ISO-17025
Accredited Testing Laboratory
PJLA ISO/IEC 1725:2005 Testing Accreditation #59423

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Mr. Sam Wade, Chief, Transportation Fuels Branch
California Air Resources Board
Industrial Strategies Division

Re: Staff Draft Discussion Paper "Co-Processing of Low Carbon Feedstocks in Petroleum Refineries"

Dear Mr. Wade,

Please let us introduce ourselves. We are the founding fathers of the use of Carbon-14 for distinguishing renewable carbon sources from petroleum sources. We began in 2003 when approached by representatives of the USDA asking if our Carbon-14 capabilities would work for their BioPreferred Program (www.biopreferred.gov), which of course it would. At their request we joined ASTM and within 3 months completed the ASTM D6866-04 standard which they had been struggling with for 3 years. The Carbon-14 technique is now standardized in a host of international standards including ASTM D6866, CEN 16137, EN 16640, ISO 16620, ISO 19984, EN 15440, ISO 13833, ISO 16620 and EN 16785. Carbon-14 analysis can be used on any type sample (gas, liquids and solids).

The Carbon-14 standardized method is also incorporated in a variety of regulatory programs including the California AB32 program, US EPA GHG Protocol, US EPA Renewable Fuels Standard, United Nations Carbon Development Mechanism, Western Climate Initiative, Climate Registry's Greenhouse Gas Reporting Protocol and EU Emissions Trading Scheme.

Carbon-14 is an extremely well-established method having been in use by many industries (including the biofuels industry) and academic researchers for several decades. The premises set forth by NREL that Carbon-14 is not a viable analytical method to estimate the biocarbon distribution from FCC co-processing and only mass balance should be used, is unfounded.

Many studies have been done to try to find alternatives to the Carbon-14 method to determine the biocarbon composition of materials. None so far have been found to replicate the robustness, consistency and accuracy/precision of the Carbon-14 method. The EN 16785 is the only standard that allows a variant of the Mass Balance method that NREL is advocating under EN 16785-2. The EN 16785-1 requires that the biocarbon fraction be determined by the Carbon-14 method. However, when incorporating this EN 16785 method, certification schemes like the "Single European Bio-based Content Certification" **only** allow the use of EN 16785-1 due to its reliability and the value of a third-party certification. http://www.biobasedcontent.eu/en/about-us/

The result is provided as a single number on the 1st page of the report, with graphical representation that is easily understood by regulators, policy makers, corporate officers and the public (see attached example). The overwhelming advantage of Carbon-14 is that it is an independent factual measurement on the final product. In that regard, it can stand alone as a qualitative indicator of the presence of renewable vs petroleum feedstocks. Under most reasonable circumstances, both high accuracy and precision are produced for quantitative measure. When questioned, it can also be rapidly re-measured. In comparison, our understanding is that a Mass Balance report is an estimation based on feed-stock "declarations" made by the authors. As such, understanding the result must require extensive knowledge and experience. And in the case of validating a result, extensive (and expensive) efforts would be needed in comparison to a simple re-measurement of a Carbon-14 result. The underlying weakness of the Mass Balance method is that it is based on declarations of feedstock input. Setting aside the accuracy of those declarations, non-homogeneity (i.e. heterogeneity) of materials introduces unknown error not incurred in the Carbon-14 method. This has been extensively researched particularly within the bioplastic industry which uses biofuels as a major component in the manufacture of its products. The bioplastic industry realizing the issues of non-homogeneity, has concluded

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after years of extensive studies that Carbon-14 is the only viable method to determine the percentage of biocarbon, including samples with a low percentage of biocarbon.

Also of significant importance is that Carbon-14 measurements are strictly 3rd party generated with little to no contribution from the manufacturer.

We are not experts in the Mass Balance method and it is clear NREL is not an expert in the Carbon-14 method. They misrepresented the capabilities of Carbon-14 with regards to determining renewable gasoline and diesel yields attributable to the addition of bio-oil in FCC co-processing. The analytical measure of Carbon-14 is good down to 0.4% +/- 0.1% 1RSD on the biocarbon content of the product on a single measurement. This can be reduced even further with multiple measurements. NREL's declaration that the Carbon-14 cannot measure precisely/accurately samples with less than 10% biocarbon content is factually incorrect.

Most international standards do not cite error limitations. However, the ASTM-D6866 standard cites a universal absolute value of +/-3%. This has been done since this standard applies across all industries and therefore considers a high degree of variability in indeterminate errors likely to exist between different manufacturing processes. Stake holders using Carbon-14 results for specific applications, such as biofuel blending, quite often to use the analytical measure called percent modern carbon (pMC) which has an error as low as 0.1 pMC. This is especially useful in cases of very high dilution of biocarbon content. pMC is converted to % biocarbon content through the simple application of a constant (REF) defined within the standard. REF is applied to best approximate the value of Carbon-14 in present day biomass from the pMC value and is an accepted practice that increases the accuracy of the result relative to biocarbon/biomass content. This approximation is well understood as are any errors associated with it.

Concerning the variability of the pMC correction factor, this is well understood. The ASTM D6866 method (along with other standardized methods) considers this variability in the final calculation. The variability of the pMC value due to the bomb curve has been extensively studied, and the result of these studies have been incorporated in the recommended pMC values of the standardized methods such as ASTM D6866. The only limitation with the pMC correction might be if the feedstock used to produce the biofuel uses old growth trees that can show some variability in the pMC value. However, almost exclusively all biofuels are produced from feedstocks harvested within the last 10 years, therefore this variability does not concern the biofuel industry.

Regarding the comment that Carbon-14 methods are not commercially available, that is a misconception. There are many commercial entities around the world, like ours, that can analyze biofuels using the Carbon-14 method. At Beta Analytic, we have analyzed thousands of biofuel samples to determine the biocarbon content. The turn-around time to produce a result is 2 to 5 business days and the cost is $390 per sample. Our capacity alone is between 100-150 samples daily. Samples are easily packaged in tiny glass micro-sample vials containing only 0.1-0.3ml of fuel and are readily shipped with minimal shipping requirements.

We believe the Carbon-14 method is a simple cost-effective method to determine the biocarbon in fuels just as it has been over the last 13 years for the USDA and other regulatory bodies. However, since we are not experts in the Mass Balance method, we cannot comment on it beyond what we have done here. Our recommendation is that CARB adopt the Carbon-14 method as the method of choice for its needs.

Sincerely,

Florencia Goren
Global Operations Manager
Beta Analytic