PA5) 바이오디젤유를 이용한 디젤엔진에서 에탄올 함량이 카보닐 배출에 미치는 영향

Influence of Ethanol Content on Carbonyl Emissions for Biodiesel-fueled Diesel Engine Exhaust

Xu Na · Ho-Jin Lim
Kyungpook National University, Department of Environmental Engineering

1. Introduction

Because of the high prices of petroleum fuels and politics problems, several countrie are trying to find transportation in order to save fuel and reduce the emissions of pollutants. Biodiesel fuels are being used as alternative fuels for diesel engine worldwide. The use of biodiesel may potentially reduce the dependence on diesel fuel and improve air quality. In this study, carbonyl emissions (e.g. formaldehyde, acetaldehyde, acrolein, and acetone) were evaluated by a diesel-engine using blended fuels of diesel-biodiesel-ethanol. In general carbonyls are common toxic air pollutant and even carcinogenic to human body.

2. Methods

In this study, diluted exhaust of air-cooled diesel generator (KDE 3500E, Kipor, China) was used. Diesel fuel (S1) was purchased from a gas stations, some biodiesel (G, M) fuels were purchased from manufacturer, the other biodiesels (soybeen, cannola, corn, grape seed, olive and sunflower oils) are produced from vegetable oils and methanol by transesterification reaction in the lab. Absolute ethanol was used as purchased with no further purification. Dilution ratios were determined using CO and NO_X concentrations in two manifolds prior to and after a diluter. Carbonyls were collected by three impingers in series with 2,4-dinitrophenylhydrazine (DNPH) solution, the air flow through the DNPH solution was 0.1L/min. After sampling, dealing with by acetonitrile and analyzing by high performance liquid chromatograthy (HPLC) with UV detection. The effects of blended fuel were examined for BD0E0, BD5E0, BD10E0, BD20E1, BD20E2 (first and second numbers indicate biodiesel and ethanol contents by volume, respectively) relative to diesel fuels.

3. Results

Fourteen carbonyls were identified and quantified in the exhaust, including formaldehyde, acetaldehyde, acrolein, acetone, propionaldehyde, crotonaldehyde, butyraldehyde, benzaldehyde, isovaleraldehyde, valeraldehyde, o-tolualdehyde, m-tolualdehyde, p-tolualdehyde and hexaldehyde. For S1G, total concentrations are 5649.2mg/m^3, 5238.7mg/m^3, 8080.1mg/m^3, 17621.5mg/m^3, 26640.67mg/m^3, and 23244.6mg/m^3 for BD0E0, BD5E0-S1G, BD10E0-S1G, BD20E0-S1G, BD20E1-S1G, and BD20E2-S1G, respectively. For S1M, total concentrations are 5649.2mg/m^3, 20848.8mg/m^3, 17363.2mg/m^3, 17525.5 mg/m^3, 38287.8mg/m^3, and 19630.1mg/m^3 for BD0E0, BD5E0-S1M, BD10E0-S1M, BD20E0-S1M, BD20E1-S1M, and BD20E2-S1M, respectively. Blended fuels with diesel-biodiesel-ethanol tent to emit more carbonyls than diesel-biodiesel fuels. For 1% and 2% ethanol, total concentrations decrease by 14.6% and 95.0% for S1G and S1M, respectively.

For S1SB (soybeen oil), total concentrations are 13897.9mg/m^3, 18573.1mg/m^3, 15653.1mg/m^3, 19760.2 mg/m^3, 47830.1mg/m^3, and 55446.3mg/m^3 for BD0E0, BD5E0-S1SB, BD10E0-S1SB, BD20E0-S1SB,

BD20E1-S1SB, and BD20E2-S1SB, respectively. For S1CO, total concentrations are 13897.9mg/m^3, 19662.5mg/m^3, 20361.3mg/m^3, 21045.9mg/m^3, 25294.4mg/m^3, and 60789.9mg/m^3 for BD0E0, BD5E0-S1CO, BD10E0-S1CO, BD20E0-S1CO, BD20E1-S1CO, and BD20E2-S1CO, respectively (see Fig. 1). For S1CN, the total concentrations are 13897.91mg/m^3, 13676.26mg/m^3, 17082.48mg/m^3, 13033.97mg/m^3, 16793.02mg/m^3, and 40041.28mg/m^3, for BD0E0, BD5E0-S1CN, BD10E0-S1CN, BD20E0-S1CN, BD20E1-S1CN, and BD20E2-S1CN, respectively (see Fig. 2). The total carbonyl emissions fueled with biodiesel fuel were higher than those from fossil diesel. All carbonyl emissions show a strong relation with the biodiesel content, indicating that carbonyl emissions are influenced by the biodiesel content and biodiesel fuel blends probably the source of these carbonyls.

It was found that acetone is the most dominant carbonyl emission of all the blended fuels. Ethanol blend in fuel would increase acetaldehyde emission because ethanol was the main precursor of acetaldehyde in emissions.

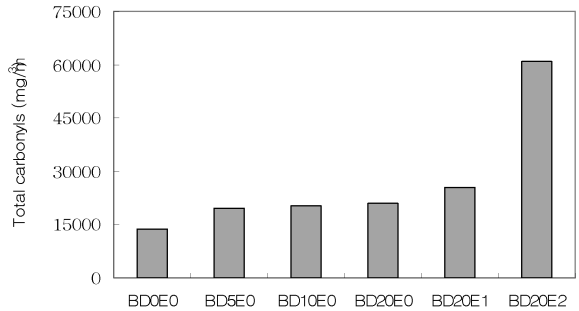

Fig. 1. Total carbonyl concentration in the exhaust of diesel-corn biodiesel blends.

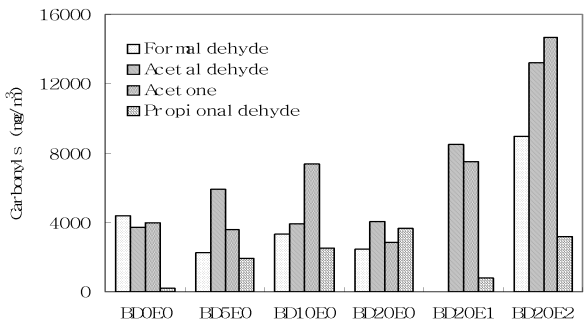

Fig. 2. Individual carbonyl concentration in the exhaust of diesel-canola biodiesel blends.

Acknowledgements

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