GC-TCD for the Measurement of Component By-Product of Catalytic Hydrodeoxygenation of Bio-Oil: Toward Obtaining Realiable Analytical Data

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Abstract

The hydrodeoxygenation (HDO) is a highly sought-out technology for upgrading of bio-oil into more useful chemicals. In this study, the HDO of bio-oil by involving hydrogen and Ru/C-based catalysts was experimentally conducted and some compounds in the gasesous by-product were found. The compounds were identified as H_2, CO_2, CH_4, and CO by using gas chromatographic equipped with thermal conductivity detector (GC-TCD) method.

From analytical chemistry perspective, quantitative measurement is reasonably essential by taking into account an accurate measurement process for providing reliable measured data. The measured data is commonly used as the basis for decision making in many aspect of chemical process. In this regards, the GC-TCD for the measurement of HDO gasesous product was developed and validated. The validation parameters include selectivity, precision (repeatability and reproducibility), accuracy, linearity, limit of detection (LoD), limit of quantitation (LoQ), and robustness.

It was found that the developed method is able to separate the target components (H_2, CO_2, CH_4 and CO) from their mixtures without any special sample treatment and no interference from other possible components in the HDO gaseous were observed (Figure 1b). In addition, under the validation criteria, the method was found to be selective, precise, accurate, and robust.

Application of the developed and validated GC-TCD method for the measurement of components by-product of HDO of bio-oil showed an outstanding performance with relative standard deviation (RSD) less than 1.0% for all target components.

In conlusion, conducting validation process of any analytical method is highly recommended before it is used for measuring a real sample and it is a trustworthy way of obtaining reliable analytical data. The method validation process presented in this study can be easily and conveniently adopt for routine analysis with regard to the measurement of compounds in the gaseous peroducts of any expremintel HDO of bio-oil.

Image

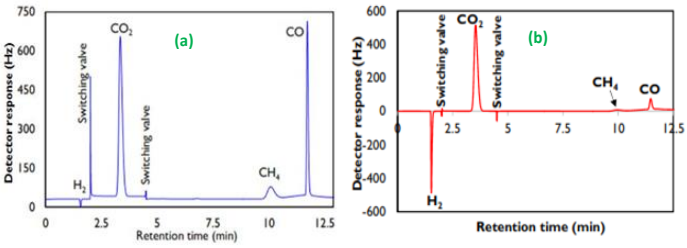


Figure 1: Representative GC-TCD chromatogram of (a) the the standard gas mixture, and (b) the HDO gaseous sample obtained using Ru/C at optimized conditions.

Recent Publications (minimum 5)

1. Balagurumurthy B, Oza TS, Bhaskar T, Adhikari DP (2013) Renewable hydrocarbons through biomass hydropyrolysis process: challenges and opportunities. Journal of Material Cycles and Waste Management 15:9-15.
2. Cheng S, Wei L, Zhao X., Huamg Y, Raynie D, Qiu C., Kiratu J, Yu Y (2015) Directly catalytic upgrading bio-oil vapor produced by prairie cordgrass pyrolysis over Ni/HZSM-5 using a two stage reactor. AIMS Energy 3:227-240.
3. Dickerson T, Soria J (2013) Catalytic Fast Pyrolysis: A Review. Energies 6:514-538.
4. Cheng S, Wei L, Alsowij MR, Corbin F, Julson J, Boakye E, Raynie D (2017) In situ hydrodeoxygenation upgrading of pine sawdust bio-oil to hydrocarbon biofuel using Pd/C catalyst. Journal of the Energy Institute. In press.
5. Budiman H, Zuas O. (2015) Validation of analytical method for determination of high level carbon dioxide (CO_2) in nitrogen gas (N_2) matrix using gas chromatography thermal conductivity detector. Periódico Tchê Química 12:7-16.
6. Zuas O, Mulyana MR, Budiman H (2016). Analytical method validation of GC-FID for the simultaneous measurement of hydrocarbons (C_2-C_4) in their gas mixture. RCD Química 45:22-27.
7. Zuas O, Budiman H (2016) Estimating precision and accuracy of GC-TCD method for carbon dioxide, propane and carbon monoxide determination at different flow rate of carrier gas. Chemical Industry 70:451–459.



Biography

Oman Zuas has his expertise in analytical chemistry with the main subject on the development and validation of gas chrematography method. Harry Budiman is appointed as the senior researcher who works in the gas analysis laboratory under Zuas's research group. Dieni Mansur has expertise in the developmend of high presurized system for biomass conversion by utilizing novel metal-based catalysts.

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Notes/Comments: