be used as excellent markers, including compounds 1a, 5a, 7a, 1b, 5b, 7b, and 5c. These markers were invisible in HSD at an effectively usable level, but they provided distinctive colors in the extracted phase when they were extracted with 50% ethylenediamine in 20% propylene glycol and 30% methanol using 30 seconds of shaking time. The extracted system was used as the qualitative determination in the field test, which could remove a marker from HSD to the extracted phase at about 97.92 ± 0.2 % by weight. The treat rate of these markers was divided into 2 patterns. The first one was 0.5 to 15 ppm using the volume ratio of marked HSD to extractant as 6:1. The second one was 5 ppm except for compound 5b that was added at 3 ppm using individual volume ratio of each marked HSD to extractant. The distinctive colors in the extracted phase could be quantitatively determined by UV/VIS spectrophotometry. From the ASTM testing methods, the marker did not show any effect on the physical properties of HSD. Furthermore, these markers were found to be stable in diesel fuel after at least three months storage.

Suggestion for further studies:

1.The mechanism of the reaction or complexation of ethylenediamine and cosolvent with marker should be studied to fully understand the mechanism because it would help improve the detection of azo dye markers.

2.Compounds 1c and 2c, which gave the yellow color in extracted phase, might be used as markers in other kinds of fuel. Since the treat rates of these compounds were 2 ppm, they would be invisible in green or red fuel.

3.All synthesized compounds should be investigated as dyes in HSD and gasoline, which were the yellow fuels.