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Abstract
The fuels of various octane numbers and from different sources were used to investigate their influences on the emission of polycyclic aromatic hydrocarbons (PAHs) from the motorcycle engine. These fuels included Refinery Gasoline from C company, C92-Leadfree Gasoline (C92-LFG), C95-Leadfree Gasoline (C95-LFG), C98-Leadfree Gasoline (C98-LFG), Cracking Gasoline from T company, T92-Leadfree Gasoline (T92-LFG), T95-Leadfree Gasoline (T95-LFG), T98-Leadfree Gasoline (T98-LFG), and Base Gasoline from Chinese Petroleum Company (CPC), 92-Leadfree Base Gasoline (92-LFBG), 95-Leadfree Base Gasoline (95-LFBG) and 98-Leadfree Base Gasoline (98-LFBG). The engine was simulated for the idling condition and cruising speed at 30 and 50 km/hr. The concentration of 21 individual PAHs in the gasoline themselves and engine exhaust were determined and analyzed by a gas chromatography/mass spectrometer (GC/MS). Besides, the cases of adding 100 times of Naphthalene (Nap), 10 times of Nap and 100 times of Pyrene (Pyr) into C95-LFG were also conducted for observing the variation of PAHs in the combustion process.

The results of this study were summarized as follows. For the total-PAHs contain, the sequence of the top five for these nine Lead-free fuels is T98-LFG(165mg/L) > C95-LFG (56.6mg/L) > T92-LFG (52.6mg/L) > C92-LFG (42.1mg/L) > C98-LFG (34.6mg/L). It means that, in general, the Refinery Gasoline from C company contain more total-PAHs than the Cracking Gasoline from T company do, and the base Gasoline from CPC contain the least total-PAHs. The main parts of PAHs contained in all fuels are those of lower rings. The PAHs contained in Refinery Gasoline consist of 85.0~92.8% low molecular weight, 2.57~3.47% medium molecular weight and 4.62~11.5% high molecular weight PAHs, respectively. However, there are 97.6~99.98% low molecular weight PAHs and only 0.02~2.40% others for the Cracking Gasoline. In the aspect of the total-PAH emission factor per kilometer of traveling, which from the using of T company fuels is higher than that from the using of C Company fuels for both octane numbers 92 and 95 fuels. In another word, the emission factor of T92-LFG (39334μg/L-Fuel)is 2.08 times of magnitude higher than that of C92-LFG (18953μg/L-Fuel) and that of T95-LFG (31590μg/L-Fuel) is 1.48 times of magnitude higher than that of C95-LFG (21394μg/L-Fuel). On the contrary, the emission factor of C98-LFG (104008μg/L-Fuel) is 1.90 times of magnitude higher than that of T98-LFG (54778μg/L-Fuel). In the case of different operating conditions, the condition of the speed 50 km/hr has the lowest emission factor, and that of the speed 30 km/hr has the highest one. For those PAHs contained in emission exhaust, there are 86~96% of Nap, 2~12% of AcPy plus AcP, and 1~2% of others. While

all the other PAHs were reduced, the AcPy was increased in the combustion process for all 92, 95 and 95-LFG. However, for the Base Gasoline, Nap, AcPy, PA, FL, Pyr, BeP and BbC was increased, while the others were reduced in the combustion process.

In these nine Lead-free fuels, 95-LFBG has the highest total-BaPeq emission factor, 35.5μg/L-Fuel, and the following are C98-LFG (123μg/L-Fuel), 92-LFBG (123μg/L-Fuel) , T98-LFG (77.8μg/L-Fuel), 98-LFBG (50μg/L-Fuel) and T92-LFG (40.5μg/L-Fuel). For those of octane numbers 92 and 95, the BaPeq emissiom factors from Refinery Gasoline are lower than those from Cracking Gasoline, but the opposite result is found for octane number 98 fuels. In the aspect of the total BaPeq O/I Ratio, the values from Refinery Gasoline (0.076~0.158) are significantly smaller than those from the Cracking Gasoline (0.726~1.10), and again, the opposite result is found for octane number 98 fuels.

In general, the PAHs contained in the fuels themselves are the main sources of the PAHs existing in the emission exhaust. In addition, from the results of adding 100 times of original Nap mass into C95-LFG, the emission factor of AcPy increased from 1445μg/L-Fuel to 13093μg/L-Fuel, i.e. 9.06 times increased, while that of Nap increased from 19260μg/L-Fuel to 32941μg/L-Fuel, i.e. 1.71 times increased. These results infer that the main part of the dissipated Nap was oxidized and transformed into small end products, CO2 and H2O, and the minor part was transformed into AcPy via an addition reaction in the combustion process. Furthermore, for the case of adding 100 times of original Pyr mass into C95-LFG, the O/I Ratio of total PAHs reached 0.781. For the case of adding Pyr, AcPy remained increasing as the cases of adding Nap, but Nap were turned from decreasing effect for the cases of adding Nap into increasing effect for this case.
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