Supplementary Materials

Three-Dimensional-Printed Vortex Tube Reactor for Continuous Flow Synthesis of Polyglycolic Acid Nanoparticles with High Productivity

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This file supplementary Table S1-3.

Table S1. Properties of water and ethanol for CFD calculation from the engineering database (Solidworks).

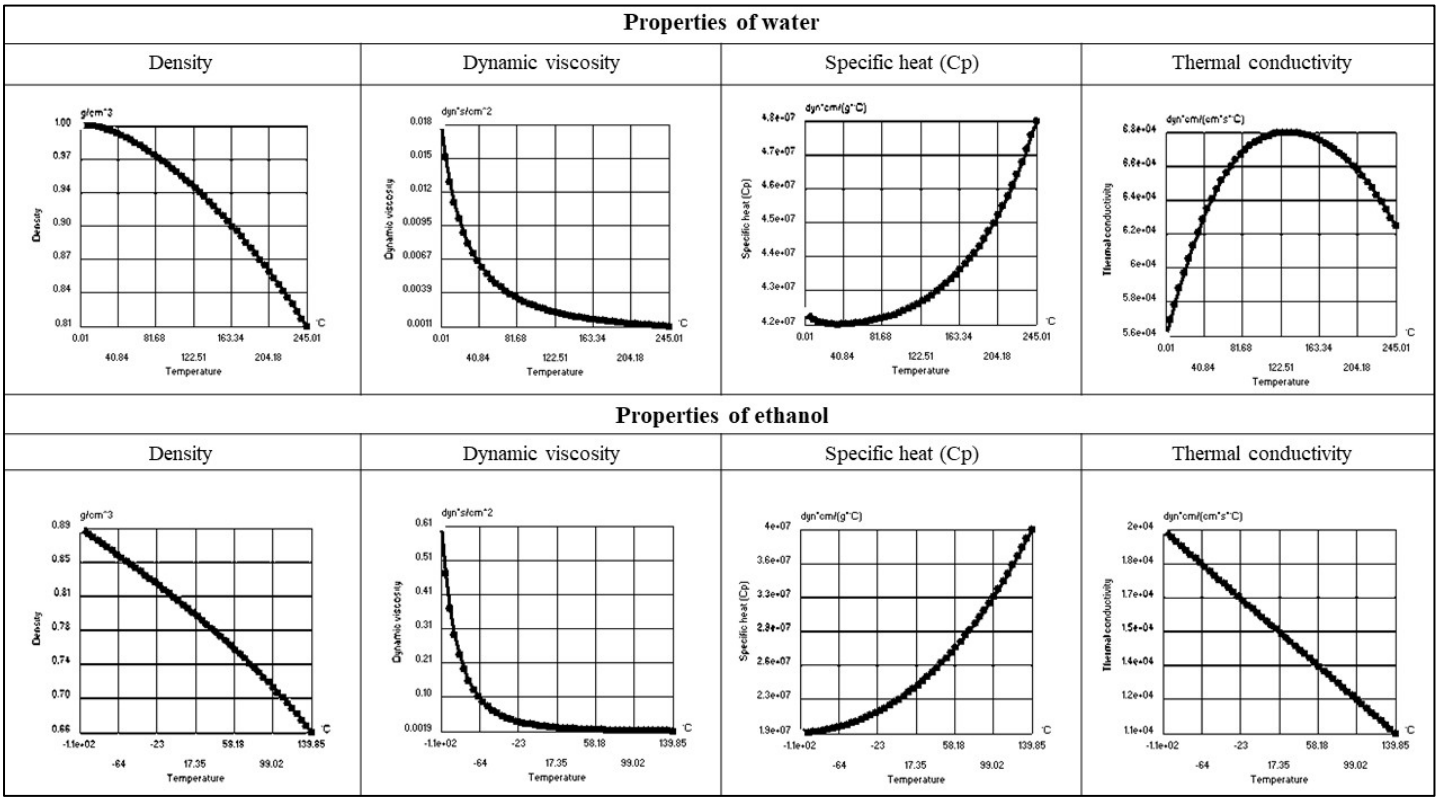


Table S2. Difference mesh refinement of the automating generated mesh in seven levels.

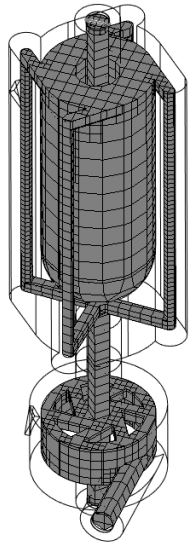
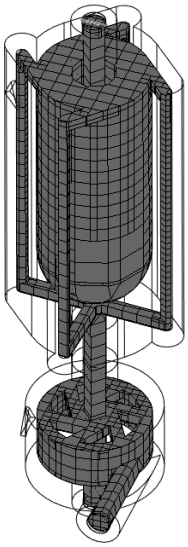
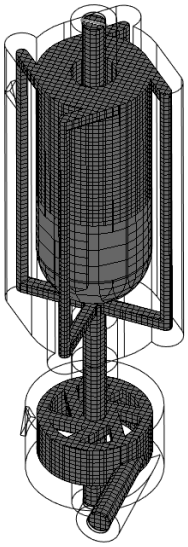
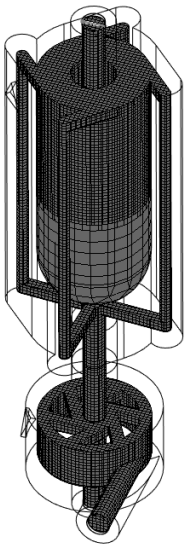
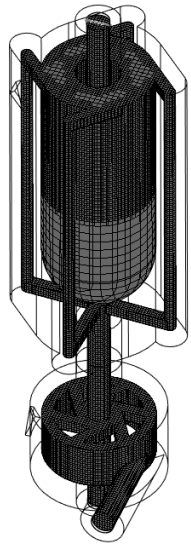
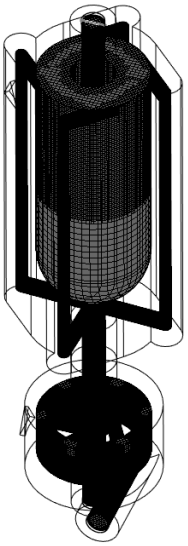
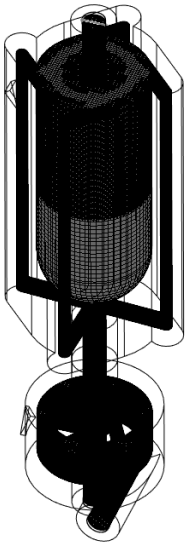
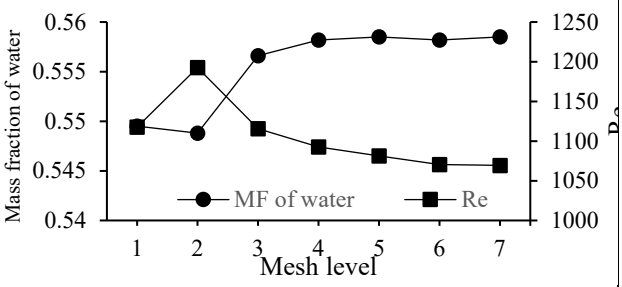
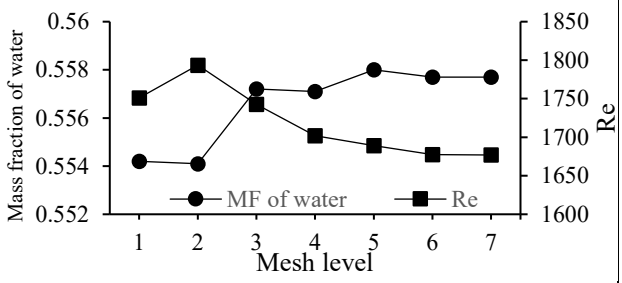
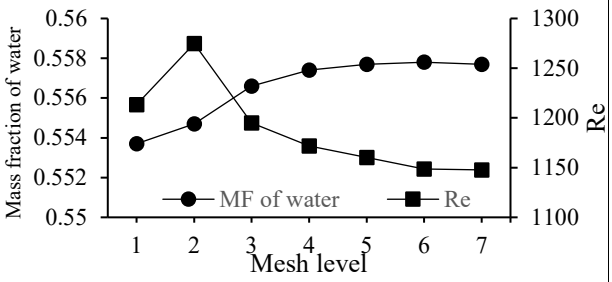
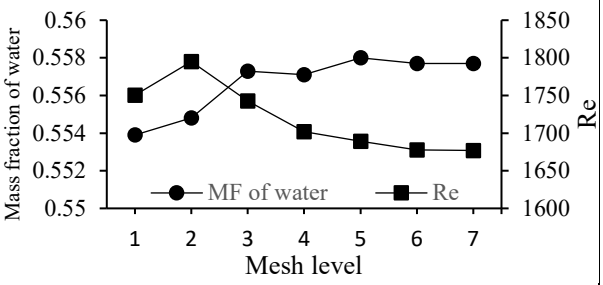
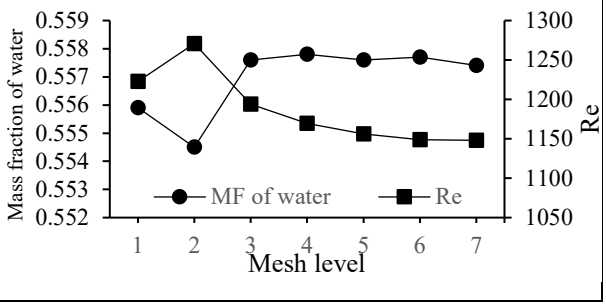
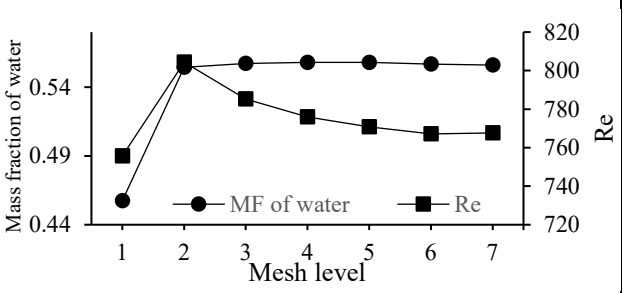
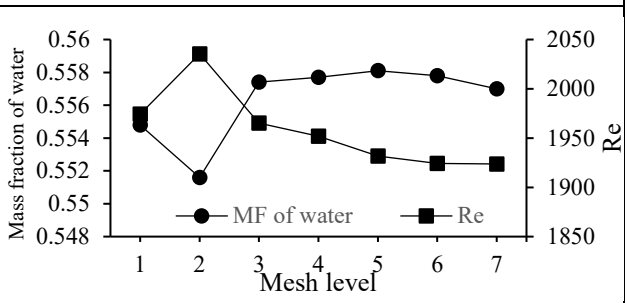
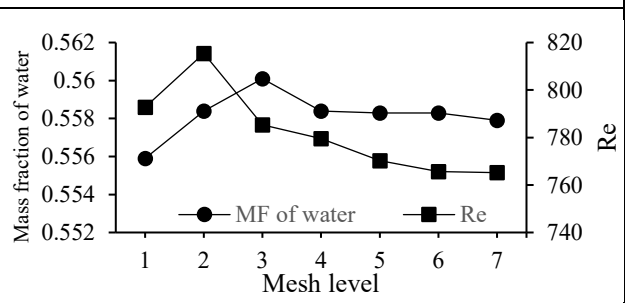
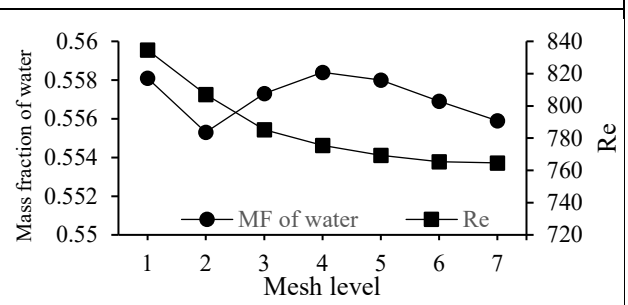
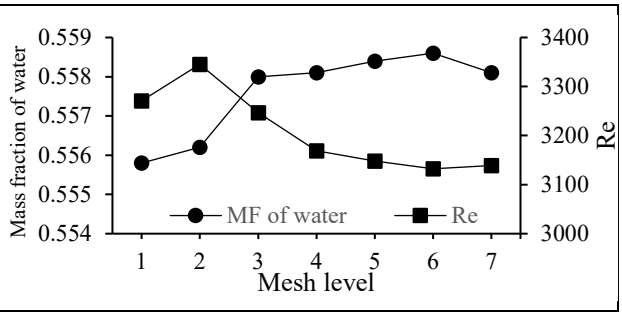
Mesh refinement			
Level 1	Level 2	Level 3	Level 4
			
Level 5	Level 6	Level 7	
			

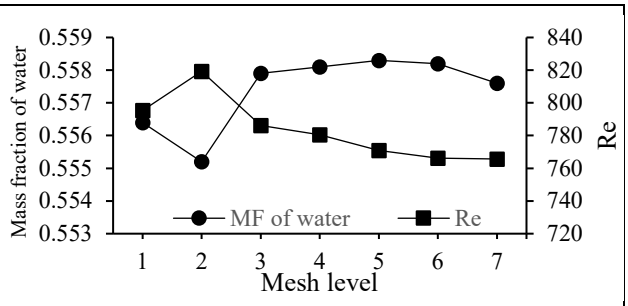
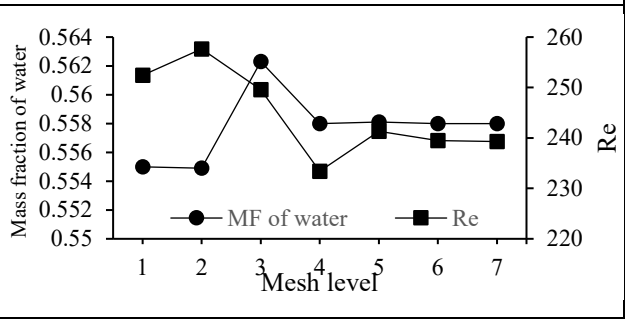
Table S3. Mesh independency test using the vortex tube reactor model.

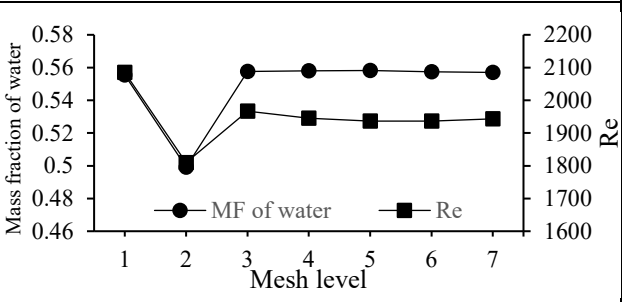
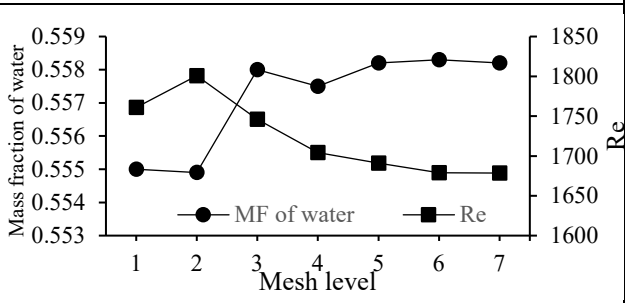
Model	Mesh level	Mesh cell count	Iteration	Mass fraction of water	Reynold number	Convergence plot of mesh independency test using the vortex tube reactor model
1	1	3,268	160	0.5495	1,117.56	
	2	3,558	160	0.5488	1,192.62	
	3	24,010	268	0.5566	1,115.46	
	4	48,429	300	0.5582	1,092.6	
	5	122,228	351	0.5585	1,081.32	
	6	817,569	521	0.5582	1,070.28	
	7	2,236,753	695	0.5585	1,069.44	
2	1	3,117	127	0.5542	1,751.05	
	2	2,677	141	0.5541	1,793.60	
	3	17,398	216	0.5572	1,742.80	
	4	44,850	261	0.5571	1,701.90	
	5	112,741	320	0.558	1,689.10	
	6	821,352	508	0.5577	1,677.65	
	7	2,276,391	676	0.5577	1,676.95	
3	1	3,163	160	0.5537	1,213.29	
	2	3,320	160	0.5547	1,274.74	
	3	15,409	239	0.5566	1,195.06	
	4	30,693	246	0.5574	1,171.68	
	5	76,805	283	0.5577	1,160.21	
	6	658,343	447	0.5578	1,148.58	
	7	1,828,178	620	0.5577	1,147.72	
4	1	3,117	126	0.5539	1,750.41	
	2	2,677	146	0.5548	1,795.03	
	3	17,377	217	0.5573	1,742.72	
	4	44,878	262	0.5571	1,701.94	
	5	112,391	319	0.558	1,689.10	
	6	821,325	508	0.5577	1,677.65	
	7	2,276,856	676	0.5577	1,676.95	
5	1	2,335	160	0.5559	1,222.86	
	2	2,435	148	0.5545	1,270.80	
	3	14,856	195	0.5576	1,194.00	
	4	34,843	222	0.5578	1,169.70	
	5	90,903	261	0.5576	1,156.02	
	6	133,316	437	0.5577	1,148.88	
	7	1,997,191	598	0.5574	1,148.04	

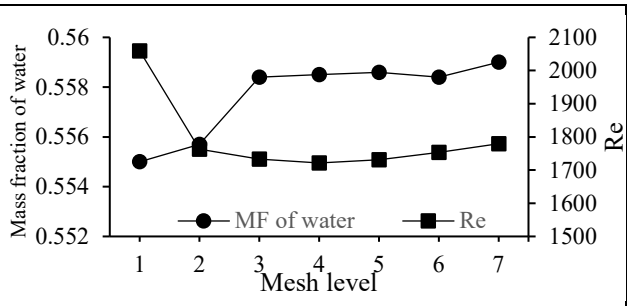
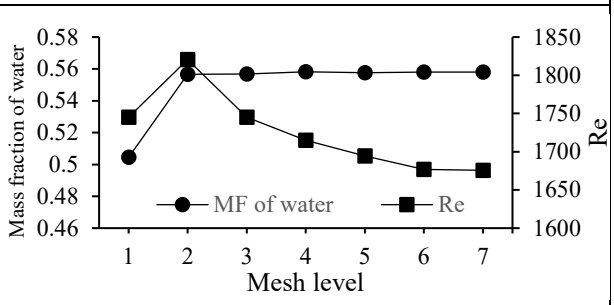
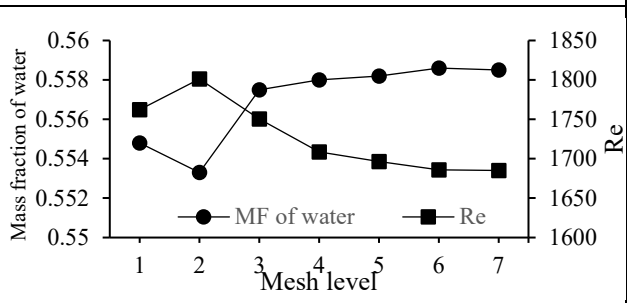
Model	Mesh level	Mesh cell count	Iteration	Mass fraction of water	Reynold number	Convergence plot of mesh independency test using the vortex tube reactor model
6	1	1,409	58	0.4574	755.68	
	2	2,418	116	0.5543	804.36	
	3	11,806	184	0.5571	785.24	
	4	32,957	201	0.558	775.96	
	5	85,334	226	0.558	770.76	
	6	849,119	383	0.5568	767.20	
	7	603,021	363	0.556	767.72	
7	1	5,039	145	0.5548	1,974.36	
	2	3,664	144	0.5516	2,035.48	
	3	16,898	228	0.5574	1,965.32	
	4	36,375	260	0.5577	1,952.00	
	5	102,972	310	0.5581	1,931.88	
	6	1,031,558	488	0.5578	1,924.36	
	7	2,843,638	651	0.557	1,923.72	
8	1	5,498	167	0.5559	792.80	
	2	3,687	160	0.5584	815.44	
	3	23,934	276	0.5601	785.36	
	4	53,093	292	0.5584	779.52	
	5	156,980	301	0.5583	770.20	
	6	1,428,243	526	0.5583	765.72	
	7	3,882,523	696	0.5579	765.20	
9	1	1,425	134	0.5581	834.60	
	2	2,591	123	0.5553	807.08	
	3	15,666	200	0.5573	785.24	
	4	45,878	220	0.5584	775.44	
	5	120,732	248	0.558	769.36	
	6	1,010,688	419	0.5569	765.36	
	7	884,499	414	0.5559	764.64	
10	1	3,117	136	0.5558	3,270.55	
	2	2,677	160	0.5562	3,345.20	
	3	17,377	244	0.558	3,246.45	
	4	44,822	328	0.5581	3,168.95	
	5	113,014	389	0.5584	3,148.10	
	6	821,352	534	0.5586	3,132.25	

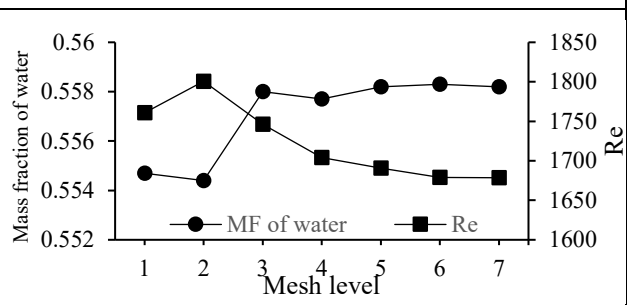
	7	2,276,551	823	0.5581	3,139.20	

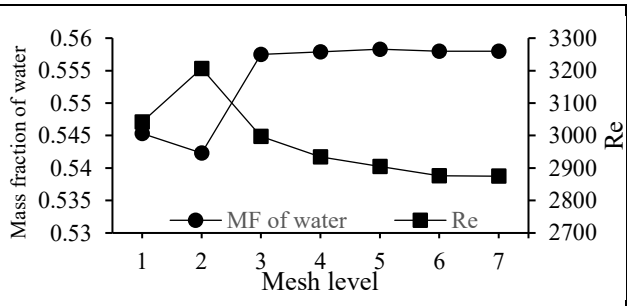
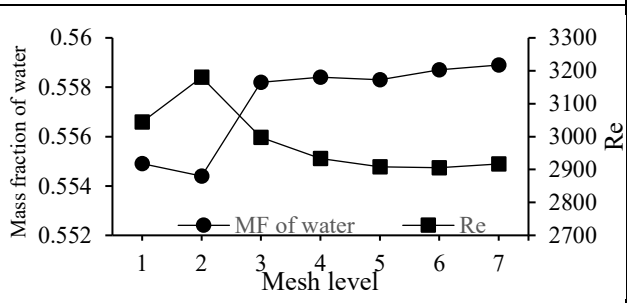
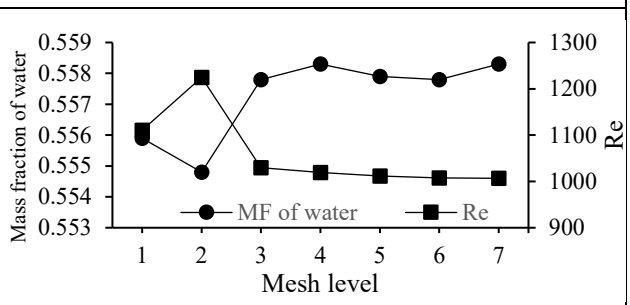
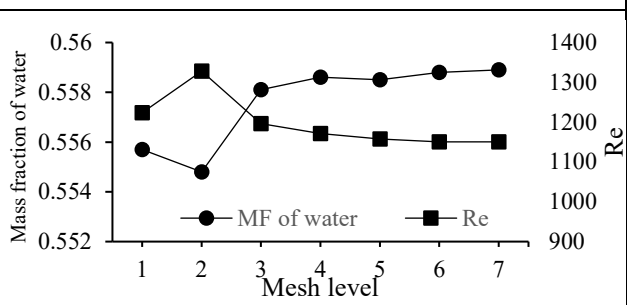
Model	Mesh level	Mesh cell count	Iteration	Mass fraction of water	Reynold number	Convergence plot of mesh independency test using the vortex tube reactor model
11	1	2,275	160	0.5556	3,033.30	
	2	2,187	159	0.5549	3,175.20	
	3	9,708	191	0.5578	2,997.30	
	4	22,226	223	0.558	2,936.70	
	5	59,830	311	0.5594	2,912.88	
	6	639,576	461	0.5593	2,911.32	
	7	1,747,745	571	0.5578	2,923.44	
12	1	3,163	160	0.5516	3,018.54	
	2	3,230	160	0.5472	3,169.38	
	3	15,416	239	0.5573	2,992.98	
	4	30,406	293	0.5577	2,932.80	
	5	76,609	361	0.558	2,905.38	
	6	658,350	531	0.5578	2,879.04	
	7	1,828,150	693	0.558	2,877.78	
13	1	1,409	130	0.5543	2,090.64	
	2	2,418	118	0.5549	2,020.12	
	3	11,806	201	0.5583	1,972.92	
	4	32,957	230	0.5585	1,950.56	
	5	85,334	279	0.5587	1,947.00	
	6	849,077	434	0.5586	1,940.40	
	7	602,989	474	0.559	1,950.80	
14	1	4,928	163	0.5564	795.28	
	2	3,664	147	0.5552	819.28	
	3	16,898	254	0.5579	786.20	
	4	36,361	258	0.5581	780.48	
	5	102,953	268	0.5583	770.92	

	6	1,032,001	459	0.5582	766.20	
	7	2,844,953	624	0.5576	765.68	
15	1	3,117	140	0.555	252.40	
	2	2,677	136	0.5549	257.65	
	3	17,377	244	0.5623	249.60	
	4	44,822	202	0.558	233.40	
	5	112,839	239	0.5581	241.35	
	6	821,352	401	0.558	239.45	
	7	2,277,101	536	0.558	239.30	

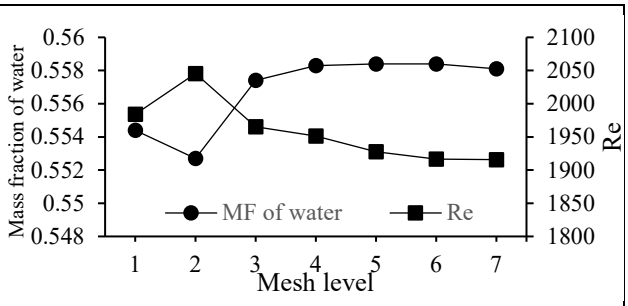
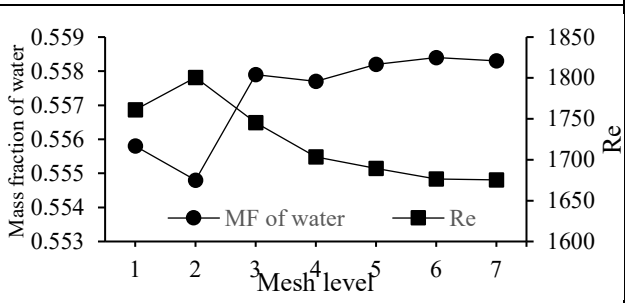
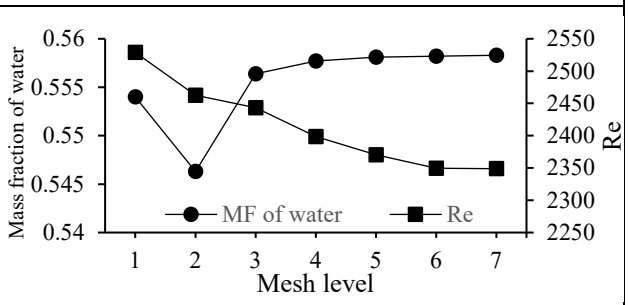
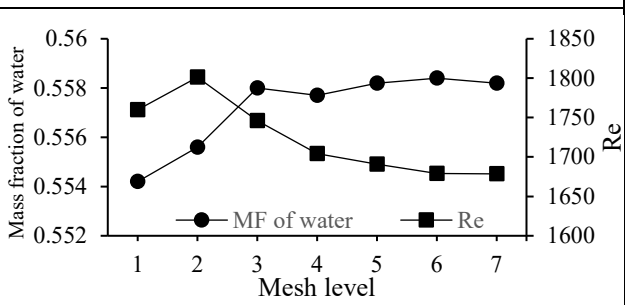
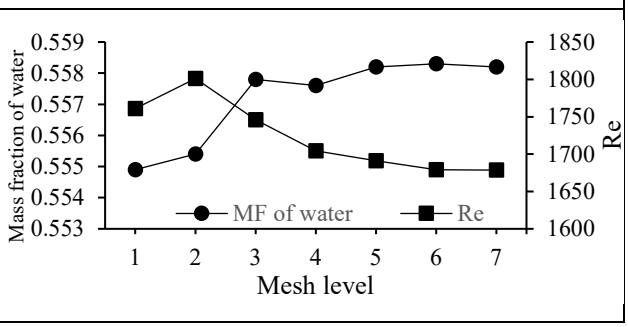
Model	**Mesh level**	**Mesh cell count**	**Iteration**	**Mass fraction of water**	**Reynold number**	**Convergence plot of mesh independency test using the vortex tube reactor model**
16	1	1,271	130	0.5555	2,084.84	
	2	2,503	41	0.4992	1,809.56	
	3	15,572	195	0.5576	1,967.12	
	4	45,731	232	0.558	1,945.00	
	5	121,093	303	0.5582	1,936.92	
	6	1,010,660	449	0.5574	1,936.08	
	7	866,158	441	0.5571	1,942.88	
17	1	3,117	134	0.555	1,760.80	
	2	2,677	146	0.5549	1,800.80	
	3	17,398	244	0.558	1,746.10	
	4	44,815	273	0.5575	1,704.20	
	5	112,965	339	0.5582	1,690.90	
	6	821,352	506	0.5583	1,679.05	
	7	2,276,793	681	0.5582	1,678.55	
18	1	927	134	0.555	2,059.35	
	2	1,654	102	0.5557	1,763.00	
	3	10,552	166	0.5584	1,733.30	
	4	29,829	188	0.5585	1,721.45	

	5	72,492	217	0.5586	1,730.95	
	6	195,603	275	0.5584	1,753.35	
	7	533,735	373	0.559	1,779.45	
19	1	4,420	163	0.5045	1,745.15	
	2	3,757	160	0.5567	1,820.60	
	3	23,927	267	0.5569	1,745.05	
	4	57,463	354	0.5582	1,715.00	
	5	150,026	404	0.5576	1,694.40	
	6	941,032	584	0.5581	1,676.70	
	7	2,541,242	814	0.5581	1,675.65	
20	1	3,047	133	0.5548	1,762.20	
	2	2,389	130	0.5533	1,801.15	
	3	10,147	200	0.5575	1,750.60	
	4	22,750	247	0.558	1,708.75	
	5	60,695	268	0.5582	1,696.50	
	6	673,532	437	0.5586	1,685.70	
	7	1,882,891	552	0.5585	1,685.10	

Model	**Mesh level**	**Mesh cell count**	**Iteration**	**Mass fraction of water**	**Reynold number**	**Convergence plot of mesh independency test using the vortex tube reactor model**
21	1	3,117	131	0.5547	1,760.8	
	2	2,677	143	0.5544	1,800.65	
	3	17,398	244	0.558	1,746.10	
	4	44,822	280	0.5577	1,704.25	
	5	112,741	342	0.5582	1,690.90	
	6	821,366	506	0.5583	1,679.00	
	7	2,277,094	680	0.5582	1,678.55	
22	1	3,258	160	0.5453	3,042.18	
	2	3,558	160	0.5423	3,206.94	
	3	23,821	267	0.5575	2,997.66	
	4	48,992	335	0.5579	2,934.78	

	5	122,312	452	0.5583	2,905.02	
	6	817,667	636	0.558	2,876.46	
	7	2,236,669	867	0.558	2,874.78	
23	1	2,335	160	0.5549	3,044.70	
	2	2,435	160	0.5544	3,180.12	
	3	14,835	230	0.5582	2,997.96	
	4	34,836	270	0.5584	2,933.40	
	5	90,896	331	0.5583	2,908.20	
	6	733,085	518	0.5587	2,905.50	
	7	1,997,415	670	0.5589	2,916.90	
24	1	1,446	135	0.5559	1,110.75	
	2	3,138	114	0.5548	1,224.63	
	3	15,544	210	0.5578	1,029.81	
	4	35,977	236	0.5583	1,019.04	
	5	101,130	262	0.5579	1,011.36	
	6	276,519	307	0.5578	1,007.88	
	7	750,381	395	0.5583	1,006.74	
25	1	2,275	158	0.5557	1,223.34	
	2	2,187	147	0.5548	1,328.04	
	3	9,729	201	0.5581	1,196.64	
	4	22,184	209	0.5586	1,171.02	
	5	59,858	237	0.5585	1,157.82	
	6	639,597	381	0.5588	1,150.86	
	7	1,747,738	520	0.5589	1,150.50	

Model	**Mesh level**	**Mesh cell count**	**Iteration**	**Mass fraction of water**	**Reynold number**	**Convergence plot of mesh independency test using the vortex tube reactor model**
26	1	5,387	164	0.5544	1,984.04	
	2	3,687	160	0.5527	2,045.56	
	3	23,934	276	0.5574	1,965.12	
	4	53,100	326	0.5583	1,951.28	

	5	156,961	366	0.5584	1,927.64	
	6	1,427,656	580	0.5584	1,916.36	
	7	3,879,258	786	0.5581	1,915.76	
27	1	3,187	137	0.5558	1,761.15	
	2	2,890	147	0.5548	1,800.65	
	3	24,677	268	0.5579	1,745.20	
	4	66,594	312	0.5577	1,703.315	
	5	170,598	378	0.5582	1,689.45	
	6	1,013,285	557	0.5584	1,676.45	
	7	2,784,134	765	0.5583	1,675.35	
28	1	2,603	160	0.554	2,528.96	
	2	2,263	160	0.5463	2,462.39	
	3	12,410	225	0.5564	2,443.49	
	4	27,077	297	0.5577	2,398.55	
	5	70,760	393	0.5581	2,370.55	
	6	630,716	624	0.5582	2,349.69	
	7	1,673,348	817	0.5583	2,348.85	
29	1	3,117	129	0.5542	1,759.85	
	2	2,677	153	0.5556	1,801.15	
	3	17,377	244	0.558	1,746.10	
	4	44,850	274	0.5577	1,704.25	
	5	112,363	340	0.5582	1,690.90	
	6	821,352	506	0.5584	1,679.05	
	7	2,277,087	681	0.5582	1,678.55	
30	1	3,117	132	0.5549	1,760.95	
	2	2,677	152	0.5554	1,801.10	
	3	17,377	240	0.5578	1,746.10	
	4	44,850	274	0.5576	1,704.20	
	5	112,650	343	0.5582	1,690.90	
	6	821,086	506	0.5583	1,679.00	
	7	2,276,912	681	0.5582	1,678.55	