

Table 1. Physical properties of biodiesel and diesel fuels.

Property	Units	Fuels	
		Biodiesel	Diesel
Density at 25°C	g/cm ³	0.84	0.80
Viscosity at 40°C	mm ² /s	4.1	3
Refractive index	-	1.47	1.43
Flash point	°C	130	50
Cloud point	°C	4	-12
Water content	%	0.0072	-
Sulfur content	%	0.0003	0.0015
Cetane number	-	57	44

Table 2. Composition of fuel emulsions.

Sample number	Surfactant (vol. %)	Biodiesel (vol. %)	Diesel fuel (vol. %)	Water (vol. %)	Total fuel in emulsion (vol. %)
1	3	7	80	10	87
2	5.25	12.25	72.5	10	84.75
3	7.5	17.5	65	10	82.5
4	0	7	93	0	100
5	0	12.25	87.75	0	100
6	0	17.5	82.5	0	100
7	0	0	100	0	100

Table 3. Properties of biodiesel nanoemulsions.

Fuel composition				Fuel properties		
Surfactant (%)	Biodiesel (%)	Water (%)	Diesel (%)	Density (g/cm ³)	Viscosity (cP)	Average water droplet size (nm)
3.00	7.00	10	80.00	0.840	10.00	110
5.25	12.25	10	72.50	0.860	11.11	22.5
7.50	17.5	10	65.00	0.858	13.24	10.5
0.00	7.00	0.0	93.00	0.821	3.40	-
0.00	12.25	0.0	87.75	0.828	3.62	-
0.00	17.5	0.0	82.50	0.831	4.32	-
0.00	0.0	0.0	100.00	0.800	3.00	-

Table 4. Statistical analysis of engine parameters.

Properties	B7& emulsion			B12.25&emulsion			B17.5&emulsion		
	B7,S3,W1	B7	F.Test	B12.25,S5	B12.25	F.Test	B17.5,S	B17.5	F.Test
	0			.25,W10			7.5,W1		
							0		
Power (kW)	38.08	40.33	0.927*	40.01	39..32	0.817*	40.03	38.6	0.856*
Torque (Nm)	225.65	232.18	0.977*	236.76	227.20	0.277*	236.29	230.72	0.684*
BSFC (g/kWh)	265.05	232.66	0.579*	249.21	244.1	0.058*	265.7	244.2	0.061*
NO _x (ppm)	918	920.6	0.916*	908.8	937.4	0.578*	913.8	977.2	0.098*
CO (ppm)	3105.4	2428.5	0.476*	3125.4	2436.2	0.567*	3059.8	2393.4	0.730*
CO ₂ (%)	10.14	9.48	0.327*	9.52	9.48	0.987*	9.6	9.5	0.391*
Exhaust T. (°C)	405.05	435.84	0.960*	394.25	430.94	0.945*	391.66	438.92	0.664*
Soot opacity (%)	5.51	12.21	0.073*	5.83	13.83	0.009	7.06	15.34	0.04

* Significant at P<0.05.