CHAPTER V

DISCUSSION

5.1 SPECIFIC OBJECTIVE NO. 1 to 3: TO DETERMINE THE CHEMICAL FINGERPRINT OF RON 95 FROM PETRONAS, SHELL AND BHP PETROL

Referring to the 1st phase analysis, the GC-FID result showed about 100 retention times at 4.00 min to 78.90 min was identified to determine the chemical fingerprint of RON 95 petrol from Petronas, Shell and BHP. Reffering to the QUEST modeling analysis, relevant retention time that represent the chemical fingerprint for Petronas has been identified at 5.25 min (peak area: <=0.000). 6.70 min (peak area: <=0.809), 9.20 min (peak area: >0.000), 10.25 min (peak area: <=0.000), and 22.95 min (peak area: >1.934). Relevant chemical fingerprint for Shell RON 95 petrol was identified at 5.25 min (peak area: >0.000), 5.60 min (peak area: >0.000), 6.70 min (peak area: <=0.809), 9.20 min (peak area: >= 0.000), 10.25 min (peak area: <=0.000), and 22.95 min (peak area: <=1.934). While identified chemical fingerprint for BHP RON 95 petrol are at 5.60 min (peak area: <=0.000), 6.70 min (peak area: >0.809), and 10.25 min (peak area: >0.000). Based on the detail analysis of the chromatograms, it was found that the fuel composition between oil companies were statistic significantly different. This was supported by similar research done by Sandercock et al. (2003) in which they mentioned that PAH composition from different gasoline vary from one sample to another (Sandercock et al. 2003).

It is felt that the differences that resulted in unique chemical composition could be due to the issue of different refineries/distributors, storage tanks and source from where the oil was obtained from the ground.

Petrol is a complex mixture of hydrocarbon molecules composing of alkanes and aromatics which have near similar chemical properties (Ahmad et al. 2001). Lee at al stated that carbon numbers of hydrocarbon in petrol varies from 4 to 12 (Lee at al. 2008). Besides the molecules itself, petrol also may include additives like methanol, ethanol, t-butanol and MTBE. The choice of additive may vary from different companies based on their requirements and output of their research.

Specifically, selection of this additive depends on the cost transferred to customer, environmental effect and the most important is the properties of the additive. Additive that are low cost, environmental friendly and able to give a significant impact to car performance will usually be consider an essential additive. In conclusion, different additive will have different chemical composition and it also affected the compound composition of the petrol hence eventually the chemical fingerprint of the manufacturer.

Second factor that influence petrol composition/fingerprint is the factor of refinery and distributor. Different service station will have different petrol supplier and the origin of the petrol is from often different refinery. Petronas and Shell companies for example have their own refineries and distributors. BHP petrol in Malaysia on the other hand do not have one and will usually relay on buying fuel from existing refinery or importing them from oversea.

However, the true origin of the petrol sample from selected service station for these three commercial brand is unknown. It also important to note that the distributors and refinery that supply the petrol to a specific service station may change depending on the several factors. The choice can depend on the price of the petrol, the quantity desired and also the location of the nearest distributor or refinery.

Based on the result, it is suggested that differences in petrol composition could also be depended on the refinery at which the petrol was distilled. This was supported by Amber et al where they stated that differences in the C_0 to C_2 naphthalene content was very dependent on the refinery (Hupp, A. et al. 2008).

As mentioned above, the composition of the petrol will also depend on petrol storage tank. Storage tank are used as a temporary storage for petrol before supply to the service station by the distributors. Each petrol supplier will have different type of storage tank and condition. Contamination of the storage tank will affect the composition of the petrol due to leakage or others chemical added into the tank. This will allow air and other substances mix with the petrol and again change the composition of the petrol. Apart from above, degree of petrol evaporation will modify petrol content as lighter and volatile compound may be lost due to evaporation.

5.2 SPECIFIC OBJECTIVE NO. 4: TO IDENTIFY THE DIFFERENCES IN PETROL COMPOSITION OF RON 95 PETROL FROM DIFFERENT SERVICE STATION FOR PETRONAS, SHELL AND BHP

Referring to the fourth specific objective is to identify the differences composition of RON 95 petrol from different service station for similar brand. The detail result shown in Chapter IV (Table 4.2 and Table 4.6).

Bespite favourable result from prior objectives, it was found that RON 95 petrol composition cannot be statistically identified based on location of which station to the fuel sample was collected. It is thus safe to conclude that petrol compositions of the various Petronas petrol station in the study exactly the same with each other. Based on this conclusion we can also agree that the supplier of the various selected Petronas fuel station had obtained his/her supply from only one refinery or distributor.

The composition of the petrol will depend not only on the refinery, but also on the residual level in the tank when filled. Therefore, each petrol sample is chemically unique because of the inherent differences in the tank level when filled. This unique petrol composition is useful in comparing petrol samples even when they are from similar supplier and service station (Hupp, A. et al. 2008)

Besides the issue of residual level in storage tank, other factor that also effect to the composition of the petrol is the issue of evaporation in the tank at the service station. Degree of evaporation of the petrol largely depends on the volume of the petrol and also the temperature changes in the tank. Rate of evaporation will increase when the volume of petrol in the tank is low surrounding temperature is high. As a result, more volatile components of the petrol may be loss during evaporation. Thus, more organic compounds which are less volatile will be detected in the laboratory analysis (Whyte et al. 2007). Therefore, in the future peaks of less volatile compounds should be studied in detail when looking for chemical fingerprint of similar source of fuel supplier but different petrol stations.

Determination of the petrol composition of RON 95 for different/similar brand based on location of service station using principle component analysis (PCA) have been used previously with limited success. Due to this, PCA was also employed to investigate the series of components for determination of petrol composition. Unfortunately, no positive results were obtained due to the complexity of GC-FID data and the limited computation resources at hand.

5.3 OVERALL DISCUSSION

Referring to the GC-FID chromatograms, variations in the peak number of the samples depends on several factors. The possible factor that could affect this analysis such as quantity of the sample collected the sample preparation procedure and the sensitivity of the instrument used.

Based on Table 4.6 and Figure 4.6 in Chapter IV, there are six standard retention times recorded most relevant. It is suggested as the basic component identification for chemical fingerprints RON 95 petrol of Petronas, Shell and BHP. QUEST modeling analysis by using GC-FID data is sufficient for the identification of chemical fingerprint of RON 95 petrol from different brand were give more than 90% validation.

In conclusion, this method was successful to determine the chemical fingerprint of RON 95 commercial petrol (Petronas, Shell and BHP) in Malaysia.