Hydraulic Analysis Report - B2 : INT-1

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Simulation case: C:\Users\neetsaki\Desktop\course design2\Simulation 8.apw

2019/9/1

Contents

Hydraulic Analysis Report - B2 : INT-1

User Name: Job Code:

Project: Description:

1. Column Internals Summary

Summary

Property	Value	Unit
Number of Trayed/Packed stages	37	
Total height	22.5552	meter
Total head loss (Hot liquid height)	5.90638	meter
Total pressure drop	0.444655	bar
Number of sections	2	
Number of diameters	2	

Sections

Column 1	Start Stage	End Stage	Diameter (meter)	Section Height (meter)	Internals Type	Tray or Packing Type	Section Pressure Drop (bar)	% Approach to Flood	Limiting Stage
CS-1	2	29	0.762456	17.0688	Trayed	SIEVE	0.366108	101.892	2
CS-2	30	38	0.761421	5.4864	Trayed	SIEVE	0.0785472	80.0003	30

User Name: Job Code:

Project: Description:

2. Feed/Draw Summary

Feed/Draw Summary

Stage	Stream	Feed/Draw
1	D	Draw
29	F	Feed
38	VAPOR	Feed
	B	Draw

Hydraulic Analysis Report - B2 : INT-1

User Name: Job Code:

Project: Description:

3. CS-1

3.1. Tray Geometry

Section

Property	Value	Unit
Tray type	SIEVE	
Diameter	0.762456	meter
Tray spacing	0.6096	meter
Number of passes	1	
Hole diameter	0.0127	meter
Hole area / Active area	0.1	
Number of Holes	288	
Deck gauge thickness	10 GAUGE	
Deck gauge thickness value	3.4	mm
Cross-sectional area	0.456583	sqm
Active area	0.365266	sqm
Net area	0.410925	sqm

Downcomer geometry

Property	Side	Unit
Downcomer clearance	0.0381	meter
Downcomer width top	0.119306	meter
Downcomer width bottom	0.119306	meter
Downcomer area top	0.0456583	sqm
Downcomer area bottom	0.0456583	sqm

Weir geometry

Property	Side	Unit
Weir height	0.0508	meter

Hydraulic Analysis Report - B2 : INT-1

User Name: Job Code:

Project: Description:

Property	Side	Unit
Weir length	0.554009	meter

Panels

Property	A	Unit
Flow path length	0.523845	meter

User Name: Job Code:

Project: Description:

3.2. Results Summary

Summary

Property	Value	Unit
Section starting stage	2	
Section ending stage	29	
Calculation Mode	Sizing	
Tray type	SIEVE	
Number of passes	1	
Tray spacing	0.6096	meter
Section Diameter	0.762456	meter
Section height	17.0688	meter
Section pressure drop	0.366108	bar
Section head loss (Hot liquid height)	4.97795	meter
Trays with weeping	None	

Limiting conditions

Property	Value	Unit	Tray	Location
Maximum % jet flood	101.892		2	
Maximum % downcomer backup (aerated)	55.9246		2	
Maximum downcomer loading	210.433	cum/hr/sqm	29	Side
Maximum % downcomer choke flood	34.4301		29	Side
Maximum weir loading	17.3427	cum/hr-meter	29	Side
Maximum aerated height over weir	0.0935382	meter	29	
Maximum % approach to system limit	65.8905		2	

Hydraulic Analysis Report - B2 : INT-1

User Name: Job Code:

Project: Description:

Property	Value	Unit	Tray	Location
Maximum Cs based on bubbling area	0.134479	m/sec	2	

Messages Summary

Messages
The diameter is 0.7625 meter. We recommend that this column and any column with a diameter less than 0.9144 meter be designed so as not to exceed 75% jet flood.
Stages 2 - 5 are operating above the maximum of 100% jet flood specified.
Stages 2 - 26 have very high dry pressure drop. We recommend any combination of the following actions: increasing the section diameter, increasing the tray spacing, increasing the open area, decreasing downcomer widths (if possible), or moving to a smaller number of passes.
Entrainments on Stages 2 - 28 are above the specified maximum percent liquid entrainment of 10.

Hydraulic Analysis Report - B2 : INT-1

User Name: Job Code:

Project: Description:

3.3. By Tray Results

3.3.1. Hydraulic Results

CS-1 Hydraulic results (1)

Stage	% Jet flood	Total pressure drop (bar)	% Downcomer backup (Aerated)	Dry pressure drop (bar)	Dry pressure drop (Hot liquid height) (meter)	Total pressure drop (Hot liquid height) (meter)	Downcomer backup (Aerated) (meter)
2	101.892	0.0145581	55.9246	0.0123684	0.169738	0.199788	0.369326
3	101.402	0.0144572	55.5624	0.0122659	0.168293	0.19836	0.366934
4	100.921	0.0143587	55.2093	0.0121657	0.166884	0.196967	0.364602
5	100.447	0.0142621	54.8637	0.0120675	0.165505	0.195604	0.36232
6	99.98	0.0141673	54.5244	0.0119711	0.164152	0.194266	0.360079
7	99.5181	0.0140738	54.1901	0.0118761	0.162818	0.192947	0.357871
8	99.0604	0.0139814	53.8596	0.0117822	0.1615	0.191644	0.355689
9	98.6057	0.0138899	53.5318	0.0116892	0.160192	0.190352	0.353524
10	98.153	0.013799	53.2055	0.0115967	0.158892	0.189066	0.351369
11	97.7009	0.0137084	52.8795	0.0115045	0.157593	0.187782	0.349216
12	97.2484	0.0136177	52.5524	0.0114123	0.156291	0.186494	0.347056
13	96.7937	0.0135267	52.2227	0.0113196	0.154979	0.185197	0.344879
14	96.3352	0.013435	51.8887	0.0112261	0.153651	0.183884	0.342673
15	95.8709	0.0133419	51.5483	0.0111312	0.1523	0.182547	0.340425
16	95.3981	0.0132471	51.199	0.0110344	0.150914	0.181177	0.338118
17	94.9137	0.0131498	50.8375	0.010935	0.149483	0.17976	0.335731
18	94.4134	0.013049	50.4598	0.0108318	0.14799	0.178282	0.333237
19	93.8917	0.0129434	50.0603	0.0107237	0.146414	0.17672	0.330598
20	93.3407	0.0128315	49.6315	0.0106088	0.144726	0.175047	0.327767
21	92.7497	0.0127107	49.1629	0.0104848	0.142887	0.173222	0.324672
22	92.1024	0.0125777	48.6387	0.0103478	0.140835	0.171185	0.32121
23	91.3736	0.012427	48.0348	0.0101922	0.138481	0.168844	0.317222

Hydraulic Analysis Report - B2 : INT-1

User Name: Job Code:

Project: Description:

Stage	% Jet flood	Total pressure drop (bar)	% Downcomer backup (Aerated)	Dry pressure drop (bar)	Dry pressure drop (Hot liquid height) (meter)	Total pressure drop (Hot liquid height) (meter)	Downcomer backup (Aerated) (meter)
24	90.5218	0.0122497	47.3119	0.0100089	0.135674	0.166048	0.312448
25	89.4731	0.0120306	46.4005	0.00978185	0.132153	0.162533	0.306429
26	88.0811	0.0117396	45.1652	0.00947985	0.127411	0.157783	0.298271
27	86.0076	0.0113105	43.2995	0.00903367	0.120311	0.150634	0.28595
28	82.5653	0.0106086	40.0916	0.00830182	0.108328	0.138429	0.264765
29	80.0003	0.0100555	35.9128	0.00785728	0.0964108	0.123383	0.237168

CS-1 Hydraulic results (2)

Stage	Downcomer backup (Unaerated) (meter)	% Downcomer backup (Unaerated)	Liquid mass rate / Column area (kg/hr-sqm)	Liquid volume rate / Column area (cum/hr/sqm)	Fs (net area) (sqrt(atm))	Fs (bubbling area) (sqrt(atm))	Cs (net area) (m/sec)
2	0.224076	33.9304	10257.3	13.8044	0.010226	0.0115043	0.119537
3	0.222626	33.7108	10225.6	13.7587	0.0101835	0.0114564	0.119027
4	0.221213	33.4968	10195	13.7147	0.0101418	0.0114096	0.118528
5	0.219829	33.2873	10165.3	13.6721	0.0101008	0.0113634	0.118038
6	0.218471	33.0816	10136.2	13.6303	0.0100604	0.011318	0.117555
7	0.217132	32.8789	10107.3	13.5889	0.0100204	0.011273	0.117076
8	0.215809	32.6785	10078.5	13.5476	0.00998072	0.0112283	0.116602
9	0.214497	32.4798	10049.5	13.5058	0.00994124	0.0111839	0.116129
10	0.21319	32.282	10019.9	13.4633	0.00990184	0.0111396	0.115657
11	0.211885	32.0844	9989.53	13.4194	0.0098624	0.0110952	0.115184
12	0.210576	31.8861	9958.02	13.3738	0.00982277	0.0110506	0.114707
13	0.209256	31.6863	9924.99	13.3258	0.00978281	0.0110057	0.114225
14	0.20792	31.4839	9890.01	13.2747	0.00974231	0.0109601	0.113735
15	0.206558	31.2777	9852.52	13.2198	0.00970107	0.0109137	0.113234

Hydraulic Analysis Report - B2 : INT-1

User Name: Job Code:

Project: Description:

Stage	Downcomer backup (Unaerated) (meter)	% Downcomer backup (Unaerated)	Liquid mass rate / Column area (kg/hr-sqm)	Liquid volume rate / Column area (cum/hr/sqm)	Fs (net area) (sqrt(atm))	Fs (bubbling area) (sqrt(atm))	Cs (net area) (m/sec)
16	0.20516	31.066	9811.87	13.1599	0.00965881	0.0108662	0.112718
17	0.203714	30.8471	9767.21	13.0938	0.00961517	0.0108171	0.112183
18	0.202203	30.6183	9717.44	13.0197	0.00956972	0.0107659	0.111621
19	0.200606	30.3765	9661.08	12.9355	0.00952184	0.0107121	0.111025
20	0.198892	30.1169	9596.12	12.8379	0.00947071	0.0106545	0.110383
21	0.197019	29.8333	9519.67	12.7226	0.00941516	0.0105921	0.109679
22	0.194925	29.5162	9427.52	12.583	0.00935344	0.0105226	0.108889
23	0.192513	29.151	9313.09	12.409	0.00928288	0.0104432	0.107974
24	0.189627	28.7139	9165.68	12.1841	0.00919903	0.0103489	0.106873
25	0.185989	28.163	8966.38	11.8794	0.00909408	0.0102308	0.105476
26	0.181059	27.4165	8678.21	11.4381	0.0089526	0.0100717	0.103564
27	0.173613	26.2891	8217.28	10.7322	0.00873938	0.0098318	0.100633
28	0.160812	24.3507	7348.81	9.40384	0.0083779	0.00942514	0.0954809
29	0.144161	21.8293	17488	21.0433	0.0081505	0.00916932	0.0900721

CS-1 Hydraulic results (3)

Stage	Cs (bubbling area) (m/sec)	Side downcomer exit velocity (m/sec)	Approach to system limit (%)	% Side Downcomer Choke Flood	Height over weir (Aerated) (meter)	Height over weir (Unaerated) (meter)	Side downcomer volume (l)
2	0.134479	0.0829456	65.8905	22.5871	0.0599586	0.00976826	10.2309
3	0.133905	0.0826708	65.4854	22.5113	0.0597048	0.0097349	10.1647
4	0.133344	0.0824067	65.0932	22.4394	0.0594605	0.00970304	10.1002
5	0.132793	0.0821505	64.7115	22.3696	0.0592235	0.0096723	10.037
6	0.132249	0.0818993	64.3378	22.3012	0.0589915	0.00964235	9.975
7	0.131711	0.0816507	63.9703	22.2335	0.0587623	0.00961287	9.91389

Hydraulic Analysis Report - B2 : INT-1

User Name: Job Code:

Project: Description:

Stage	Cs (bubbling area) (m/sec)	Side downcomer exit velocity (m/sec)	Approach to system limit (%)	% Side Downcomer Choke Flood	Height over weir (Aerated) (meter)	Height over weir (Unaerated) (meter)	Side downcomer volume (l)
8	0.131177	0.0814022	63.6067	22.1658	0.0585342	0.00958357	9.85347
9	0.130646	0.0811514	63.2454	22.0975	0.0583051	0.00955415	9.79355
10	0.130115	0.0808957	62.8844	22.0279	0.0580732	0.00952432	9.73391
11	0.129582	0.0806323	62.5217	21.9562	0.0578362	0.00949375	9.67432
12	0.129046	0.0803582	62.1551	21.8815	0.057592	0.00946211	9.61454
13	0.128504	0.0800698	61.7825	21.803	0.0573379	0.009429	9.5543
14	0.127952	0.079763	61.4009	21.7195	0.057071	0.00939396	9.49327
15	0.127389	0.0794328	61.0073	21.6296	0.0567877	0.00935647	9.43108
16	0.126808	0.079073	60.5978	21.5316	0.0564835	0.00931584	9.36726
17	0.126206	0.0786758	60.1676	21.4234	0.0561529	0.00927124	9.30124
18	0.125574	0.0782309	59.7106	21.3023	0.0557887	0.0092216	9.23227
19	0.124903	0.0777247	59.2187	21.1644	0.0553815	0.00916547	9.15933
20	0.124181	0.0771383	58.681	21.0048	0.0549183	0.00910093	9.08108
21	0.123389	0.0764453	58.0825	20.8161	0.054381	0.00902522	8.99556
22	0.1225	0.0756063	57.4013	20.5876	0.0537429	0.00893435	8.89994
23	0.121471	0.0745608	56.6046	20.3029	0.0529636	0.00882224	8.78982
24	0.120233	0.0732098	55.6402	19.935	0.0519776	0.00867902	8.65803
25	0.118661	0.0713789	54.419	19.4365	0.050671	0.00848762	8.49192
26	0.116509	0.0687276	52.7752	18.7145	0.0488256	0.00821521	8.26683
27	0.113212	0.0644859	50.3545	17.5595	0.0459566	0.00778882	7.92689
28	0.107416	0.0565042	46.3707	15.3861	0.0407726	0.00700647	7.3424
29	0.101331	0.126442	42.082	34.4301	0.0935382	0.0162319	6.58214

CS-1 Hydraulic results (4)

Hydraulic Analysis Report - B2 : INT-1

User Name: Job Code:

Project: Description:

Stage	Side downcomer residence time (hr)	Side downcomer velocity from top (m/sec)	Side downcomer velocity from bottom (m/sec)
2	0.00162322	0.0383456	0.0383456
3	0.00161808	0.0382186	0.0382186
4	0.00161296	0.0380965	0.0380965
5	0.00160787	0.037978	0.037978
6	0.00160283	0.0378619	0.0378619
7	0.00159786	0.037747	0.037747
8	0.00159297	0.0376321	0.0376321
9	0.00158818	0.0375162	0.0375162
10	0.0015835	0.0373979	0.0373979
11	0.00157894	0.0372762	0.0372762
12	0.00157454	0.0371494	0.0371494
13	0.00157031	0.0370161	0.0370161
14	0.00156628	0.0368743	0.0368743
15	0.00156249	0.0367216	0.0367216
16	0.00155898	0.0365553	0.0365553
17	0.00155581	0.0363717	0.0363717
18	0.00155305	0.036166	0.036166
19	0.00155082	0.035932	0.035932
20	0.00154925	0.0356609	0.0356609
21	0.00154858	0.0353405	0.0353405
22	0.00154912	0.0349527	0.0349527
23	0.0015514	0.0344693	0.0344693
24	0.00155634	0.0338448	0.0338448
25	0.00156564	0.0329983	0.0329983

Hydraulic Analysis Report - B2 : INT-1

User Name: Job Code:

Project: Description:

Stage	Side downcomer residence time (hr)	Side downcomer velocity from top (m/sec)	Side downcomer velocity from bottom (m/sec)
26	0.00158294	0.0317727	0.0317727
27	0.00161768	0.0298117	0.0298117
28	0.00171007	0.0261218	0.0261218
29	0.000685066	0.0584538	0.0584538

User Name: Job Code:

Project: Description:

3.3.2. State Conditions

CS-1 State conditions

Stage	Liquid temperature (C)	Vapor temperature (C)	Liquid mass flow (kg/hr)	Vapor mass flow (kg/hr)	Liquid volume flow (l/min)	Vapor volume flow (l/min)
2	78.9891	79.1549	4683.31	5932.36	105.048	65144.7
3	79.1549	79.3201	4668.82	5917.87	104.7	64762.5
4	79.3201	79.4849	4654.87	5903.92	104.365	64385.4
5	79.4849	79.6491	4641.31	5890.36	104.041	64013
6	79.6491	79.8129	4628	5877.06	103.723	63645.3
7	79.8129	79.9762	4614.83	5863.89	103.408	63282
8	79.9762	80.1392	4601.68	5850.73	103.093	62922.9
9	80.1392	80.3019	4588.41	5837.47	102.775	62567.9
10	80.3019	80.4645	4574.91	5823.97	102.452	62216.8
11	80.4645	80.6269	4561.05	5810.1	102.118	61869.5
12	80.6269	80.7895	4546.66	5795.71	101.771	61525.7
13	80.7895	80.9523	4531.58	5780.64	101.406	61185.2
14	80.9523	81.1156	4515.61	5764.66	101.017	60847.9
15	81.1156	81.2799	4498.49	5747.55	100.599	60513.5
16	81.2799	81.4454	4479.93	5728.99	100.143	60181.7
17	81.4454	81.6128	4459.54	5708.6	99.6402	59852.2
18	81.6128	81.783	4436.82	5685.87	99.0767	59524.6
19	81.783	81.9572	4411.09	5660.14	98.4356	59198.3
20	81.9572	82.1373	4381.42	5630.48	97.693	58872.8
21	82.1373	82.3261	4346.52	5595.57	96.8153	58547.1
22	82.3261	82.5285	4304.44	5553.5	95.7528	58219.9
23	82.5285	82.7529	4252.2	5501.25	94.4287	57889.3
24	82.7529	83.0155	4184.9	5433.95	92.7177	57552.5

Hydraulic Analysis Report - B2 : INT-1

User Name: Job Code:

Project: Description:

Stage	Liquid temperature (C)	Vapor temperature (C)	Liquid mass flow (kg/hr)	Vapor mass flow (kg/hr)	Liquid volume flow (l/min)	Vapor volume flow (l/min)
25	83.0155	83.351	4093.9	5342.95	90.3989	57204.7
26	83.351	83.8465	3962.32	5211.37	87.0411	56838.2
27	83.8465	84.7843	3751.87	5000.93	81.6691	56442.4
28	84.7843	87.4329	3355.34	4604.4	71.5606	56336.8
29	87.395	87.5404	7984.74	4505.03	160.134	54496.2

User Name: Job Code:

Project: Description:

3.3.3. Physical Properties

CS-1 Physical properties

Stage	Liquid molecular weight	Vapor molecular weight	Liquid mass density (gm/cc)	Vapor mass density (gm/cc)	Liquid viscosity (cP)	Vapor viscosity (cP)	Surface tension (dyne/cm)
2	42.1779	42.206	0.743045	0.00151774	0.423259	0.0107601	23.5694
3	42.0495	42.1047	0.743209	0.00152297	0.421867	0.0107726	23.7572
4	41.9257	42.0069	0.743362	0.00152828	0.420497	0.0107849	23.9376
5	41.8053	41.9117	0.743508	0.00153364	0.419147	0.0107969	24.1126
6	41.6871	41.8183	0.743651	0.00153901	0.417811	0.0108088	24.2839
7	41.57	41.7259	0.743792	0.00154438	0.416488	0.0108206	24.4532
8	41.4532	41.6337	0.743935	0.00154971	0.415174	0.0108324	24.6221
9	41.3356	41.5408	0.744084	0.00155497	0.413866	0.0108442	24.7921
10	41.2162	41.4464	0.74424	0.00156013	0.412561	0.0108562	24.9649
11	41.0939	41.3498	0.744408	0.00156515	0.411255	0.0108683	25.1424
12	40.9673	41.2498	0.744591	0.00157	0.409943	0.0108806	25.3264
13	40.8351	41.1455	0.744795	0.00157463	0.408622	0.0108934	25.5192
14	40.6957	41.0353	0.745024	0.00157898	0.407286	0.0109065	25.7234
15	40.5469	40.9179	0.745286	0.00158299	0.405929	0.0109203	25.9422
16	40.3863	40.7911	0.745588	0.00158658	0.404542	0.0109348	26.1796
17	40.2108	40.6525	0.745941	0.00158964	0.403115	0.0109503	26.4406
18	40.0161	40.4988	0.746361	0.00159202	0.401634	0.0109669	26.7316
19	39.7968	40.3258	0.746865	0.00159355	0.400081	0.0109852	27.0613
20	39.5452	40.1273	0.747482	0.00159397	0.39843	0.0110055	27.4416
21	39.2506	39.895	0.74825	0.0015929	0.396646	0.0110287	27.8893
22	38.8971	39.6162	0.749229	0.00158981	0.394673	0.0110557	28.4294
23	38.4601	39.2718	0.750513	0.00158384	0.392428	0.0110882	29.1002
24	37.8993	38.8302	0.752265	0.00157362	0.389769	0.0111291	29.9643

Hydraulic Analysis Report - B2 : INT-1

User Name: Job Code:

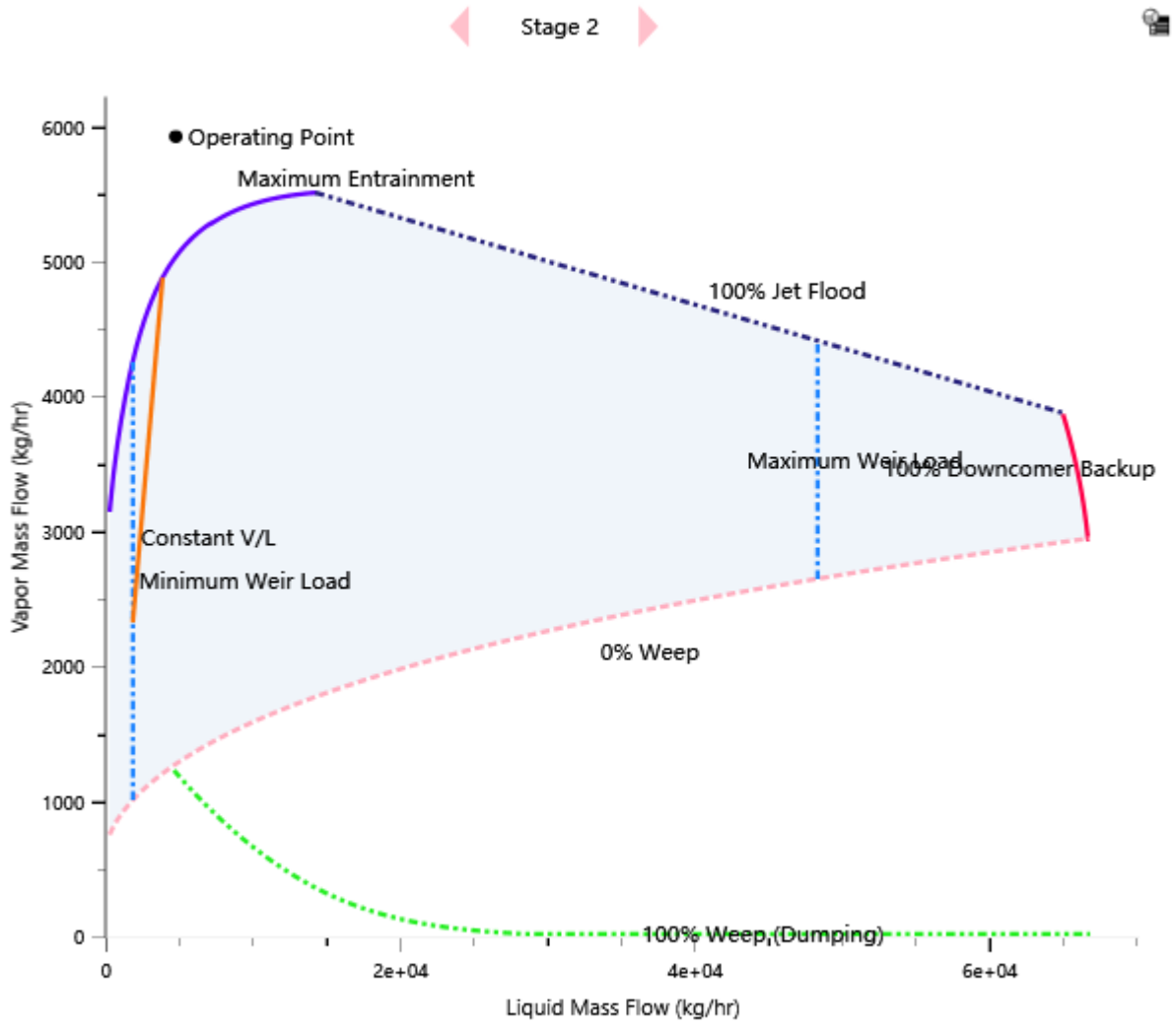
Project: Description:

Stage	Liquid molecular weight	Vapor molecular weight	Liquid mass density (gm/cc)	Vapor mass density (gm/cc)	Liquid viscosity (cP)	Vapor viscosity (cP)	Surface tension (dyne/cm)
25	37.1439	38.2357	0.754784	0.00155668	0.386444	0.0111833	31.132
26	36.0553	37.3801	0.758707	0.00152813	0.381954	0.0112612	32.8178
27	34.3197	36.0191	0.765665	0.0014767	0.375154	0.0113883	35.5055
28	31.0555	33.4711	0.781469	0.00136216	0.3628	0.0116483	40.5436
29	24.3831	33.4986	0.831048	0.00137778	0.336352	0.0116499	50.6578

User Name: Job Code:

Project: Description:

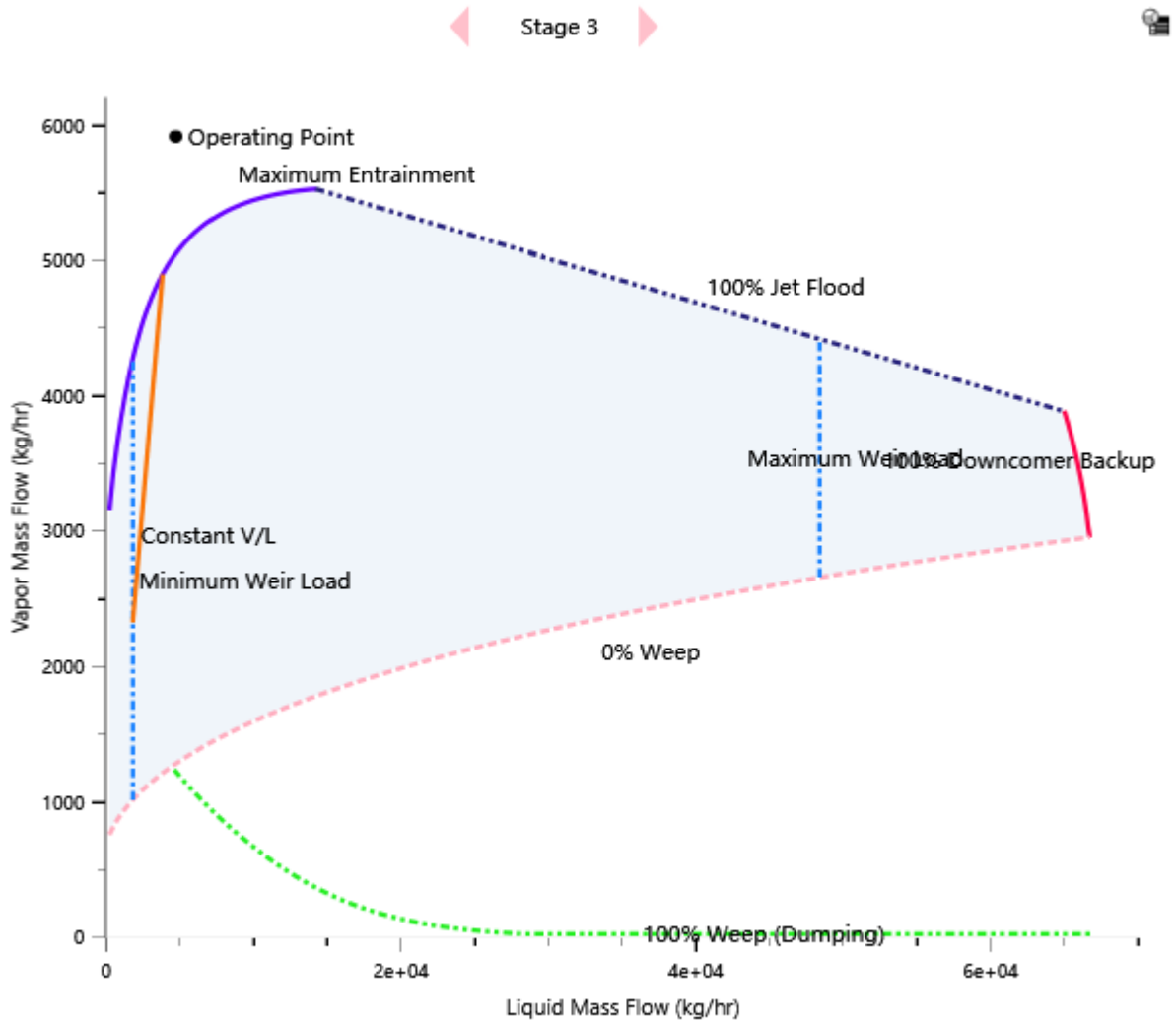
3.4. Hydraulic Plots



Hydraulic Analysis Report - B2 : INT-1

User Name: Job Code:

Project: Description:



Hydraulic Analysis Report - B2 : INT-1

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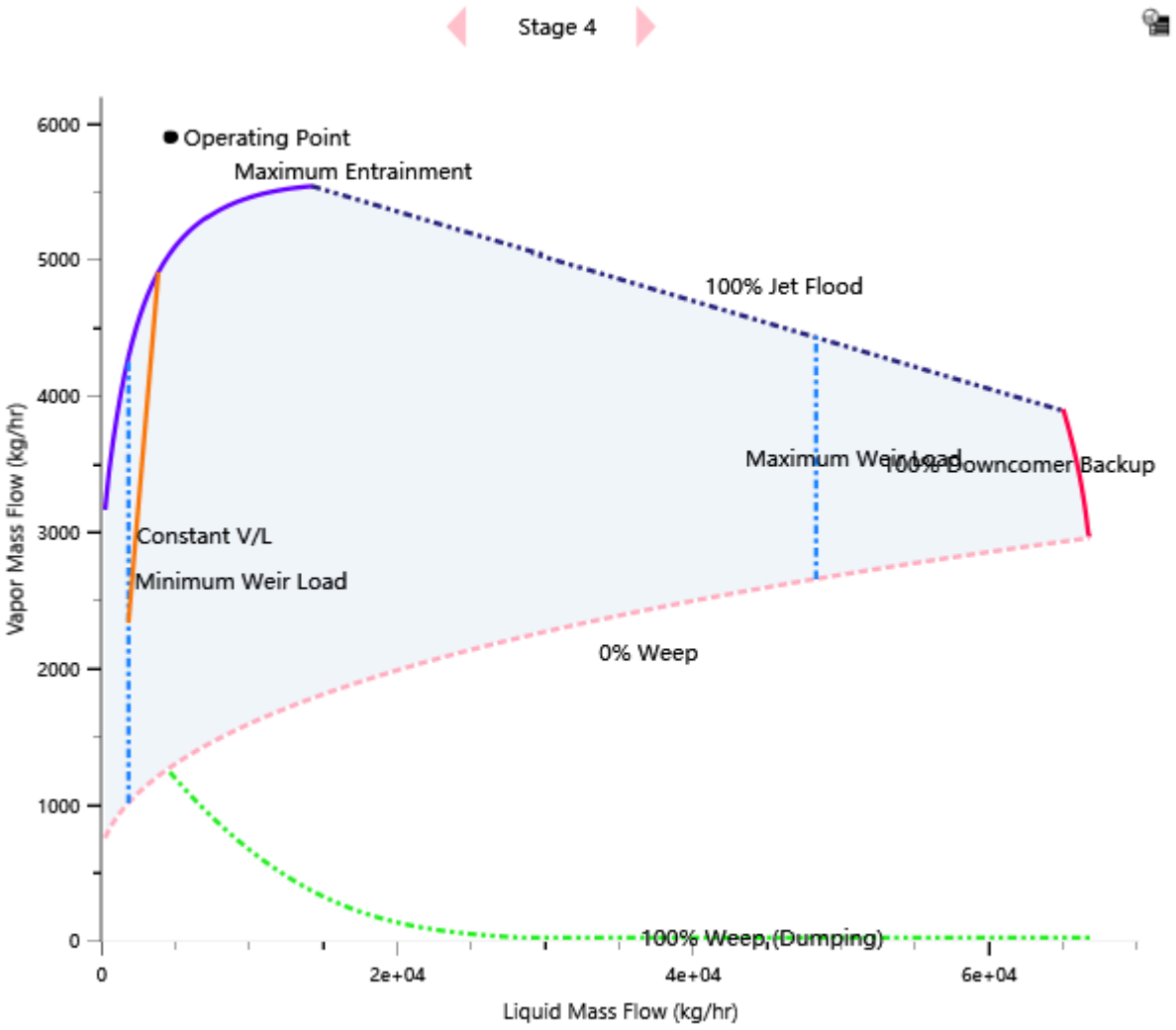
Project: Description:



Hydraulic Analysis Report - B2 : INT-1

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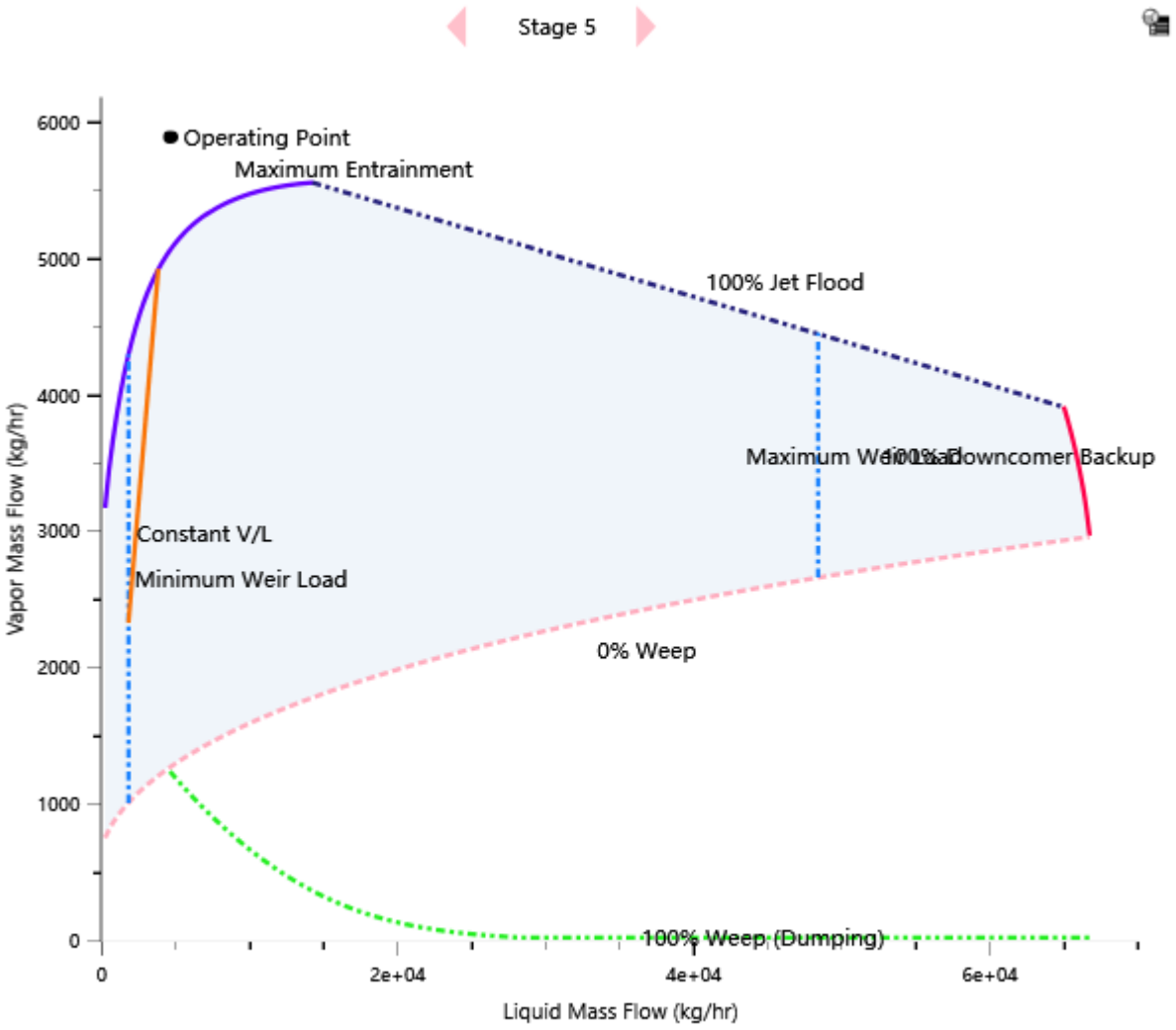
Project: Description:



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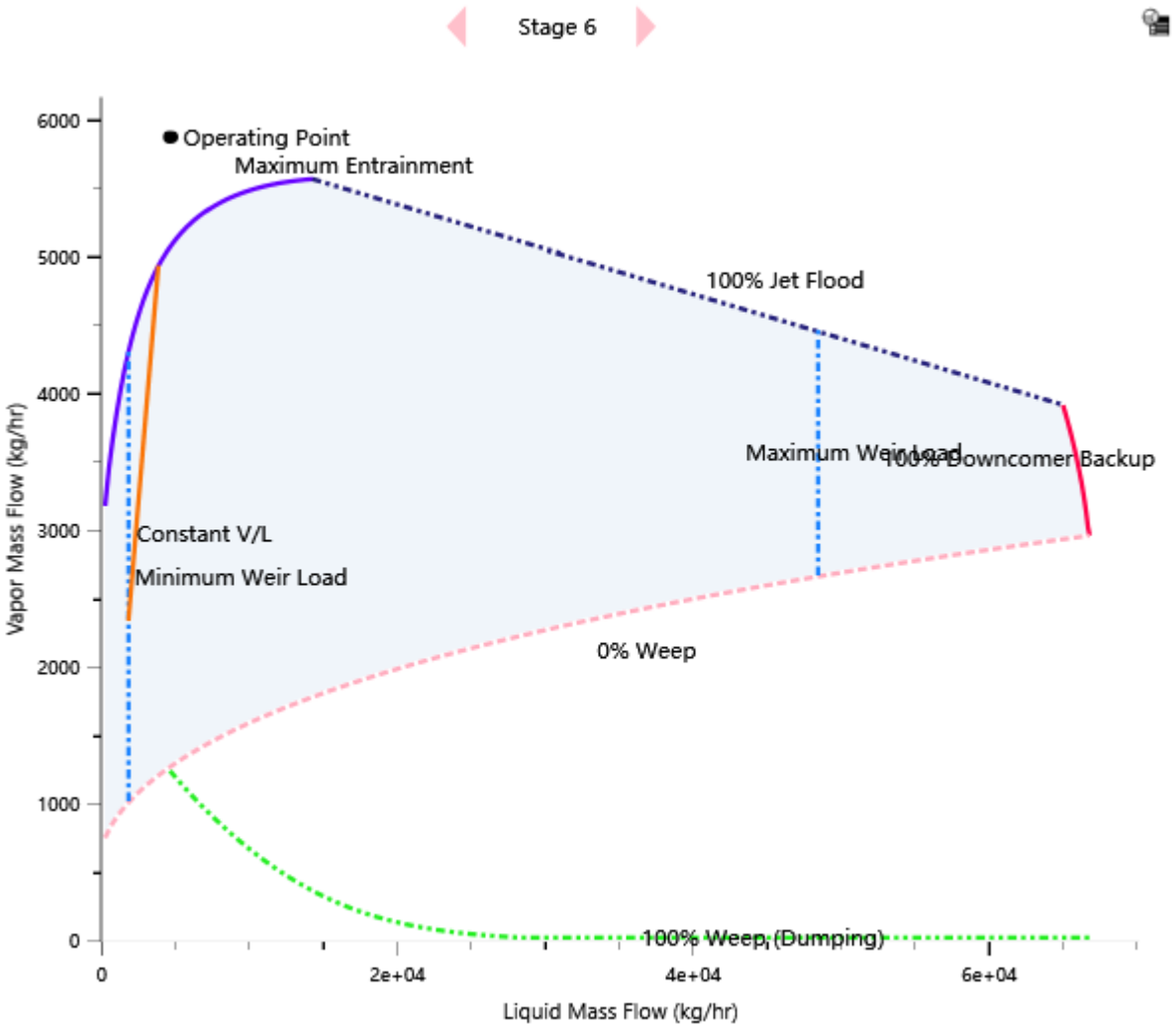
Project: Description:



Hydraulic Analysis Report - B2 : INT-1

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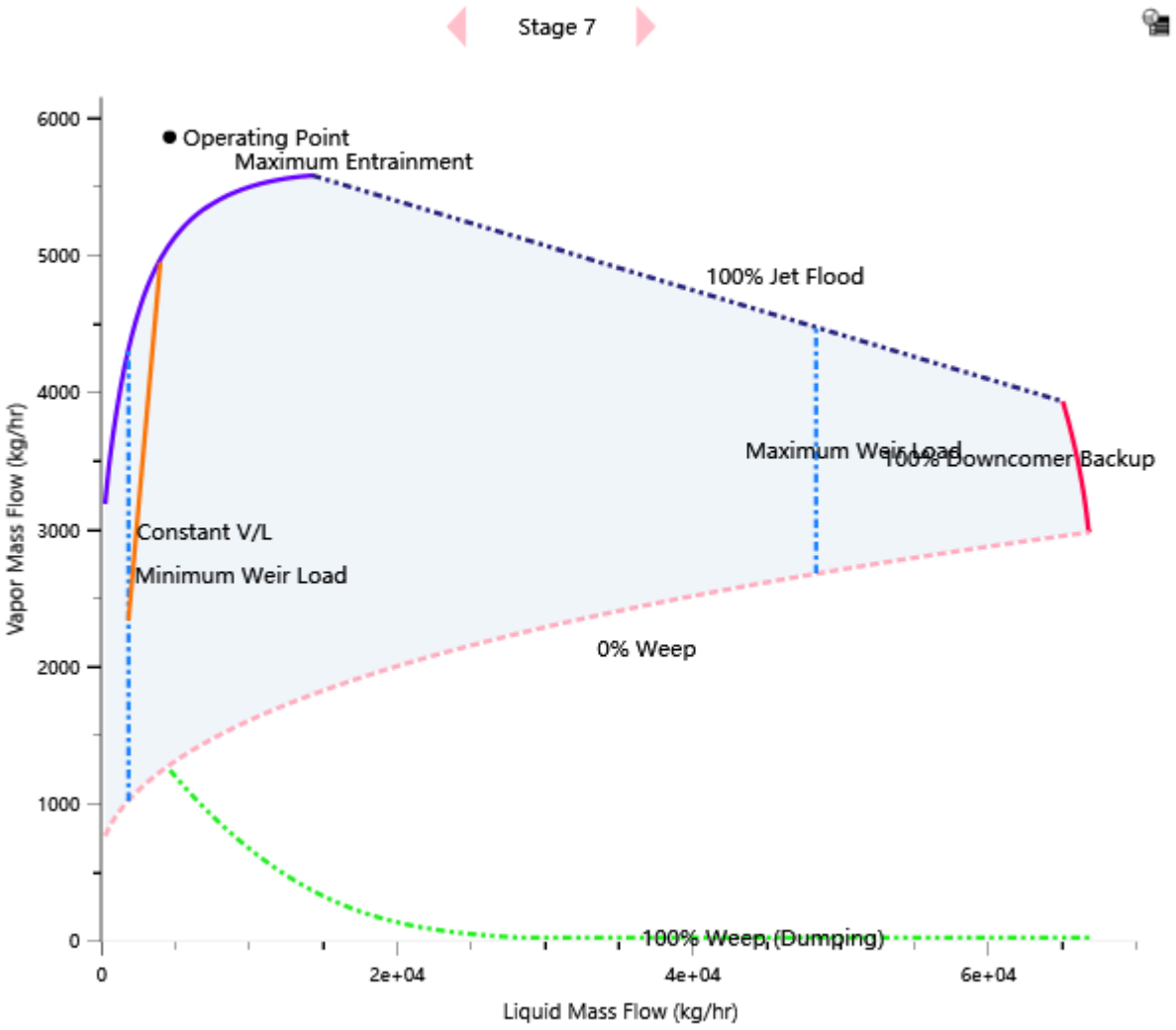
Project: Description:



Hydraulic Analysis Report - B2 : INT-1

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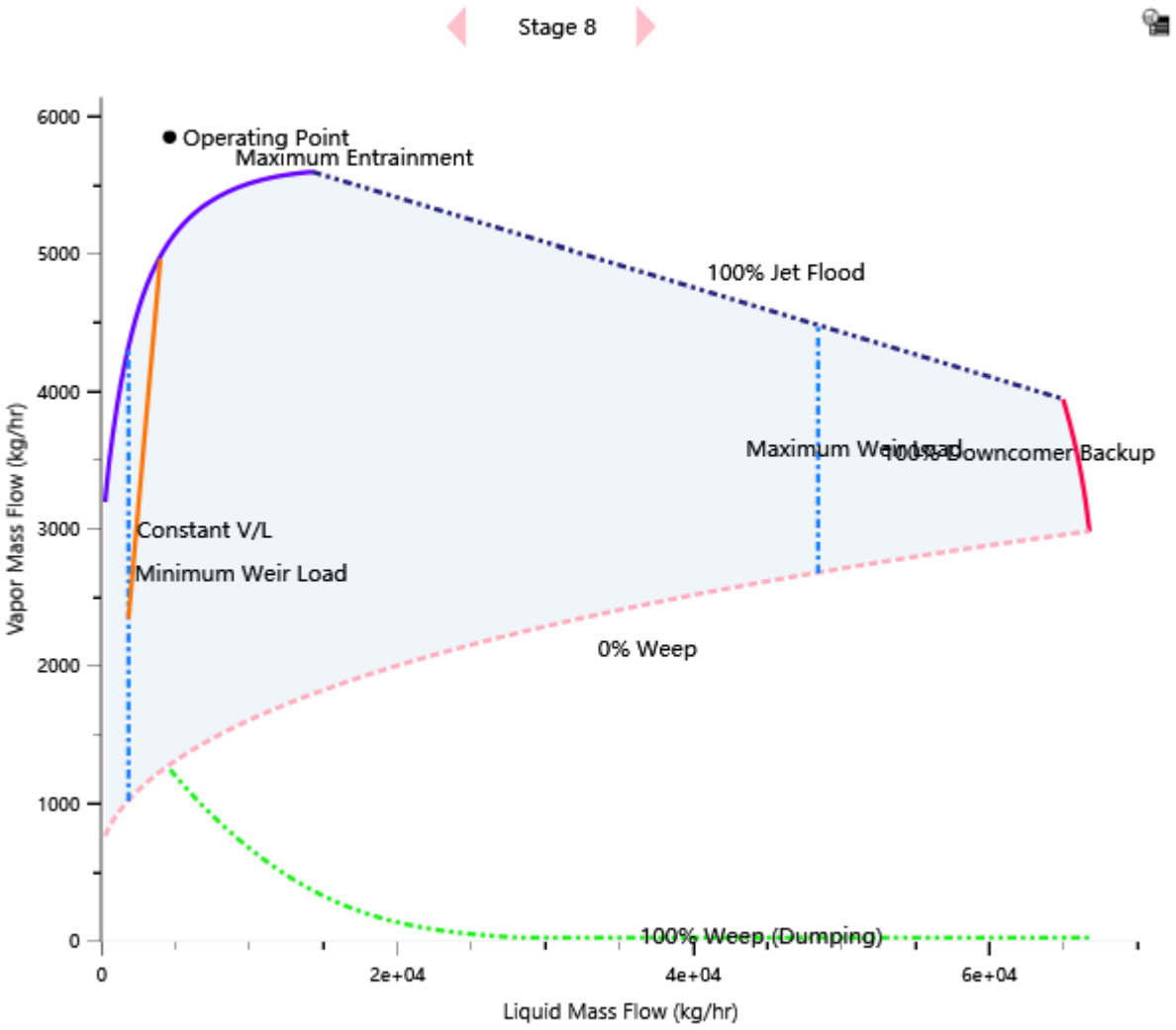
Project: Description:



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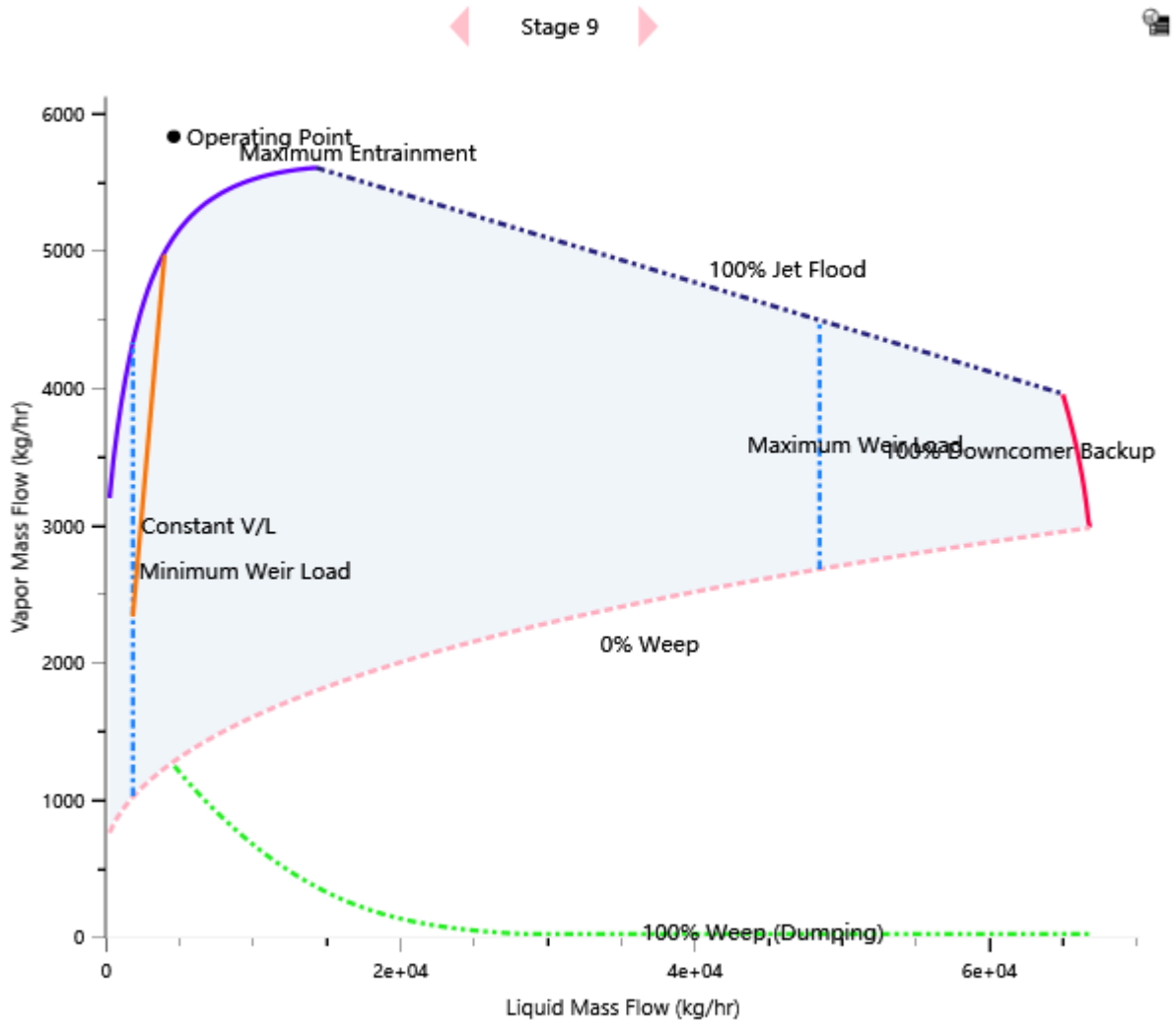
Project: Description:



Hydraulic Analysis Report - B2 : INT-1

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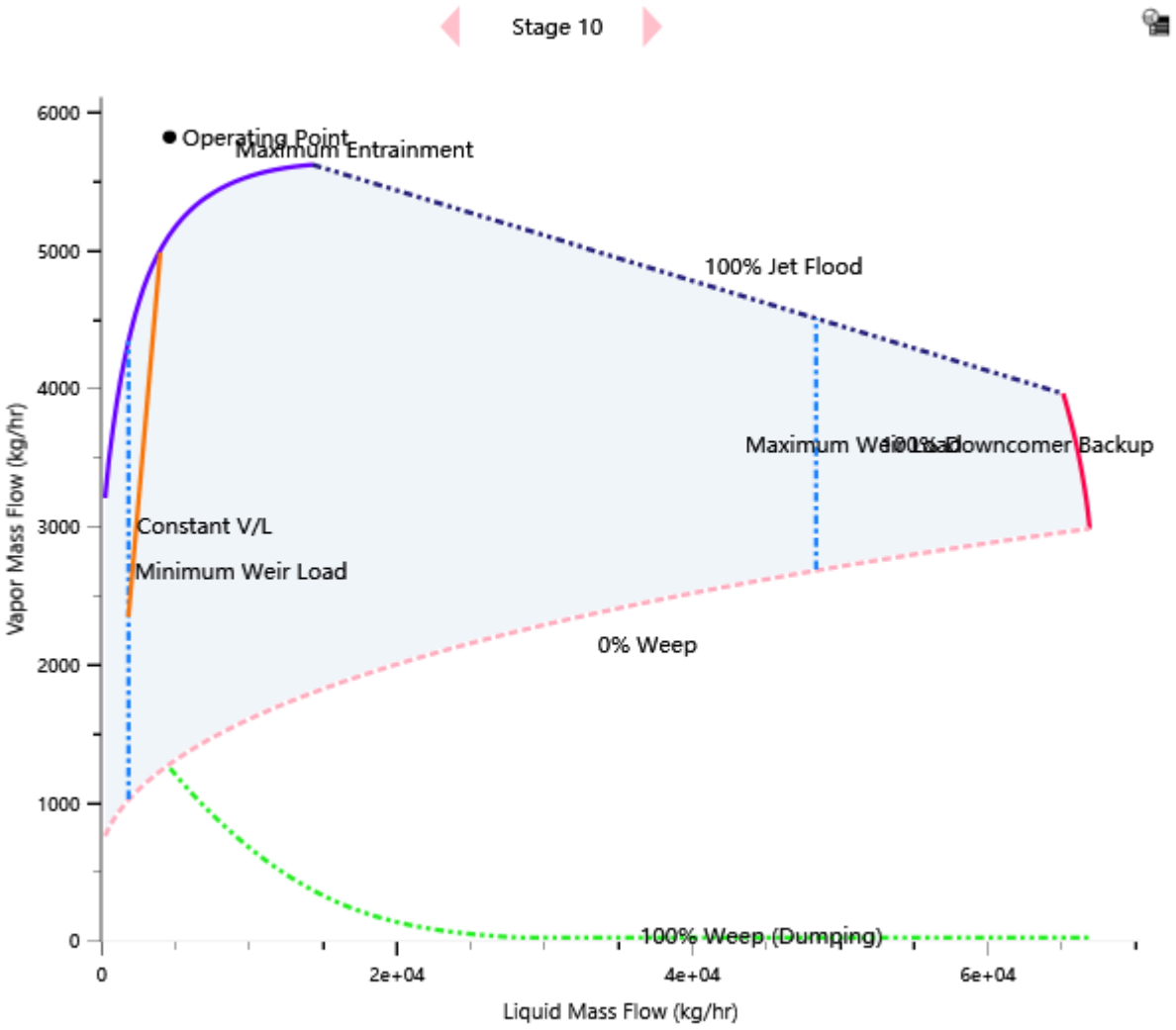
Project: Description:



Hydraulic Analysis Report - B2 : INT-1

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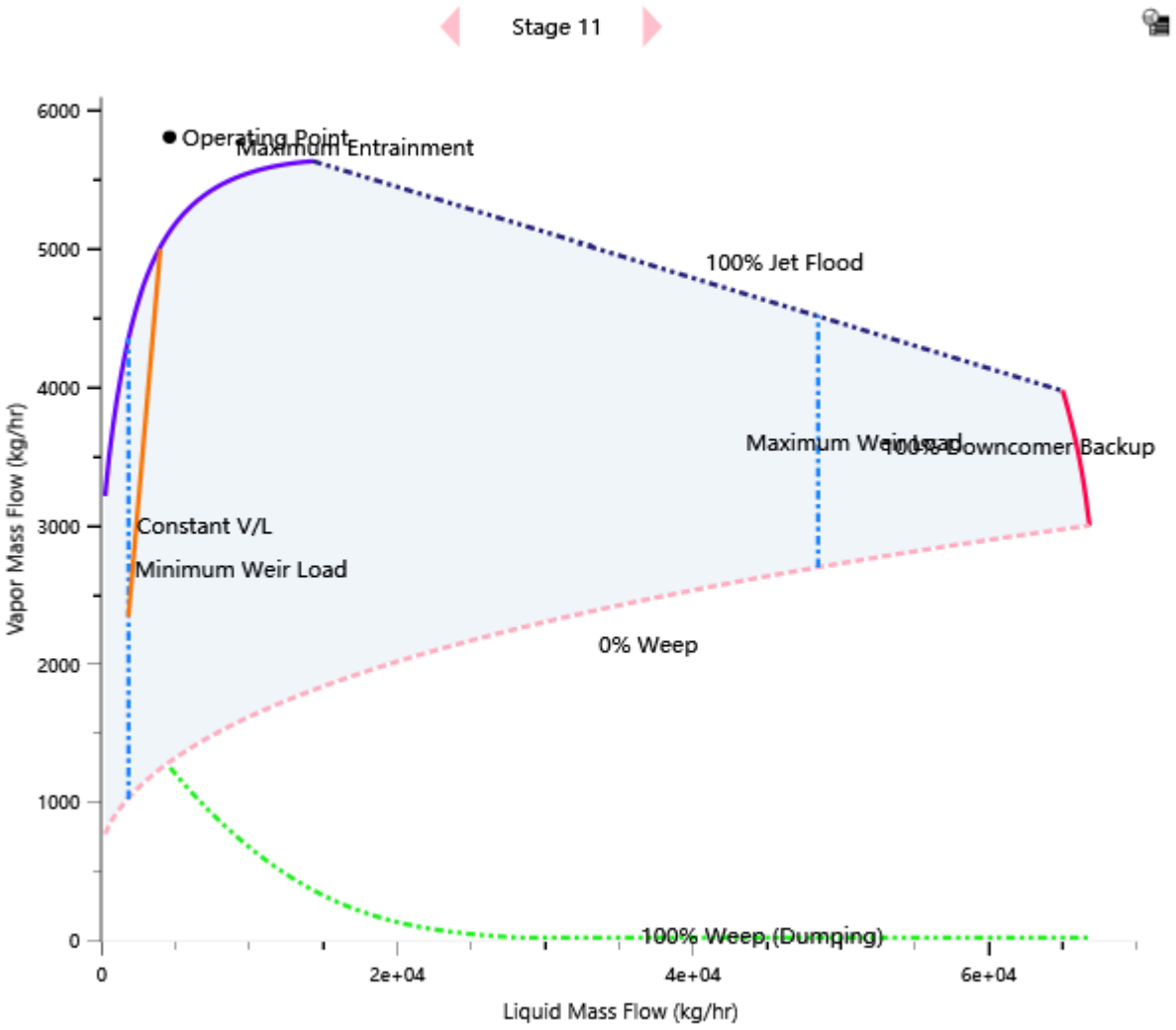
Project: Description:



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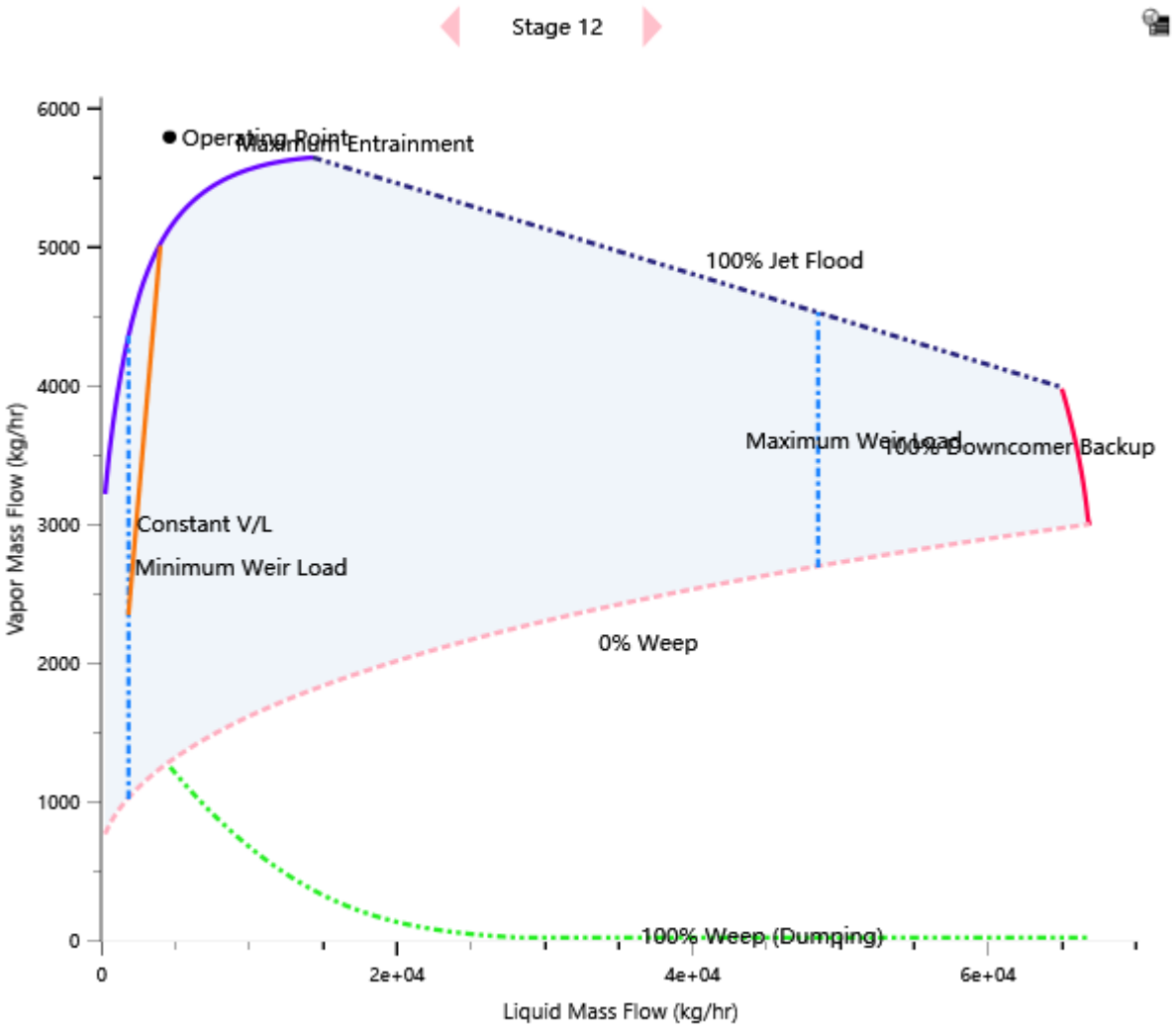
Project: Description:



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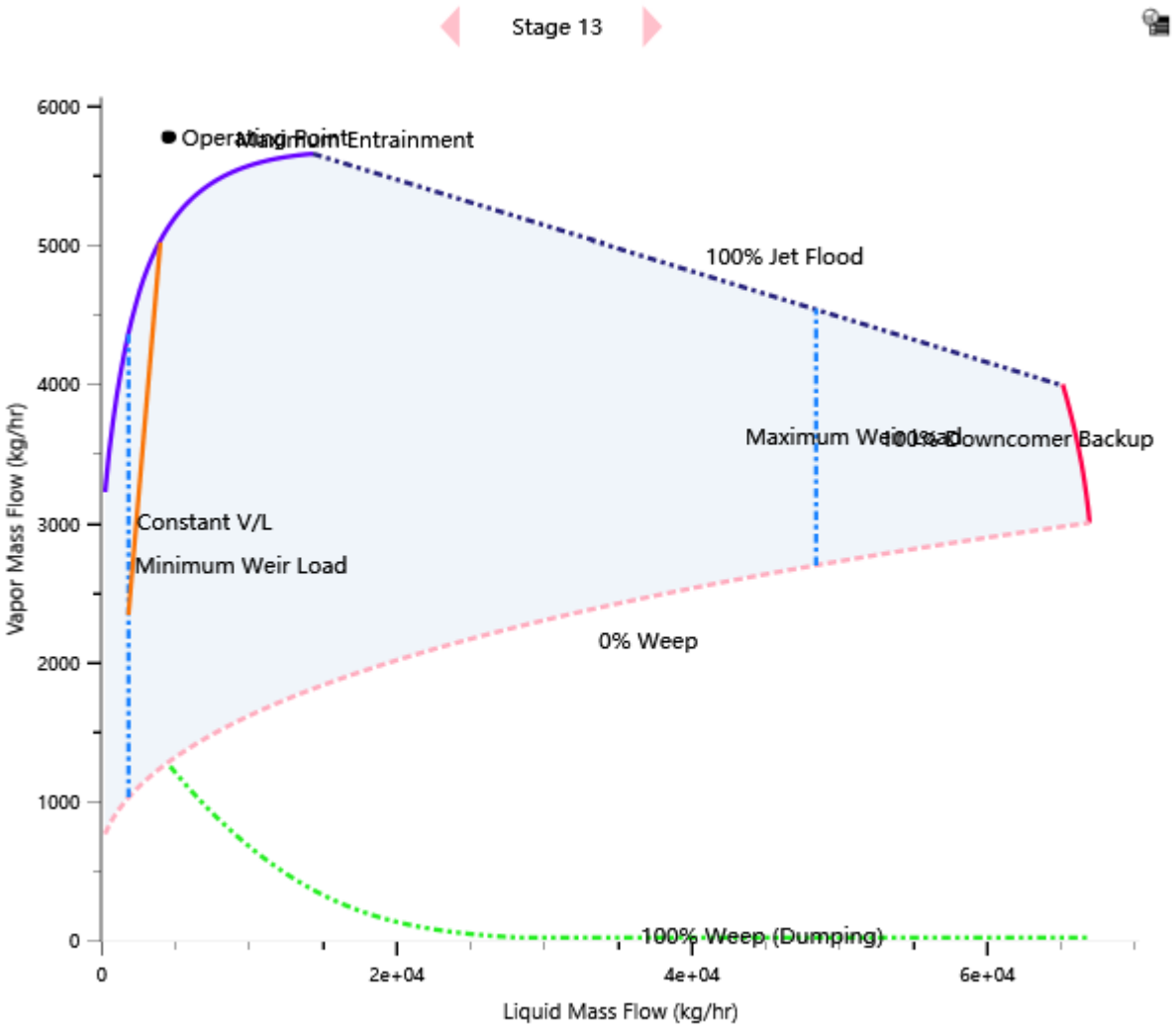
Project: Description:



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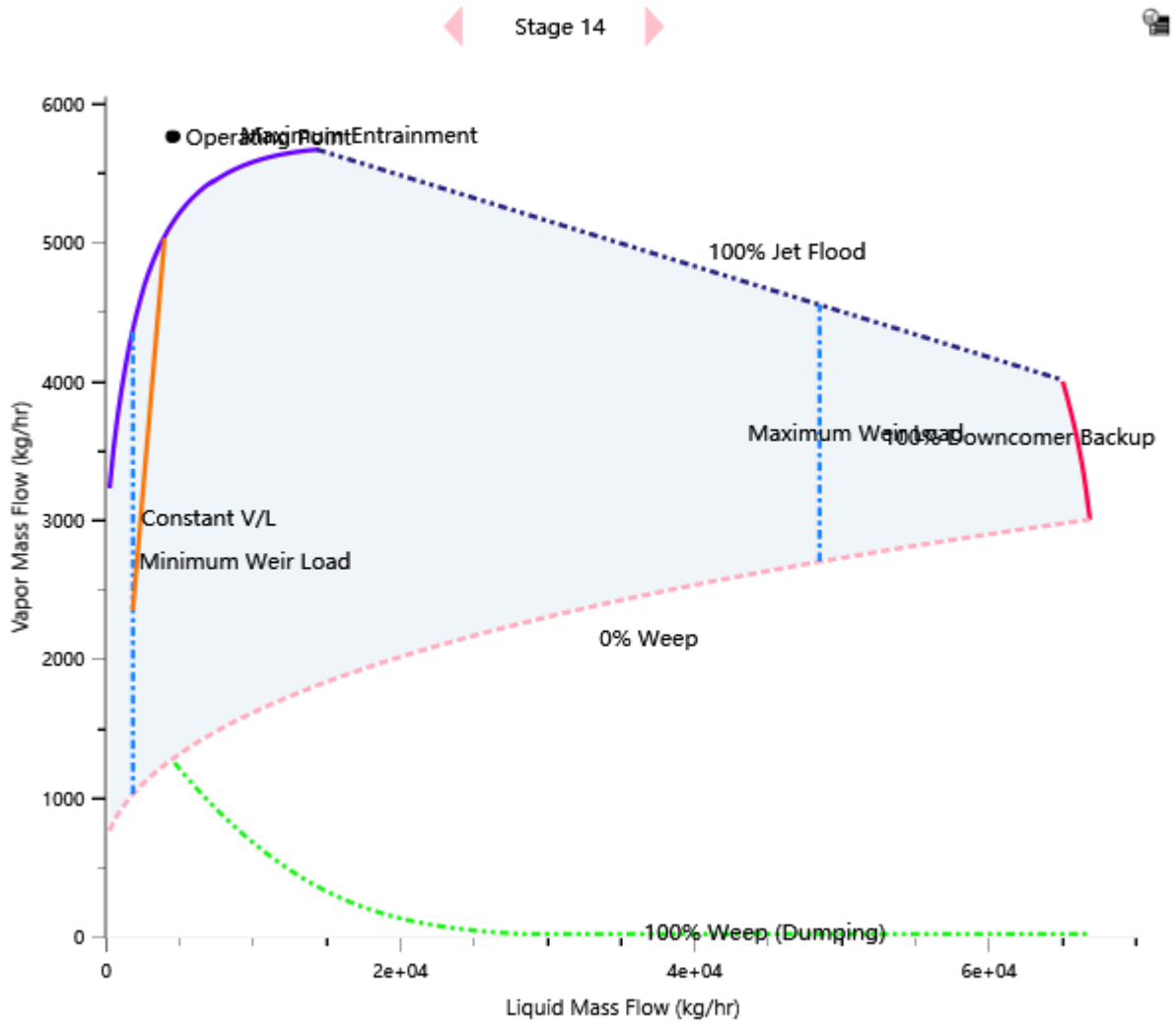
Project: Description:



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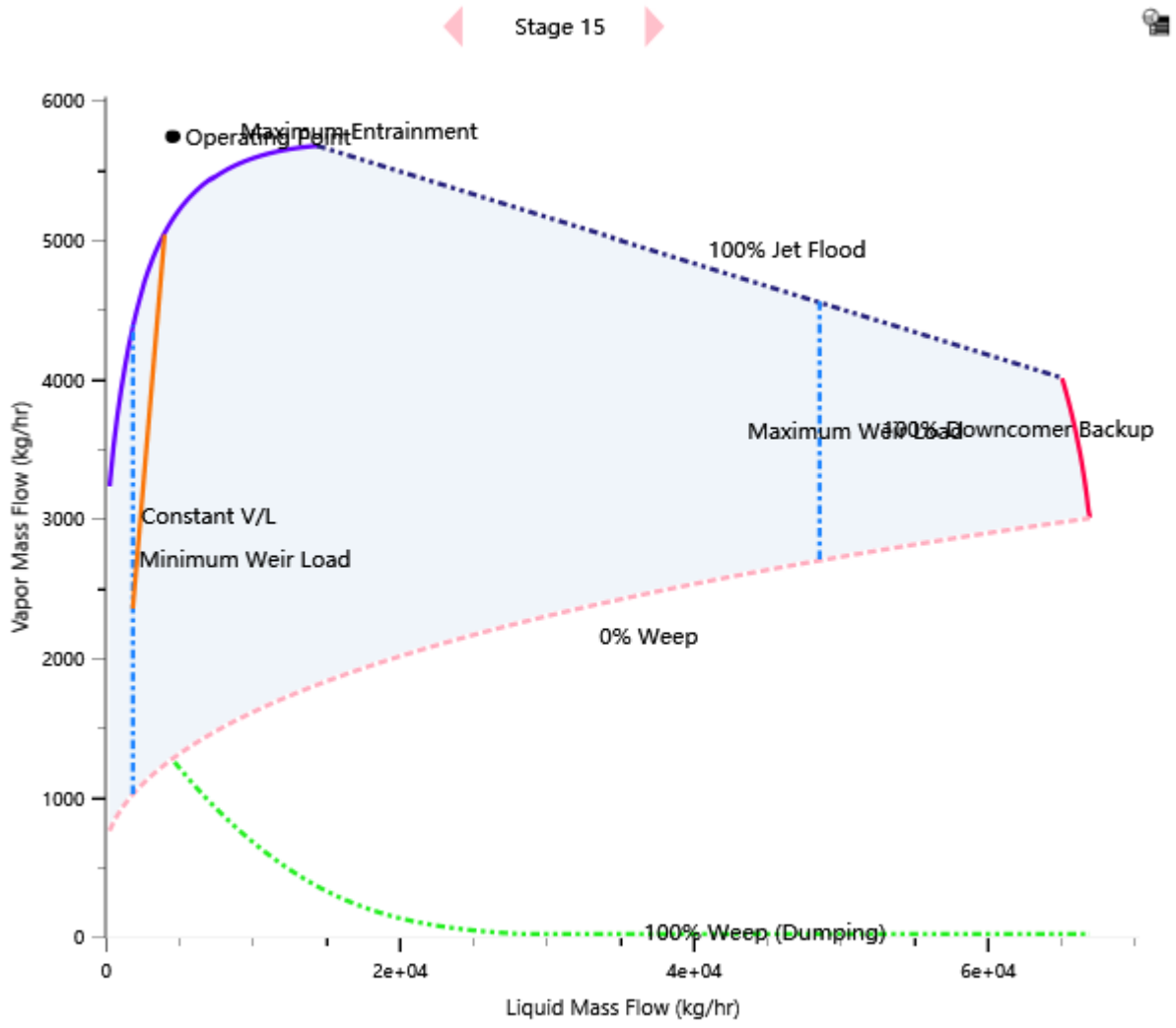
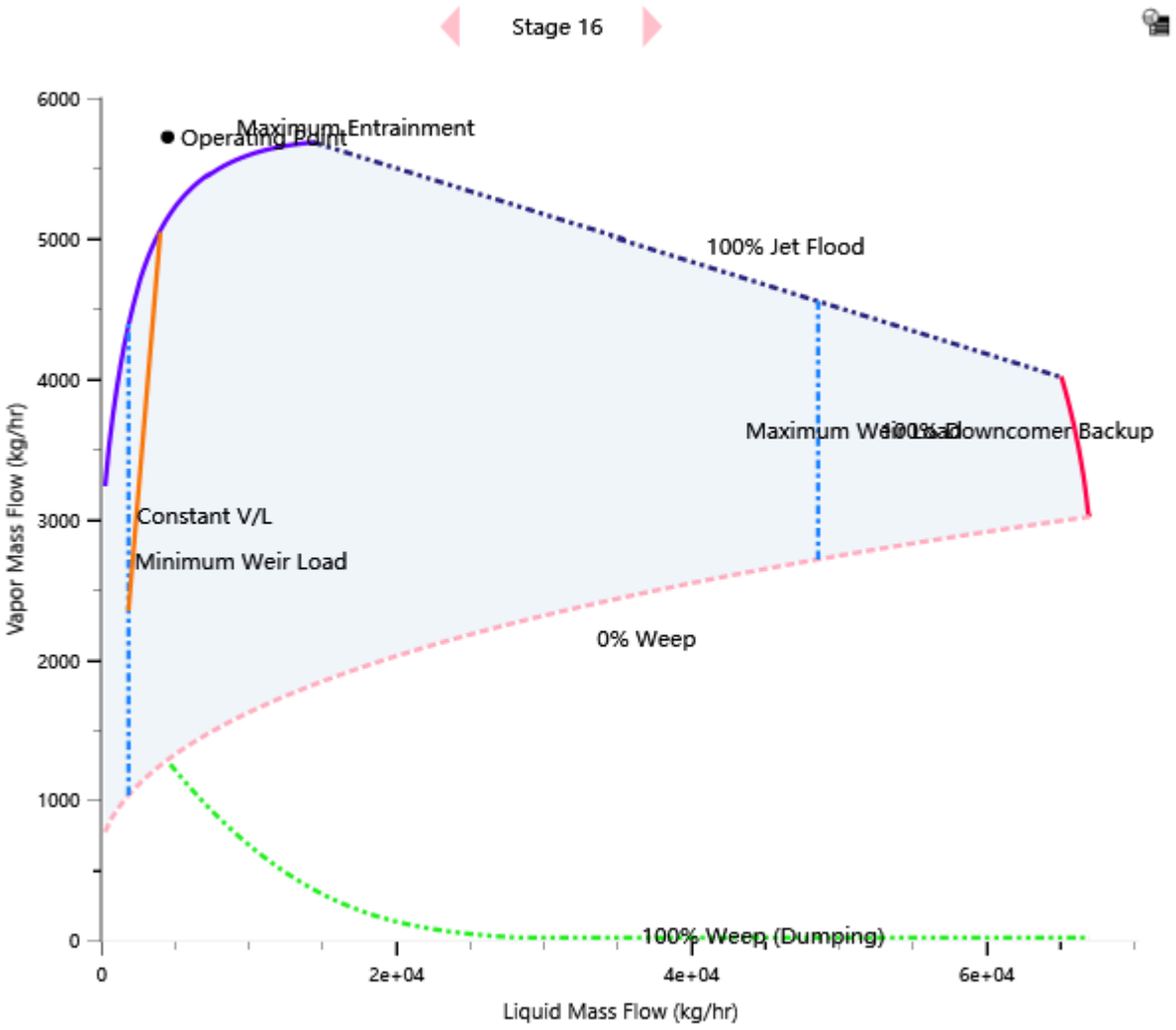
Project: Description:



Hydraulic Analysis Report - B2 : INT-1

User Name: Job Code:

Project: Description:



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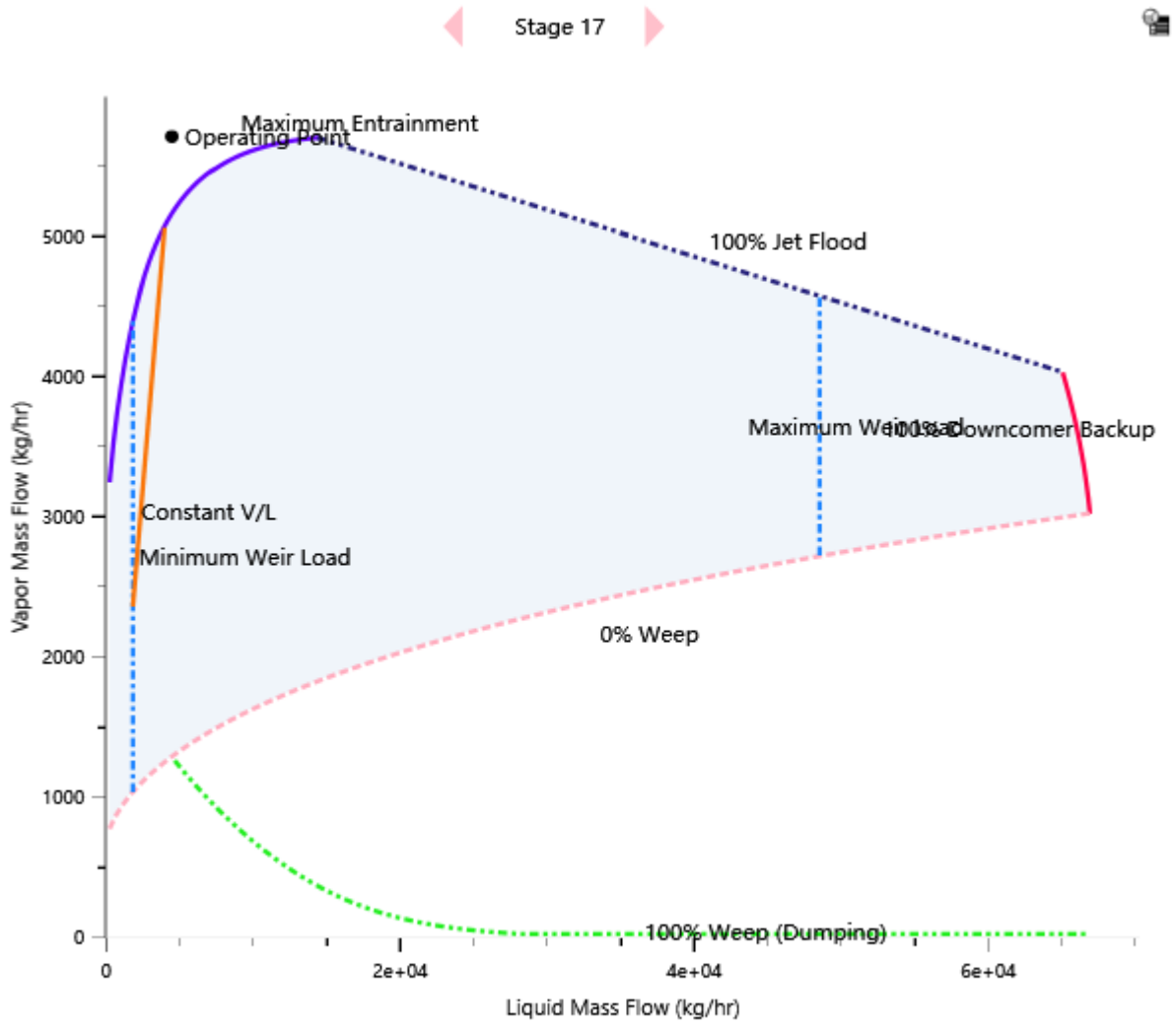
Project: Description:



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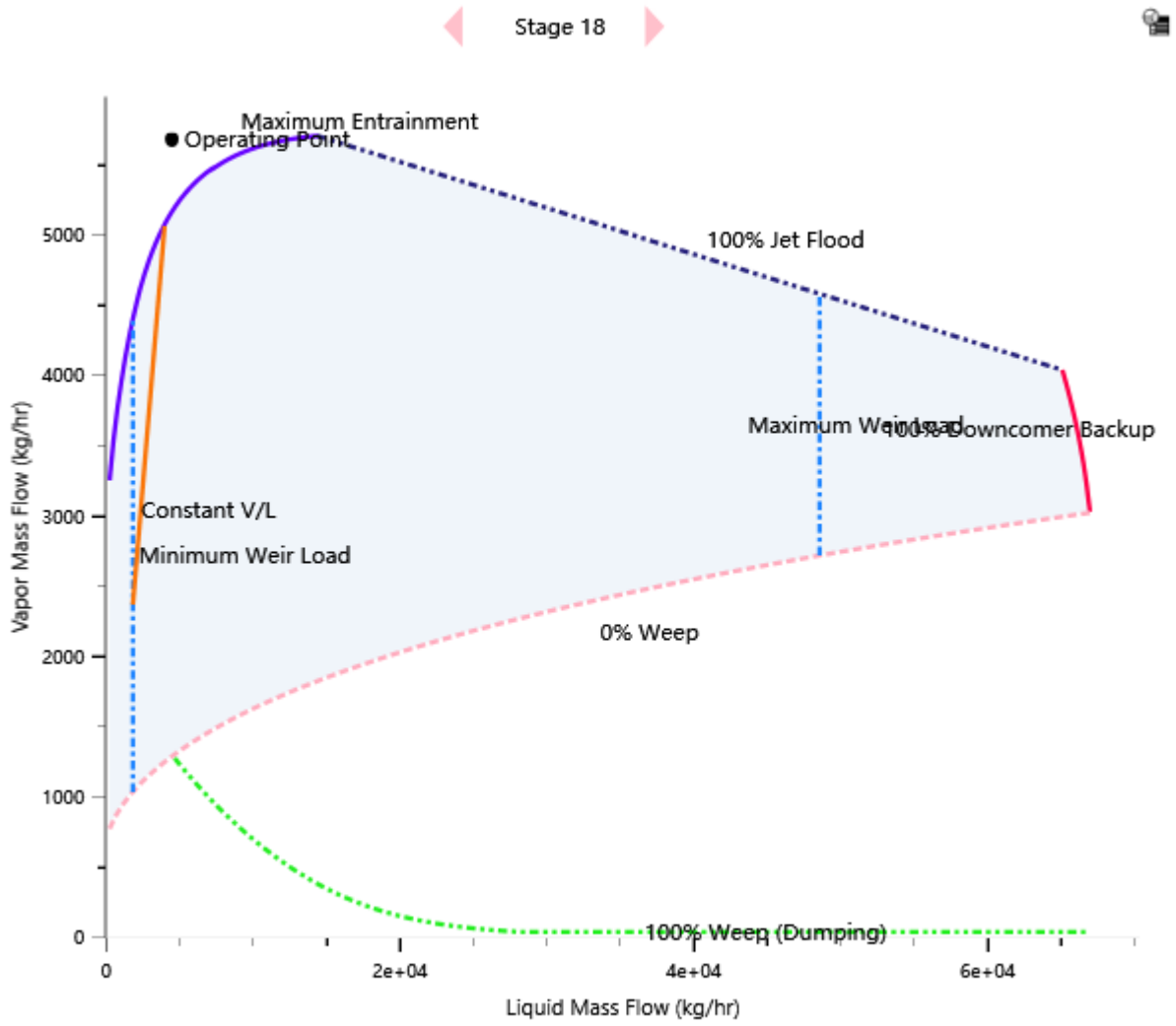
Project: Description:



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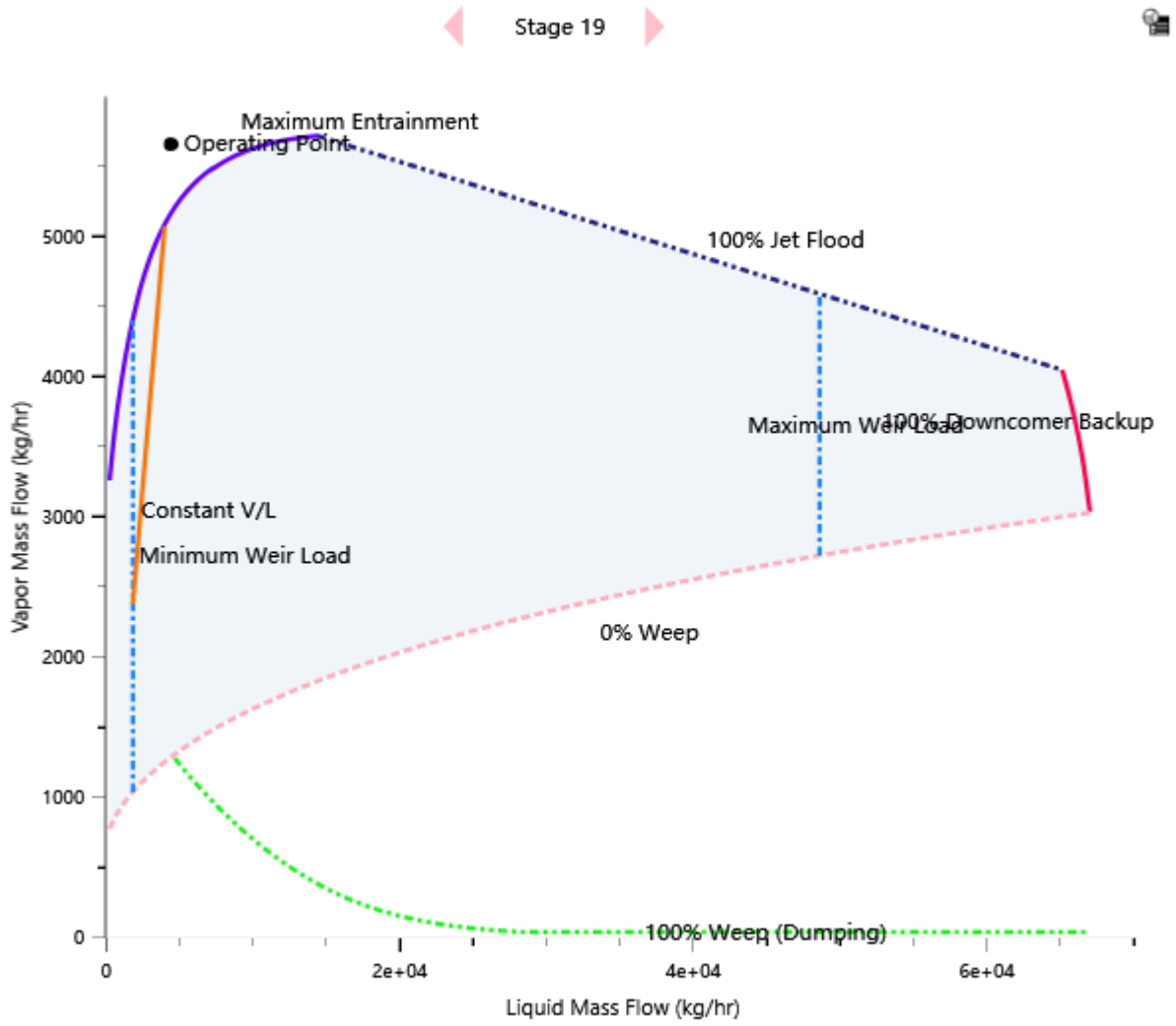

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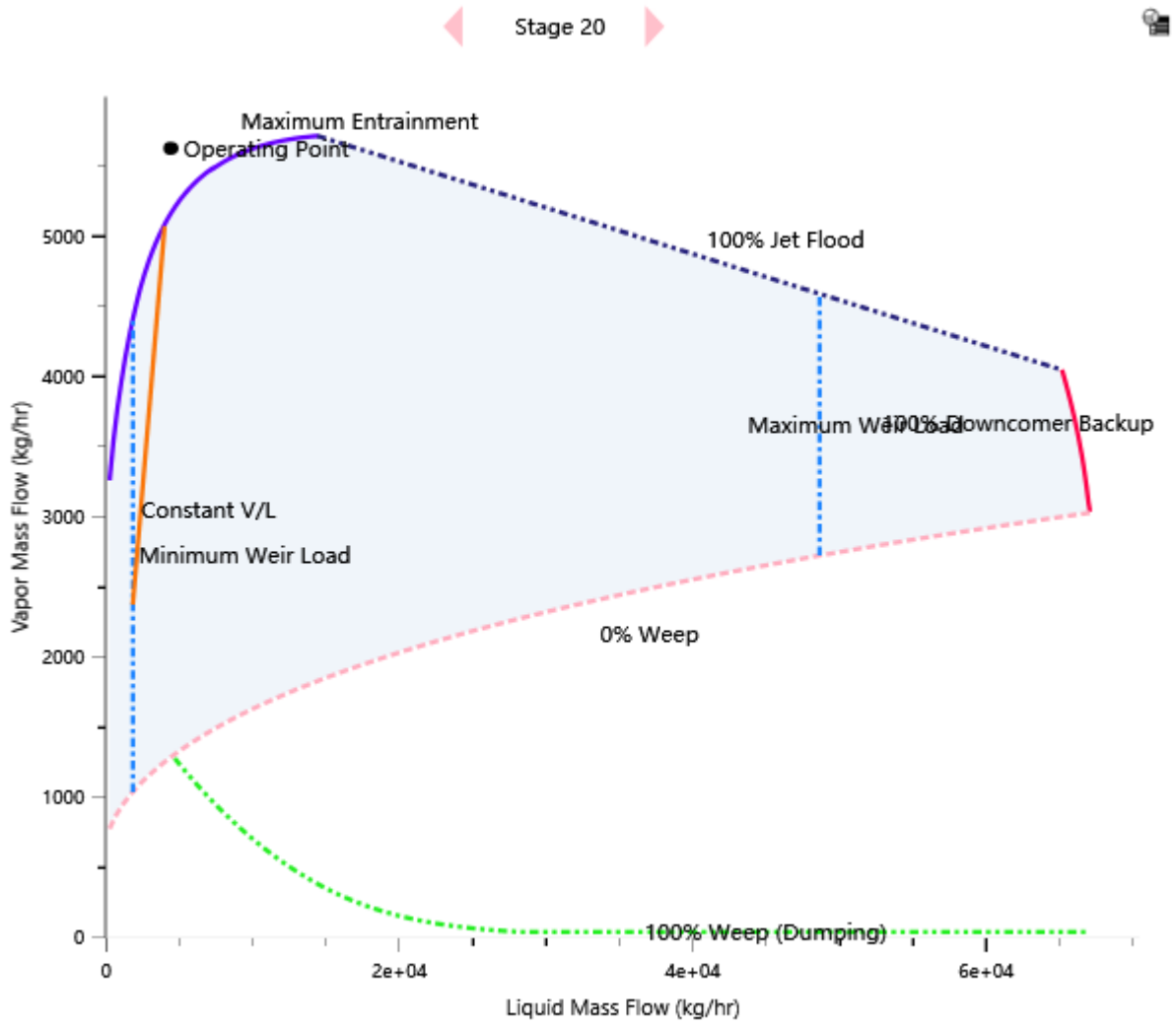

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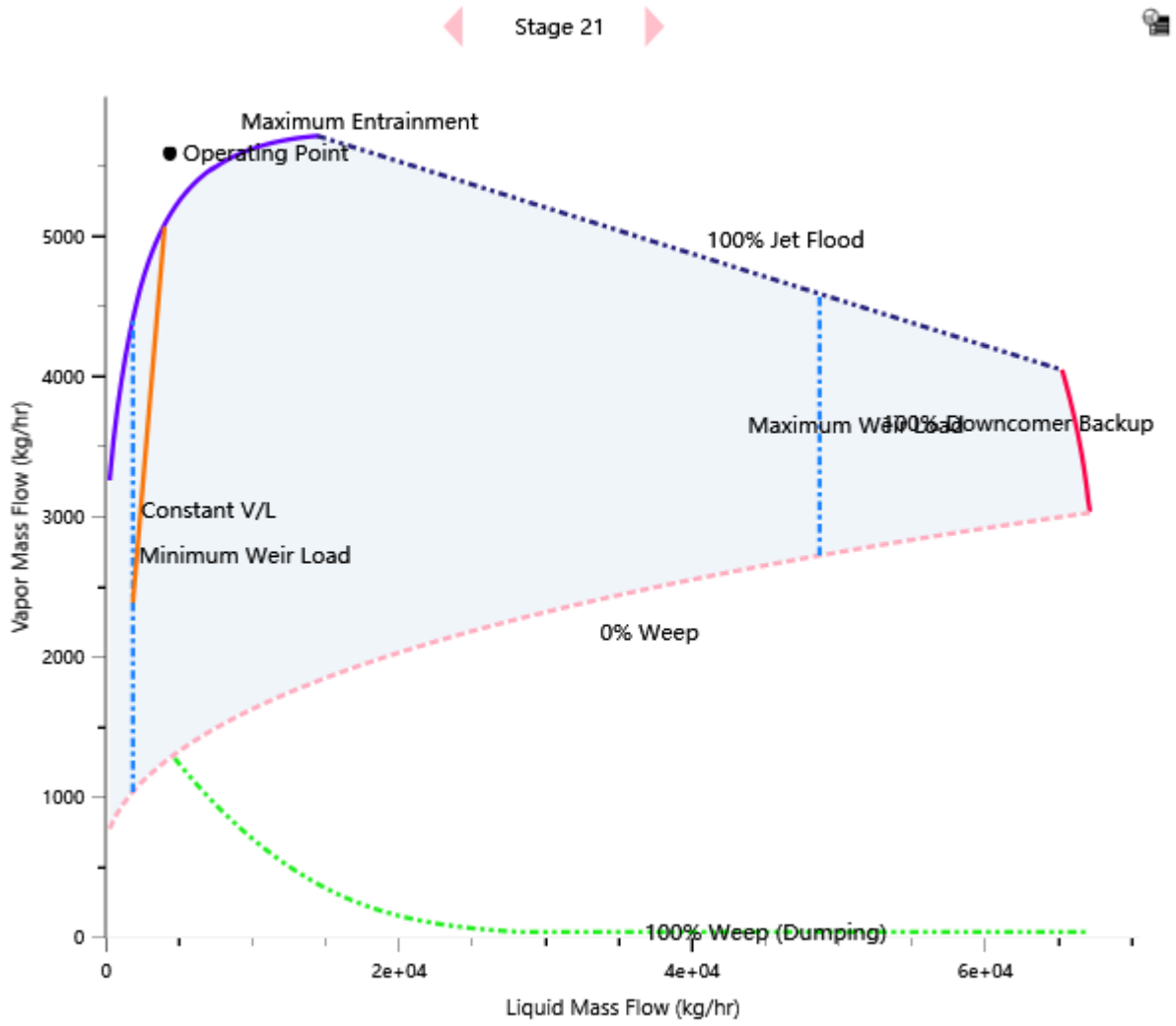

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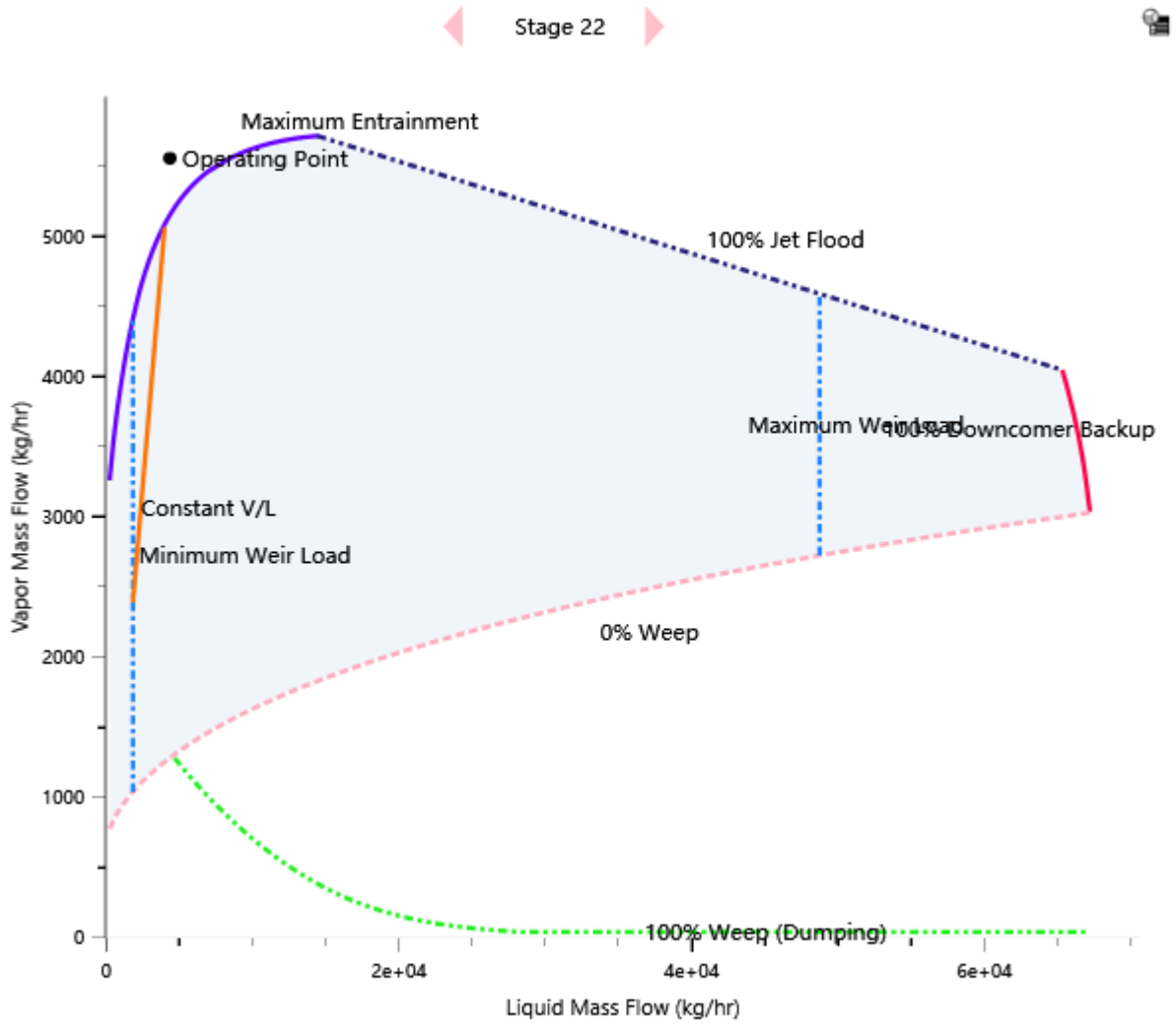

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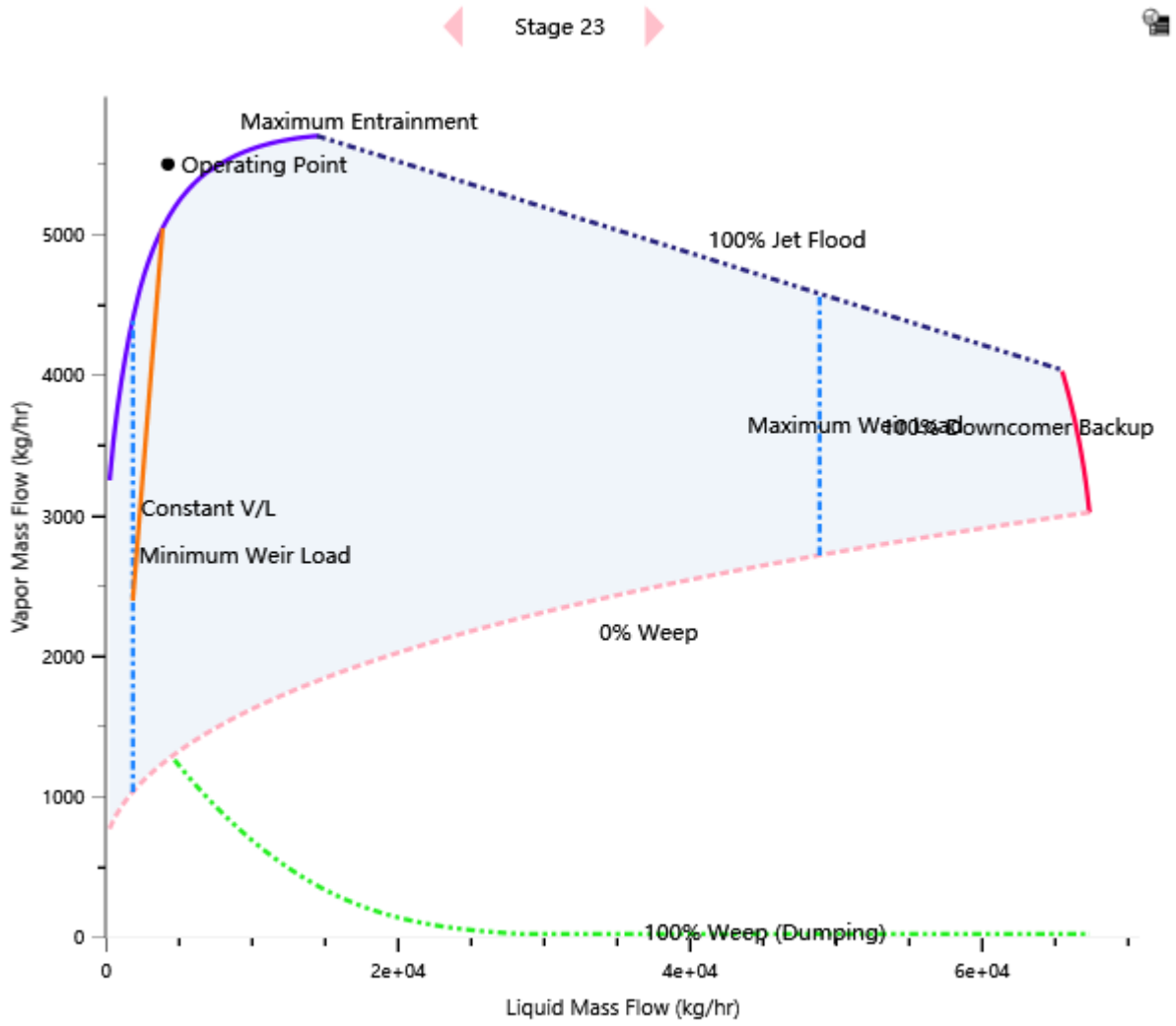

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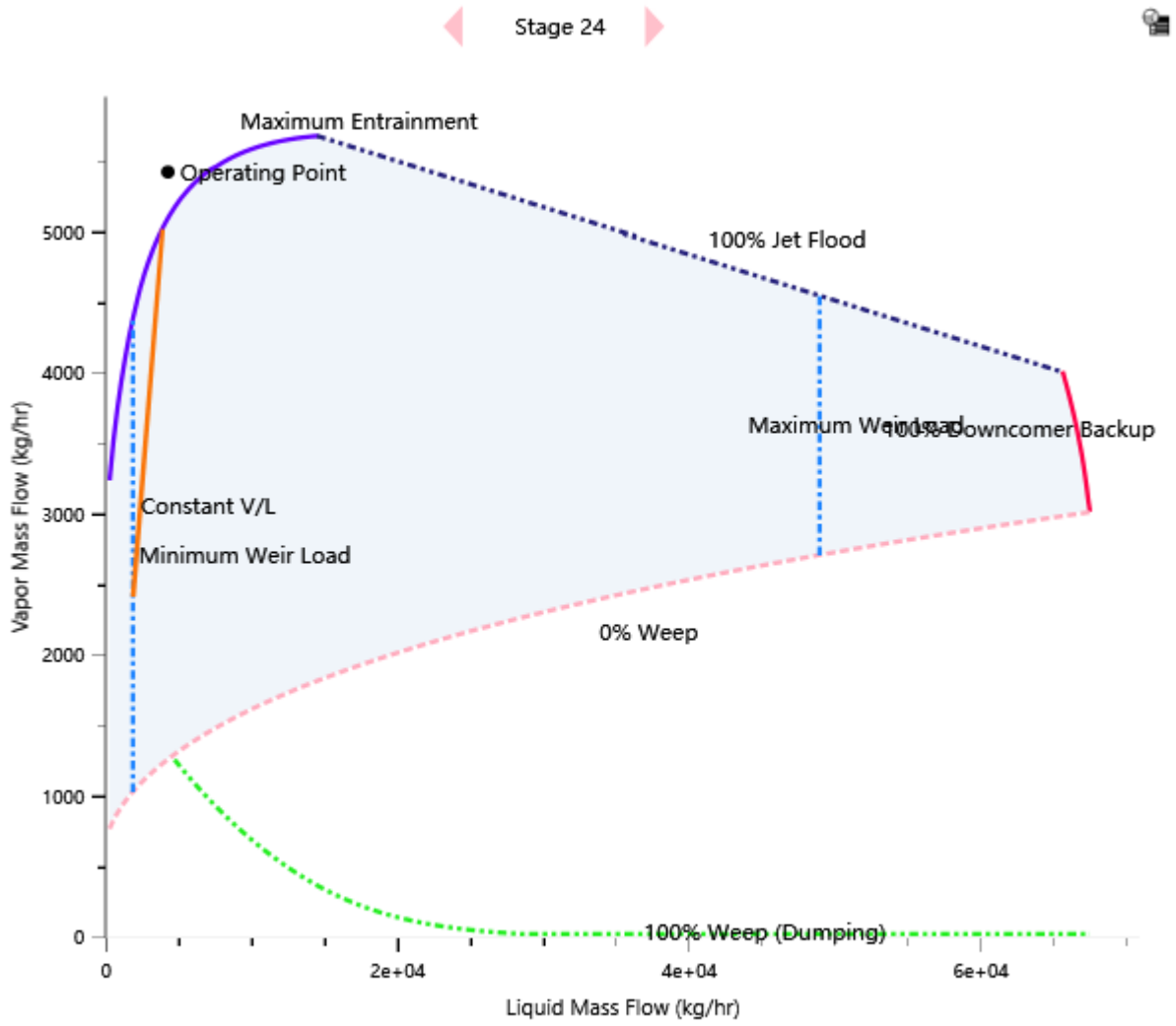

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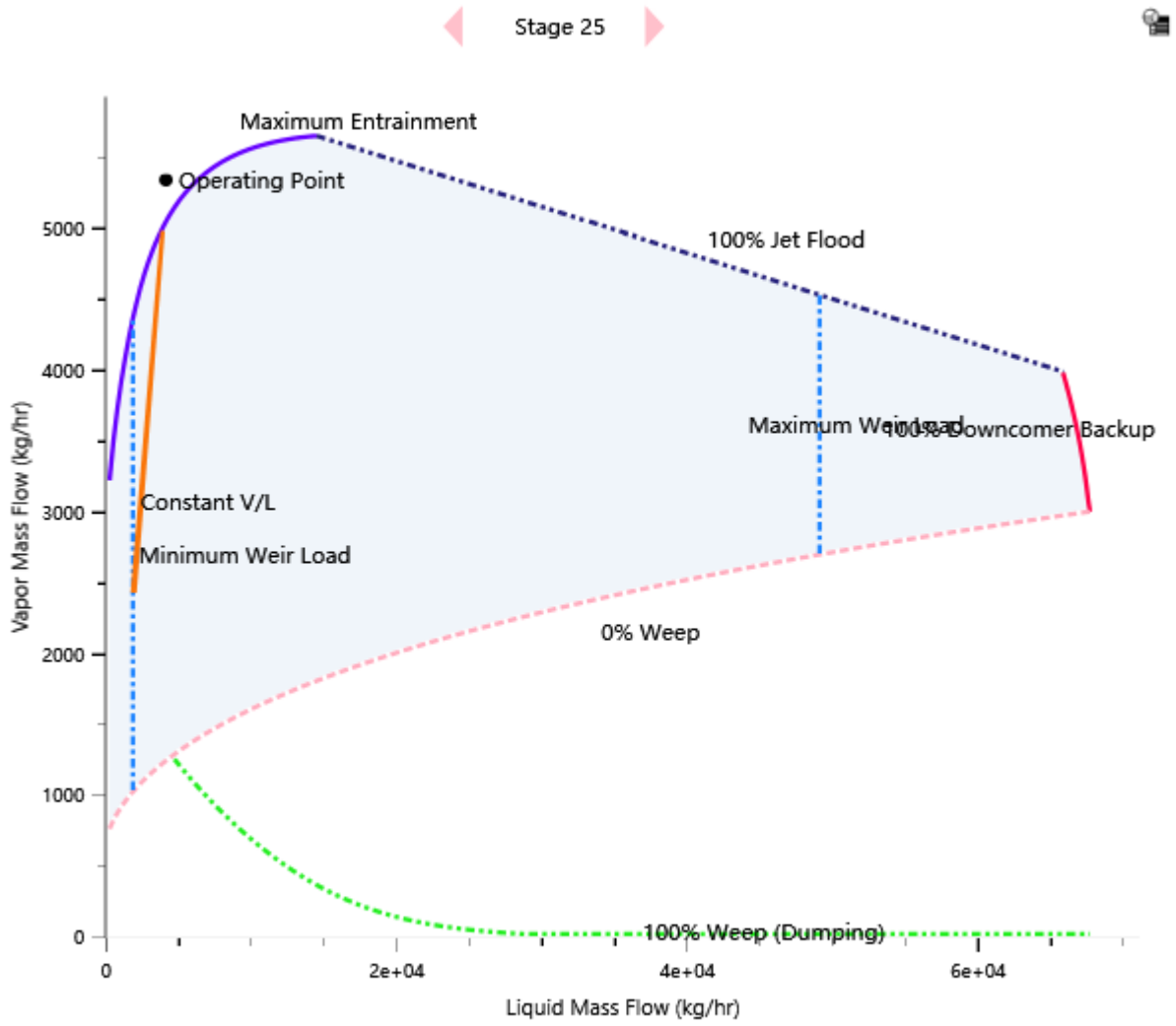

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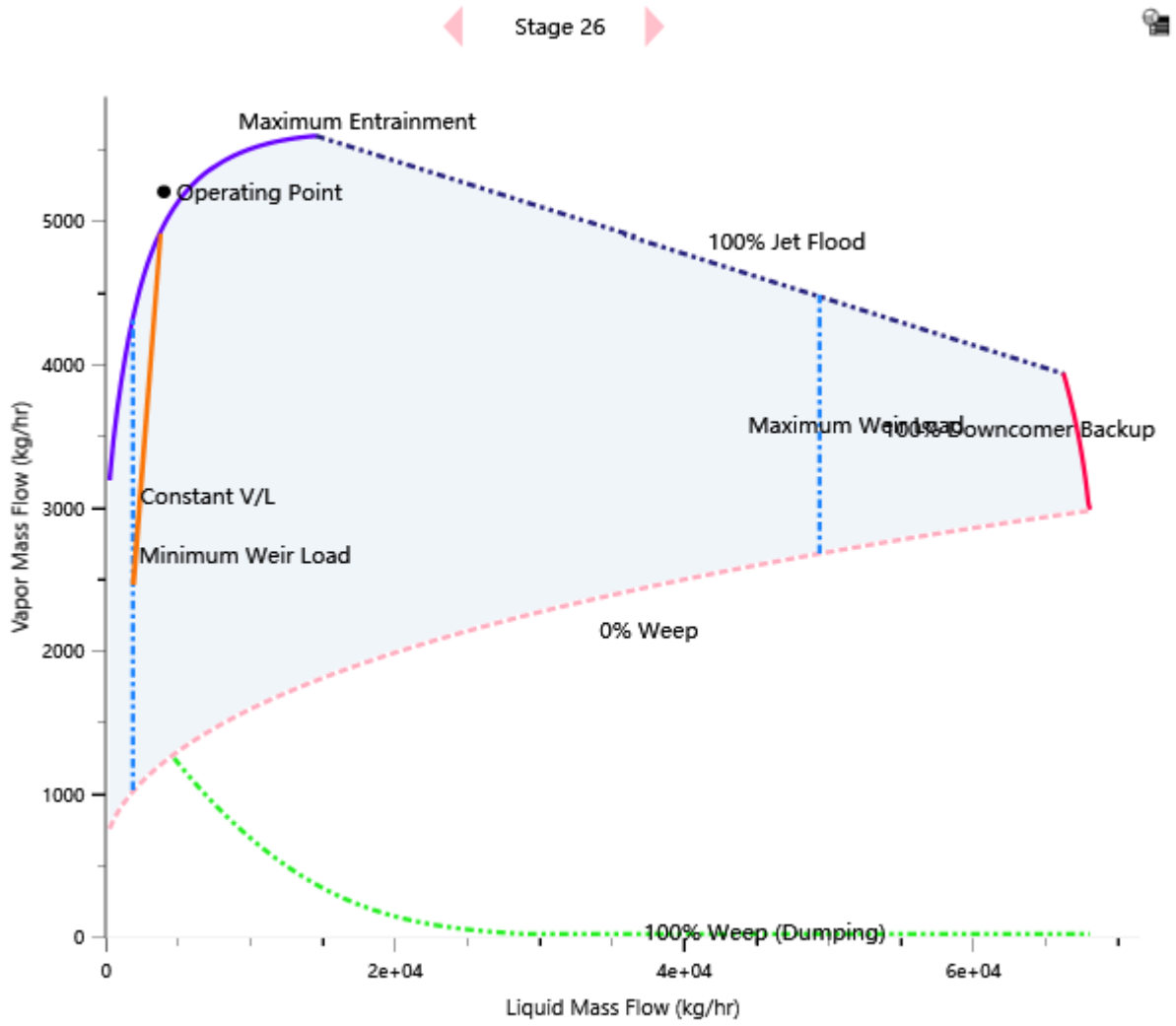

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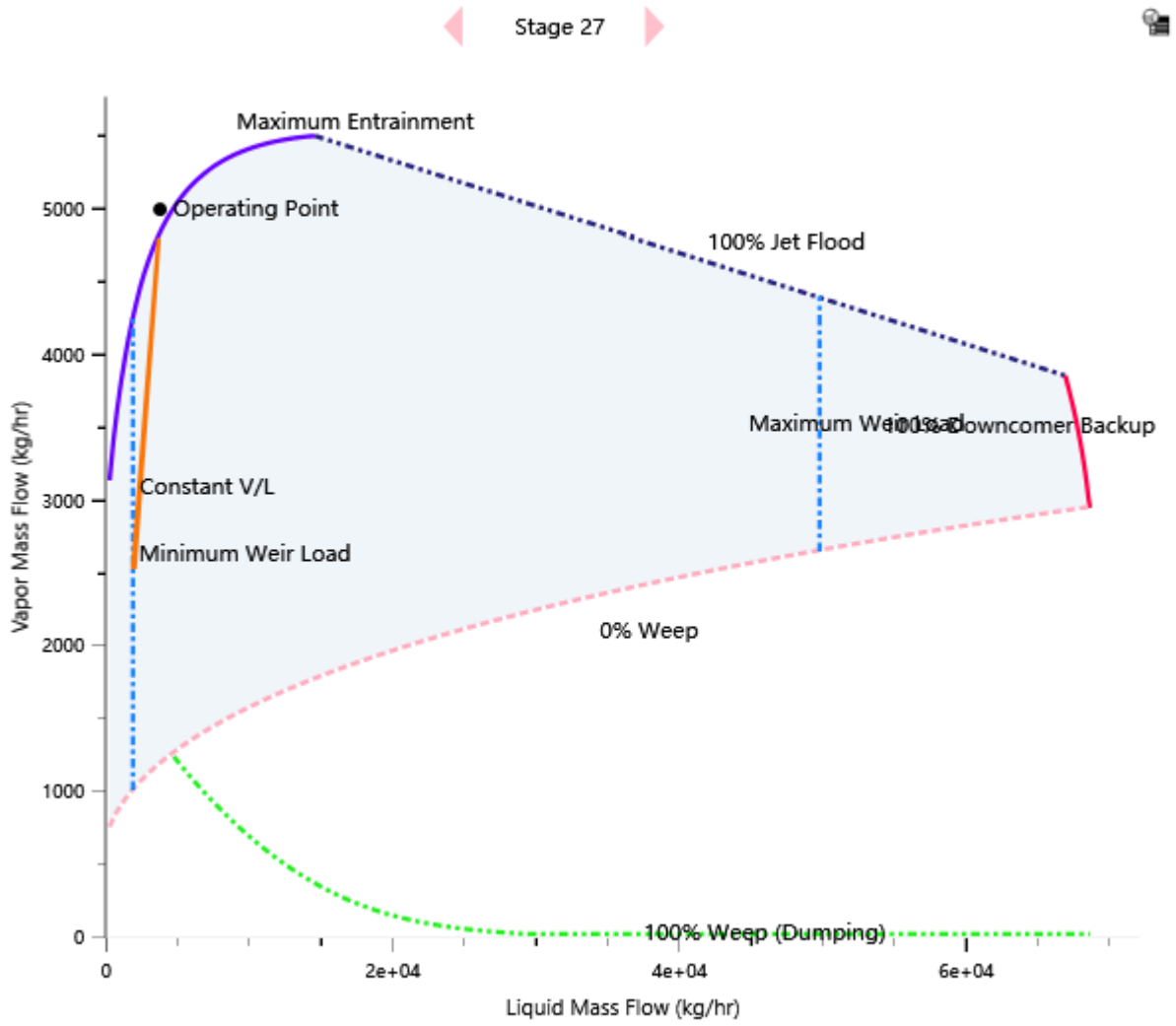

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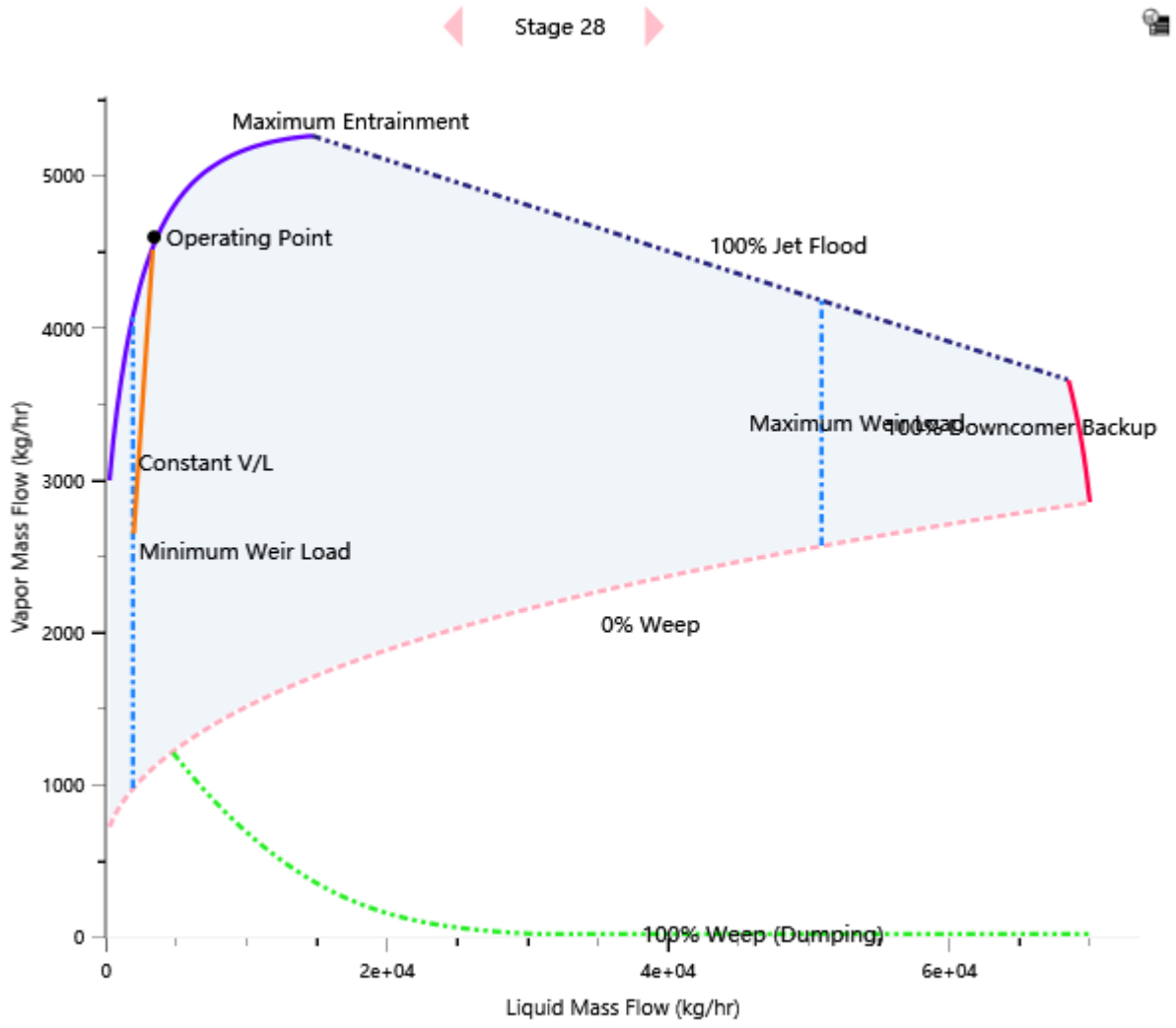
Project: Description:



Hydraulic Analysis Report - B2 : INT-1

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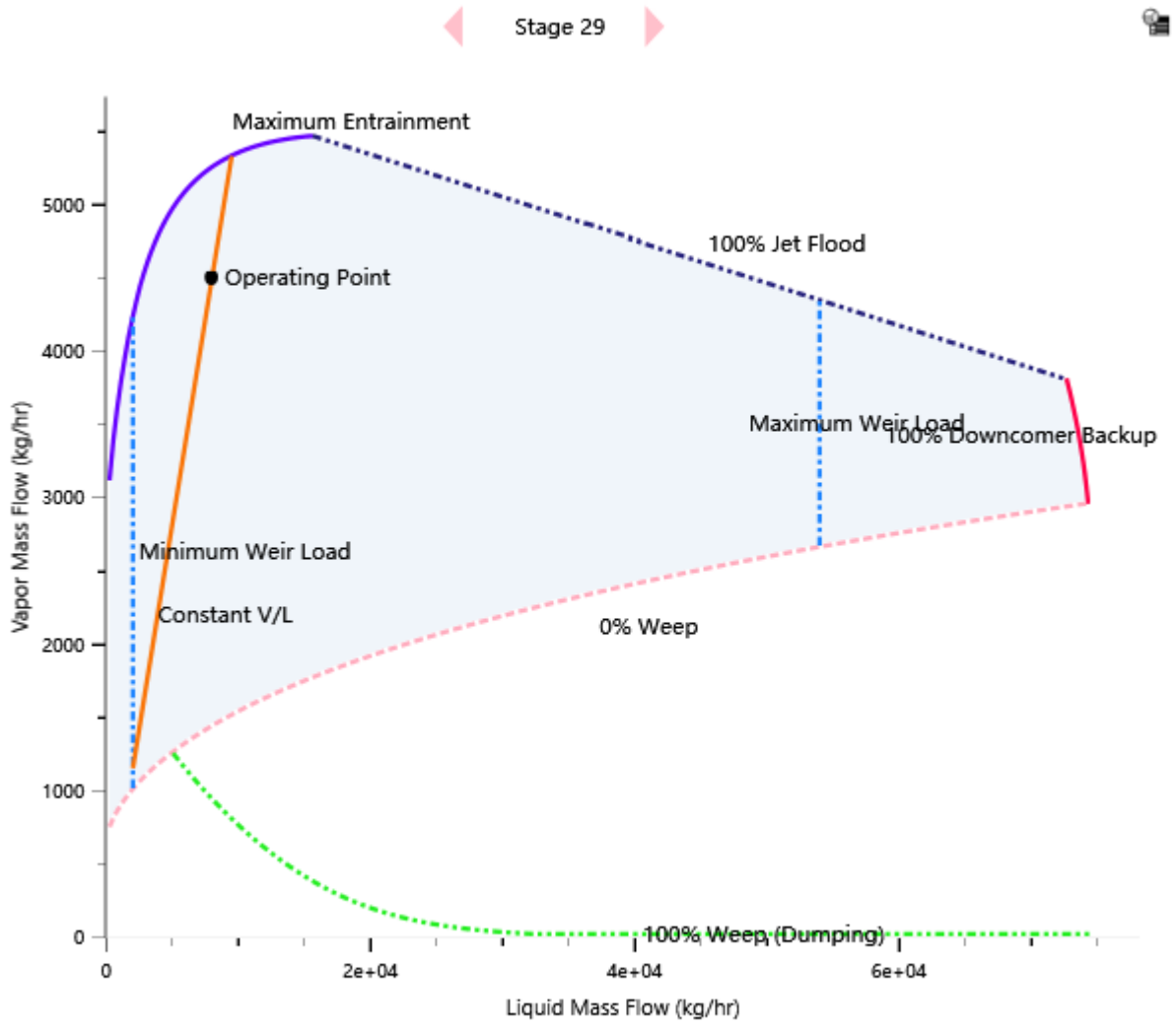
Project: Description:



Hydraulic Analysis Report - B2 : INT-1

User Name: Job Code:

Project: Description:

4. CS-2

4.1. Tray Geometry

Section

Property	Value	Unit
Tray type	SIEVE	
Diameter	0.761421	meter
Tray spacing	0.6096	meter
Number of passes	1	
Hole diameter	0.0127	meter
Hole area / Active area	0.1	
Number of Holes	288	
Deck gauge thickness	10 GAUGE	
Deck gauge thickness value	3.4	mm
Cross-sectional area	0.455344	sqm
Active area	0.364276	sqm
Net area	0.40981	sqm

Downcomer geometry

Property	Side	Unit
Downcomer clearance	0.0381	meter
Downcomer width top	0.119144	meter
Downcomer width bottom	0.119144	meter
Downcomer area top	0.0455344	sqm
Downcomer area bottom	0.0455344	sqm

Weir geometry

Property	Side	Unit
Weir height	0.0508	meter

Hydraulic Analysis Report - B2 : INT-1

User Name: Job Code:

Project: Description:

Property	Side	Unit
Weir length	0.553257	meter

Panels

Property	A	Unit
Flow path length	0.523134	meter

User Name: Job Code:

Project: Description:

4.2. Results Summary

Summary

Property	Value	Unit
Section starting stage	30	
Section ending stage	38	
Calculation Mode	Sizing	
Tray type	SIEVE	
Number of passes	1	
Tray spacing	0.6096	meter
Section Diameter	0.761421	meter
Section height	5.4864	meter
Section pressure drop	0.0785472	bar
Section head loss (Hot liquid height)	0.928431	meter
Trays with weeping	None	

Limiting conditions

Property	Value	Unit	Tray	Location
Maximum % jet flood	80.0003		30	
Maximum % downcomer backup (aerated)	35.9463		30	
Maximum downcomer loading	211.059	cum/hr/sqm	30	Side
Maximum % downcomer choke flood	34.5324		30	Side
Maximum weir loading	17.3707	cum/hr-meter	30	Side
Maximum aerated height over weir	0.093653	meter	30	
Maximum % approach to system limit	42.1172		30	

Hydraulic Analysis Report - B2 : INT-1

User Name: Job Code:

Project: Description:

Property	Value	Unit	Tray	Location
Maximum Cs based on bubbling area	0.101403	m/sec	30	

Messages Summary

Messages
The diameter is 0.7614 meter. We recommend that this column and any column with a diameter less than 0.9144 meter be designed so as not to exceed 75% jet flood.

User Name: Job Code:

Project: Description:

4.3. By Tray Results

4.3.1. Hydraulic Results

CS-2 Hydraulic results (1)

Stage	% Jet flood	Total pressure drop (bar)	% Downcomer backup (Aerated)	Dry pressure drop (bar)	Dry pressure drop (Hot liquid height) (meter)	Total pressure drop (Hot liquid height) (meter)	Downcomer backup (Aerated) (meter)
30	80.0003	0.0100649	35.9463	0.00786707	0.0965465	0.123518	0.237389
31	79.731	0.0100231	35.8258	0.00782048	0.0959635	0.122991	0.236594
32	79.1856	0.00992384	35.4981	0.00770885	0.0944563	0.121596	0.234429
33	77.4544	0.00958415	34.305	0.00732267	0.0890593	0.116564	0.22655
34	72.601	0.00867125	31.0669	0.00625753	0.0741479	0.102749	0.205166
35	67.3128	0.00776852	27.8577	0.00514518	0.0587292	0.0886731	0.183972
36	65.9428	0.00751541	26.903	0.00481687	0.0541123	0.0844274	0.177667
37	65.7765	0.0074743	26.7397	0.00476405	0.053354	0.0837068	0.176589
38	66.6243	0.00752185	26.826	0.00482694	0.0540363	0.0842051	0.177159

CS-2 Hydraulic results (2)

Stage	Downcomer backup (Unaerated) (meter)	% Downcomer backup (Unaerated)	Liquid mass rate / Column area (kg/hr-sqm)	Liquid volume rate / Column area (cum/hr/sqm)	Fs (net area) (sqrt(atm))	Fs (bubbling area) (sqrt(atm))	Cs (net area) (m/sec)
30	0.144295	21.8497	17537.2	21.1059	0.00815558	0.00917503	0.0901358
31	0.143812	21.7765	17520.9	21.0839	0.0081314	0.00914782	0.0898634
32	0.142498	21.5775	17420.1	20.932	0.00807315	0.0090823	0.0891544
33	0.137718	20.8537	16957.4	20.225	0.00786834	0.00885188	0.0865662
34	0.124741	18.8888	15558.7	18.0796	0.00727361	0.00818281	0.0789764
35	0.111877	16.9408	13962	15.6286	0.00659552	0.00741996	0.0702755
36	0.108049	16.3612	13379.3	14.7396	0.00638162	0.00717932	0.0674523
37	0.107395	16.2621	13267.1	14.5709	0.00634654	0.00713985	0.0669772
38	0.107741	16.3146	13185.5	14.4754	0.00638828	0.00718682	0.0674029

CS-2 Hydraulic results (3)

Hydraulic Analysis Report - B2 : INT-1

User Name: Job Code:

Project: Description:

Stage	Cs (bubbling area) (m/sec)	Side downcomer exit velocity (m/sec)	Approach to system limit (%)	% Side Downcomer Choke Flood	Height over weir (Aerated) (meter)	Height over weir (Unaerated) (meter)	Side downcomer volume (l)
30	0.101403	0.126646	42.1172	34.5324	0.093653	0.0162481	6.57041
31	0.101096	0.126513	41.9893	34.4964	0.0935197	0.0162427	6.54839
32	0.100299	0.125602	41.631	34.248	0.0929045	0.016179	6.48857
33	0.0973869	0.12136	40.2919	33.0911	0.0902031	0.0158649	6.2709
34	0.0888485	0.108486	36.4398	29.5809	0.072706	0.013225	5.68003
35	0.07906	0.0937791	32.2333	25.5708	0.0578505	0.0110489	5.09425
36	0.0758839	0.0884445	30.971	24.1162	0.0537706	0.0104569	4.91997
37	0.0753493	0.0874324	30.7858	23.8402	0.0530528	0.0103493	4.89017
38	0.0758282	0.0868593	30.9804	23.6839	0.0529124	0.010284	4.90594

CS-2 Hydraulic results (4)

Stage	Side downcomer residence time (hr)	Side downcomer velocity from top (m/sec)	Side downcomer velocity from bottom (m/sec)
30	0.000683672	0.0586276	0.0586276
31	0.000682093	0.0585664	0.0585664
32	0.000680765	0.0581446	0.0581446
33	0.000680928	0.0561806	0.0561806
34	0.000689958	0.050221	0.050221
35	0.000715846	0.0434128	0.0434128
36	0.000733055	0.0409433	0.0409433
37	0.000737049	0.0404748	0.0404748
38	0.000744306	0.0402095	0.0402095

User Name: Job Code:

Project: Description:

4.3.2. State Conditions

CS-2 State conditions

Stage	Liquid temperature (C)	Vapor temperature (C)	Liquid mass flow (kg/hr)	Vapor mass flow (kg/hr)	Liquid volume flow (l/min)	Vapor volume flow (l/min)
30	87.5404	87.6991	7985.46	4505.75	160.174	54259.8
31	87.6991	87.9246	7978.07	4498.35	160.007	54027.2
32	87.9246	88.4778	7932.14	4452.43	158.855	53805.3
33	88.4778	90.5338	7721.44	4241.72	153.489	53648.7
34	90.5338	96.625	7084.55	3604.83	137.207	53944.9
35	96.625	103.353	6357.5	2877.79	118.607	55561.5
36	103.353	106.032	6092.2	2612.48	111.86	57298.6
37	106.032	106.751	6041.1	2561.39	110.58	57800.8
38	106.751	120.689	6003.94	2524.23	109.855	59425.8

User Name: Job Code:

Project: Description:

4.3.3. Physical Properties

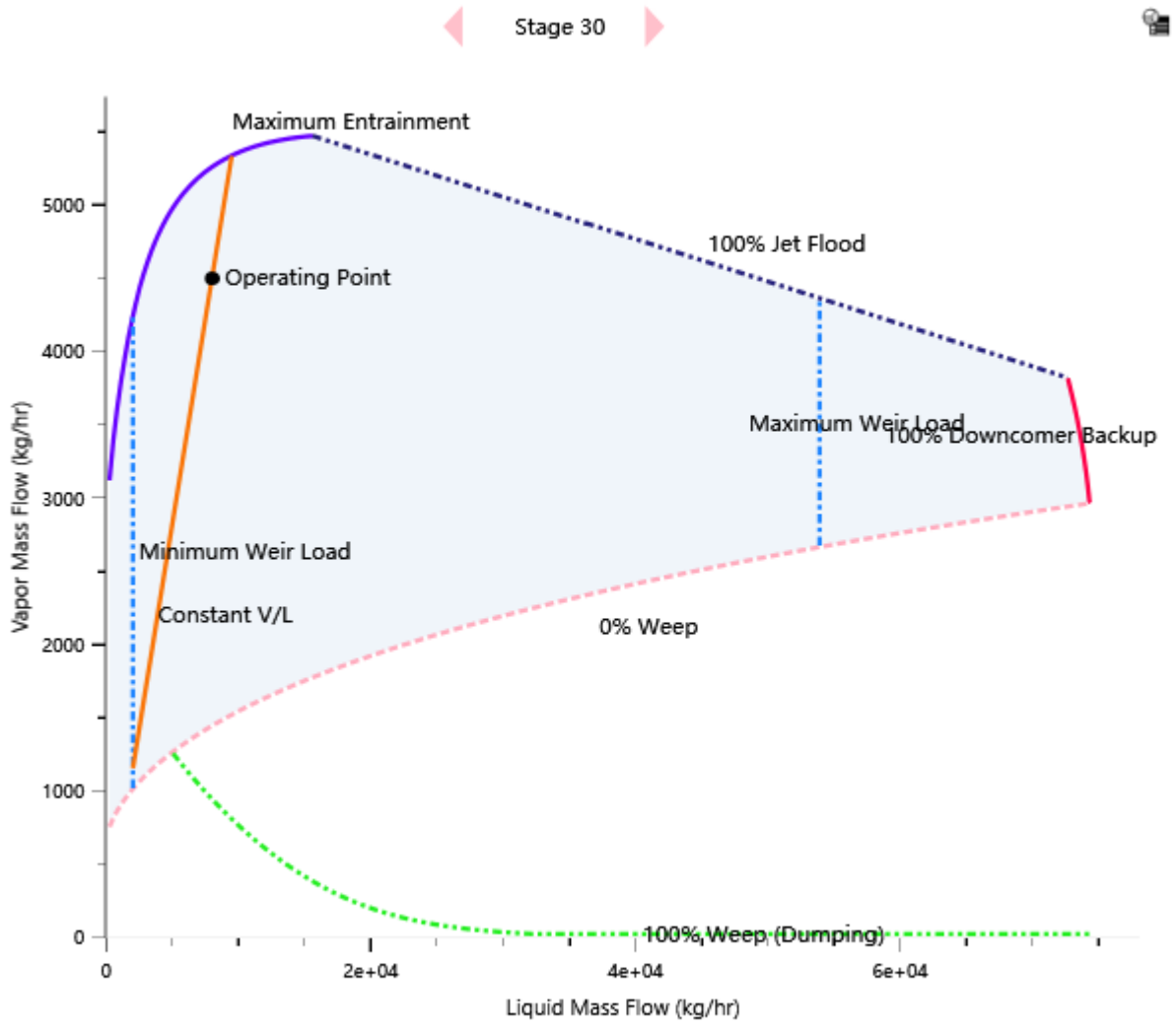
CS-2 Physical properties

Stage	Liquid molecular weight	Vapor molecular weight	Liquid mass density (gm/cc)	Vapor mass density (gm/cc)	Liquid viscosity (cP)	Vapor viscosity (cP)	Surface tension (dyne/cm)
30	24.3792	33.4837	0.830913	0.001384	0.33572	0.011656	50.6391
31	24.3522	33.4139	0.831011	0.00138768	0.334987	0.0116679	50.6546
32	24.2151	33.0831	0.83222	0.00137918	0.333749	0.0117078	50.8317
33	23.6036	31.6209	0.838435	0.00131775	0.330199	0.0118694	51.697
34	21.7084	27.0301	0.860565	0.00111374	0.318272	0.0123309	54.3027
35	19.3471	21.2201	0.893359	0.000863244	0.292255	0.0127396	56.8469
36	18.3179	18.7147	0.907713	0.000759903	0.269939	0.0128209	57.1393
37	18.0724	18.1292	0.910519	0.000738566	0.262144	0.0128326	56.9928
38	18.0243	18.0153	0.910889	0.00070795	0.260145	0.0133548	56.9258

User Name: Job Code:

Project: Description:

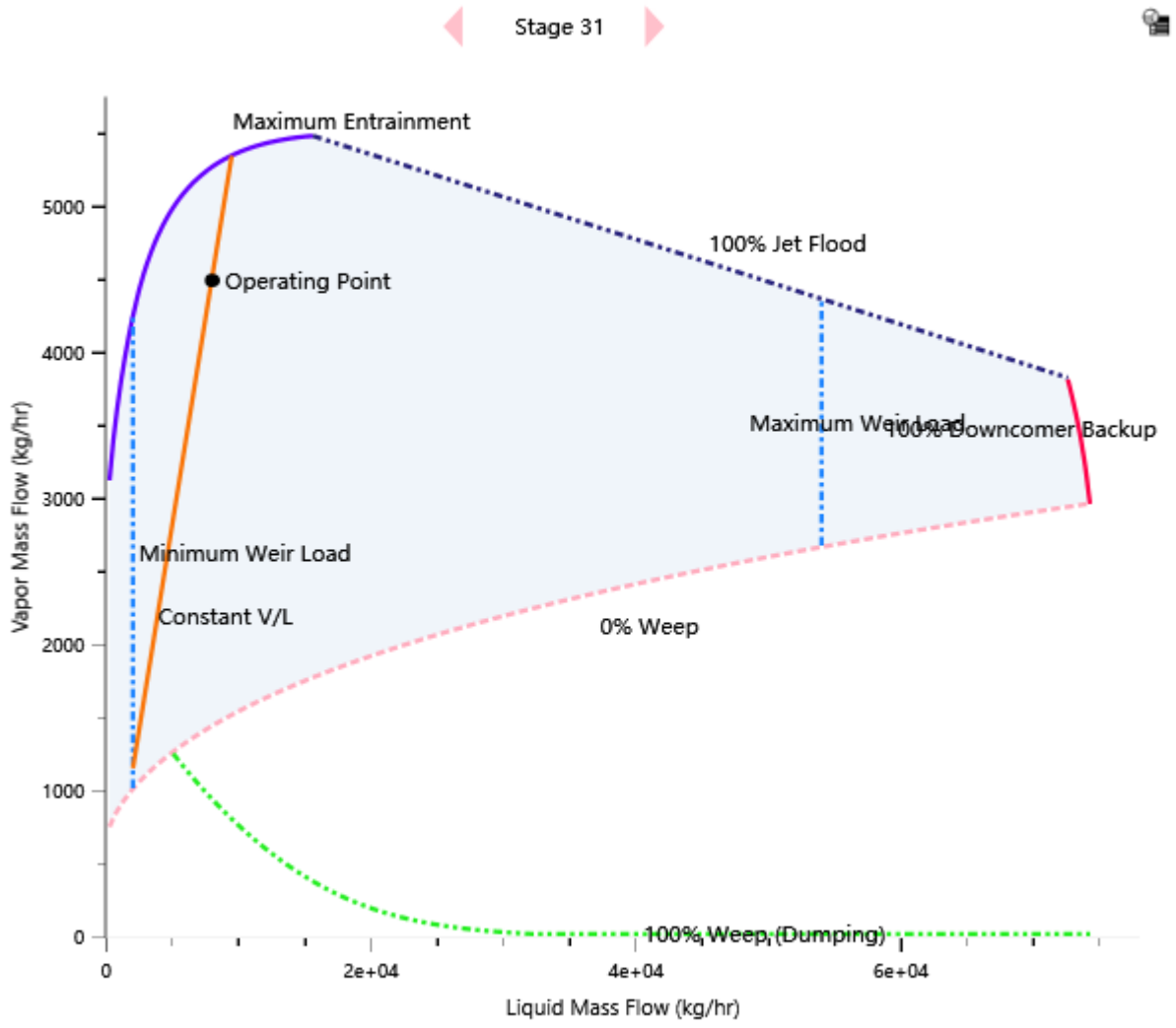
4.4. Hydraulic Plots



Hydraulic Analysis Report - B2 : INT-1

User Name: Job Code:

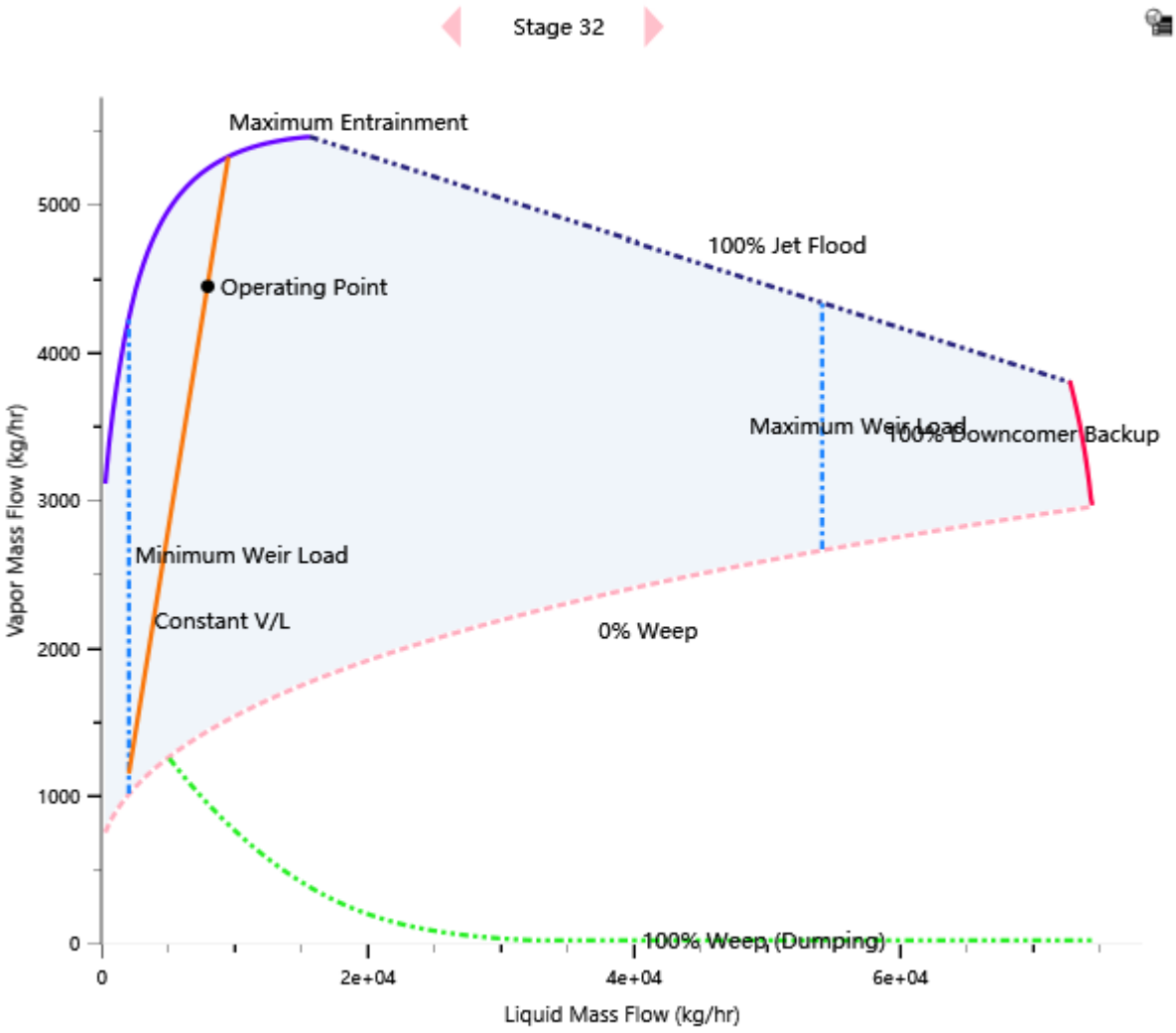
Project: Description:



Hydraulic Analysis Report - B2 : INT-1

User Name: Job Code:

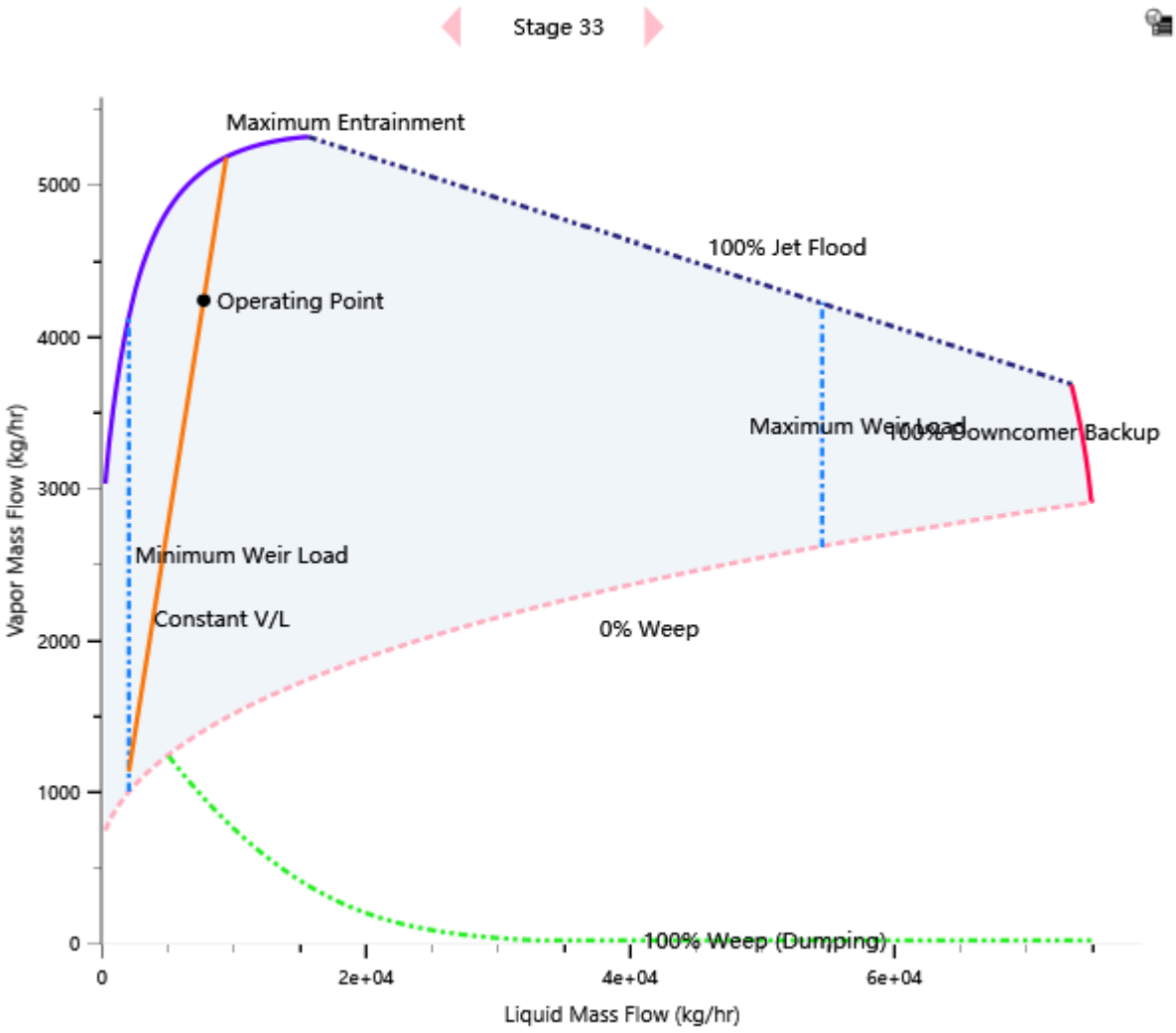
Project: Description:



Hydraulic Analysis Report - B2 : INT-1

User Name: Job Code:

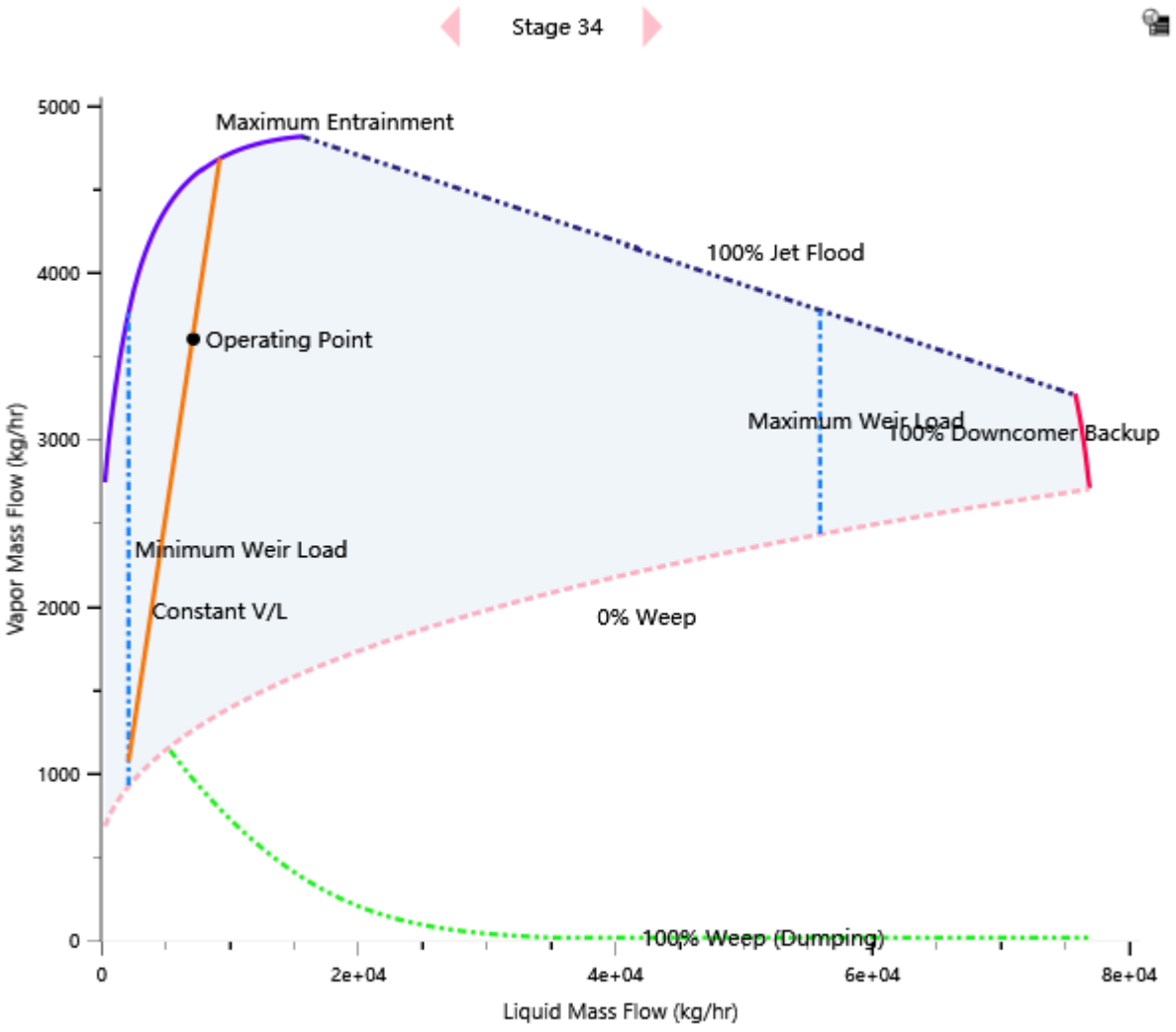
Project: Description:



Hydraulic Analysis Report - B2 : INT-1

User Name: Job Code:

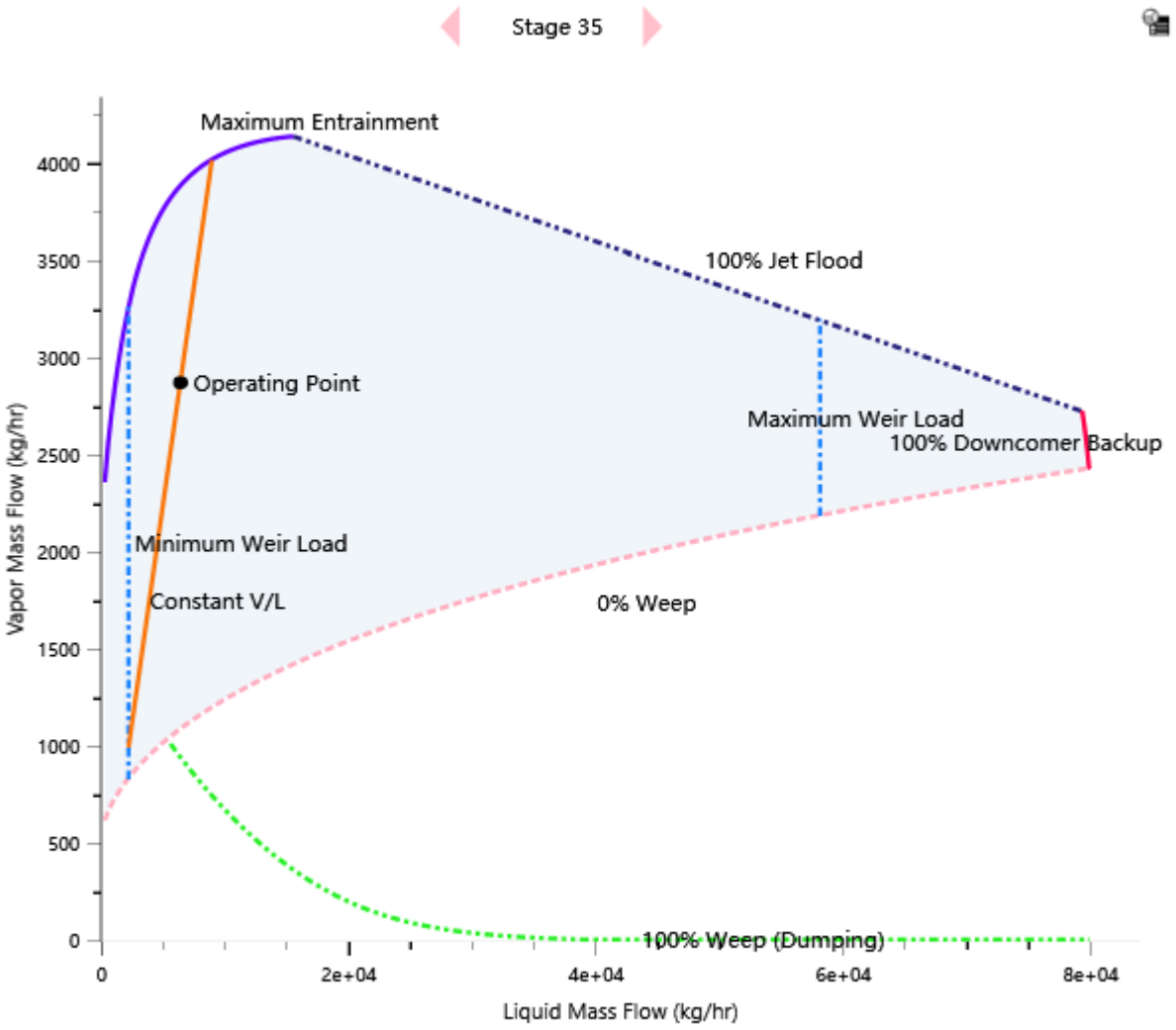
Project: Description:



Hydraulic Analysis Report - B2 : INT-1

User Name: Job Code:

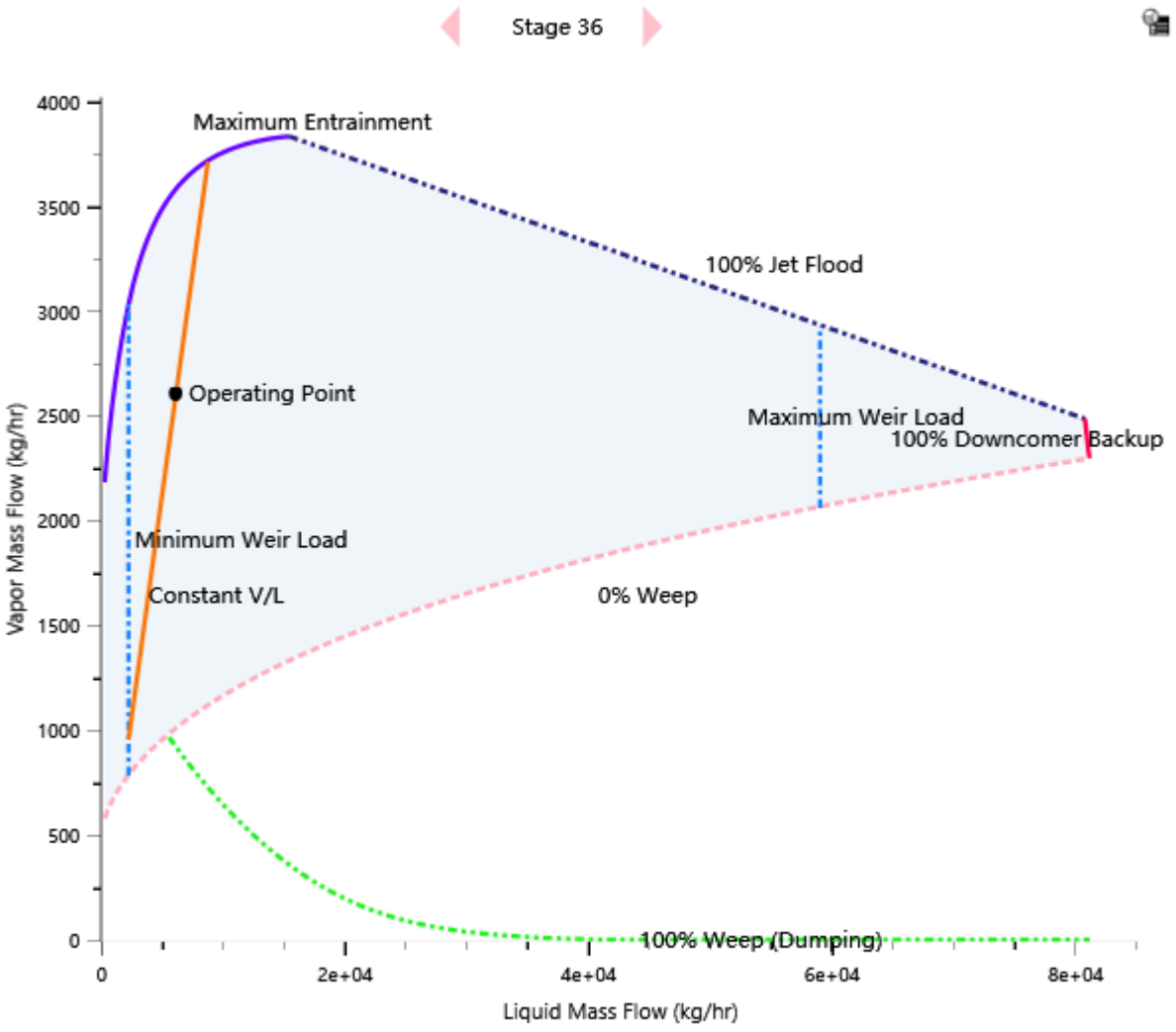
Project: Description:



Hydraulic Analysis Report - B2 : INT-1

User Name: Job Code:

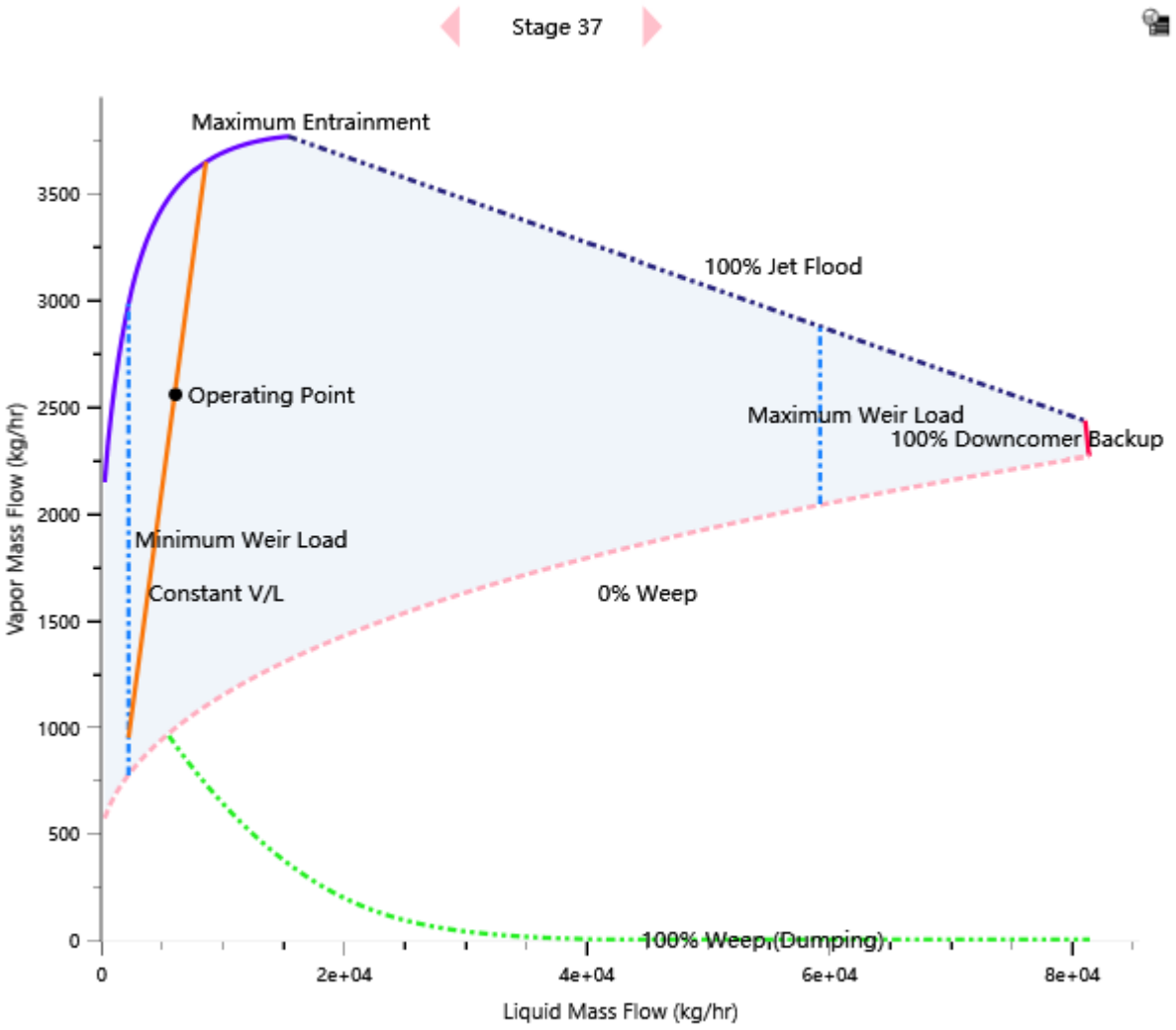
Project: Description:



Hydraulic Analysis Report - B2 : INT-1

User Name: Job Code:

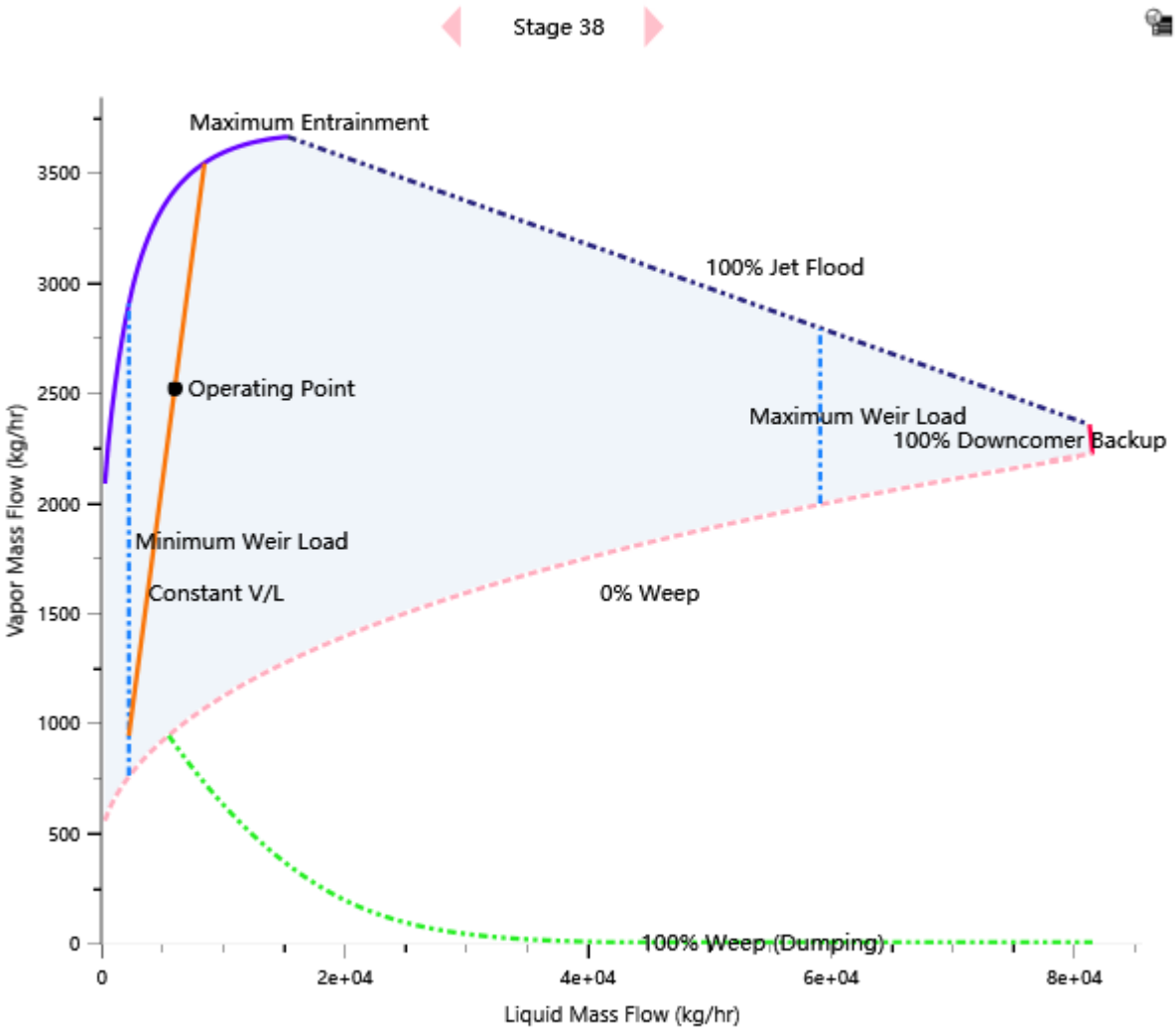
Project: Description:



Hydraulic Analysis Report - B2 : INT-1

User Name: Job Code:

Project: Description:



5. Column Profile

B2 Profile (1)

Tray/Stage	Liquid temperature (C)	Vapor temperature (C)	Liquid mass flow (kg/hr)	Vapor mass flow (kg/hr)	Liquid volume flow (l/min)
1	78.8227	78.9891	5947.55	5947.55	133.437
2	78.9891	79.1549	4683.31	5932.36	105.048
3	79.1549	79.3201	4668.82	5917.87	104.7
4	79.3201	79.4849	4654.87	5903.92	104.365
5	79.4849	79.6491	4641.31	5890.36	104.041

Hydraulic Analysis Report - B2 : INT-1

User Name: Job Code:

Project: Description:

Tray/Stage	Liquid temperature (C)	Vapor temperature (C)	Liquid mass flow (kg/hr)	Vapor mass flow (kg/hr)	Liquid volume flow (l/min)
6	79.6491	79.8129	4628	5877.06	103.723
7	79.8129	79.9762	4614.83	5863.89	103.408
8	79.9762	80.1392	4601.68	5850.73	103.093
9	80.1392	80.3019	4588.41	5837.47	102.775
10	80.3019	80.4645	4574.91	5823.97	102.452
11	80.4645	80.6269	4561.05	5810.1	102.118
12	80.6269	80.7895	4546.66	5795.71	101.771
13	80.7895	80.9523	4531.58	5780.64	101.406
14	80.9523	81.1156	4515.61	5764.66	101.017
15	81.1156	81.2799	4498.49	5747.55	100.599
16	81.2799	81.4454	4479.93	5728.99	100.143
17	81.4454	81.6128	4459.54	5708.6	99.6402
18	81.6128	81.783	4436.82	5685.87	99.0767
19	81.783	81.9572	4411.09	5660.14	98.4356
20	81.9572	82.1373	4381.42	5630.48	97.693
21	82.1373	82.3261	4346.52	5595.57	96.8153
22	82.3261	82.5285	4304.44	5553.5	95.7528
23	82.5285	82.7529	4252.2	5501.25	94.4287
24	82.7529	83.0155	4184.9	5433.95	92.7177
25	83.0155	83.351	4093.9	5342.95	90.3989
26	83.351	83.8465	3962.32	5211.37	87.0411
27	83.8465	84.7843	3751.87	5000.93	81.6691
28	84.7843	87.4329	3355.34	4604.4	71.5606
29	87.395	87.5404	7984.74	4505.03	160.134

Hydraulic Analysis Report - B2 : INT-1

User Name: Job Code:

Project: Description:

Tray/Stage	Liquid temperature (C)	Vapor temperature (C)	Liquid mass flow (kg/hr)	Vapor mass flow (kg/hr)	Liquid volume flow (l/min)
30	87.5404	87.6991	7985.46	4505.75	160.174
31	87.6991	87.9246	7978.07	4498.35	160.007
32	87.9246	88.4778	7932.14	4452.43	158.855
33	88.4778	90.5338	7721.44	4241.72	153.489
34	90.5338	96.625	7084.55	3604.83	137.207
35	96.625	103.353	6357.5	2877.79	118.607
36	103.353	106.032	6092.2	2612.48	111.86
37	106.032	106.751	6041.1	2561.39	110.58
38	106.751	120.689	6003.94	2524.23	109.855

B2 Profile (2)

Tray/Stage	Vapor volume flow (l/min)	Liquid molecular weight (kg/kmol)	Vapor molecular weight (kg/kmol)	Liquid mass density (gm/cc)	Vapor mass density (gm/cc)
1	65532.1	42.3121	42.3121	0.742866	0.00151263
2	65144.7	42.1779	42.206	0.743045	0.00151774
3	64762.5	42.0495	42.1047	0.743209	0.00152297
4	64385.4	41.9257	42.0069	0.743362	0.00152828
5	64013	41.8053	41.9117	0.743508	0.00153364
6	63645.3	41.6871	41.8183	0.743651	0.00153901
7	63282	41.57	41.7259	0.743792	0.00154438
8	62922.9	41.4532	41.6337	0.743935	0.00154971
9	62567.9	41.3356	41.5408	0.744084	0.00155497
10	62216.8	41.2162	41.4464	0.74424	0.00156013
11	61869.5	41.0939	41.3498	0.744408	0.00156515
12	61525.7	40.9673	41.2498	0.744591	0.00157

Hydraulic Analysis Report - B2 : INT-1

User Name: Job Code:

Project: Description:

Tray/Stage	Vapor volume flow (l/min)	Liquid molecular weight (kg/kmol)	Vapor molecular weight (kg/kmol)	Liquid mass density (gm/cc)	Vapor mass density (gm/cc)
13	61185.2	40.8351	41.1455	0.744795	0.00157463
14	60847.9	40.6957	41.0353	0.745024	0.00157898
15	60513.5	40.5469	40.9179	0.745286	0.00158299
16	60181.7	40.3863	40.7911	0.745588	0.00158658
17	59852.2	40.2108	40.6525	0.745941	0.00158964
18	59524.6	40.0161	40.4988	0.746361	0.00159202
19	59198.3	39.7968	40.3258	0.746865	0.00159355
20	58872.8	39.5452	40.1273	0.747482	0.00159397
21	58547.1	39.2506	39.895	0.74825	0.0015929
22	58219.9	38.8971	39.6162	0.749229	0.00158981
23	57889.3	38.4601	39.2718	0.750513	0.00158384
24	57552.5	37.8993	38.8302	0.752265	0.00157362
25	57204.7	37.1439	38.2357	0.754784	0.00155668
26	56838.2	36.0553	37.3801	0.758707	0.00152813
27	56442.4	34.3197	36.0191	0.765665	0.0014767
28	56336.8	31.0555	33.4711	0.781469	0.00136216
29	54496.2	24.3831	33.4986	0.831048	0.00137778
30	54259.8	24.3792	33.4837	0.830913	0.001384
31	54027.2	24.3522	33.4139	0.831011	0.00138768
32	53805.3	24.2151	33.0831	0.83222	0.00137918
33	53648.7	23.6036	31.6209	0.838435	0.00131775
34	53944.9	21.7084	27.0301	0.860565	0.00111374
35	55561.5	19.3471	21.2201	0.893359	0.000863244
36	57298.6	18.3179	18.7147	0.907713	0.000759903

Hydraulic Analysis Report - B2 : INT-1

User Name: Job Code:

Project: Description:

Tray/Stage	Vapor volume flow (l/min)	Liquid molecular weight (kg/kmol)	Vapor molecular weight (kg/kmol)	Liquid mass density (gm/cc)	Vapor mass density (gm/cc)
37	57800.8	18.0724	18.1292	0.910519	0.000738566
38	59425.8	18.0243	18.0153	0.910889	0.00070795

B2 Profile (3)

Tray/Stage	Liquid viscosity (cP)	Vapor viscosity (cP)	Surface tension (dyne/cm)
1	0.424677	0.0107472	23.3721
2	0.423259	0.0107601	23.5694
3	0.421867	0.0107726	23.7572
4	0.420497	0.0107849	23.9376
5	0.419147	0.0107969	24.1126
6	0.417811	0.0108088	24.2839
7	0.416488	0.0108206	24.4532
8	0.415174	0.0108324	24.6221
9	0.413866	0.0108442	24.7921
10	0.412561	0.0108562	24.9649
11	0.411255	0.0108683	25.1424
12	0.409943	0.0108806	25.3264
13	0.408622	0.0108934	25.5192
14	0.407286	0.0109065	25.7234
15	0.405929	0.0109203	25.9422
16	0.404542	0.0109348	26.1796
17	0.403115	0.0109503	26.4406
18	0.401634	0.0109669	26.7316
19	0.400081	0.0109852	27.0613

Hydraulic Analysis Report - B2 : INT-1

User Name: Job Code:

Project: Description:

Tray/Stage	Liquid viscosity (cP)	Vapor viscosity (cP)	Surface tension (dyne/cm)
20	0.39843	0.0110055	27.4416
21	0.396646	0.0110287	27.8893
22	0.394673	0.0110557	28.4294
23	0.392428	0.0110882	29.1002
24	0.389769	0.0111291	29.9643
25	0.386444	0.0111833	31.132
26	0.381954	0.0112612	32.8178
27	0.375154	0.0113883	35.5055
28	0.3628	0.0116483	40.5436
29	0.336352	0.0116499	50.6578
30	0.33572	0.011656	50.6391
31	0.334987	0.0116679	50.6546
32	0.333749	0.0117078	50.8317
33	0.330199	0.0118694	51.697
34	0.318272	0.0123309	54.3027
35	0.292255	0.0127396	56.8469
36	0.269939	0.0128209	57.1393
37	0.262144	0.0128326	56.9928
38	0.260145	0.0133548	56.9258