

# Appendix A

## Solar Radiation Data

There are two types of consolidated data that was collected for the performance analysis of parabolic dish and trough type solar collector systems. First data collected is the environmental data in which all the environmental parameters like wind speed, direct and diffuse solar radiation intensity, wind direction, relative humidity and air temperature etc. Second data is taken from the experimental set up under Varanasi climatic conditions. Although, the data were collected throughout the day of the year 2017 but some of them have been included in this thesis to support the understanding of the results.

### A.1 Summer Environmental Data

Tables [A.1](#) to [A.15](#) represent the summer environmental data.

### A.2 Winter Environmental Data

Tables [A.16](#) to [A.21](#) show the winter environmental data.

### A.3 Experimental Data

Tables [A.22](#) and to [A.26](#) show the data that was obtained from the parabolic trough collectors.

Table A.1: Environmental data for the month of March 1, 2017

S.N	Time hrs.	Beam solar radiation ( $W/m^2$ )	Diffuse solar radiation ( $W/m^2$ )	Air temperature ( $^{\circ}C$ )	Wind speed ( $m/s$ )	Wind direction $^{\circ}(W-N)$	Relative humidity (%)
1	08:00	528	97	24.9	0.6	290	24
2	09:00	701	106	27.7	0.5	259	17
3	10:00	858	134	31	1.1	24	15
4	11:00	899	150	32.8	0.5	110	17
5	12:00	897	146	33.7	0.8	45	20
6	13:00	838	152	33.8	1	108	32
7	14:00	668	162	34.3	1.4	47	24
8	15:00	425	232	33.9	0.9	130	25
9	16:00	245	110	34.8	1.8	109	24
10	17:00	71	50	33.3	0.3	89	28
11	18:00	4	0	31.3	0.7	185	31

Table A.2: Environmental data for the month of March 10, 2017

S.N	Time	Beam solar radiation ( $W/m^2$ )	Diffuse solar radiation ( $W/m^2$ )	Air temperature ( $^{\circ}C$ )	Wind speed ( $m/s$ )	Wind direction $^{\circ}(W-N)$	Relative humidity (%)
1	08:00	386	153	23.5	1.9	155	62
2	09:00	558	212	25	1	144	57
3	10:00	687	252	26.6	1.2	144	56
4	11:00	718	282	28.9	2.5	126	52
5	12:00	758	289	30	3.1	142	51
6	13:00	631	288	31.6	0.4	188	50
7	14:00	482	270	30.6	2.7	112	49
8	15:00	382	226	30.5	4.7	103	50
9	16:00	249	165	28.6	4.5	42	52
10	17:00	85	72	26.3	3.8	103	57
11	18:00	7	5	24	4.5	109	65

Table A.3: Environmental data for the month of March 20, 2017

S.N	Time hrs.	Beam solar radiation ( $W/m^2$ )	Diffuse solar radiation ( $W/m^2$ )	Air temperature ( $^{\circ}C$ )	Wind speed ( $m/s$ )	Wind direction $^{\circ}(W-N)$	Relative humidity (%)
1	08:00	452	141	24.2	0.5	39	54
2	09:00	647	177	26.2	1.2	263	47
3	10:00	803	211	28.2	1.4	28	44
4	11:00	859	214	30.2	1.9	255	42
5	12:00	954	225	31.1	2.7	306	39
6	13:00	773	240	32.2	1	39	35
7	14:00	690	229	32.9	1.8	334	36
8	15:00	487	219	32.5	1.7	53	34
9	16:00	306	165	32.6	2.3	42	33
10	17:00	103	79	32.3	3	339	33
11	18:00	11	5	30.7	1.5	324	35

Table A.4: Environmental data for the month of March 30, 2017

S.N	Time hrs.	Beam solar radiation ( $W/m^2$ )	Diffuse solar radiation ( $W/m^2$ )	Air temperature ( $^{\circ}C$ )	Wind speed ( $m/s$ )	Wind direction $^{\circ}(W-N)$	Relative humidity (%)
1	08:00	616	140	32.7	1.6	54	30
2	09:00	700	144	34	1.3	328	29
3	10:00	875	159	37.4	2.7	24	30
4	11:00	925	171	39	1.8	98	22
5	12:00	602	180	40.7	1.9	333	17
6	13:00	808	188	41.2	4.9	71	14
7	14:00	690	183	41.5	2.7	107	10
8	15:00	535	178	41.8	5.8	86	10
9	16:00	267	136	41.8	3.3	64	10
10	17:00	78	69	41.2	1.5	90	10
11	18:00	3	0	38.6	0.5	83	14

Table A.5: Environmental data for the month of April 1, 2017

S.N	Time hrs.	Beam solar radiation ( $W/m^2$ )	Diffuse solar radiation ( $W/m^2$ )	Air temperature ( $^{\circ}C$ )	Wind speed ( $m/s$ )	Wind direction $^{\circ}(W-N)$	Relative humidity (%)
1	08:00	557	134	31.4	0.4	14	35
2	09:00	722	138	34.3	2.2	19	29
3	10:00	834	144	37.3	1.5	65	27
4	11:00	913	130	40.4	0.9	67	21
5	12:00	882	180	41.7	2.3	99	15
6	13:00	803	178	42.5	1.9	56	14
7	14:00	633	195	42.8	4.2	25	10
8	15:00	478	162	42.6	2.9	340	10
9	16:00	251	135	42.4	3.4	278	10
10	17:00	79	64	41.8	2.2	82	10
11	18:00	9	1	39.3	1	72	13

Table A.6: Environmental data for the month of April 10, 2017

S.N	Time hrs.	Beam solar radiation ( $W/m^2$ )	Diffuse solar radiation ( $W/m^2$ )	Air temperature ( $^{\circ}C$ )	Wind speed ( $m/s$ )	Wind direction $^{\circ}(W-N)$	Relative humidity (%)
1	08:00	657	123	29.7	1.8	327	15
2	09:00	804	129	31.5	1.8	106	10
3	10:00	908	144	33.5	3	49	10
4	11:00	919	154	34	2.9	21	10
5	12:00	909	199	35.5	3.5	65	10
6	13:00	849	201	35.9	4.4	25	10
7	14:00	602	206	36.9	2.7	63	10
8	15:00	471	197	36.8	4.4	64	10
9	16:00	270	148	37	2.9	12	10
10	17:00	129	97	36.8	3	22	10
11	18:00	90	67	35	2.8	192	10

Table A.7: Environmental data for the month of April 20, 2017

S.N	Time hrs.	Beam solar radiation ( $W/m^2$ )	Diffuse solar radiation ( $W/m^2$ )	Air temperature ( $^{\circ}C$ )	Wind speed ( $m/s$ )	Wind direction $^{\circ}(W-N)$	Relative humidity (%)
1	08:00	425	190	31	1.2	390	56
2	09:00	595	289	33.9	1.2	169	54
3	10:00	669	242	35.3	0.4	173	50
4	11:00	723	244	36.8	1.6	147	48
5	12:00	620	246	38	2.5	153	44
6	13:00	558	298	39.9	0.5	284	39
7	14:00	367	251	40.8	1.4	137	37
8	15:00	209	184	40.4	1.3	102	38
9	16:00	88	142	39.8	2	129	38
10	17:00	9	83	38.5	5.5	179	40
11	18:00	7	7	37.1	1.2	178	41

Table A.8: Environmental data for the month of April 30, 2017

S.N	Time	Beam solar radiation ( $W/m^2$ )	Diffuse solar radiation ( $W/m^2$ )	Air temperature ( $^{\circ}C$ )	Wind speed ( $m/s$ )	Wind direction $^{\circ}(W-N)$	Relative humidity (%)
	hrs.						
1	08:00	488	236	32.1	5.7	138	52
2	09:00	653	219	33.1	4.2	127	49
3	10:00	745	250	34.4	1.7	207	47
4	11:00	793	295	35.8	2.9	151	47
5	12:00	815	318	36.5	1.8	125	47
6	13:00	440	333	37.9	1.1	147	42
7	14:00	433	329	39	1.4	169	34
8	15:00	430	249	40.2	1.2	104	30
9	16:00	168	171	39.4	1.6	120	29
10	17:00	130	134	39	1.9	197	32
11	18:00	3	0	37.5	0.6	121	34

Table A.9: Environmental data for the month of May 1, 2017

S.N	Time hrs.	Beam solar radiation ( $W/m^2$ )	Diffuse solar radiation ( $W/m^2$ )	Air temperature ( $^{\circ}C$ )	Wind speed ( $m/s$ )	Wind direction $^{\circ}(W-N)$	Relative humidity (%)
1	08:00	472	175	34.5	1	335	37
2	09:00	538	238	34.8	4.4	110	38
3	10:00	666	273	34.3	6.8	144	38
4	11:00	699	326	34.9	3.2	79	38
5	12:00	733	288	35.7	3.3	162	37
6	13:00	706	276	36	2.7	208	36
7	14:00	547	252	36.3	2.6	202	37
8	15:00	336	264	36.8	1.4	113	39
9	16:00	292	199	36.2	2	259	39
10	17:00	94	93	35.5	1.6	201	40
11	18:00	24	27	34.5	2.1	231	42

Table A.10: Environmental data for the month of May 10, 2017

S.N	Time hrs.	Beam solar radiation ( $W/m^2$ )	Diffuse solar radiation ( $W/m^2$ )	Air temperature ( $^{\circ}C$ )	Wind speed ( $m/s$ )	Wind direction $^{\circ}(W-N)$	Relative humidity (%)
1	08:00	286	254	29.3	2.2	14	71
2	09:00	287	246	31	1.4	244	65
3	10:00	757	251	32.6	1.7	332	61
4	11:00	785	225	36.4	1.4	174	43
5	12:00	773	234	38.1	2.1	237	40
6	13:00	684	223	39.9	0.9	265	32
7	14:00	589	228	40.2	0.8	238	29
8	15:00	371	202	38.8	1.9	149	42
9	16:00	246	191	38.3	2.4	170	40
10	17:00	68	83	37.7	1.8	179	40
11	18:00	0	0	36.3	1.5	177	41

Table A.11: Environmental data for the month of May 20, 2017

S.N	Time hrs.	Beam solar radiation ( $W/m^2$ )	Diffuse solar radiation ( $W/m^2$ )	Air temperature ( $^{\circ}C$ )	Wind speed ( $m/s$ )	Wind direction $^{\circ}(W-N)$	Relative humidity (%)
1	08:00	620	148	36.6	2	86	31
2	09:00	664	148	37.2	1.3	39	32
3	10:00	698	153	38.1	1.2	64	30
4	11:00	796	175	41.1	2.5	64	22
5	12:00	813	183	42.2	4.2	92	19
6	13:00	714	177	43.5	3	160	13
7	14:00	587	169	43.6	2.9	56	11
8	15:00	412	160	43.9	1.5	114	12
9	16:00	222	126	43.9	2.2	7	10
10	17:00	72	70	43	2	61	13
11	18:00	45	43	42.5	2	52	15

Table A.12: Environmental data for the month of May 31, 2017

S.N	Time	Beam solar radiation ( $W/m^2$ )	Diffuse solar radiation ( $W/m^2$ )	Air temperature ( $^{\circ}C$ )	Wind speed ( $m/s$ )	Wind direction $^{\circ}(W-N)$	Relative humidity (%)
1	08:00	552	256	33.2	0.6	195	72
2	09:00	642	216	34.7	0.8	190	57
3	10:00	741	259	36	2.7	107	54
4	11:00	761	230	37.2	1.8	165	49
5	12:00	772	241	37.9	1.2	218	43
6	13:00	661	215	40.2	2.5	146	40
7	14:00	578	226	39.6	2	181	38
8	15:00	405	173	40.6	1.8	261	35
9	16:00	161	306	41.1	1.5	146	35
10	17:00	80	80	40.5	1.2	170	35
11	18:00	57	47	40.2	1	160	36

Table A.13: Environmental data for the month of June 1, 2017

S.N	Time hrs.	Beam solar radiation ( $W/m^2$ )	Diffuse solar radiation ( $W/m^2$ )	Air temperature ( $^{\circ}C$ )	Wind speed ( $m/s$ )	Wind direction $^{\circ}(W-N)$	Relative humidity (%)
1	08:00	549	197	37	0.8	53	49
2	09:00	628	200	38	0.8	163	50
3	10:00	719	220	38.5	0.8	315	42
4	11:00	778	234	39.7	0.8	74	41
5	12:00	763	332	40.6	1.9	148	35
6	13:00	497	278	41.3	0.7	97	38
7	14:00	376	292	41.7	0.5	124	35
8	15:00	173	151	40.7	1.2	44	35
9	16:00	237	319	41.7	0.6	42	35
10	17:00	104	101	40.4	1.8	101	36
11	18:00	51	48	39.9	2.6	104	37

Table A.14: Environmental data for the month of June 10, 2017

S.N	Time hrs.	Beam solar radiation ( $W/m^2$ )	Diffuse solar radiation ( $W/m^2$ )	Air temperature ( $^{\circ}C$ )	Wind speed ( $m/s$ )	Wind direction $^{\circ}(W-N)$	Relative humidity (%)
1	08:00	540	194	37	0.2	126	56
2	09:00	569	199	36.7	0.91	260	55
3	10:00	780	234	38.9	1.9	178	44
4	11:00	826	235	40	1.2	119	48
5	12:00	701	369	40.6	0.1	226	35
6	13:00	654	754	40.4	2.2	156	31
7	14:00	593	202	41.4	2.5	125	24
8	15:00	395	213	41.2	1.2	118	31
9	16:00	215	149	39.8	1.2	139	35
10	17:00	84	88	37.9	4.2	159	37
11	18:00	41	1	37.8	1.9	134	47

Table A.15: Environmental data for the month of June 30, 2017

S.N	Time hrs.	Beam solar radiation ( $W/m^2$ )	Diffuse solar radiation ( $W/m^2$ )	Air temperature ( $^{\circ}C$ )	Wind speed ( $m/s$ )	Wind direction $^{\circ}(W-N)$	Relative humidity (%)
1	08:00	646	114	36.4	1.5	176	53
2	09:00	688	107	36.7	1.4	265	52
3	10:00	772	251	37.7	2.7	240	50
4	11:00	803	281	38.2	2.7	238	49
5	12:00	858	348	38.8	1.9	130	49
6	13:00	926	343	39.3	3.4	146	44
7	14:00	226	197	39.9	1	177	44
8	15:00	467	226	40	3.8	252	42
9	16:00	218	222	39.5	2.7	272	43
10	17:00	84	82	39.6	1.4	153	47
11	18:00	37	31	39	2.5	305	47

Table A.16: Environmental data for the month of January 3, 2017

S.N	Time (hrs.)	Beam solar radiation ( $W/m^2$ )	Diffuse solar radiation ( $W/m^2$ )	Air temperature ( $^{\circ}C$ )	Wind speed ( $m/s$ )	Wind direction $^{\circ}(W-N)$	Relative humidity (%)
1	08:00	47	40	18	1.5	59	98
2	09:00	114	97	17.4	1.7	67	-
3	10:00	335	242	19.7	1.4	57	-
4	11:00	425	344	20.6	1.6	35	77
5	12:00	249	230	21.3	1.2	57	-
6	13:00	372	322	21.9	0.9	35	-
7	14:00	226	190	22.1	0.8	103	-
8	15:00	170	136	22.3	1.3	77	-
9	16:00	92	64	22.1	2.3	55	-
10	17:00	0	0	20.9	0.5	52	84
11	18:00	0	0	20.6	0.3	74	-

Table A.17: Environmental data for the month of February 26, 2017

S.N	Time	Beam solar radiation	Diffuse solar radiation	Air temperature	Wind speed	Wind direction	Relative humidity
	hrs.	$(W/m^2)$	$(W/m^2)$	$(^{\circ}C)$	$(m/s)$	$^{\circ}(W-N)$	$(\%)$
1	08:00	534	108	22.1	1.5	23	37
2	09:00	682	114	24	2	337	37
3	10:00	872	137	26.3	2.7	65	35
4	11:00	948	141	28.6	3.5	298	32
5	12:00	946	141	30.1	2.1	69	20
6	13:00	856	148	30.5	3.8	66	24
7	14:00	661	152	31.4	2.1	96	25
8	15:00	540	179	31.2	1.9	65	24
9	16:00	287	162	31.1	1.5	68	24
10	17:00	77	51	30.2	0.7	61	29
11	18:00	3	0	28.2	0.4	60	31

Table A.18: Environmental data for the month of February 27, 2017

S.N	Time	Beam solar radiation ( $W/m^2$ )	Diffuse solar radiation ( $W/m^2$ )	Air temperature ( $^{\circ}C$ )	Wind speed ( $m/s$ )	Wind direction $^{\circ}(W-N)$	Relative humidity (%)
1	08:00	498	91	21.8	1.1	354	48
2	09:00	765	114	24.7	1.8	272	39
3	10:00	861	124	26	1	339	31
4	11:00	945	140	27.6	0.9	13	15
5	12:00	921	159	28.9	1.3	57	30
6	13:00	819	153	29.7	1.9	32	26
7	14:00	660	129	30.1	2.1	39	26
8	15:00	540	112	30.4	2.1	51	26
9	16:00	316	247	30.1	1.4	75	27
10	17:00	97	60	29.5	2	70	18
11	18:00	7	0	27.3	0.6	7	17

Table A.19: Environmental data for the month of February 28, 2017

S.N	Time	Beam solar radiation	Diffuse solar radiation	Air temperature	Wind speed	Wind direction	Relative humidity
	hrs.	( $W/m^2$ )	( $W/m^2$ )	( $^{\circ}C$ )	( $m/s$ )	$^{\circ}(W-N)$	(%)
1	08:00	438	83	21.6	0.7	21	39
2	09:00	746	114	25.4	1.1	21	19
3	10:00	849	135	27.2	1.3	61	27
4	11:00	937	157	29.5	1.2	84	28
5	12:00	922	255	30.4	1.5	59	10
6	13:00	841	151	31.3	1.9	326	10
7	14:00	685	143	32	2.8	57	20
8	15:00	391	125	32.3	0.5	63	23
9	16:00	243	160	31.9	0.7	68	24
10	17:00	86	60	31.3	1.1	60	26
11	18:00	2	0	28.6	0.3	356	26

Table A.20: Environmental data for the month of November 18, 2017

S.N	Time	Beam solar radiation ( $W/m^2$ )	Diffuse solar radiation ( $W/m^2$ )	Air temperature ( $^{\circ}C$ )	Wind speed ( $m/s$ )	Wind direction $^{\circ}(W-N)$	Relative humidity (%)
	hrs.						
1	08:00	484	129	27.6	0.3	41	41
2	09:00	497	124	28.3	0.3	294	52
3	10:00	729	179	30.3	0.1	140	47
4	11:00	756	189	31.3	0.5	115	45
5	12:00	615	233	32	0.6	175	42
6	13:00	247	188	31.5	0.2	32	44
7	14:00	458	184	32.3	1.6	45	42
8	15:00	237	103	32.1	1.3	96	44
9	16:00	63	43	31.4	0.5	91	47
10	17:00	0	0	30	0.9	115	52
11	18:00	-	-	-	-	-	-

Table A.21: Environmental data for the month of November 18, 2017

S.N	Time	Beam solar radiation	Diffuse solar radiation	Air temperature	Wind speed	Wind direction	Relative humidity
	hrs.	$(W/m^2)$	$(W/m^2)$	$(^{\circ}C)$	$(m/s)$	$^{\circ}(W-N)$	$(\%)$
1	10:00	705	185	24.4	0.1	204	39
2	11:00	726	196	26.3	0.5	84	35
3	12:00	729	192	27.4	0.3	391	27
4	13:00	607	198	28.4	0.5	19	26
5	14:00	475	169	28.7	1.2	18	26
6	15:00	243	114	28.4	0.8	97	27
7	16:00	45	29	26.4	0.8	100	32

Table A.22: Experimental data without vacuum at annular space of receiver for the month of April 25, 2017

S.No.	Time	Hot Water Temp. (°C)	Absorber inlet temp. (°C)	Absorber outlet temp. (°C)	Absorber tube temp. (°C)	Tank inlet temp. (°C)	Tilt angle (in degree)	Point 1	Point 2	Supporting rod temp. (°C)	Mass flow rate LPM	Surface Azimuth (in degree)
1	09:30	46.5	49.1	55.4	89	58.6	40	62	61	42.4	5.88	90
2	10:00	48.7	59.4	64.4	79	67.2	35	62	61	44	5.88	80
3	10:30	52.7	62.1	67.9	80	69.8	28	63	66	43.6	5.88	80
4	11:00	55.7	63.1	67.1	64	70.6	21	66	66	44.7	5.88	60
5	11:30	58.3	65.5	69.2	72	72.7	16	67	67	45	5.88	30
6	12:00	60.6	66.8	69.1	61	73.1	15	66	67	45.5	5.88	0
7	12:30	62.2	68.9	69.5	59	73.3	19	67	67	46.4	5.88	-35
8	01:00	64.2	69.6	73.4	63	76.2	25	72	72	46.6	5.88	-55
9	01:30	65.8	70.9	73.8		76.2	30	73	74	47.4	5.88	-75
10	02:00	67.1	72.1	72.2	53	75.9	35	70	71	46.4	5.88	-76
11	02:30	68	71.4	73.6	71	76.6	44	74	74	48.8	5.88	-80
12	03:00	69.2	72.7	74.1	60	77.6	49	73	73	47	5.88	-90
13	03:30	69.5	70.8	71.1	43	74.6	50	68	69	46.4	5.88	-90

Table A.23: Experimental data with a vacuum pressure of 260 torr at annular space of receiver for the month of April 11, 2017

S.No.	Time	Hot water Temp. ( $^{\circ}C$ )	Absorber inlet temp. ( $^{\circ}C$ )	Absorber outlet temp. ( $^{\circ}C$ )	Absorber tube temp. ( $^{\circ}C$ )	Tank inlet temp. ( $^{\circ}C$ )	Tilt angle (in degree)	Helical coil temp. Point 1	Helical coil temp. Point 2	Supporting rod temp. ( $^{\circ}C$ )	Mass flow rate LPM	Surface Azimuth (in degree)
1	09:30	33.6	43.8	58.3	70	47.8	40	57	58	37.8	5.88	76
2	10:00	36	50.3	58	72	59.9	35	62	61	39.3	5.88	70
3	10:30	39.3	55.4	65.2	63	63.3	28	59	69	39.5	5.88	62
4	11:00	42	75.5	62.1	78	63.6	25	68	67	39.5	5.88	62
5	11:30	44.7	54.2	60.6	69	63	20	64	64	39.3	5.88	50
6	12:00	46.8	58.1	58.8	61	62.2	20	60	60	41.1	5.88	34
7	12:30	49.2	58.8	63	75	65.6	20	66	66	42.1	5.88	22
8	01:00	50.9	57.3	60.7	51	62.9	25	62	61	41.2	5.88	18
9	01:30	52	57.8	61.5	49	63.7	30	62	62	42.6	5.88	28
10	02:00	53.3	59.5	60.5	45	63.6	34	62	62	43	5.88	40
11	02:30	55.1	61.7	64.5	56	66	45	68	69	44.4	5.88	45
12	03:00	56	61.6	64.8	56	65.7	46	68	69	43.5	5.88	28
13	03:30	56.7	59.7	59.3	39	62.5	50	54	55	43.6	5.88	90

Table A.24: Experimental data with a vacuum pressure of 10 torr at annular space of receiver for the month of April 24, 2017

S.No.	Time	Hot water Temp. (°C)	Absorber		Absorber outlet temp. (°C)	Absorber tube temp. (°C)	Tank inlet temp. (°C)	Tilt angle (in degree)	Helical coil temp.		Supporting rod temp. (°C)	Mass flow rate LPM	Surface Azimuth (in degree)
			inlet temp. (°C)	inlet temp. (°C)					Point 1	Point 2			
1	09:30	34	45	62.4	88	51.4	40	64	64	37.5	5.57	80	
2	10:00	35	45.9	54.6	75	57.1	35	58	58	36.4	5.88	80	
3	10:30	38.4	49.9	55.7	74	68.6	29	56	54	38.9	5.88	70	
4	11:00	42	52.5	59.4	88	64.3	23	58	58	41.7	3.97	60	
5	11:30	45.5	56.3	60	73	65.3	16	57	56	42.5	5.13	40	
6	12:00	48.5	57.9	60.5	63	65.3	15	57	58	42.8	5.57	20	
7	12:30	51.2	60.7	64.7	78	66.4	16	62	62	44	5.88	-25	
8	01:00	53.5	60.2	63.7	67	66.9	24	61	62	45.7	5.88	-45	
9	01:30	55.2	61.5	66.5	73	69.1	29	66	65	46.2	5.88	-72	
10	02:00	57.2	64.5	66.4	69	69.5	35	62	63	47.2	5.88	-80	
11	02:30	59	66.7	68.4	65	71.8	41	65	65	48	5.88	-85	
12	03:00	60.5	64.6	67.2	57	70.4	48	62	62	47.7	5.88	-90	
13	03:30	61.4	62.6	63.5	45	67	51	59	60	44.8	5.88	-90	

Table A.25: Experimental data with a vacuum pressure of 660 torr at annular space of receiver for the month of May 5, 2017

S.No.	Time	Hot water Temp.	Absorber inlet temp.	Absorber outlet temp.	Absorber tube temp.	Tank inlet temp.	Tilt angle (in degree)	Helical coil temp. Point 1	Helical coil temp. Point 2	Supporting rod temp.	Mass flow rate LPM	Surface Azimuth (in degree)
1	09:30	37.2	49.4	54.2	88	60.4	36	66	64	39.8	5.88	90
2	10:00	40.6	53.5	59.8	84	62.7	33	141	147	40.3	5.88	85
3	10:30	42.5	56.6	63.1	92	66.3	27	68	68	42.4	5.88	85
4	11:00	47.5	63.4	66.8	87	69.7	16	69	67	44.1	5.88	80
5	11:30	51.2	59.7	66	88	68.8	11	68	66	42	5.88	60
6	12:00	54.6	61.7	62.7	56	66.4	10	63	63	43.1	5.88	10
7	12:30	56.5	61.1	65.1	68	66.9	18	66	65	43.2	5.88	-30
8	01:00	57.2	62.9	64.7	70	67.2	30	61	61	43.9	5.88	-20
9	01:30	59.2	66.5	69.9	78	73	29	69	69	44.1	5.88	-70
10	02:00	62.4	68.4	72.6	93	74.8	35	71	71	43.1	5.88	-80
11	02:30	65	70.1	74.3	101	76.7	43	73	73	47.5	5.88	-85
12	03:00	66.6	67.5	69.7	54	72.6	48	69	69	43.3	5.88	-90
13	03:30	66.8	66.1	67.4	45	70.5	48	66	66	43.2	5.88	-90

Table A.26: Experimental data with a vacuum pressure of 60 torr at annular space of receiver for the month of May 14, 2017

S.No.	Time	Hot water Temp. (°C)	Absorber inlet temp. (°C)	Absorber outlet temp. (°C)	Absorber tube temp. (°C)	Tank inlet temp. (°C)	Tilt angle (in degree)	Helical coil temp. Point 1	Point 2	Supporting rod temp. (°C)	Mass flow rate LPM	Surface Azimuth (in degree)
1	09:30	42	46.9	52.3	81	56.9	38	62	61	41.2	5.88	90
2	10:00	45.4	55.3	60.6	79	64.9	30	66	65	41.8	5.88	90
3	10:30	49.5	59.2	65.1	77	68.5	24	70	69	43.6	5.88	90
4	11:00	54.1	59.9	65.3	81	67.5	14	66	65	44.1	5.88	85
5	11:30	55.3	61.9	67.4	86	70.3	10	69	68	46.2	5.88	80
6	12:00	58.6	65.8	73.2	86	74.5	6	72	71	45.3	5.88	75
7	12:30	61.1	63.9	68.5	71	70.9	11	66	66	46.2	5.88	-19
8	01:00	61.9	63.7	66.8	68	69.8	20	62	62	47.4	5.88	-55
9	01:30	63.2	66.9	71	81	73.3	25	68	68	47.4	5.88	-80
10	02:00	65.4	69.3	73.7	89	74.4	35	72	72	48.4	5.88	-90
11	02:30	66.9	69.5	72.8	71	76.1	40	69	69	49.3	5.88	-100
12	03:00	67.6	67.6	70.5	69	73.2	46	70	70	49.7	5.88	-115
13	03:30	68	66.9	68.3	50	71.6	50	65	65	47.7	5.88	-115