CHAPTER VIII

CONCLUSIONS AND RECCOMENDATIONS

The surface activity of KL and 1% Rh/KL catalyst were elucidated. The surface activity could be observed from the changes of hydrocarbon components in tire-derived oil. However, the components in tire-derived oil were complex mixtures; therefore, this research work employed a GC × GC / TOF-MS to reveal and observed the changes of all hydrocarbon compounds in tire-derived oil, which thus disclosed the surface activity of KL and 1% Rh/KL catalysts.

Tire-derived oil (TDO) was analyzed by using the GC × GC / TOF-MS to reveal the components, and more than 1,500 hydrocarbon compounds were found in the tire-derived oil were, and can be classified into groups of MAHs, SATs, OLEs, TERs, DAHs, PAHs, and PPAHs including sulphur compounds. Moreover, MAHs were categorized into two groups: (a) mono-aromatics with saturated substituents (MAHs-SS) such as indanes, alkylbenzenes, and tetralins, and (b) mono-aromatics with unsaturated substituents (MAHs-US) such as indenes and alkenylbenzene. The carbon number of SATs ranged between C13 to C16. OLEs were di-olefins and tri-olefins with C8-C14. TERs were classified into 3-carene and d-Limonene found to have carbon numbers in the range of C10-C15. DAHs consisted of naphthalene and alkylnaphthalenes with C10-C14. PAHs contained phenanthrenes, anthracenes, fluorenes, and pyrenes, with C12-C14. Twenty-two S-compounds of PPAHs were found in the tire-derived oil, and can be classified into four classes: thiophenes, benzothiophenes, dibenzothiophenes, and phenalenothiophenes. Moreover, each class was also categorized based on carbon number. As a result, the S-compounds with C7–C11 consisted of thiophenes, benzothiophenes, and their derivatives, whereas those of C12–C13 consisted of C12-benzothiophenes, dibenzothiophenes, and their derivatives Finally, the C14 S-compounds were the combination of dibenzothiophenes and phenalenothiophenes. Furthermore, detected by GC x GC / TOF-MS, phenalenothiophenes was the new group of S-compounds found in the TDO.

The surface activity of KL catalyst was investigated, and it was found that the yields of alkenylbenzenes (C11 and C12) and DAHs (C11 and C12) significantly decreased. Moreover, it was revealed that among those groups, DAHs (mostly, 2-ethylnapthalene) was hydrogenated to C12-tetralins (mostly, 2-ethyltetralin), which is a species in MAHs. Therefore, it can be concluded that the KL catalyst provided hydrogenation.

The surface activity of rhodium over KL catalyst was investigated, and it was found that the yield of alkenylbenzene (C11) increased in conjunction with the decrease in alkylbenezene (C11) due to dehydrogenation, whereas the yield of alkylbenzenes (C12) did not change, but the rhodium exhibited the ring opening ability on cyclohexylbenzene via multiplet mechanism. Furthermore, the dramatical increment of C12-DAHs (mostly, 2-ethlynaphthalene) was attributed to the conversion of C12-tetralins (mostly, 2-ethyltetralins). Therefore, it can be concluded that rhodium over KL catalyst provided dehydrogenation and ring opening.

The synergistic effect of rhodium over KL catalyst was observed, and rhodium was found to reduce hydrogenation ability over KL catalyst.

We recommend next generations to use this methodology to categorize the components in tire-derived oils and observe the catalyst activity. The details in PAHs must be studied and categorized to obtaine good results.