Załącznik 2 do wniosku o wszczęcie postępowania w sprawie nadania stopnia doktora

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Abstract

In many European countries, isotope methods are being used to investigate environmental changes. To determine the biocomponents of liquid fuels using radiocarbon (^{14}C) content analysis, it is necessary to adapt the sample preparation to the conditions of the Gliwice Radiocarbon and Mass Spectrometry Laboratory.

In this study, the accelerator mass spectrometry (AMS) and liquid scintillation counting (LSC) methods were tested using liquid fuel samples submitted in 2018 by an external oil company in large quantity, including a purely bio-based hydrotreated vegetable oil (HVO) and one petrodiesel sample of infinite ^{14}C age (ON/UF-BC), bio-oil samples, and one reference sample of 100 % biomass and several fuel blends produced from ON/UF-BC and HVO with various proportions.

For AMS, samples for ^{14}C measurements were prepared using tin capsules for liquids for combustion in elemental analyser (EA) and graphitisation in an automated system (AGE). For the LSC method, the benzene sample was prepared. To safely enable the conversion of the fuel samples to lithium carbide (Li_2C_2) without causing any explosion, each liquid fuel was mixed with purified quartz sand. Benzene resublimation method was also tested to speed up the procedure. IRMS measurements were conducted for benzene to determine the $\delta^{13}C$ and account for isotopic fractionation.

The background values were acquired based on the ^{14}C measurement results for pure petrodiesel. The results for liquid fuel blends proved that the ^{14}C content agreed between the AMS and LSC methods. Additionally, a linear relation between the ^{14}C and the HVO contents confirmed the reproducibility between the two methods and allowed to validate them. The reproducibility of the AMS results was verified in several aliquots of one of the blends and the results were deemed consistent. Moreover, the bio-oil results allowed to detect that one of the samples was not produced from the investigated reference biomass.

The results of the study showed that both AMS and LSC are effective radiocarbon dating methods but their choice depends on specific research needs, balancing accuracy, sample size, and available resources. AMS is superior for small samples and high precision while LSC is more practical for larger samples.