

Bio-Oil Diesel Mixture Fuels

The BDM Process™

Until the invention of the BDM Process™, the use of bio-oils in conventional heat and power generation systems required major modifications. These bio-oils were usually more viscous than conventional diesel fuel, harder to ignite, strongly acidic, and had low calorific values compared to conventional petroleum-based products. The BDM Process™ overcomes these difficulties to produce a stable bio-oil/diesel fuel mixture with properties similar to those of No. 2 fuel oil. CETC invites you to become a licensee of this process.



Figure 1: Operational Bench Scale Unit

Mixing Bio-Oils and Diesel Fuel: the BDM Process™

It used to be that bio-oils were insoluble in No. 2 diesel oil. Mix the two and they formed two separate phases (see Figure 2). Now an effective process for mixing them is available: the BDM Process™, (see Figure 1). Once mixed by this process, the two oils form a blend that is stable, non-corrosive and easy to ignite. Laboratory evaluation of bio-oil/diesel fuel mixtures (see Table 1) according to ASTM and ISO standard test methods attest to these properties.

The BDM Process™ produces a bio-oil/diesel fuel mixture with properties similar to those of conventional diesel fuel (see Figure 3). Most boilers, turbines and power generation stations can use this blended fuel without major modifications. Significant capital savings can be realized where a site conversion is planned.

Bio-oils are produced from the pyrolysis of various biomass feedstocks such as hardwoods and softwoods, grasses, agricultural wastes, etc.

The benefits of using a bio-oil/diesel fuel mixture include:

- comparable combustion performance efficiencies;
- enormous fuel savings;
- only minor adjustments to combustion equipment; and
- lower emissions of NO_x, SO_x and CO₂.

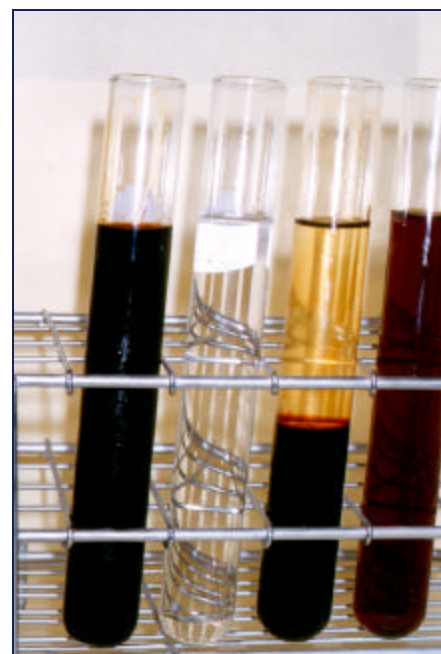


Figure 2: (left to right) Ensyn bio-oil only; diesel fuel only; immiscible Ensyn bio-oil/diesel mixture (two phases); BDM Process™ fuel (single phase)

Plans for further development include:

- testing and blending proprietary biomass-derived oils produced from pyrolytic processes;
- optimizing and scaling up continuous production of BDM Process™ fuels to improve or customize their physical properties making further enhancements to the combustion characteristics of the fuel.

The BDM Process™ has also been used effectively to blend heavier fuel oils, such as No. 4 and 6, with bio-oils. This added benefit will greatly accelerate the penetration of blended bio-oil fuels into existing oil-fired facilities used to generate electricity. Formulated BDM Process™ fuels could save a power utility hundreds of thousand dollars every year in fuel savings alone, depending on the fuels blended and

their relative proportions. Savings accrued will depend primarily on site specifics, e.g., on avoidance or containment of retrofitting costs.

Parameter	ASTM Test	Diesel Fuel Grade 2	Bio-Oil/Diesel Fuel Mixtures (Wt. %)				
			5	10	20	30	40
Flash Point (°C)	(Open Cup) D-92	92	86	86	82	82	90
	(Closed Cup) D-93	68	70	71	74	72	76
Fire Point (°C)	D-92	94	90	94	98	94	98
Heat of Combustion (cal/g)	ISO-1928	10738	10611	10274	9764	9263	8601
Pour Point (°C)	D-97	-46	N/A	-48	N/A	-48	N/A
Cloud Point (°C)	D-5773	-18	N/A	23	N/A	22	N/A
Corrosion (Cu, 3h @ 100°C)	D-130	1b	N/A	1a	N/A	1a	N/A
Ash (%wt)	D-482	0	N/A	0.02	N/A	0.13	N/A
Water & Sediment (% vol)	D-1796	0	N/A	0.1	N/A	0.2	N/A

Table 1: Similarities between Grade-2 Diesel Fuel and Some Bio-Oil/Diesel Fuels

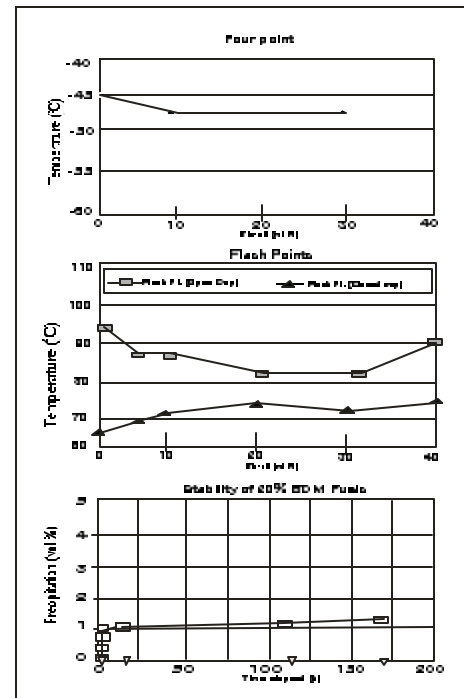


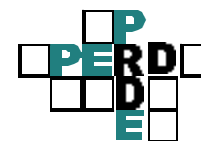
Figure 3: Physical Properties of Ensyn Bio-Oil/Diesel Mixture Fuels

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