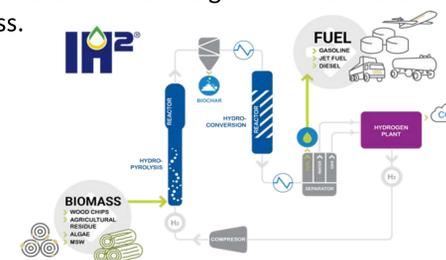


Abstract

Biomass utilization is a fast-growing field in the renewable energy sector. IH² technology, championed by GTI along with Shell, directly involves the conversion of biomass to high quality renewable fuel. The success of the IH² process depends on proper in-lab analytical assessment of these biomass feedstocks throughout the conversion process. Modern ASTM Standards focus on proximate and ultimate analysis of materials whose matrix is different than biomass, such as coal and coke. Biomass characterization requires slightly different analytical parameters than that of coal or coke. The ASTM methods related to biomass are dated and don't reference advances in instrumentation within the industry. GTI's lab staff has worked in support of gasification for over 30 years and IH² technology since its inception. During this time, GTI analytical staff have developed many method modifications to efficiently and effectively evaluate biomass materials.

Background

GTI opened its doors in 1941. At that time, the primary feedstocks being utilized across the energy industry were coal and natural gas. Fast forward to present day and emphasis has shifted to sustainable forms of low carbon energy. IH² biomass conversion technology was developed to directly address this industry need. To support IH² operations, the GTI analytical lab needed to expand its capabilities and shift its focus from coal analysis to biomass. Instead of starting from square one, GTI utilized their expertise in coal evaluation to make the transition. This transition offered a lot of insight and allowed GTI to further refine their analytical process.



ASTM Biomass Methodology

Sample Preparation (E1757)

- Dry sample in a convectional oven at 45C
- Knife-mill to reduce the size of the particles to -20/+80 mesh fraction
- Riffle the milled sample at least 3 times to homogenize the sample



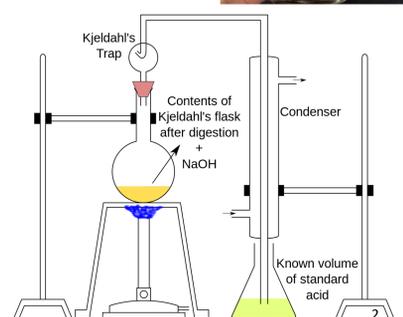
Proximate Analysis (E871/872/1358/1534/1755/1756, D1102)

- Manual sample weighing-reweighing
- Time intensive (2 hours in furnace, cool, weigh, repeat)
- Increased sample size (2 grams)
- Lower temperature for ash step (750C vs 600C)



Ultimate Analysis (E775/777/778)

- Kjeldahl method for Nitrogen, Eschka mixture method for Sulfur
- Wet chemistry methodology, a lot of moving parts required (reagents, glassware, etc.)
- Methodology written specifically for Refuse Derived Fuel and not woody biomass
- Effective, but time consuming



Heating Value & Bulk Density (E711 & E873)

- Heating value standard for biomass has been withdrawn from ASTM
- Old versions of the method seem to be very similar to existing methodology for coal and coke analysis
- Bulk density method meant for large sample quantities; method requires filling a 12"x 12" x 12" box with sample material



GTI Biomass Methodology

Sample Preparation (E1757)

- GTI follows E1757 for sample prep



Proximate Analysis (D7582)

- Using LECO TGA-701
- Analyze moisture, volatile matter and ash simultaneously or separately
- Automated program with sample turret requires minimum labor



Ultimate Analysis (D5373/4239)

- Using LECO CHN-628 & S832-DR
- Analyze carbon, hydrogen and nitrogen at the same time in <10 mins
- Soot build-up in the analyzers when analyzing biomass – more maintenance
- Select appropriate standards similar to biomass matrix to ensure proper standardization and analysis
- Use Com-aid to slow down the rapid combustion in biomass
- Less wet chemistry involved and less labor intensive



Heating Value & Bulk Density (D5865 & D7481)

- GTI follows D5865 to analyze biomass samples – creates more soot build-up, more maintenance in the combustion vessels
- Bulk density method requires ~250mL sample size
- Mechanical tapping with a counter vs. six inches height drop for five times



Conclusions

- Modifications are necessary for effective biomass evaluation while keeping in mind sound scientific principles
- Efficient in-lab analysis can save both time and money
- GTI will attend the upcoming ASTM E48 meeting in June 2022 to propose updates to standards referencing modern instrumentation techniques
- GTI analytical team is currently exploring international standards for biomass analysis to further improve our practices. ISO seems to have a lot of great standards available

Questions? Contact Us!

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Pictures:
1 - <https://www.miningreview.com/coal/india-coal-market-sees-growth-despite-global-challenges>
2 - https://en.wikipedia.org/wiki/Kjeldahl_method#/media/File:Kjeldahl's_distillation.svg
3 - <https://www.tomra.com/en/sorting/recycling/refuse-derived-fuel>