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Beta Analytic Inc.
4985 SW 74 Court
Miami, Florida 33155
Tel: 305-667-5167
Fax: 305-663-0964
beta@radiocarbon.com
www.betalabservices.com

Darden Hood
President

Thierry Tamers
Director

Ronald Hatfield
Christopher Patrick
Deputy Directors

Mauricio Larenas
Marketing and Development

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Mr. Christopher Sherry
Regional Greenhouse Gas Initiative
401 East State St., 1st Floor
PO Box 409
Trenton, NJ 08625

RE: Public Comment: RGGI – Regional Greenhouse Gas Initiative: Quantification of carbon-neutral CO2 emissions using ASTM-D6866: Application towards energy-from-biomass

Commenter:
Mr. Darden Hood
Beta Analytic Inc.
ASTM D-20 committee member

SUMMARY STATEMENT: In support of greenhouse gas reductions initiatives within RGGI, the American Society for Testing Materials recommends incorporation of ASTM-D6866 into the policies and procedures of biomass resource and development within the participating states. With implementation of a multi-state cap-and-trade program with a market-based emissions trading system being central to the initiatives of RGGI, D6866 measurements provide a standardized and harmonized reference point for calculation and reporting of greenhouse vs. carbon neutral CO2 emissions. Since carbon-neutral CO2 is directly subtracted from the cap, ASTM-D6866 provides a performance standardized certification tool with real and measurable means to verify and monitor biomass-to-fuel consumption. This standardized test method provides a direct measure of the carbon-neutral CO2 vs. fossil CO2 (GHG) content within emission sources (e.g. incineration stack emissions, manufacturing exhaust, automotive exhaust), bio-ethanol content of fuel blends and bio-based content of manufactured products. It is applicable to solids, liquids, and gases containing entirely biomass carbon, a mixture of biomass and fossil carbon, and entirely fossil carbon.

Results are reported as a single value (e.g. 63% biomass CO2 or 63% biobased content), providing both financial and regulatory communities with an understandable standardized reference value for reporting and comparison (and trading in the case of cap-and-trade agreements for GHG emissions).

Relationship of biomass CO2 output as measured by ASTM-D6866 to electricity or heat output. There is a direct relationship between the D-6866 result and energy or heat output. Efforts to determine the exact relationship are on-going within the Electric Power Research Institute (EPRI), the Renewable Energy Association in the UK (REA) and within working groups within ASTM. Support and input from all stakeholders is welcomed in this regard.

(ASTM-D6866: Standard Methods for determining the Biobased Content of Natural Range Materials using Radiocarbon and Isotope Ratio Mass spectrometry)

Applicability of ASTM-D6866 to Greenhouse gas emissions

ASTM-D6866 makes a direct measurement of the percentage carbon-neutral CO2 within a bulk CO2/gas effluent. A single result is provided (e.g. 63% Biomass CO2). A facility knowing its total tonnage CO2 output and D6866 result can directly calculate the tonnage of both carbon-neutral CO2 and fossil CO2 expelled, regardless of feedstock variability. It provides a verification and monitoring tool for separating fossil carbon from carbon-neutral emissions in greenhouse gas emissions inventories.

Give the financial community confidence in emission reduction projects. Relating percentages between projects, facilities, and projections is common practice within the investment community. Being able to relate percentage reductions in fossil CO2 emissions by monitoring percentage carbon-neutral CO2 increases provides an understandable reference point to stimulate investment.

Avoid double counting**:** Single ASTM-D6866 results can be tied to specific facility or industry emissions for trading and regulatory purposes. Since single measurements representing a true running average can be made directly on stack effluents over a time period of choice (1 week, 1 month, etc), traceability is direct and double counting can be avoided.

Transparency and public understanding: The public understands percentages. Last month Plant A produced 4000 tons of CO2 and 50% of it was greenhouse gas. This month Plant A produced 4000 tons of CO2 but only 25% was greenhouse gas. Plant A reduced its GHG emissions by 25% using a verifiable and publicly transparent vehicle.

Verifiable emissions reductions: The combined knowledge of tonnage CO2 output and % biomass provides a simple, transparent measure to monitor reductions. For example, assume last period a facility produced 4000 tons CO2 with 50% biomass CO2 and this period it produced 4000 tons @ 75% biomass CO2. This facility has reduced its GHG emissions by 25%. Additionally, last period this facility had 2000 tons of tradable carbon-neutral CO2 and this month it has 3000 tons of tradable carbon-neutral CO2. If all facilities are operating under the same mechanism, a single, transparent and verifiable tool is at work.

Applicability of ASTM-D6866 to other Regulatory Interests (and under their review)

AB32: California's greenhouse gas emission initiative. D6866 measurements on CO2 effluent is a standardized means for verification and harmonization of relative carbon-neutral vs. GHG emissions. With immediate availability and precedence within Federal law, implementation would help provide the State Air Resources Board (ARB) meet the January 1, 2008 requirements for implementing annual reporting and verification of GHG emissions.

Renewable Portfolio Standards (RPS) Policy within 23 states now require electricity providers to obtain a minimum percentage of their power from renewable energy resources by a certain date. Together these states account for more than 42% of the electricity sales in the United States. However, each state has its own methods of administering these policies. D6866 results measured on stack emissions would provide a standardized and harmonized reference point for calculation and reporting.

International application: Renewable Obligation Certificates (ROCs) in the UK. The UK has banned installation of further landfills within its borders. Future expansion in trash disposal must go to incinerators. As in the US, these incinerators routinely combine biomass with fossil fuels to generate electricity. As an incentive, facilities are awarded ROCs (Renewable Obligation Certificates) on the order of 40GBP (~ $80.00) for each megawatt hour generated from biomass. OFGEM, the overseeing body regulating the reporting and rewarding of ROCs is reviewing ASTM-D6866 as "reliable and accurate" (requirements of legislation) means to simplify and economize the process.

International application: Greenhouse Gas Reduction Initiatives within the European Union. The European Committee for Standardization (CEN) is the ASTM equivalent within the European Union. It has accepted ASTM-D6866 and the premises under which it was written. It is writing a similar Technical Specification for the EU to standardize the determination of biomass carbon content within solid recovered fuels. Future specifications are expected for flue gas, biodiesel mixtures, and biomethane. These technical specifications are being written by CEN for the purposes of satisfying European Environmental Energy Agency requirements outlined in ETA Technical Report No 2/2006: Applications of the Emissions Trading Directive of EU Member States. Additionally it is foreseen that small facilities not presently required to abide by Kyoto protocol emission standards will have to in the future. Standardization of methodologies in monitoring and reporting are needed as the volume of these participants expands.

Kyoto Protocols: CDM. Carbon-neutral CO2 emissions quantified by ASTM-D6866 measurements provide a single value reference from which cap deductions are made. Knowing tonnage CO2 out put and the Biomass CO2 output, of say 63%, allows the producer to either (1) reduce his output calculation of greenhouse gas emission by 63% or (2) offer 63% of his tonnage for sale in the carbon credit arena.

Application to biofuels

ASTM-D6866 is presently under review for inclusion in EPA 40 CFR Part 80: Renewable Fuels Standard Requirements for 2006.

ASTM-D6866 makes a direct measurement on the % renewable content vs. fossil content of gasoline blends regardless of chemical composition. In doing so, it identifies fuel blends containing renewable ethanol vs. synthetic ethanol derived from coal or natural gas.

Since renewable ethanol is synthesized from modern day plants and the gasoline itself is synthesized from fossil petroleum, a measure on the blend will directly quantify the amount of renewable ethanol in that blend. A blend containing 10% renewable ethanol will give a result of 10% renewable content, whereas a blend containing 10% synthetic ethanol will give a result of 0% renewable content, even though in both cases 10% ethanol is present in the gasoline blend. This characterization supports the underlying intent and motives behind bio-ethanol use and consumption. It also adds protection to domestic stakeholders in the absence of truly verifiable origin of imported ethanol, is an applicable tool for identifying traceability and can be used to aide in validating awarded tax credits.

Application to Biobased Content of Manufactured Products.

ASTM-D6866 is the required method of analysis for preferred procurement by the Federal Government of products containing the greatest amount of renewable carbon. It has been empirically tested and identified as the required method for identification and designation of items for the Federal Preferred Procurement List. In this regard, it is cited in Federal Law 7 CFR 2902.

Field application (logistics, expense in collecting gas for analysis).

With regards to stack effluents, gas for analysis is obtained directly from the exhaust of continuous emission monitoring systems (CEMS). Cost per CEMS modification is limited to a few $100 in piping, valves, gas flow controller, and perhaps computer control. Gas is collected on a continuous basis for a time of interest (e.g. 2 weeks, 1 month) and a single measurement is made on 0.1 to1.0 liter of collected effluent. The result represents a true running average of carbon-neutral vs. greenhouse CO2 emissions. The gas is sent to an ASTM-D6866 laboratory for analysis. Analysis can be performed in as little as 48 hours at a typical cost of $500-$600 each.

Origin/History of ASTM-D6866

ASTM-D6866 is a standardized application of radiocarbon dating techniques. A working standard was completed in 2004 and is now cited in Federal Law (7 CFR part 2902). It is used for designating manufactured items for inclusion in the Federal governments preferred

procurement list. It was written at the request of the USDA to satisfy legislation requiring Federal agencies to give preferred procurement to manufacturers using the greatest amount of renewable biomass (vs. plastic or other fossil components) in their products (per the 2002 Farm Bill). A standardized method was needed to verify manufacturers claims of renewable content. Radiocarbon dating was directly applicable, but was an unregulated industry. The USDA needed standardization of the techniques and reporting for the purposes of inclusion in regulatory policy.

In October 2006, testimony was made before the EPA for inclusion of ASTM-D6866 into EPA 40 CFR Part 80: Renewable Fuels Standard Requirements for 2006. The method had direct applicability towards providing a standardized and verifiable means to validate the origin of ethanol within fuel blends as being from either renewable or fossil (synthetic) sources. With worldwide growth in synthetic ethanol production, inclusion of ASTM-D6866 into the standard was warranted for the purposes of protecting the intent and integrity of the RFS, tracing origin, protecting domestic stakeholders from poorly traceable ethanol imports (with regards to renewable vs. synthetic origin), and protecting the integrity and validity of awarded tax credits. That testimony is presently under review.

Understanding ASTM-D6866 results: Greenhouse Gas Emissions

The application of ASTM-D6866 to derive a "Biomass content" for carbon dioxide effluents is built upon the same concepts as those used by the US Department of Agriculture to derive the biobased content of manufactured products containing biomass carbon. It is done by comparing a relative amount of radiocarbon (C14) in an unknown sample to that of a modern reference standard. The ratio in contemporary biomass will be 100% and the ratio in fossil materials will be zero. Carbon dioxide derived from combustion of a mixture of present day biomass and fossil carbon will yield an ASTM-D6866 result which directly correlates to the amount of biomass carbon combusted.

The modern reference standard is a National Institute of Standards and Technology (NIST) standard with a defined radiocarbon content of 100% contemporary carbon for the year AD 1950. AD 1950 was chosen since it represented a time prior to thermo-nuclear weapons testing which introduced large amounts of excess radiocarbon into the atmosphere with each explosion (termed "bomb carbon"). This was a logical point in time to use as a reference since this excess bomb carbon would change with increased or decreased weapons testing. A correction for this effect is applied per the ASTM-D-6866 requirements.

Carbon dioxide effluent derived from combustion of 100% present day biomass will yield results of 100% renewable content. Carbon dioxide effluent derived from the combustion of 100% fossil fuel will yield results of 0% renewable content. Carbon dioxide produced from mixed fuels (biomass plus fossil fuel) will yield a percentage result in direct proportion to the biomass carbon consumed vs. fossil carbon consumed in the combustion. The final result is

referred to as the MEAN BIOMASS RESULT and assumes all the carbon in the carbon dioxide was derived from either present day living or fossil sources.

The results provided in this report involved materials provided without any source information. This situation is highly probable in a real life situation. The MEAN VALUE quoted in this report encompasses an absolute range of 6% (plus and minus 3% on either side of the MEAN BIOMASS RESULT) to account for variations in end-component radiocarbon signatures (a conservative approximation). It is presumed that all materials are present day or fossil in origin and that the desired result is the amount of biomass component "present" in the material, not the amount of biomass material "used" in the manufacturing process. The most conservative interpretation of the reported percentages is as maximum values.

ASTM-D6866 results relate directly to the percentage carbon-neutral CO2 in an incineration effluent. A value of 71% renewable content measured on CO2 effluent would indicate that 71% of the exhausted CO2 was from biomass (29% from fossil fuel). It does not represent the weight of biomass combusted or the weight of fossil fuel combusted. This is advantageous since the weight of the fuels only indirectly relate to the up-take of carbon dioxide from the atmosphere. The respiration uptake compound was carbon dioxide and the combustion effluent was carbon dioxide. The ASTM-D6866 result directly and specifically relates to the amount of carbon-neutral CO2 consumed and expelled.

ASTM-D6866 results presume all the carbon in the analyte was either present day or fossil. This assumption does not apply well to landfill gases since they will include excess bomb carbon from perhaps 20-40 years ago. The "present day" end-component is not known in that case. The method best applies to high concentration CO2 effluents from combustion sources.

Understanding D-6866 results by illustration: Greenhouse Gas Emissions

Location: A waste to energy incineration facility.

Gas collection: A gas glow controller was connected between the exhaust port of a CEMS and one liter gas collection bag. The flow meter was calibrated to introduce CEMS exhaust into the gas bag at a rate of 4.7cc per hour for 7 days. This produced 800 cc of gas representing a running average of stack effluent for 7 days. The gas bag was sent to a laboratory providing ASTM-D6866 analysis.

ASTM-D6866 result was 71% renewable content.

What does the result mean?

71% of the carbon produced in the combustion of the feedstock was from renewable biomass.

29% of the carbon produced in the combustion of the feedstock was from fossil fuel.

71% of the carbon produced in the combustion was carbon-neutral CO2.

29% of the carbon produced in the combustion was greenhouse gas.

The ratio represents renewable carbon to total carbon and fossil carbon to total carbon. It does not represent the weight of biomass combusted vs. the weight of fossil fuel combusted.

Applications using the result

0.29 x tonnage CO2 emitted is greenhouse gas, to be reported to regulators

71% of the tonnage CO2 produced can be subtracted from the CAP total (since it is carbon-neutral CO2)

Only 29% of the tonnage CO2 produced applies towards the CAP

Illustrative calculation of tonnage biomass vs. fossil fuel combusted in a mixed stream without sorting or mixing.

Parameters:

The biomass fuel component is 30% carbon,
The fossil fuel component is 50% carbon
1 ton of CO2 is generated.
The D-6866 result is 71% renewable content (indicating 71% of the carbon in the CO2 was from the biomass).

By itself, the biomass component would produce 1.1 ton CO2 per ton biomass combusted ((1 x 0.3)/0.2727 C in CO2)
The fossil fuel would generate 1.8 tons CO2 per ton of fossil mass combusted ((1 x 0.5)/0.2727 C in CO2).

Renewable biomass combusted = 0.65 ton
(1 ton CO2 = 0.2727 ton C, 0.2727 x 71% renewable carbon = 0.19 ton biomass carbon,
0.19 ton biomass carbon / 0.3 = 0.65 ton biomass fuel combusted.)

Fossil fuel combusted = 0.16 ton
(1 ton CO2 = 0.2727 ton C, 0.2727 x 29% fossil carbon = 0.08 ton fossil carbon,
0.08 ton fossil carbon / 0.5 = 0.16 ton fossil fuel combusted.)

The combusted mixture consisted of 80% biomass (0.64/ (0.64+0.16) and 20 % fossil material (0.16/ (0.64+0.16).

Please send comment and inquiries to:

Darden Hood
President
Beta Analytic Inc.
4985 SW 74 Court
Miami, Florida 33155
Tel: 305-667-5167
Fax: 305-663-0964
dhood@betalabservices.com
www.betalabservices.com