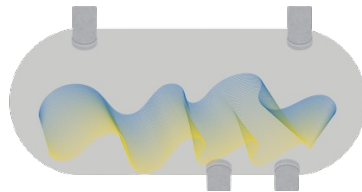# Oil and Gas Separation: Liquid in Gas Carry Over Report

EQUIPMENT TAG
Equipment Tag with Description

Project Name: Default Project

Client Name: Company Name

Contractor Name: Contractor Name

Prepared By: Prepared By Name

Revision No.: Rev 0

Date: 2025-08-14 15:47:37

Oil and Gas Separation: Liquid in Gas Carry Over Report

Results

Separator Performance Summary

Parameter	Value
Mean particle diameter dv50 at the inlet (estimated)	3087.95 um
Inlet flow regime	Annular
Entrainment at inlet pipe	1.19 %
Entrainment after Inlet Device	7734.79 kg/hr
Inlet device efficiency	98.81 %
Entrainment after Gravity Settling Section	2331.22 kg/hr
Gravity Settling Section efficiency	69.86 %
Entrainment after Mist Extractor Section	5.72 kg/hr
Mist extractor efficiency	99.75 %
Separator Performance - Liquid Carryover	0.2196 US Gal / MMSCF

Oil and Gas Separation: Liquid in Gas Carry Over Report

1. Input Parameters (SI Units)

Pipe Inside Diameter (D): 0.7000 m

Liquid Density (rho_l): 730.70 kg/m³

Liquid Viscosity (mu_l): 0.00074300 Pa.s

Gas Density (rho_g): 35.00000 kg/m³

Gas Viscosity (mu_g): 0.000014880 Pa.s

Liquid Surface Tension (sigma): 0.022 N/m

Selected Inlet Device: No inlet device

Total Liquid Mass Flow Rate: 180.00 kg/s

Number of Points for Distribution: 20

-----Separator Type: Horizontal-----

Gas Space Height (hg): 1.600 m

Effective Separation Length (Le): 12.000 m

Length from Inlet Device to Mist Extractor (L_to_ME): 1.000 m

Perforated Plate Used: No

Operating Pressure: 500.0 psig

-----Mist Extractor Type: Mesh Pad-----

Mesh Pad Type: Standard mesh pad
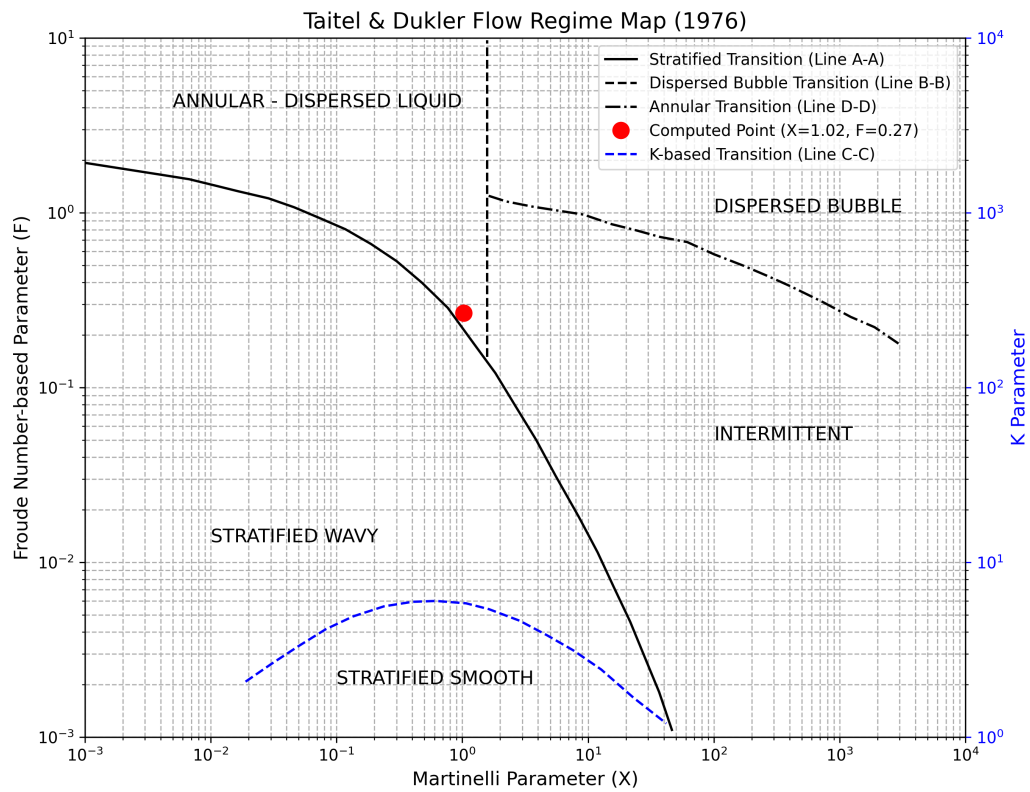
Mesh Pad Thickness: 6.00 in

2. Flow Regime Analysis

Martinelli Parameter (X) = 1.02

Froude Number-based Parameter (F) = 0.27

K Parameter (K) = 177.21

The calculated flow regime is: Annular

Oil and Gas Separation: Liquid in Gas Carry Over Report

3. Calculation Results

Inputs Used for Calculation (Converted to FPS for internal calculation):

Pipe Inside Diameter (D): 2.30 ft

Liquid Density (rho_l): 45.62 lb/ft^3

Liquid Viscosity (mu_l): 0.0004993 lb/ft-sec

Superficial Gas Velocity (Vg): 12.18 ft/sec

Gas Density (rho_g): 2.1850 lb/ft^3

Gas Viscosity (mu_g): 0.00001000 lb/ft-sec

Liquid Surface Tension (sigma): 0.0484 poundal/ft

Liquid Mass Flow Rate: 180.00 kg/s

Gas Mass Flow Rate: 50.00 kg/s

Operating Pressure: 500.0 psig

Step 1: Calculate Superficial Gas Reynolds Number (Re_g)

$$Re_g = \frac{D \cdot V_g \cdot \rho_g}{\mu_g}$$

Calculation (FPS): Re_g = (2.30 ft * 12.18 ft/sec * 2.1850 lb/ft^3) / 0.00001000 lb/ft-sec = 6115026.18

Result: Superficial Gas Reynolds Number (Re_g) = 6115026.18 (dimensionless)

Step 2: Calculate Initial Volume Median Diameter (d_v50) (Kataoka et al., 1983)

$$d_{v50} = 0.01 \cdot \frac{\sigma}{\rho_g V_g^2} \cdot Re_g^{2/3} \cdot \left(\frac{\rho_g}{\rho_l}\right)^{-1/3} \cdot \left(\frac{\mu_g}{\mu_l}\right)^{2/3}$$

Calculation (FPS): d_v50 = 0.01 * (0.0484 / (2.1850 * 12.18^2)) * (6115026.18)^(2/3) * (2.1850 / 45.62)^(-1/3) * (0.00001000 / 0.0004993)^(2/3) = 0.010131 ft

Result: Initial Volume Median Diameter (d_v50) = 3087.95 um (0.003088 m)

Step 3: Calculate Inlet Momentum (rho_m V_m^2)

Equation: rho_m * V_m^2

Calculation (FPS): rho_m V_m^2 = 8.5727 lb/ft³ * (14.282^2) = 1747.82 lb/ft-sec^2

Result: Inlet Momentum (rho_m V_m^2) = 2601.03 Pa

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Step 4: Liquid Separation Efficiency / Droplet Size Distribution Shift Factor

Selected Inlet Device: No inlet device

Estimated Shift Factor : 0.080

Equation: d_v50,adjusted = d_v50,original * Shift Factor

Calculation (FPS): d_v50,adjusted = 0.010131 ft * 0.080 = 0.000810 ft

Result: Adjusted Volume Median Diameter (d_v50) = 247.04 um (0.000247 m)

Step 5: Calculate Parameters for Upper-Limit Log Normal Distribution

Using typical values, a = 4.0 and delta = 0.72. (Pan and Hanratty)

For Original d_v50:

Equation: d_max, original = a * d_v50, original

Calculation (FPS): d_max,original = 4.0 * 0.010131 ft = 0.040524 ft

Result: Maximum Droplet Size (Original d_max) = 12351.78 um (0.012352 m)

For Adjusted d_v50:

Equation: d_max, adjusted = a * d_v50,adjusted

Calculation (FPS): d_max,adjusted = 4.0 * 0.000810 ft = 0.003242 ft

Result: Maximum Droplet Size (Adjusted d_max) = 988.14 um (0.000988 m)

Step 6: Calculate Entrainment Fraction (E)

The entrainment fraction is calculated using the following correlation (Pan and Hanratty (2002)) :

$$\frac{\left(\frac{E}{E_M}\right)}{1 - \left(\frac{E}{E_M}\right)} = A_2 \left(\frac{DU_G^3 \rho_L^{0.5} \rho_G^{0.5}}{\sigma}\right) \left(\frac{\rho_G^{1-m} \mu_G^m}{d^{1+m} g \rho_L}\right)^{\frac{1}{2-m}}$$

$$\left(\frac{\rho_G U_G^2 d_{32}}{\sigma}\right) \left(\frac{d_{32}}{D}\right) = 0.0091$$

Gas Velocity (UG): 3.71 m/s

Liquid Loading (WL): 180.00 kg/s

Result: Entrainment Fraction (E) = 0.0119 (dimensionless)

Result: Total Entrained Liquid Mass Flow Rate = 2.1486 kg/s

Result: Total Entrained Liquid Volume Flow Rate = 0.002940 m³/s

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Step 7: Calculate F-factor and Effective Gas Velocity in Separator

L/Di Ratio (L_to_ME / D_pipe): 0.50

Inlet Device: No inlet device

Perforated Plate Used: No

Calculated F-factor: 2.750

Effective Gas Velocity = Gas Velocity * F-Factor

Effective Gas Velocity in Separator (V_g_effective_separator): 1.25 m/s

L/Di Ratio (L_to_ME / D_pipe): 0.50

Oil and Gas Separation: Liquid in Gas Carry Over Report

Step 8: Gas Gravity Separation Section Efficiency

Separator Type: Horizontal

Gas Space Height (hg): 1.600 m

Effective Separation Length (Le): 12.000 m

Overall Separation Efficiency of Gravity Section: 69.86%

Total Entrained Liquid Mass Flow Rate After Gravity Settling: 0.6476 kg/s, (2331.2189 kg/hr)

Total Entrained Liquid Volume Flow Rate After Gravity Settling: 0.000886 m³/s, (3.1904 m3/hr)

Detailed Separation Performance in Gas Gravity Section

Droplet Size (um)	Vt (ft/s)	Cd	Re_p	Flow Regime	Time Settle (s)	h_max_settle (ft)	Efficiency (Edp)
2	0.00	25000.0000	0.0	Stokes'	9983.983	0.005	0.10%
3	0.00	12133.8695	0.0	Stokes'	5941.138	0.008	0.16%
5	0.00	4747.4439	0.0	Stokes'	3174.213	0.016	0.30%
6	0.00	2083.6822	0.0	Stokes'	1796.214	0.028	0.53%
9	0.01	963.6144	0.0	Stokes'	1043.350	0.048	0.92%
12	0.01	289.9245	0.1	Stokes'	488.829	0.103	1.96%
16	0.02	116.8597	0.2	Stokes'	265.084	0.190	3.62%
22	0.04	44.8961	0.6	Stokes'	140.343	0.359	6.84%
31	0.07	18.8735	1.5	Stokes'	77.723	0.648	12.35%
42	0.14	5.9075	4.3	Intermediate	37.142	1.356	25.84%
58	0.26	2.4308	10.7	Intermediate	20.350	2.475	47.15%
79	0.41	1.3480	23.0	Intermediate	12.944	3.892	74.13%
109	0.66	0.6920	51.6	Intermediate	7.922	6.359	100.00%
149	0.90	0.5127	96.2	Intermediate	5.824	8.649	100.00%
204	1.14	0.4400	166.6	Intermediate	4.609	10.930	100.00%
280	1.39	0.4042	279.0	Intermediate	3.773	13.351	100.00%
383	1.64	0.4000	450.0	Intermediate	3.206	15.713	100.00%
525	1.92	0.4000	722.2	Newton's	2.738	18.396	100.00%
720	2.24	0.4000	1158.8	Newton's	2.339	21.537	100.00%
987	2.63	0.4000	1859.6	Newton's	1.998	25.215	100.00%

Oil and Gas Separation: Liquid in Gas Carry Over Report

Step 9: Mist Extractor Performance

Mist Extractor Type: Mesh Pad

Mesh Pad Type: Standard mesh pad

Mesh Pad Thickness: 6.00 in

Wire Diameter: 0.011 in

Specific Surface Area: 85.0 ft^2/ft^3

Overall Separation Efficiency of Mist Extractor: 99.75%

Total Entrained Liquid Mass Flow Rate After Mist Extractor: 0.0016 kg/s

Total Entrained Liquid Volume Flow Rate After Mist Extractor: 0.000002 m³/s

Detailed Separation Performance in Mist Extractor Section

Droplet Size (um)	Ew	Epad
2	0.00%	0.00%
3	3.47%	29.60%
5	16.28%	80.74%
6	33.01%	96.45%
9	51.27%	99.44%
12	67.72%	99.89%
16	80.15%	99.97%
22	88.36%	99.99%
31	93.31%	99.99%
42	96.13%	99.99%
58	97.69%	99.99%
79	98.53%	100.00%
109	98.98%	100.00%
149	99.23%	100.00%
204	99.35%	100.00%
280	99.42%	100.00%
383	99.46%	100.00%
525	99.48%	100.00%
720	99.49%	100.00%
987	99.49%	100.00%

Final Carry-Over from Separator Outlet:
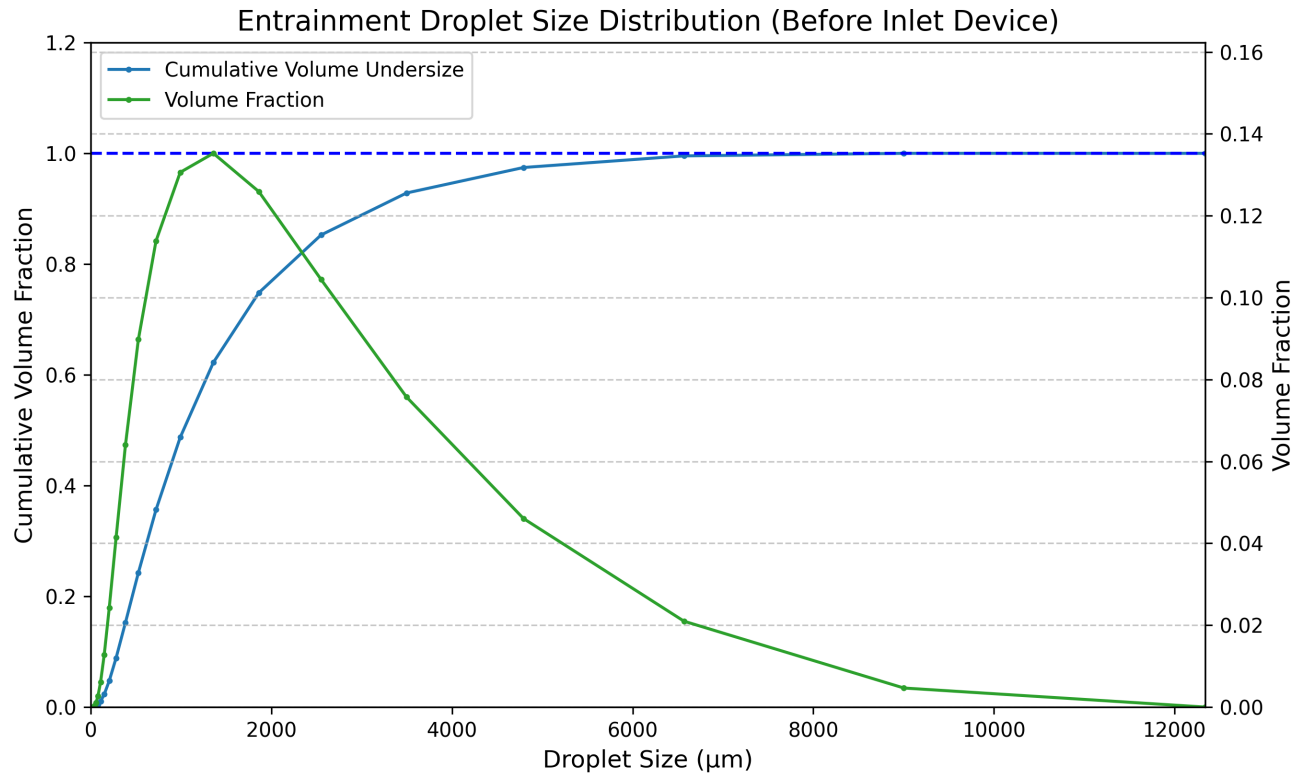
Total Carry-Over Mass Flow Rate: 0.0016 kg/s

Total Carry-Over Volume Flow Rate: 0.000002 m³/s

4. Droplet Distribution Results

The following graphs show the calculated entrainment droplet size distribution:

4.1. Distribution at Inlet

4.2. Distribution after Inlet Device

Entrainment Droplet Size Distribution (After Inlet Device)

4.3. Distribution after Gravity Settling Section

Entrainment Droplet Size Distribution (after Gravity Settling)
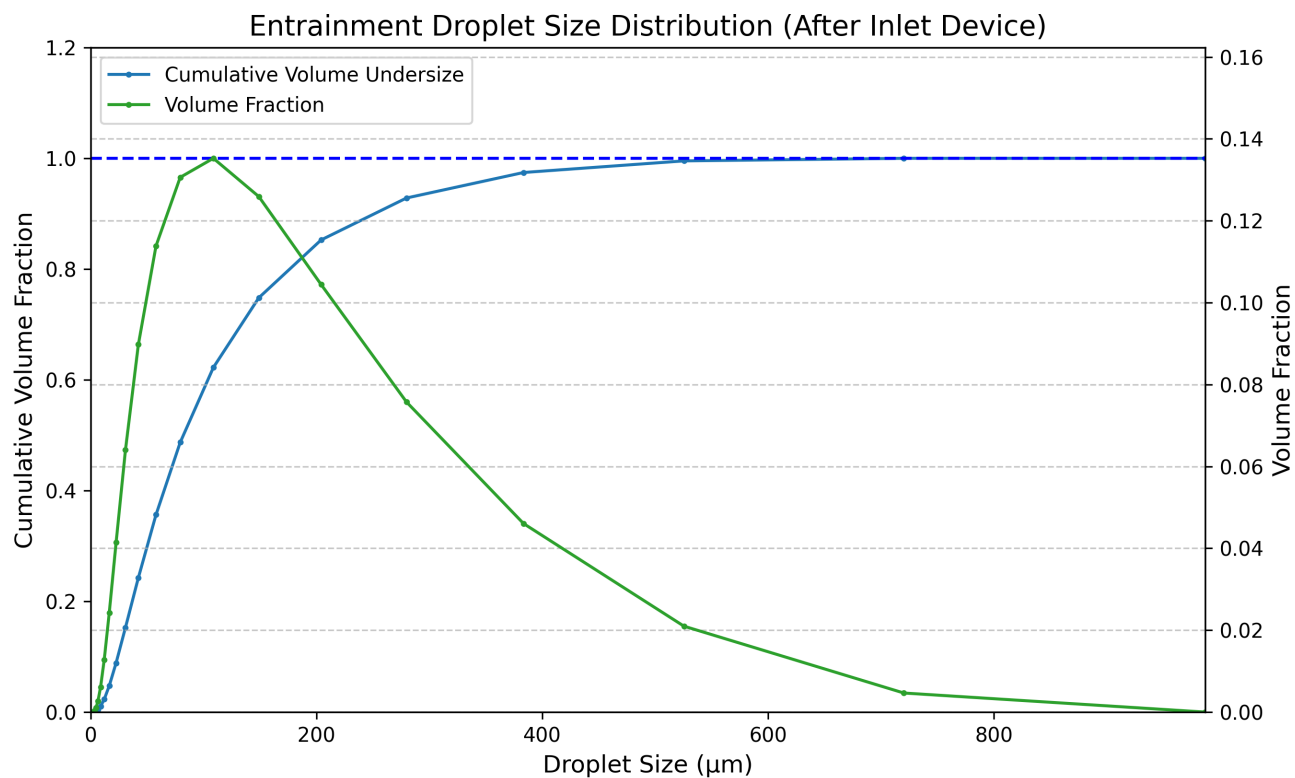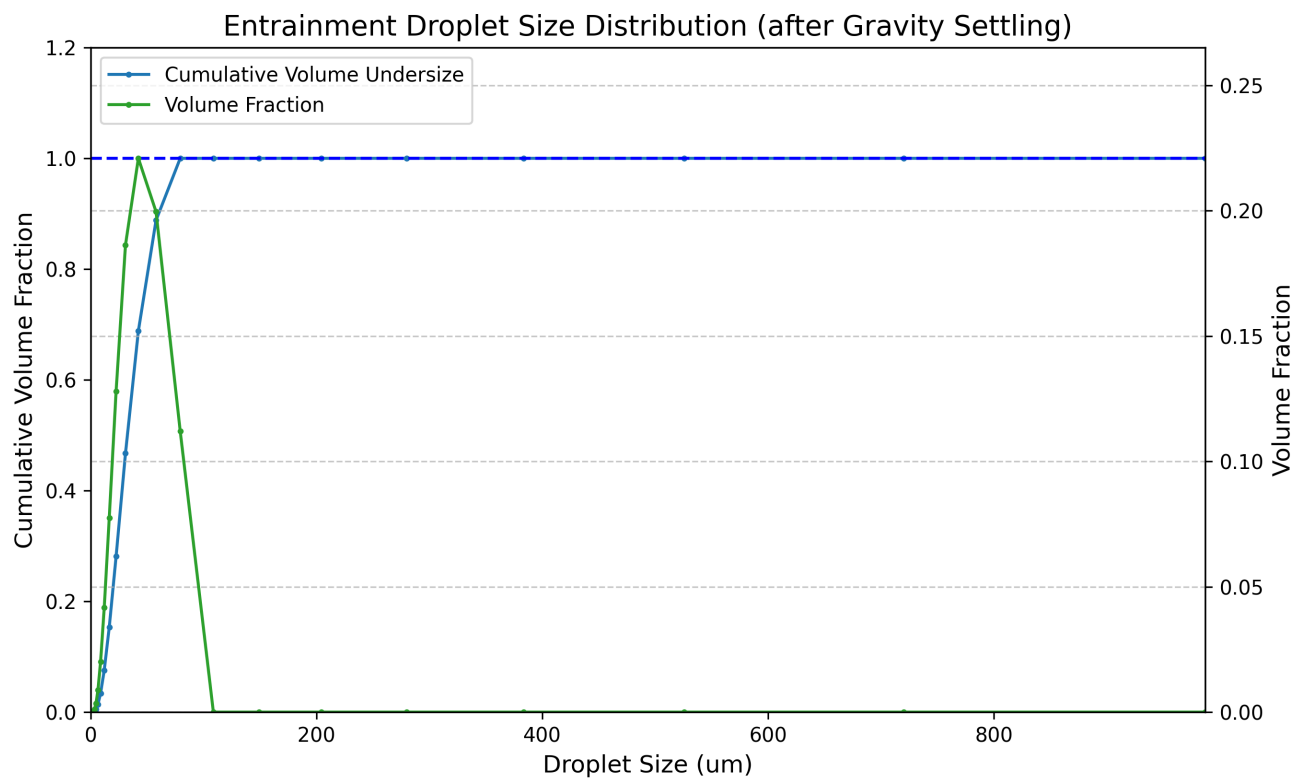
4.4. Distribution after Mist Extractor

Entrainment Droplet Size Distribution (after Mist Extractor)
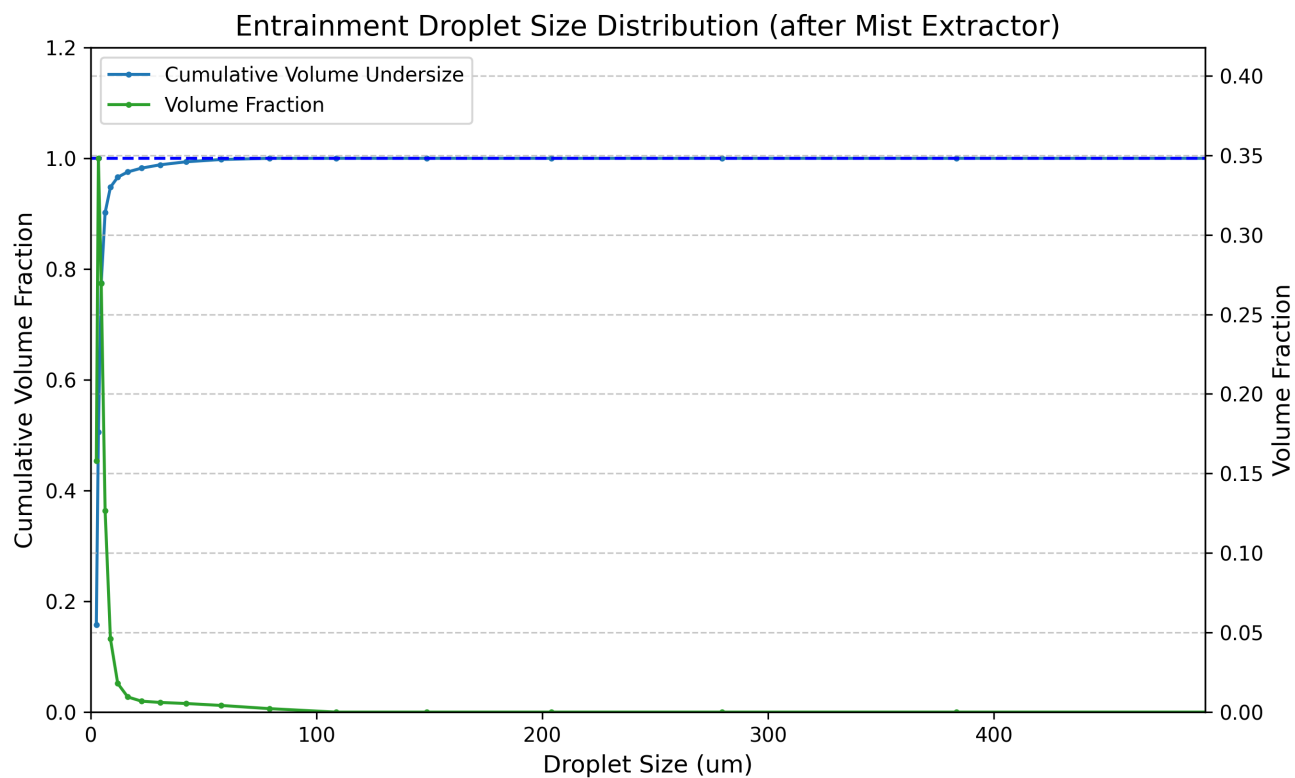
Oil and Gas Separation: Liquid in Gas Carry Over Report

5. Volume Fraction Data Tables

5.1. Distribution at Inlet

Droplet Size (um)	Volume Fraction	Cumulative Undersize	Entrained Mass Flow (kg/s)	Entrained Volume Flow (m³/s)
30.88	0.0001	0.0001	0.000251	0.000000343
42.33	0.0004	0.0005	0.000787	0.000001077
58.01	0.0010	0.0015	0.002228	0.000003049
79.52	0.0027	0.0042	0.005698	0.000007798
108.99	0.0061	0.0103	0.013173	0.000018028
149.39	0.0128	0.0231	0.027528	0.000037674
204.76	0.0242	0.0473	0.052027	0.000071201
280.65	0.0414	0.0887	0.088961	0.000121747
384.67	0.0641	0.1528	0.137675	0.000188415
527.25	0.0898	0.2426	0.192884	0.000263971
722.68	0.1138	0.3564	0.244612	0.000334765
990.54	0.1306	0.4870	0.280598	0.000384013
1357.69	0.1352	0.6223	0.290582	0.000397676
1860.93	0.1259	0.7482	0.270500	0.000370194
2550.69	0.1044	0.8526	0.224348	0.000307031
3496.11	0.0757	0.9283	0.162710	0.000222677
4791.95	0.0460	0.9744	0.098926	0.000135385
6568.10	0.0210	0.9953	0.045068	0.000061678
9002.59	0.0047	1.0000	0.009998	0.000013682
12339.43	0.0000	1.0000	0.000000	0.000000000

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5.2. Distribution after Inlet Device

Droplet Size (um)	Volume Fraction	Cumulative Undersize	Entrained Mass Flow (kg/s)	Entrained Volume Flow (m³/s)
2.47	0.0001	0.0001	0.000251	0.000000343
3.39	0.0004	0.0005	0.000787	0.000001077
4.64	0.0010	0.0015	0.002228	0.000003049
6.36	0.0027	0.0042	0.005698	0.000007798
8.72	0.0061	0.0103	0.013173	0.000018028
11.95	0.0128	0.0231	0.027528	0.000037674
16.38	0.0242	0.0473	0.052027	0.000071201
22.45	0.0414	0.0887	0.088961	0.000121747
30.77	0.0641	0.1528	0.137675	0.000188415
42.18	0.0898	0.2426	0.192884	0.000263971
57.81	0.1138	0.3564	0.244612	0.000334765
79.24	0.1306	0.4870	0.280598	0.000384013
108.62	0.1352	0.6223	0.290582	0.000397676
148.87	0.1259	0.7482	0.270500	0.000370194
204.05	0.1044	0.8526	0.224348	0.000307031
279.69	0.0757	0.9283	0.162710	0.000222677
383.36	0.0460	0.9744	0.098926	0.000135385
525.45	0.0210	0.9953	0.045068	0.000061678
720.21	0.0047	1.0000	0.009998	0.000013682
987.15	0.0000	1.0000	0.000000	0.000000000

Oil and Gas Separation: Liquid in Gas Carry Over Report

5.3. Distribution after Gravity Settling Section

Droplet Size (um)	Volume Fraction	Cumulative Undersize	Entrained Mass Flow (kg/s)	Entrained Volume Flow (m³/s)
2.47	0.0004	0.0004	0.000251	0.000000343
3.39	0.0012	0.0016	0.000785	0.000001075
4.64	0.0034	0.0050	0.002221	0.000003039
6.36	0.0088	0.0138	0.005668	0.000007757
8.72	0.0202	0.0339	0.013052	0.000017862
11.95	0.0417	0.0756	0.026988	0.000036934
16.38	0.0774	0.1530	0.050143	0.000068624
22.45	0.1280	0.2810	0.082878	0.000113423
30.77	0.1864	0.4674	0.120677	0.000165153
42.18	0.2209	0.6883	0.143049	0.000195770
57.81	0.1996	0.8879	0.129266	0.000176908
79.24	0.1121	1.0000	0.072582	0.000099332
108.62	0.0000	1.0000	0.000000	0.000000000
148.87	0.0000	1.0000	0.000000	0.000000000
204.05	0.0000	1.0000	0.000000	0.000000000
279.69	0.0000	1.0000	0.000000	0.000000000
383.36	0.0000	1.0000	0.000000	0.000000000
525.45	0.0000	1.0000	0.000000	0.000000000
720.21	0.0000	1.0000	0.000000	0.000000000
987.15	0.0000	1.0000	0.000000	0.000000000

Oil and Gas Separation: Liquid in Gas Carry Over Report

5.4. Distribution After Mist Extractor

Droplet Size (um)	Volume Fraction	Cumulative Undersize	Entrained Mass Flow (kg/s)	Entrained Volume Flow (m³/s)
2.47	0.1578	0.1578	0.000251	0.000000343
3.39	0.3481	0.5059	0.000553	0.000000757
4.64	0.2693	0.7752	0.000428	0.000000585
6.36	0.1267	0.9019	0.000201	0.000000275
8.72	0.0460	0.9479	0.000073	0.000000100
11.95	0.0180	0.9659	0.000029	0.000000039
16.38	0.0095	0.9754	0.000015	0.000000021
22.45	0.0069	0.9823	0.000011	0.000000015
30.77	0.0060	0.9883	0.000010	0.000000013
42.18	0.0054	0.9937	0.000009	0.000000012
57.81	0.0042	0.9979	0.000007	0.000000009
79.24	0.0021	1.0000	0.000003	0.000000005
108.62	0.0000	1.0000	0.000000	0.000000000
148.87	0.0000	1.0000	0.000000	0.000000000
204.05	0.0000	1.0000	0.000000	0.000000000
279.69	0.0000	1.0000	0.000000	0.000000000
383.36	0.0000	1.0000	0.000000	0.000000000
525.45	0.0000	1.0000	0.000000	0.000000000
720.21	0.0000	1.0000	0.000000	0.000000000
987.15	0.0000	1.0000	0.000000	0.000000000

6. Mesh Pad Efficiency & Pressure Drop

Actual face velocity before Mesh Pad: 2.02 ft/s; (0.62 m/s)

Allowable velocity before Mesh Pad: 1.56 ft/s; (0.48 m/s)

Mesh Pad Estimated Pressure Drop: 348.57 Pa; (0.35 kPa)

Estimated Carryover percent : 82.6 %

Estimated Carryover : 82.6 % of Inlet flow rate 3.190 m3/hr = 2.636 m3/hr

!!FLOODING RISK: OPERATING VELOCITY EXCEEDS ALLOWABLE VELOCITY FOR SELECTED MESHPAD GAS LOAD FACTOR (Ks).

The following graph shows the estimated efficiency and pressure drop across the Mesh Pad: