

Supplementary Materials: Enhancing the Drag Reduction Phenomenon within a Rotating Disk Apparatus Using Polymer-Surfactant Additives

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Uncertainty Analysis Tables

Table S1. Stander deviation and stander error for five PIB concentrations at different rotational speeds.

Rotational Speed (rpm)	No. Of Iterations	50 ppm		100 ppm		150 ppm		200 ppm		300 ppm	
		Torque	%DR	Torque	%DR	Torque	%DR	Torque	%DR	Torque	%DR
2000 rpm	Reading 1	0.381	7.0731707	0.378	7.804878	0.376	8.2926829	0.393	4.1463415	0.394	3.902439
	Reading 2	0.382	6.8292683	0.378	7.804878	0.375	8.5365854	0.394	3.902439	0.394	3.902439
	Reading 3	0.381	7.0731707	0.376	8.2926829	0.375	8.5365854	0.393	4.1463415	0.396	3.4146341
	Reading 4	0.381	7.0731707	0.376	8.2926829	0.375	8.5365854	0.393	4.1463415	0.395	3.6585366
	Reading 5	0.38	7.3170732	0.377	8.0487805	0.374	8.7804878	0.392	4.3902439	0.396	3.4146341
	Average	0.381	7.073171	0.377	8.04878	0.375	8.536585	0.393	4.146341	0.395	3.658537
	ST. Deviation	0.000707	0.172465	0.001	0.243902	0.000707	0.172465	0.000707	0.172465	0.001	0.243902
	ST. Error	0.000316	0.077129	0.000447	0.109076	0.000316	0.077129	0.000316	0.077129	0.000447	0.109076
2200 rpm	Reading 1	0.429	7.5431034	0.425	8.4051724	0.422	9.0517241	0.441	4.9568966	0.449	3.2327586
	Reading 2	0.427	7.9741379	0.424	8.6206897	0.422	9.0517241	0.442	4.7413793	0.445	4.0948276
	Reading 3	0.427	7.9741379	0.421	9.2672414	0.421	9.2672414	0.442	4.7413793	0.447	3.6637931
	Reading 4	0.426	8.1896552	0.422	9.0517241	0.422	9.0517241	0.44	5.1724138	0.446	3.8793103
	Reading 5	0.426	8.1896552	0.423	8.8362069	0.423	8.8362069	0.44	5.1724138	0.448	3.4482759
	Average	0.427	7.974138	0.423	8.836207	0.422	9.051724	0.441	4.956897	0.447	3.663793
	ST. Deviation	0.001225	0.263954	0.001581	0.340763	0.000707	0.152394	0.001	0.215517	0.001581	0.340763
	ST. Error	0.000548	0.118044	0.000707	0.152394	0.000316	0.068153	0.000447	0.096382	0.000707	0.152394
2400 rpm	Reading 1	0.482	11.070111	0.48	11.439114	0.47	13.284133	0.491	9.4095941	0.498	8.1180812
	Reading 2	0.48	11.439114	0.478	11.808118	0.472	12.915129	0.488	9.9630996	0.5	7.7490775
	Reading 3	0.48	11.439114	0.479	11.623616	0.472	12.915129	0.487	10.147601	0.5	7.7490775
	Reading 4	0.479	11.623616	0.479	11.623616	0.473	12.730627	0.489	9.7785978	0.501	7.5645756
	Reading 5	0.479	11.623616	0.479	11.623616	0.473	12.730627	0.49	9.5940959	0.501	7.5645756
	Average	0.48	11.43911	0.479	11.62362	0.472	12.91513	0.489	9.778598	0.5	7.749077
	ST. Deviation	0.001225	0.225968	0.000707	0.130463	0.001225	0.225968	0.001581	0.291723	0.001225	0.225968
	ST. Error	0.000548	0.101056	0.000316	0.058345	0.000548	0.101056	0.000707	0.130463	0.000548	0.101056

Table S1. Cont.

Rotational Speed (rpm)	No. Of Iterations	50 ppm		100 ppm		150 ppm		200 ppm		300 ppm	
		Torque	%DR	Torque	%DR	Torque	%DR	Torque	%DR	Torque	%DR
2600 rpm	Reading 1	0.521	12.436975	0.52	12.605042	0.515	13.445378	0.532	10.588235	0.549	7.7310924
	Reading 2	0.523	12.10084	0.521	12.436975	0.514	13.613445	0.533	10.420168	0.546	8.2352941
	Reading 3	0.521	12.436975	0.521	12.436975	0.513	13.781513	0.535	10.084034	0.547	8.0672269
	Reading 4	0.523	12.10084	0.521	12.436975	0.514	13.613445	0.532	10.588235	0.546	8.2352941
	Reading 5	0.522	12.268908	0.522	12.268908	0.514	13.613445	0.533	10.420168	0.547	8.0672269
	Average	0.522	12.26891	0.521	12.43697	0.514	13.61345	0.533	10.42017	0.547	8.067227
	ST. Deviation	0.001	0.168067	0.000707	0.118841	0.000707	0.118841	0.001225	0.205839	0.001225	0.205839
	ST. Error	0.000447	0.075162	0.000316	0.053148	0.000316	0.053148	0.000548	0.092054	0.000548	0.092054
2800 rpm	Reading 1	0.589	14.637681	0.585	15.217391	0.584	15.362319	0.604	12.463768	0.608	11.884058
	Reading 2	0.589	14.637681	0.584	15.362319	0.583	15.507246	0.603	12.608696	0.607	12.028986
	Reading 3	0.588	14.782609	0.586	15.072464	0.581	15.797101	0.604	12.463768	0.607	12.028986
	Reading 4	0.587	14.927536	0.588	14.782609	0.581	15.797101	0.602	12.753623	0.606	12.173913
	Reading 5	0.587	14.927536	0.587	14.927536	0.581	15.797101	0.602	12.753623	0.607	12.028986
	Average	0.588	14.78261	0.586	15.07246	0.582	15.65217	0.603	12.6087	0.607	12.02899
	ST. Deviation	0.001	0.144928	0.001581	0.229151	0.001414	0.204958	0.001	0.144928	0.000707	0.102479
	ST. Error	0.000447	0.064814	0.000707	0.102479	0.000632	0.09166	0.000447	0.064814	0.000316	0.04583
3000 rpm	Reading 1	0.654	17.942284	0.648	18.695107	0.645	19.071518	0.667	16.311167	0.672	15.683814
	Reading 2	0.653	18.067754	0.647	18.820577	0.644	19.196989	0.667	16.311167	0.67	15.934755
	Reading 3	0.653	18.067754	0.647	18.820577	0.644	19.196989	0.666	16.436637	0.668	16.185696
	Reading 4	0.656	17.691343	0.647	18.820577	0.644	19.196989	0.665	16.562108	0.669	16.060226
	Reading 5	0.654	17.942284	0.646	18.946048	0.643	19.322459	0.665	16.562108	0.671	15.809285
	Average	0.654	17.94228	0.647	18.82058	0.644	19.19699	0.666	16.43664	0.67	15.93476
	ST. Deviation	0.001225	0.153669	0.000707	0.088721	0.000707	0.088721	0.001	0.125471	0.001581	0.198386
	ST. Error	0.000548	0.068723	0.000316	0.039677	0.000316	0.039677	0.000447	0.056112	0.000707	0.088721

Table S2. Stander deviation and stander error for five SDS concentrations at different rotational speeds.

Rotational Speed (rpm)	No. Of Iterations	200 ppm		400 ppm		600 ppm		800 ppm		1000 ppm	
		Torque	%DR	Torque	%DR	Torque	%DR	Torque	%DR	Torque	%DR
2000 rpm	Reading 1	0.435	−6.097561	0.407	0.7317073	0.405	1.2195122	0.402	1.9512195	0.394	3.902439
	Reading 2	0.433	−5.6097561	0.406	0.9756098	0.406	0.9756098	0.399	2.6829268	0.394	3.902439
	Reading 3	0.433	−5.6097561	0.406	0.9756098	0.404	1.4634146	0.399	2.6829268	0.395	3.6585366
	Reading 4	0.432	−5.3658537	0.406	0.9756098	0.403	1.7073171	0.398	2.9268293	0.393	4.1463415
	Reading 5	0.432	−5.3658537	0.405	1.2195122	0.402	1.9512195	0.397	3.1707317	0.394	3.902439
	Average	0.433	−5.60976	0.406	0.97561	0.404	1.463415	0.399	2.682927	0.394	3.902439
	ST. Deviation	0.001225	0.298718	0.000707	0.172465	0.001581	0.385644	0.001871	0.4563	0.000707	0.172465
	ST. Error	0.000548	0.133591	0.000316	0.077129	0.000707	0.172465	0.000837	0.204063	0.000316	0.077129
2200 rpm	Reading 1	0.483	−4.0948276	0.457	1.5086207	0.455	1.9396552	0.447	3.6637931	0.44	5.1724138
	Reading 2	0.486	−4.7413793	0.457	1.5086207	0.454	2.1551724	0.445	4.0948276	0.441	4.9568966
	Reading 3	0.486	−4.7413793	0.456	1.7241379	0.453	2.3706897	0.447	3.6637931	0.442	4.7413793
	Reading 4	0.488	−5.1724138	0.456	1.7241379	0.455	1.9396552	0.446	3.8793103	0.442	4.7413793
	Reading 5	0.487	−4.9568966	0.454	2.1551724	0.453	2.3706897	0.445	4.0948276	0.44	5.1724138
	Average	0.486	−4.74138	0.456	1.724138	0.454	2.155172	0.446	3.87931	0.441	4.956897
	ST. Deviation	0.001871	0.403196	0.001225	0.263954	0.001	0.215517	0.001	0.215517	0.001	0.215517
	ST. Error	0.000837	0.180315	0.000548	0.118044	0.000447	0.096382	0.000447	0.096382	0.000447	0.096382
2400 rpm	Reading 1	0.565	−4.2435424	0.528	2.5830258	0.527	2.7675277	0.518	4.4280443	0.515	4.9815498
	Reading 2	0.564	−4.0590406	0.529	2.398524	0.525	3.1365314	0.518	4.4280443	0.512	5.5350554
	Reading 3	0.564	−4.0590406	0.528	2.5830258	0.525	3.1365314	0.52	4.0590406	0.512	5.5350554
	Reading 4	0.564	−4.0590406	0.531	2.0295203	0.523	3.5055351	0.517	4.6125461	0.51	5.904059
	Reading 5	0.563	−3.8745387	0.529	2.398524	0.525	3.1365314	0.517	4.6125461	0.511	5.7195572
	Average	0.564	−4.05904	0.529	2.398524	0.525	3.136531	0.518	4.428044	0.512	5.535055
	ST. Deviation	0.000707	0.130463	0.001225	0.225968	0.001414	0.260925	0.001225	0.225968	0.001871	0.345171
	ST. Error	0.000316	0.058345	0.000548	0.101056	0.000632	0.116689	0.000548	0.101056	0.000837	0.154365
2600 rpm	Reading 1	0.615	−3.3613445	0.579	2.6890756	0.57	4.2016807	0.564	5.210084	0.556	6.5546218
	Reading 2	0.613	−3.0252101	0.579	2.6890756	0.571	4.0336134	0.563	5.3781513	0.558	6.2184874
	Reading 3	0.613	−3.0252101	0.578	2.8571429	0.572	3.8655462	0.565	5.0420168	0.559	6.0504202
	Reading 4	0.612	−2.8571429	0.577	3.0252101	0.57	4.2016807	0.564	5.210084	0.56	5.8823529
	Reading 5	0.612	−2.8571429	0.577	3.0252101	0.572	3.8655462	0.564	5.210084	0.557	6.3865546
	Average	0.613	−3.02521	0.578	2.857143	0.571	4.033613	0.564	5.210084	0.558	6.218487
	ST. Deviation	0.001225	0.205839	0.001	0.168067	0.001	0.168067	0.000707	0.118841	0.001581	0.265738
	ST. Error	0.000548	0.092054	0.000447	0.075162	0.000447	0.075162	0.000316	0.053148	0.000707	0.118841

Table S2. Cont.

Rotational Speed (rpm)	No. Of Iterations	200 ppm		400 ppm		600 ppm		800 ppm		1000 ppm	
		Torque	%DR	Torque	%DR	Torque	%DR	Torque	%DR	Torque	%DR
2800 rpm	Reading 1	0.701	−1.5942029	0.67	2.8985507	0.662	4.057971	0.649	5.942029	0.648	6.0869565
	Reading 2	0.702	−1.7391304	0.669	3.0434783	0.662	4.057971	0.648	6.0869565	0.644	6.6666667
	Reading 3	0.701	−1.5942029	0.665	3.6231884	0.66	4.3478261	0.651	5.6521739	0.646	6.3768116
	Reading 4	0.701	−1.5942029	0.668	3.1884058	0.661	4.2028986	0.65	5.7971014	0.647	6.2318841
	Reading 5	0.7	−1.4492754	0.668	3.1884058	0.66	4.3478261	0.652	5.5072464	0.645	6.5217391
	Average	0.701	−1.5942	0.668	3.188406	0.661	4.202899	0.65	5.797101	0.646	6.376812
	ST. Deviation	0.000707	0.102479	0.001871	0.271135	0.001	0.144928	0.001581	0.229151	0.001581	0.229151
	ST. Error	0.000316	0.04583	0.000837	0.121255	0.000447	0.064814	0.000707	0.102479	0.000707	0.102479
3000 rpm	Reading 1	0.787	1.2547051	0.768	3.6386449	0.759	4.7678795	0.746	6.3989962	0.733	8.0301129
	Reading 2	0.785	1.5056462	0.769	3.5131744	0.76	4.642409	0.745	6.5244668	0.735	7.7791719
	Reading 3	0.786	1.3801757	0.767	3.7641154	0.76	4.642409	0.746	6.3989962	0.733	8.0301129
	Reading 4	0.784	1.6311167	0.768	3.6386449	0.759	4.7678795	0.744	6.6499373	0.732	8.1555834
	Reading 5	0.783	1.7565872	0.768	3.6386449	0.757	5.0188206	0.744	6.6499373	0.732	8.1555834
	Average	0.785	1.505646	0.768	3.638645	0.759	4.76788	0.745	6.524467	0.733	8.030113
	ST. Deviation	0.001581	0.198386	0.000707	0.088721	0.001225	0.153669	0.001	0.125471	0.001225	0.153669
	ST. Error	0.000707	0.088721	0.000316	0.039677	0.000548	0.068723	0.000447	0.056112	0.000548	0.068723

Table S3. Stander deviation and stander error for five complex mixture concentrations at different rotational speeds.

Rotational Speed (rpm)	No. Of Iterations	PIB 50 + SDS 1000 ppm		PIB 100 + SDS 1000 ppm		PIB 150 + SDS 1000 ppm		PIB 200 + SDS 1000 ppm		PIB 300 + SDS 1000 ppm	
		Torque	%DR	Torque	%DR	Torque	%DR	Torque	%DR	Torque	%DR
2000 rpm	Reading 1	0.352	14.146341	0.351	14.3902439	0.346	15.6097561	0.355	13.41463415	0.358	12.6829268
	Reading 2	0.351	14.390244	0.35	14.63414634	0.345	15.85365854	0.355	13.41463415	0.356	13.1707317
	Reading 3	0.351	14.390244	0.349	14.87804878	0.345	15.85365854	0.354	13.65853659	0.356	13.1707317
	Reading 4	0.351	14.390244	0.348	15.12195122	0.344	16.09756098	0.353	13.90243902	0.355	13.4146341
	Reading 5	0.35	14.634146	0.347	15.36585366	0.345	15.85365854	0.353	13.90243902	0.355	13.4146341
	Average	0.351	14.39024	0.349	14.878049	0.345	15.853659	0.354	13.658537	0.356	13.170732
	ST. Deviation	0.000707	0.172465	0.001581	0.3856436	0.000707	0.1724651	0.001	0.2439024	0.001225	0.2987183
	ST. Error	0.000316	0.077129	0.000707	0.1724651	0.000316	0.0771287	0.000447	0.1090765	0.000548	0.1335909
2200 rpm	Reading 1	0.394	15.086207	0.391	15.73275862	0.385	17.02586207	0.399	14.00862069	0.402	13.362069
	Reading 2	0.392	15.517241	0.39	15.94827586	0.383	17.45689655	0.4	13.79310345	0.4	13.7931034
	Reading 3	0.391	15.732759	0.39	15.94827586	0.384	17.24137931	0.4	13.79310345	0.401	13.5775862
	Reading 4	0.392	15.517241	0.39	15.94827586	0.385	17.02586207	0.4	13.79310345	0.402	13.362069
	Reading 5	0.391	15.732759	0.389	16.1637931	0.383	17.45689655	0.401	13.57758621	0.4	13.7931034
	Average	0.392	15.51724	0.39	15.948276	0.384	17.241379	0.4	13.793103	0.401	13.577586
	ST. Deviation	0.001225	0.263954	0.000707	0.1523937	0.001	0.2155172	0.000707	0.1523937	0.001	0.2155172
	ST. Error	0.000548	0.118044	0.000316	0.0681525	0.000447	0.0963822	0.000316	0.0681525	0.000447	0.0963822
2400 rpm	Reading 1	0.457	15.682657	0.453	16.42066421	0.447	17.52767528	0.463	14.57564576	0.469	13.4686347
	Reading 2	0.455	16.051661	0.451	16.7896679	0.448	17.34317343	0.464	14.39114391	0.469	13.4686347
	Reading 3	0.455	16.051661	0.45	16.97416974	0.446	17.71217712	0.463	14.57564576	0.468	13.6531365
	Reading 4	0.454	16.236162	0.451	16.7896679	0.446	17.71217712	0.462	14.7601476	0.467	13.8376384
	Reading 5	0.454	16.236162	0.45	16.97416974	0.443	18.26568266	0.463	14.57564576	0.467	13.8376384
	Average	0.455	16.05166	0.451	16.789668	0.446	17.712177	0.463	14.575646	0.468	13.653137
	ST. Deviation	0.001225	0.225968	0.001225	0.2259677	0.001871	0.3451713	0.000707	0.1304625	0.001	0.1845018
	ST. Error	0.000548	0.101056	0.000548	0.1010558	0.000837	0.1543653	0.000316	0.0583446	0.000447	0.0825117
2600 rpm	Reading 1	0.498	16.302521	0.494	16.97478992	0.488	17.98319328	0.509	14.45378151	0.514	13.6134454
	Reading 2	0.5	15.966387	0.49	17.64705882	0.487	18.1512605	0.506	14.95798319	0.512	13.9495798
	Reading 3	0.497	16.470588	0.492	17.31092437	0.489	17.81512605	0.508	14.62184874	0.512	13.9495798
	Reading 4	0.498	16.302521	0.493	17.14285714	0.489	17.81512605	0.509	14.45378151	0.511	14.1176471
	Reading 5	0.497	16.470588	0.496	16.63865546	0.487	18.1512605	0.508	14.62184874	0.511	14.1176471
	Average	0.498	16.30252	0.493	17.142857	0.488	17.983193	0.508	14.621849	0.512	13.94958
	ST. Deviation	0.001225	0.205839	0.002236	0.3758097	0.001	0.1680672	0.001225	0.2058395	0.001225	0.2058395
	ST. Error	0.000548	0.092054	0.001	0.1680672	0.000447	0.0751619	0.000548	0.0920542	0.000548	0.0920542

Table S3. Cont.

Rotational Speed (rpm)	No. Of Iterations	PIB 50 + SDS 1000 ppm		PIB 100 + SDS 1000 ppm		PIB 150 + SDS 1000 ppm		PIB 200 + SDS 1000 ppm		PIB 300 + SDS 1000 ppm	
		Torque	%DR	Torque	%DR	Torque	%DR	Torque	%DR	Torque	%DR
2800 rpm	Reading 1	0.575	16.666667	0.574	16.8115942	0.564	18.26086957	0.585	15.2173913	0.587	14.9275362
	Reading 2	0.573	16.956522	0.572	17.10144928	0.565	18.11594203	0.584	15.36231884	0.586	15.0724638
	Reading 3	0.574	16.811594	0.572	17.10144928	0.563	18.4057971	0.584	15.36231884	0.586	15.0724638
	Reading 4	0.576	16.521739	0.571	17.24637681	0.562	18.55072464	0.584	15.36231884	0.586	15.0724638
	Reading 5	0.577	16.376812	0.571	17.24637681	0.561	18.69565217	0.583	15.50724638	0.585	15.2173913
	Average	0.575	16.66667	0.572	17.101449	0.563	18.405797	0.584	15.362319	0.586	15.072464
	ST. Deviation	0.001581	0.229151	0.001225	0.1774993	0.001581	0.2291506	0.000707	0.1024792	0.000707	0.1024792
	ST. Error	0.000707	0.102479	0.000548	0.0793801	0.000707	0.1024792	0.000316	0.0458301	0.000316	0.0458301
3000 rpm	Reading 1	0.645	19.071518	0.635	20.32622334	0.628	21.20451694	0.649	18.56963614	0.657	17.565872
	Reading 2	0.643	19.322459	0.634	20.45169385	0.626	21.45545797	0.647	18.82057716	0.655	17.816813
	Reading 3	0.644	19.196989	0.633	20.57716437	0.625	21.58092848	0.646	18.94604768	0.656	17.6913425
	Reading 4	0.642	19.44793	0.634	20.45169385	0.626	21.45545797	0.648	18.69510665	0.654	17.9422836
	Reading 5	0.641	19.5734	0.634	20.45169385	0.625	21.58092848	0.645	19.07151819	0.653	18.0677541
	Average	0.643	19.32246	0.634	20.451694	0.626	21.455458	0.647	18.820577	0.655	17.816813
	ST. Deviation	0.001581	0.198386	0.000707	0.0887211	0.001225	0.1536694	0.001581	0.1983863	0.001581	0.1983863
	ST. Error	0.000707	0.088721	0.000316	0.0396773	0.000548	0.068723	0.000707	0.0887211	0.000707	0.0887211

Error Bars Tables

Table S4. The effects of PIB concentrations on %DR of diesel fuel with different rotational speeds.

PIB Concentration	2000 rpm	ST. Error	2200 rpm	ST. Error	2400 rpm	ST. Error	2600 rpm	ST. Error	2800 rpm	ST. Error	3000 rpm	ST. Error
50	7.07317	0.07713	7.97414	0.11804	11.4391	0.10106	12.2689	0.07516	14.7826	0.06481	17.9423	0.06872
100	8.04878	0.10908	8.83621	0.15239	11.6236	0.05834	12.437	0.05315	15.0725	0.10248	18.8206	0.03968
150	8.53659	0.07713	9.05172	0.06815	12.9151	0.10106	13.6134	0.05315	15.6522	0.09166	19.197	0.03968
200	4.14634	0.07713	4.9569	0.09638	9.7786	0.13046	10.4202	0.09205	12.6087	0.06481	16.4366	0.05611
300	3.65854	0.10908	3.66379	0.15239	7.74908	0.10106	8.06723	0.09205	12.029	0.04583	15.9348	0.08872

Table S5. The effects of rotational speed on %DR of diesel fuel with different PIB concentrations.

Rotational Speed (rpm)	50 ppm	ST. Error	100 ppm	ST. Error	150 ppm	ST. Error	200 ppm	ST. Error	300 ppm	ST. Error
2000	7.07317	0.07713	8.04878	0.10908	8.53659	0.07713	4.14634	0.07713	3.65854	0.10908
2200	7.97414	0.11804	8.83621	0.15239	9.05172	0.06815	4.9569	0.09638	3.66379	0.15239
2400	11.4391	0.10106	11.6236	0.05834	12.9151	0.10106	9.7786	0.13046	7.74908	0.10106
2600	12.2689	0.07516	12.437	0.05315	13.6134	0.05315	10.4202	0.09205	8.06723	0.09205
2800	14.7826	0.06481	15.0725	0.10248	15.6522	0.09166	12.6087	0.06481	12.029	0.04583
3000	17.9423	0.06872	18.8206	0.03968	19.197	0.03968	16.4366	0.05611	15.9348	0.08872

Table S6. The effects of SDS concentrations on %DR of diesel fuel with different rotational speeds.

Surfactant Concentration	2000 rpm	ST. Error	2200 rpm	ST. Error	2400 rpm	ST. Error	2600 rpm	ST. Error	2800 rpm	ST. Error	3000 rpm	ST. Error
200	-5.6098	0.13359	-4.7414	0.18031	-4.059	0.05834	-3.0252	0.09205	-1.5942	0.04583	1.50565	0.08872
400	0.97561	0.07713	1.72414	0.11804	2.39852	0.10106	2.85714	0.07516	3.18841	0.12126	3.63864	0.03968
600	1.46341	0.17247	2.15517	0.09638	3.13653	0.11669	4.03361	0.07516	4.2029	0.06481	4.76788	0.06872
800	2.68293	0.20406	3.87931	0.09638	4.42804	0.10106	5.21008	0.05315	5.7971	0.10248	6.52447	0.05611
1000	3.90244	0.07713	4.9569	0.09638	5.53506	0.15437	6.21849	0.11884	6.37681	0.10248	8.03011	0.06872

Table S7. The effects of rotational speed on %DR of diesel fuel with different SDS concentrations.

Rotational Velocity (rpm)	200 ppm	ST. Error	400 ppm	ST. Error	600 ppm	ST. Error	800 ppm	ST. Error	1000 ppm	ST. Error
2000	−5.6098	0.13359	0.97561	0.07713	1.46341	0.17247	2.68293	0.20406	3.90244	0.07713
2200	−4.7414	0.18031	1.72414	0.11804	2.15517	0.09638	3.87931	0.09638	4.9569	0.09638
2400	−4.059	0.05834	2.39852	0.10106	3.13653	0.11669	4.42804	0.10106	5.53506	0.15437
2600	−3.0252	0.09205	2.85714	0.07516	4.03361	0.07516	5.21008	0.05315	6.21849	0.11884
2800	−1.5942	0.04583	3.18841	0.12126	4.2029	0.06481	5.7971	0.10248	6.37681	0.10248
3000	1.50565	0.08872	3.63864	0.03968	4.76788	0.06872	6.52447	0.05611	8.03011	0.06872

Table S8. The effects of complex mixture concentrations on %DR of diesel fuel with different rotational speeds.

Complex Concentration	2000 rpm	ST. Error	2200 rpm	ST. Error	2400 rpm	ST. Error	2600 rpm	ST. Error	2800 rpm	ST. Error	3000 rpm	ST. Error
50	14.3902	0.07713	15.5172	0.11804	16.0517	0.10106	16.3025	0.09205	16.6667	0.10248	19.3225	0.08872
100	14.878	0.17247	15.9483	0.06815	16.7897	0.10106	17.1429	0.16807	17.1014	0.07938	20.4517	0.03968
150	15.8537	0.07713	17.2414	0.09638	17.7122	0.15437	17.9832	0.07516	18.4058	0.10248	21.4555	0.06872
200	13.6585	0.10908	13.7931	0.06815	14.5756	0.05834	14.6218	0.09205	15.3623	0.04583	18.8206	0.08872
300	13.1707	0.13359	13.5776	0.09638	13.6531	0.08251	13.9496	0.09205	15.0725	0.04583	17.8168	0.08872

Table S9. The effects of rotational speed on %DR of diesel fuel with different complex mixture concentrations.

Rotational Velocity (rpm)	50 ppm	ST. Error	100 ppm	ST. Error	150 ppm	ST. Error	200 ppm	ST. Error	300 ppm	ST. Error
2000	14.3902	0.07713	14.878	0.17247	15.8537	0.07713	13.6585	0.10908	13.1707	0.13359
2200	15.5172	0.11804	15.9483	0.06815	17.2414	0.09638	13.7931	0.06815	13.5776	0.09638
2400	16.0517	0.10106	16.7897	0.10106	17.7122	0.15437	14.5756	0.05834	13.6531	0.08251
2600	16.3025	0.09205	17.1429	0.16807	17.9832	0.07516	14.6218	0.09205	13.9496	0.09205
2800	16.6667	0.10248	17.1014	0.07938	18.4058	0.10248	15.3623	0.04583	15.0725	0.04583
3000	19.3225	0.08872	20.4517	0.03968	21.4555	0.06872	18.8206	0.08872	17.8168	0.08872