6. 結論

現在、国際熱核融合炉の設計活動に見られるように、核融合炉の実現を目指した開発研究が精力的に行われているが、ダイバータや中性粒子入射装置のビームダンプを代表とする高熱流束機器は、従来の原子炉燃料棒が受ける熱負荷に比べ、数倍から数十倍大きい10～100MW/m^{2}の定常的熱負荷を受けることが想定されている。このような高熱負荷を定常的に除熱する工学機器は従来にないものであり、除熱能力の向上が１つの大きな課題として取り上げられている。

このような高熱流束除熱には、水によるサブクール沸騰の利用が最も有利とされるが、これまでの研究によると、流路として細管（管内径がパラメータとして限界熱流束に影響を与え、限界熱流束を増大させる効果を持つ小口径管）、あるいは捩りテープ挿入管を利用した除熱構造を用いたり、通常管（管内径が限界熱流束に影響を与えない比較的広い口径管）に対しては、圧力を上げ高流速の水を流せば高熱負荷除熱の可能性が高いことが報告されている。水のサブクール沸騰については、軽水型原子炉の開発にともなって３０年ほど前から数多くの実験的研究が為されてきた。しかしながらこれらの多くは、内径が3mm以上の比較的広い口径管を対象とし、かつ熱流束レベルも10MW/m^{2}以下の低質量速度条件に対するものがほとんどである。

細管に対するサブクール沸騰限界熱流束については、これまでに管内径が小さくなったり、加熱管長と管内径の比が小さくなると限界熱流束は大きくなるという２、３の実験データは報告されているが、これらのパラメータが限界熱流束に影響を与えはじめる境界は定量的に示されておらず、限界熱流束増大のメカニズムについても十分な説明は与えられていない。また、小口径管における沸騰時の圧力損失や流動特性については、低質量速度条件のものが幾つか報告されているのみで、限界熱流束が増大する領域に対しては殆ど明らかにされていない。

通常管に対する高質量速度条件の高限界熱流束の研究については、ごく最近の核融合炉機器の開発研究にともなって幾つかの高限界熱流束データが報告されてきている。また通常管に対しては、数多くのサブクール沸騰限界熱流束相関式がこれまでに提案されているが、核融合炉機器の除熱条件に対してはお互いにかなりのくい違いがあること、かつ相関式の適用範囲も狭いパラメータ範囲に限られていることが問題となっており、高熱流束レベルに対する信頼性のある相関式の確立とCHFメカニズムの解明が強く望まれている。

捩りテープ挿入管を用いた除熱構造は、限界熱流束促進技術の中で最も限界熱流束特性が優れているものと考えられており、最近核融合炉機器の除熱構造として活発に研究が行われているが、系統的な実験データは極めて少なく、これまでに捩りテープ挿入による増速効果により限界熱流束は増大するという報告はあるが、捩りテープ挿入管の限界熱流束特性や限界熱流束促進効果に対する圧力変化の系統的な影響については殆ど明らかにされていない。また、捩りテープ挿入管に対する限界熱流束相関式についても、これまでに旋回流による流速の増加などをパラメータとした幾つかの実験式が提案されているが、核融合炉機器の適用が考えられる種々のパラメータ条件に対しては検証されておらず、信頼性のある相関式の確立が望まれている。

本研究は、前述した各課題を明らかにすることにより、核融合炉の高熱流束機器などの除熱設計に資することを目的としたもので、以下、各課題に対する研究結果を章毎に結論としてまとめる。

第２章「細管内サブクール沸騰限界熱流束と流動特性」では、管内径、加熱管長、質量速度といった各パラメータの限界熱流束に対する影響を系統的に調べ、限界熱流束が増大するパラメータ領域を定量的に示すとともに、細管における流動特性と限界熱流束増大のメカニズムを明らかにするために、管内径1～3mmを対象とした限界熱流束および圧力損失の実験と解析を行い、以下のことを明らかにした。

(1) 管内径、あるいは加熱管長が小さくなり、質量速度が大きくなると、比較的広い口径管から導かれた従来のサブクール沸騰相関式よりも実験値の方が数倍大きくなる高熱流束域と、実験値が従来の相関式とほぼ一致する低熱流束域が存在することを明らかにした。

(2)高熱流束域と低熱流束域の境界が、管内径、加熱管長および質量速度をパラメータとして表せることを示した。

(3) 核沸騰開始や気泡離脱開始といった流動変化にともなって変わると考えられる摩擦圧力損失の変化が、Bergles-Rohsenowの核沸騰開始熱流束や、LevyあるいはSaha-Zuberの気泡離脱開始熱流束と、低熱流束域ではうまく対応することを明らかにした。

(4)しかしながら高熱流束域では、気泡離脱開始に必要な熱流束は、LevyやSaha-Zuberによる値よりも大きくなること、ならびにその摩擦圧力損失比は、低熱流束域に比べてかなり小さくなることを明らかにした。

(5)さらに流動モデルとして、Saha-Zuberの気泡離脱開始条件、およびAhmadのボイド率分布式を用い二相摩擦増倍係数の解析を行った結果、高熱流束域の二相摩擦増倍係数は低熱流束域に比べてかなり小さくなることを明らかにし、質量速度が大きくなるほど高熱流束域のボイド率が低熱流束域よりも小さくなることを示した。

第３章「通常管に対するサブクール沸騰限界熱流束」では、核融合炉の適用が考えられる低圧から中圧にかけて適用可能な相関式を確立するとともに、本圧力範囲の高熱流束条件に対して妥当な予測を与える相関式を提示し、その限界熱流束メカニズムを明らかにするため、圧力を上げた場合の高質量速度条件の限界熱流束実験を行い、圧力変化に対する熱物性値と相関式を構成する実験定数の限界熱流束に対する影響を検討した。また、核融合炉機器の適用が考えられる圧力範囲に対して、種々の限界熱流束相関式を評価した結果、以下の結論を得た。

(6) 高圧用に提案されたTongの境界層剥離モデルに基づく限界熱流束実験式中の実験定数を、低圧にも適用できるように修正し、広い圧力範囲に渡って成り立つ新たな修正Tong式を提案し、本式が、高限界熱流束データに対しても妥当な予測を与えることを示した。

(7) 圧力2.0MPa近傍以上では、加熱面への液の供給、あるいは気泡境界層内の気泡の充満といったメカニズムの面で気液密度比や粘度比の物性値は、限界熱流束を支配する重要なパラメータとなるが、圧力2.0MPa近傍以下の低圧では、この２つの物性値は液の方が極端に大きいためこれらの物性値の影響をあまり受けず、限界熱流束は主として液のサブクール度と質量速度だけで決まることを明らかにした。

第４章「捩りテープ挿入管のサブクール沸騰限界熱流束」では、テープによって発生する旋回流と圧力変化の限界熱流束促進効果に対する影響を系統的に明らかにし、核融合炉機器の適用が考えられるパラメータ範囲に対し妥当な予測を与える捩りテープ挿入管の限界熱流束相関式を確立するために、捩りテープに対する限界熱流束実験を行い、各パラメータの限界熱流束促進効果に対する影響を検討・解析した結果、次のことを明らかにした。

(8) 捩りテープ挿入による限界熱流束促進効果は、管内壁面における水の半径方向の慣性力によってうまく説明でき、慣性力が大きい場合には、その促進効果は水の半径方向の無次元遠心加速度の1/6乗に、あるいは半径方向の水の流速の1/3乗に比例して増大することを明らかにした。

(9)しかしながら、この促進効果は、圧力0.6MPa近傍以下に対しては顕著であるが、0.6MPa以上になると次第に弱まり、2.0MPa近傍でほぼ消滅してしまうことを明らかにした。

(10)これまでに誰も報告していない圧力の影響を考慮し、水の半径方向の無次元加速度をパラメータとする新しい捩りテープ挿入管の限界熱流束実験式を提案するとともに、本式が妥当な予測を与えることを示した。

第５章「核融合炉機器への適用」では、現在計画が進められている国際熱核融合炉のダイバータの設計条件に対し、細管、通常管、および捩りテープ挿入管を利用した除熱構造を用いた場合の比較検討を行った結果、均一加熱条件では、細管を用いたものが一番CHFマージンが大きく、除熱構造として最も有効であることを示したが、捩りテープ挿入管の非均一加熱条件への適用については、さらなる実験的研究が必要であることを述べた。

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付録

1. 大気圧限界熱流束実験データリスト
（管出口圧力 P= 0.1 MPa）

No.	D [mm]	L [cm]	G [kg/m²s]	T_{in} [°C]	x_{ex}	q_c [MW/m²]
1	1	1.05	8070	23.7	-.066	28.558
2	1	1.00	6710	37.7	-.038	26.668
3	1	1.00	7100	57.9	-.012	23.702
4	1	1.02	13530	15.4	-.081	57.845
5	1	1.01	13070	38.7	-.049	47.295
6	1	1.00	13020	59.1	-.007	45.657
7	1	0.98	20340	18.1	-.092	69.990
8	1	1.01	20160	38.8	-.060	60.250
9	1	0.96	19920	58.3	-.031	53.140
10	1	3.00	7130	21.1	-.037	13.363
11	1	3.03	7010	38.9	-.030	9.584
12	1	2.98	7020	61.2	-.016	6.684
13	1	3.00	13220	20.9	-.028	26.928
14	1	2.99	13000	38.1	-.005	21.450
15	1	2.98	12410	57.0	.005	17.247
16	1	2.98	20910	22.0	-.026	46.160
17	1	3.03	20000	39.1	.006	34.510
18	1	3.03	20000	59.7	.007	23.480
19	1	5.00	7270	21.3	-.031	9.380
20	1	5.00	7270	40.7	-.022	7.718
21	1	5.00	7060	59.6	-.010	5.503
22	1	4.99	13220	20.1	-.026	17.814
23	1	5.01	12680	40.3	-.002	14.723
24	1	5.04	13480	64.0	.002	11.714
25	1	5.02	20160	22.5	.003	30.860
26	1	5.00	19950	40.1	.004	25.600
28	2	0.96	7390	20.4	-.121	22.640
29	2	0.99	7040	40.0	-.085	20.470
30	2	0.98	6890	59.4	-.052	18.340
31	2	1.03	13500	21.2	-.120	32.476
32	2	0.99	12930	38.4	-.090	30.783
33	2	1.02	13050	58.8	-.059	21.160
34	2	1.00	20120	20.0	-.123	53.233
35	2	0.99	19990	41.7	-.086	43.623
36	2	1.00	19560	59.7	-.057	32.250
37	2	3.02	6870	20.6	-.090	13.278
38	2	3.04	7260	37.4	-.056	14.710
39	2	3.03	7110	56.6	-.042	9.629
40	2	3.01	13030	20.5	-.097	22.832
41	2	3.02	12940	40.2	-.072	17.666
42	2	2.97	12940	58.3	-.036	18.348
46	2	5.01	7010	21.1	-.047	15.285
47	2	4.97	7060	36.0	-.041	11.915
48	2	5.02	6900	60.4	-.017	8.333
49	2	5.00	12570	20.1	-.073	21.050
50	2	4.99	13000	41.1	-.030	19.760
51	2	5.00	12830	60.4	-.023	14.480
52	2	4.98	18110	20.3	-.082	24.526
53	2	5.08	18060	40.4	-.048	24.391
54	2	5.02	20000	60.7	.006	22.281
55	2	10.00	7110	20.5	-.037	8.494
56	2	10.02	6970	38.1	-.034	6.167
57	2	10.05	6900	60.2	-.015	4.647
58	2	10.05	12700	23.2	-.007	14.746
59	2	9.99	12920	40.6	.002	13.311
60	2	10.02	12780	63.1	.002	10.401
61	2	9.95	20000	20.8	-.011	26.490
62	2	9.98	20000	40.0	.001	19.580
63	2	9.97	20000	62.0	.005	12.590
64	3	1.02	6910	20.2	-.134	18.460
65	3	1.02	6800	38.0	-.102	18.190
66	3	0.97	6960	58.4	-.065	17.080
67	3	0.99	12570	20.3	-.133	31.288
68	3	1.01	12350	40.3	-.098	26.713
69	3	0.95	12830	55.4	-.075	17.743
70	3	1.02	20190	21.4	-.133	47.061
71	3	1.00	19800	39.0	-.103	30.471
72	3	0.96	19760	58.6	-.070	24.574
73	3	3.01	7410	21.7	-.108	14.856
74	3	3.02	7330	38.3	-.088	10.112
75	3	3.00	7230	59.8	-.052	8.923
76	3	3.00	12370	19.8	-.125	16.154
77	3	3.03	12640	41.0	-.086	15.809
78	3	3.00	12550	59.9	-.058	11.109
79	3	3.07	19480	22.8	-.121	23.476
80	3	3.03	19730	41.2	-.088	21.761
81	3	3.00	20010	60.0	-.058	15.854
82	3	5.00	6950	20.8	-.098	11.418
83	3	5.00	7490	38.4	-.075	9.186
84	3	5.04	7280	62.8	-.021	10.521
85	3	5.03	11580	21.1	-.110	15.375
86	3	5.04	12260	41.2	-.077	13.202
87	3	4.99	12220	55.2	-.054	11.725
88	3	5.01	19110	20.5	-.107	25.878
89	3	4.94	18990	40.7	-.081	18.773
90	3	4.97	19220	60.2	-.051	14.882
91	3	10.05	7240	21.2	-.070	9.046
92	3	10.01	7200	39.3	-.052	7.388
93	3	10.02	7350	60.7	-.016	6.853
94	3	10.01	12280	21.7	-.092	10.737
95	3	10.04	12560	40.8	-.063	9.800
96	3	10.04	12530	60.2	-.031	8.722
97	3	9.95	20610	21.3	-.099	16.520
98	3	9.98	20490	40.1	-.068	15.019
99	3	10.00	20000	61.1	-.026	14.707

2. 圧力損失実験データリスト（管出口圧力 0.1 MPa）

PL-9-1　D= 1 mm　L= 1 cm

G [kg/m²s]	T_{in} [°C]	x_{ex}	q_c [MW/m²]	ΔP_F [MPa]
7256.55	18.6	-.1511	0	.0138044
7255.02	18.8	-.1501	.22	.0138105
7239.14	18.9	-.1488	.68	.0127832
7345.38	19.1	-.1407	3.91	.0126938
7333.23	19.4	-.1322	7.20	.0136196
7312.1	19.5	-.1285	8.63	.0144567
7441.87	19.8	-.1175	13.14	.0150964
7194.42	20.1	-.1064	16.98	.015182
6838.14	20.2	-.0994	18.79	.0156128
7370.31	20.2	-.0951	22.02	.0177802

PL-9-2　D= 1 mm　L= 1 cm

G [kg/m²s]	T_{in} [°C]	x_{ex}	q_c [MW/m²]	ΔP_F [MPa]
13049.3	18.6	-.1511	0	.0464034
13083.6	17.3	-.1531	.27	.0466447
13095.3	17.2	-.1526	.82	.0466507
13123.2	17.3	-.1477	4.25	.0470414
13113.9	17.5	-.1409	9.05	.046212
13090.3	17.8	-.1288	17.51	.0463747
13137.9	18.3	-.1188	24.30	.0458904
13008.6	18.5	-.1162	25.69	.0450102
12980.2	18.7	-.1129	27.80	.0456063

PL-16-1　D= 1 mm　L= 1 cm

G [kg/m²s]	T_{in} [°C]	x_{ex}	q_c [MW/m²]	ΔP_F [MPa]
6987.4	64.6	-.0658	0	.013768
6655.2	63.3	-.0610	2.71	.0142381
6799.1	59.8	-.0590	6.05	.0138125
7114.8	56.9	-.0590	8.48	.0178188
7172.4	54.4	-.0575	11.03	.0191328
7198.1	53.5	-.0532	13.48	.0202493
7276.4	54	-.0462	16.15	.0236803
6964.6	55.2	-.0382	17.72	.0236234
6867.0	56.7	-.0302	19.50	.0332938
6281.2	59.5	-.0128	22.14	.0464397

PL-10-1　D= 1 mm　L= 3 cm

G [kg/m²s]	T_{in} [°C]	x_{ex}	q_c [MW/m²]	ΔP_F [MPa]
7093.6	18.1	-.1520	0	.0269952
7163.5	17.3	-.1518	.22	.02684
7250.6	17.2	-.1466	.96	.0258154
7167.5	17.2	-.1272	3.57	.024235
7296.4	17.4	-.1133	5.49	.0275382
7717.0	17.6	-.0987	7.87	.0324091
7388.1	17.8	-.0829	9.67	.0300675
6765.1	18	-.0605	11.67	.0303142

PL-16-2　D= 1 mm　L= 1 cm

G [kg/m²s]	T_{in} [°C]	x_{ex}	q_c [MW/m²]	ΔP_F [MPa]
12689.3	55.2	-.0833	0	.0465552
12595.8	57.9	-.0781	.13	.0444797
12562	58.7	-.0759	.65	.0440084
13041.4	58.4	-.0642	9.69	.0478977
12600.8	58.1	-.0514	18.86	.0456786
11976	58.4	-.0443	22.32	.0441202
11513.6	58.6	-.0428	22.19	.0413442
11513.9	59	-.0393	24.00	.0428998
10324.4	59.8	-.0300	26.08	.0395938
9507.2	60.4	-.0222	27.61	.0354854

PL-10-2　D= 1 mm　L= 3 cm

G [kg/m²s]	T_{in} [°C]	x_{ex}	q_c [MW/m²]	ΔP_F [MPa]
12722	18.3	-.1516	0	.0856597
12833.9	18.4	-.1509	.13	.0871414
12939.5	18.5	-.1479	.81	.0878311
13285.1	18.7	-.1366	3.56	.0906845
13481.4	18.9	-.1248	6.52	.093299
13421.3	19.1	-.1144	9.02	.0930541
13384.8	19.3	-.0996	12.63	.0933432
13508.6	19.6	-.0872	15.76	.0952178
11921.6	19.7	-.0723	17.19	.0759596
11672.6	19.8	-.0599	19.52	.0777053

PL-15-1　D= 1 mm　L= 3 cm

G [kg/m²s]	T_{in} [°C]	x_{ex}	q_c [MW/m²]	ΔP_F [MPa]
6714.3	54.5	-.0846	0	.02412
6760.1	55	-.0822	.18	.0244483
6948.8	56	-.0749	.89	.025134
7014.8	56.6	-.0601	2.71	.0248533
7277.4	57.6	-.0424	4.98	.0275533
7024.4	58.4	-.0326	5.91	.0269331
6248.3	58.8	-.0272	5.80	.0231467

PL-15-2　D= 1 mm　L= 3 cm

G [kg/m²s]	T_{in} [°C]	x_{ex}	q_c [MW/m²]	ΔP_F [MPa]
12365.9	63.2	-.0684	0	.0807872
12335.8	62	-.0696	.25	.0798893
12498.1	61.6	-.0670	1.04	.0814102
12815.6	61.5	-.0551	3.98	.084467
11959.3	61.7	-.0430	6.34	.0720723
12798.1	62	-.0277	10.33	.0856767
10793.5	61.5	-.0141	11.66	.0755751
8289.7	61.1	-.0075	10.12	.0563964

PL-11-1 D= 1 mm L= 5 cm

G [kg/m²s]	T_{in} [°C]	x_{ex}	q_c [MW/m²]	ΔP_F [MPa]
7212.9	16.5	-.1550	0	.033128
7251.4	16.9	-.1522	.16	.0325642
7302.8	17.4	-.1472	.50	.0306611
7372.6	17.6	-.1411	.98	.0296254
7635.7	17.9	-.1090	3.73	.0295105
7397.9	18.2	-.0840	5.66	.0290433
8546.8	18.7	-.0697	7.82	.0416001
7329.6	19	-.0562	7.78	.0316346
7210.0	19.2	-.0482	8.27	.0315268
7330.5	19.4	-.0447	8.67	.0326282
6756.8	19.7	-.0409	8.24	.0292795

PL-11-2 D= 1 mm L= 5 cm

G [kg/m²s]	T_{in} [°C]	x_{ex}	q_c [MW/m²]	ΔP_F [MPa]
13955	19.2	-.1500	0	.11355
13362.9	17.6	-.1514	.22	.103391
13473.5	17.1	-.1501	.56	.104658
13562.1	16.8	-.1479	.99	.10489
13975.9	16.5	-.1301	3.91	.108446
14420.8	16.6	-.1055	8.01	.112696
14316	16.7	-.0899	10.44	.109981
13908.1	17.2	-.0738	12.53	.102858
13645.9	17.6	-.0664	13.32	.0966982
13539.7	17.8	-.0584	14.38	.0936223
13400.1	18.1	-.0497	15.47	.0949319
11585.3	18.4	-.0356	15.15	.0743212

PL-14-1 D= 1mm L= 5 cm

G [kg/m²s]	T_{in} [°C]	x_{ex}	q_c [MW/m²]	ΔP_F [MPa]
6848.1	55.1	-.0835	0	.0277158
6940.9	56.4	-.0794	.13	.0295283
7047.6	57.2	-.0736	.47	.0312417
7117.4	58	-.0668	.90	.0307165
7331.6	58.6	-.0540	1.90	.0307685
7520.7	59	-.0439	2.74	.0331535
7826.8	59.3	-.0298	4.05	.0340403
5504.9	59.5	-.0158	3.69	.0185764

PL-12-1 D= 1 mm L=10 cm

G [kg/m²s]	T_{in} [°C]	x_{ex}	q_c [MW/m²]	ΔP_F [MPa]
7188.7	22.9	-.1431	0	.0442696
7260.1	22.5	-.1392	.18	.0430713
7392.9	21.5	-.1318	.57	.0425937
7422.9	20.6	-.1246	.95	.0404249
7292.1	19.6	-.1057	1.79	.0356679
7414.8	19	-.0846	2.75	.0355419
7745.7	18.4	-.0569	4.13	.0380897
8102.4	17.8	-.0343	5.40	.0430075

PL-14-2 D= 1 mm L= 5 cm

G [kg/m²s]	T_{in} [°C]	x_{ex}	q_c [MW/m²]	ΔP_F [MPa]
12595.3	61.7	-.0712	0	.0863582
12932.9	61.1	-.0710	.18	.0902887
12982.4	60.1	-.0703	.57	.0909583
13075.1	59.4	-.0688	.98	.0914918
13576.3	58.6	-.0573	3.01	.0970826
13899.2	58.3	-.0385	6.11	.100188
13566.7	58.1	-.0249	8.10	.0953957
13589.1	58.1	-.0166	9.40	.0951387
13528.4	58.2	-.0130	9.87	.0955007
12597.9	58.3	-.0088	9.78	.0898096
11521.2	58.3	-.0056	9.35	.0818437
12291.7	58.4	-.0013	10.55	.0975667
11453	58.5	.0020	10.24	.0909942
11590.6	58.7	.0055	10.90	.0978138
11473.7	59	.0123	11.47	.103996

PL-12-2 D= 1 mm L=10 cm

G [kg/m²s]	T_{in} [°C]	x_{ex}	q_c [MW/m²]	ΔP_F [MPa]
13168.3	16.7	-.1546	0	.129685
13382.6	16.6	-.1527	.15	.130779
13578.9	16.8	-.1475	.52	.130308
13734.3	16.9	-.1427	.89	.130653
14034.2	17	-.1303	1.87	.130858
14481.9	17.2	-.1070	3.81	.13116
14900.6	17.6	-.0816	5.99	.132285
15287.2	17.8	-.0530	8.58	.131589
14209.7	18.2	-.0376	9.15	.11103
14183.1	18.4	-.0184	10.64	.110243

PL-13-1 D= 1 mm L=10 cm

G [kg/m²s]	T_{in} [°C]	x_{ex}	q_c [MW/m²]	ΔP_F [MPa]
6855.0	55.3	-.0831	0	.0342619
7058	55.6	-.0820	.02	.0357373
7323.9	56	-.0720	.40	.0364872
7502.4	56.5	-.0616	.81	.0373773
7665	57.9	-.0339	1.91	.0365511
7248.5	59	-.0179	2.38	.0314129
7152.9	59.7	-.0050	2.82	.0302107

PL-16-3 D = 1 mm L = 1 cm

G [kg/m²s]	T_{in} [°C]	x_{ex}	q_c [MW/m²]	ΔP_F [MPa]
19331.9	60.5	-.0734	0	.112029
19408.7	59.5	-.0751	.20	.111906
19470.3	59	-.0757	.61	.11199
19711.2	58.7	-.0679	9.90	.115364
19878.9	58.7	-.0595	19.35	.118258
19922.6	58.9	-.0499	29.83	.120214
19180.5	59	-.0443	34.55	.114785

PL-13-2 D= 1 mm L=10 cm

G [kg/m²s]	T_{in} [°C]	x_{ex}	q_c [MW/m²]	ΔP_F [MPa]
12931.9	61.6	-.0714	0	.0981506
13072.2	60.7	-.0703	.20	.0990239
13160.1	59.7	-.0671	.57	.0988349
13309.6	59	-.0629	1.00	.101137
13863.8	58.8	-.0499	2.09	.107184
14642	59.2	-.0222	4.43	.111688
12595.4	59.7	-.0123	4.45	.0827316
13041.1	60.5	.0028	5.61	.0869555
13574.5	61.1	.0144	6.64	.0991474
12695.8	61.4	.0155	6.25	.0914189
11554.7	61.5	.0161	5.72	.0852941
11148.4	61.9	.0157	5.44	.0892229

PL-31-1 D= 3 mm L= 1 cm

G [kg/m²s]	T_{in} [°C]	x_{ex}	q_c [MW/m²]	ΔP_F [MPa]
7066.4	15.1	-.1576	0	.00814647
7065.8	15.7	-.1557	.88	.00836369
7088.9	16.2	-.1533	2.67	.00746815
7088.4	16.7	-.1503	5.11	.00750318
7087.9	17.1	-.1483	6.67	.00752801
7064.0	17.4	-.1459	8.86	.00749121
7063.5	17.9	-.1440	9.97	.00750919
7063.2	18.2	-.1425	11.07	.00742543
7062.8	18.6	-.1409	12.18	.00744209
7062.3	19.1	-.1390	13.28	.00795157
7085.6	19.3	-.1379	14.21	.00753158
7061.7	19.6	-.1362	15.49	.00788222
7061.4	19.9	-.1350	16.38	.00740592
7084.4	20.3	-.1337	17.10	.00796926
7083.8	20.6	-.1322	18.21	.0074946
7059.7	20.9	-.1301	19.91	.00794754

PL-31-2 D = 3 mm L= 1 cm

G [kg/m²s]	T_{in} [°C]	x_{ex}	q_c [MW/m²]	ΔP_F [MPa]
12946.3	19.8	-.1488	0	.023695
12948.9	18.4	-.1509	1.21	.0240654
12946.8	19.5	-.1468	5.68	.0239227
12945.2	20.2	-.1429	11.36	.023334
12943.9	20.6	-.1412	13.39	.0230623
12942.9	20.9	-.1396	15.82	.0228914
12941.9	21.2	-.1379	18.25	.0236002
12941.2	21.4	-.1370	19.47	.0235006
12940.2	21.7	-.1362	19.87	.0234134

PL-32-1 D= 3 mm L= 1 cm

G [kg/m²s]	T_{in} [°C]	x_{ex}	q_c [MW/m²]	ΔP_F [MPa]
6971.26	55.1	-.0835	0	.00674707
6968.85	55.8	-.0818	.43	.00680421
6942.13	56.8	-.0796	.87	.0058309
6961.94	57.8	-.0768	1.96	.00579874
6958.84	58.7	-.0742	3.05	.0056389
6953.96	60.1	-.0708	3.93	.00547086
6951.24	60.8	-.0686	5.02	.00572293
6950.08	61.1	-.0673	5.89	.00589582
6948.52	61.5	-.0655	7.20	.00547047
6922.22	62.3	-.0631	8.26	.00578258
6898.39	62.5	-.0621	8.88	.00524298
6827.41	62.9	-.0597	10.72	.0051039
6825.5	63.4	-.0577	12.00	.0045758
6823.21	64	-.0556	13.07	.0048312

PL-32-2 D= 3 mm L= 1 cm

G [kg/m²s]	T_{in} [°C]	x_{ex}	q_c [MW/m²]	ΔP_F [MPa]
12781.3	55	-.0836	0	.0173816
12778.2	55.5	-.0822	1.20	.016999
12773.1	56.3	-.0799	2.80	.0183342
12769.9	56.8	-.0777	5.60	.0162479
12766.8	57.3	-.0757	8.01	.0161302
12763	57.9	-.0736	10.01	.0155255
12753.5	59.4	-.0696	12.81	.0153127
12749	60.1	-.0675	14.41	.0152075
12744	60.8	-.0657	15.61	.0149155
12741.1	61.2	-.0642	17.20	.0145496
12739	61.5	-.0634	17.60	.0149023
12736.9	61.8	-.0625	18.40	.0149534
12618.2	62.2	-.0616	18.62	.0151642

PL-33-10 D = 3 mm L= 3 cm

G [kg/m²s]	T_{in} [°C]	x_{ex}	q_c [MW/m²]	ΔP_F [MPa]
7219.9	17	-.1540	0	.0143507
7219.5	17.3	-.1511	.98	.0135837
7218.9	17.9	-.1450	3.02	.0136178
7217.5	19.2	-.1368	5.35	.013663
7215.7	20.5	-.1296	7.31	.0139991
7212.4	22.3	-.1216	9.19	.0155069
7212.6	22.2	-.1166	11.30	.016025
7214.3	21.3	-.1159	12.28	.0163257
7215.6	20.6	-.1144	13.42	.0168265
7215.4	20.7	-.1118	14.39	.0170379
7214.6	21.1	-.1079	15.68	.0178419
7213.5	21.7	-.1044	16.65	.0177609

PL-33-20 D= 3 mm L = 3 cm

G [kg/m²s]	T_{in} [°C]	x_{ex}	q_c [MW/m²]	ΔP_F [MPa]
13010.3	18.3	-.1516	0	.0450118
13011.8	17.5	-.1516	1.08	.0461643
13011.3	17.8	-.1461	4.76	.0446747
13009.7	18.6	-.1390	8.84	.0435179
13008.2	19.4	-.1346	11.01	.0431818
13006.7	20.1	-.1309	12.77	.0424659
13005.4	20.5	-.1274	14.81	.0419565
12898.2	21.3	-.1233	16.57	.0408554
12894.9	22.3	-.1187	18.59	.0411385
12788.2	23.4	-.1135	20.71	.0398494

PL-34-10 D = 3 mm L = 3 cm

G [kg/m²s]	T_{in} [°C]	x_{ex}	q_c [MW/m²]	ΔP_F [MPa]
6915.4	55.1	-.0835	0	.0123327
6911.7	56.2	-.0790	.93	.0120741
6909.3	56.9	-.0727	2.89	.0127665
6906.5	57.7	-.0657	5.05	.0121878
6904.1	58.4	-.0590	7.15	.0122011
6796.4	59.4	-.0517	9.11	.0127193
6799.4	58.5	-.0506	10.18	.0151784
6546.5	58.8	-.0463	11.17	.0213107
6267.9	61	-.0374	12.41	.0339507
6271.4	60	-.0382	12.81	.0349689
6274.5	59	-.0383	13.41	.0359795

PL-34-20 D = 3 mm L = 3 cm

G [kg/m²s]	T_{in} [°C]	x_{ex}	q_c [MW/m²]	ΔP_F [MPa]
12837.9	55.6	-.0825	0	.0324707
12836.6	55.8	-.0809	.93	.0311576
12830.3	56.8	-.0736	4.83	.0310361
12822	58.1	-.0658	8.72	.0304534
12810.5	59.9	-.0567	12.87	.0298121
12705.7	60.3	-.0540	14.23	.0311105
12391.3	61.2	-.0506	15.05	.0365174
12295.3	60.4	-.0514	15.45	.0379146
12191.1	60.6	-.0493	16.47	.041844
12081.4	61.6	-.0458	17.46	.046922
11574.6	60.9	-.0460	17.46	.0471578
11469.8	61.2	-.0447	17.78	.0494712
11267.3	60.9	-.0436	18.53	.0514908
11264.8	61.3	-.0422	18.88	.0538584
11204.3	61.2	-.0406	19.95	.0559357
11057.9	61.5	-.0389	20.39	.0578118
10747.1	62.1	-.0357	21.06	.0595869

PL-35-1 D = 3 mm L = 5 cm

G [kg/m²s]	T_{in} [°C]	x_{ex}	q_c [MW/m²]	ΔP_F [MPa]
6990.9	15.7	-.1565	0	.014649
6989.1	17.4	-.1492	.96	.0115458
6988.6	17.9	-.1401	2.89	.0089672
6987.6	18.9	-.1300	4.86	.0105642
6987.7	18.8	-.1212	6.96	.0111558
6987.5	19	-.1164	8.01	.0110923
7100.2	19.3	-.1114	9.21	.0116411
7100.1	19.4	-.1066	10.32	.0123751
7100.5	19	-.1027	11.44	.0123403
7100.3	19.2	-.1001	11.97	.012798
7100.0	19.5	-.0974	12.50	.0125643

PL-35-2 D = 3 mm L = 5 cm

G [kg/m²s]	T_{in} [°C]	x_{ex}	q_c [MW/m²]	ΔP_F [MPa]
12640.6	19.6	-.1492	0	.0437338
12638.9	20.3	-.1455	1.03	.0425625
12638.2	20.5	-.1409	2.85	.0412059
12739.6	20.6	-.1362	4.79	.040395
12742.1	19.7	-.1333	6.79	.0410115
12742.5	19.5	-.1287	8.94	.0411244
12741.7	19.9	-.1240	10.62	.0402566
12741.7	19.9	-.1214	11.74	.0405576
12742.3	19.6	-.1196	12.78	.0412935
12702.3	19.1	-.1181	13.77	.0410086
12702.3	19.1	-.1155	14.89	.0411037
12702.1	19.2	-.1150	15.05	.0410757
12702.1	19.2	-.1133	15.76	.0410079

PL-36-1 D = 3 mm L = 5 cm

G [kg/m²s]	T_{in} [°C]	x_{ex}	q_c [MW/m²]	ΔP_F [MPa]
6896.3	55.4	-.0829	0	.0130275
6892.5	56.5	-.0768	.95	.012179
6896.6	55.3	-.0699	3.07	.0121622
6892.2	56.6	-.0593	4.97	.0120751
6887.1	58.1	-.0469	7.22	.0137461
6883.7	59.1	-.0428	7.74	.0156674
6579.0	59.5	-.0395	7.98	.0204993
6476.2	59.9	-.0348	8.71	.0299447
6274.2	60	-.0320	8.99	.0332061
6273.5	60.2	-.0289	9.58	.0400563
6107.3	61.2	-.0233	10.10	.048338
6069.7	60.4	-.0210	10.80	.0541002
6047.2	60.9	-.0160	11.60	.0618582
6027.7	60.9	-.0126	12.25	.0676731

PL-36-2 D= 3 mm L = 5 cm

G [kg/m²s]	T_{in} [°C]	x_{ex}	q_c [MW/m²]	ΔP_F [MPa]
12839.1	60.2	-.0740	0	.0413238
12797.3	60.4	-.0718	.80	.0409357
12836.9	60.5	-.0668	2.90	.0390289
12838.4	60.3	-.0623	5.00	.0379814
12839.8	60.1	-.0579	7.09	.0383991
12837.6	60.4	-.0528	9.03	.0389839
12735.4	60.5	-.0497	10.24	.0417603
12531	60.5	-.0473	11.10	.0481728
12223.1	60.8	-.0417	12.90	.0610194
12019.4	60.9	-.0391	13.67	.0647312
11670.7	61.3	-.0352	14.53	.0705933
11204.1	61	-.0287	16.63	.0817595
10999.2	61.1	-.0259	17.29	.0853683

PL-37-1 D = 3 mm L =10 cm

G [kg/m²s]	T_{in} [°C]	x_{ex}	q_c [MW/m²]	ΔP_F [MPa]
6951.5	18.3	-.1516	0	.0180342
6951.4	18.4	-.1431	.98	.0140896
7052.5	19	-.1253	2.98	.0106674
6950.4	19.4	-.1083	4.85	.0120768
6950.3	19.5	-.0903	6.95	.0131925
6949.0	20.4	-.0796	8.01	.01347
6947.1	21.5	-.0723	8.62	.0154733
6843.8	22.4	-.0653	9.12	.0161988
6739.4	23.2	-.0584	9.59	.0183998
6737.9	24.1	-.0521	10.12	.0253546

PL-37-2 D = 3 mm L =10 cm

G [kg/m²s]	T_{in} [°C]	x_{ex}	q_c [MW/m²]	ΔP_F [MPa]
13004	20.9	-.1468	0	.0549423
13116.2	17.6	-.1487	.94	.0573369
13323.3	17.9	-.1388	3.05	.0542646
13383.7	18.8	-.1290	4.90	.0528189
13381.9	19.7	-.1183	6.96	.0509882
13317.4	20.5	-.1072	9.10	.0516319
13318.1	20.3	-.1042	9.85	.0526499
13318.8	20.1	-.0998	10.93	.0529764
13111.6	20	-.0940	12.08	.0514905
13111.2	20.1	-.0898	12.98	.0515403
13006	20.3	-.0823	14.43	.0528394
12690	21.5	-.0779	14.56	.0534738
12480.6	22.1	-.0712	15.49	.056402
11856.1	22.3	-.0634	16.21	.0573642
11438.8	22.6	-.0551	17.15	.060763

PL-38-1 D = 3 mm L =10 cm

G [kg/m²s]	T_{in} [°C]	x_{ex}	q_c [MW/m²]	ΔP_F [MPa]
6881.6	59.7	-.0749	0	.0152957
6882	59.6	-.0662	1.03	.0147216
6983.2	59.7	-.0486	3.11	.0136653
6880.2	60.1	-.0298	5.17	.0182749
6880.2	60.1	-.0244	5.80	.0269554
6581.6	58.7	-.0197	6.35	.0378608
6479.7	58.8	-.0156	6.68	.0469647
6376.2	59.4	-.0075	7.34	.0642741
6071.1	60	.0050	8.16	.0871371

PL-38-2 D = 3 mm L =10 cm

G [kg/m²s]	T_{in} [°C]	x_{ex}	q_c [MW/m²]	ΔP_F [MPa]
12841.8	59.8	-.0747	0	.0470024
13049.5	59.3	-.0710	1.02	.0473156
12843.7	59.5	-.0618	2.94	.0436856
12943.3	59.8	-.0519	5.00	.0427291
12942.7	59.9	-.0415	7.24	.0428994
12740.2	59.8	-.0365	8.25	.0483117
12631.8	60.6	-.0303	9.17	.0577374
12231	59.6	-.0298	9.38	.0586957
11614	60.6	-.0194	10.59	.0713714
11097.6	61.6	-.0100	11.52	.079482

PL-9-3 D = 1 mm L = 1 cm

G [kg/m²s]	T_{in} [°C]	x_{ex}	q_c [MW/m²]	ΔP_F [MPa]
19877	20.5	-.1475	0	.111117
19864.5	19.1	-.1498	.41	.109724
19890.8	19.2	-.1492	.83	.109987
19902.6	19.5	-.1457	4.16	.111288
20119.6	19.8	-.1407	9.25	.115288
20034	19.6	-.1320	19.47	.114712
20095.2	19.9	-.1272	24.35	.115349
20095.1	20.2	-.1240	27.29	.116481
20001.7	20.4	-.1212	29.88	.114421
20018.9	20.5	-.1190	32.21	.113826
20095.1	20.7	-.1166	34.64	.115432
20140.2	20.8	-.1146	36.82	.11566
19865.6	21	-.1124	38.40	.113378
20067.7	21.1	-.1100	41.30	.114408

PL-10-3 D = 1 mm L = 3 cm

G [kg/m²s]	T_{in} [°C]	x_{ex}	q_c [MW/m²]	ΔP_F [MPa]
19514.5	20.6	-.1474	0	.199368
19526.3	20.7	-.1470	.06	.199599
19766.5	20.7	-.1450	.82	.204149
20143.4	20.7	-.1301	6.45	.209394
20267.2	20.8	-.1144	12.42	.211907
20610.9	20.8	-.0992	18.52	.221994
20486.4	19.8	-.0835	25.19	.221584
20311	18.7	-.0783	27.73	.218367
19434.3	18.1	-.0677	30.81	.207567

PL-15-3 D = 1 mm L = 3 cm

G [kg/m²s]	T_{in} [°C]	x_{ex}	q_c [MW/m²]	ΔP_F [MPa]
19022.3	57.5	-.0790	0	.189084
19004.3	56.1	-.0807	.33	.188212
19115.2	56.4	-.0783	.99	.189719
19749.1	57.2	-.0605	7.09	.202377
20017.4	57.9	-.0430	13.27	.205839
19166.6	58.8	-.0305	16.60	.187613
16165.1	58.8	-.0266	15.19	.137157
17429.7	58.6	-.0236	17.48	.161316
15499.8	58.7	-.0179	17.17	.132752
16715.2	58.8	-.0128	20.04	.157124
15761.8	59	-.0043	21.33	.148179

PL-11-3 D = 1 mm L = 5 cm

G [kg/m²s]	T_{in} [°C]	x_{ex}	q_c [MW/m²]	ΔP_F [MPa]
19486.9	19.4	-.1496	0	.212574
19545.1	19.3	-.1494	.08	.213071
19642.8	18.8	-.1487	.45	.215058
19663.7	18.4	-.1477	.82	.213486
20009.4	17.9	-.1361	3.68	.218526
20275.9	17.5	-.1194	7.71	.221095
20163.5	17.1	-.1035	11.46	.216914
20804	17.1	-.0849	16.17	.227342
21018.7	17.5	-.0653	20.83	.228857
20788.3	17.8	-.0549	22.91	.222066
20317.3	18.1	-.0493	23.54	.2106
19057	18.3	-.0475	22.40	.187453
18128.6	18.5	-.0272	25.38	.173868
18250	18.8	-.0190	27.12	.177765

PL-14-3 D = 1 mm L = 5 cm

G [kg/m²s]	T_{in} [°C]	x_{ex}	q_c [MW/m²]	ΔP_F [MPa]
18899.5	60.6	-.0733	0	.185417
18968	56.7	-.0796	.19	.185984
19050	56.8	-.0779	.51	.18637
19119	57	-.0757	.91	.188312
19345.5	56.8	-.0675	2.79	.19178
19680.9	55.8	-.0554	5.93	.197133
20208.8	55.3	-.0378	10.32	.204418
20719.6	55.9	-.0207	14.33	.213932
20423.7	56.4	-.0071	17.05	.209446
17266.7	56.7	.0056	16.78	.152999
15924.3	56.9	.0170	17.46	.142826

PL-12-3 D = 1 mm L = 10cm

G [kg/m²s]	T_{in} [°C]	x_{ex}	q_c [MW/m²]	ΔP_F [MPa]
19427.3	19.4	-.1496	0	.245499
19607.6	19.9	-.1475	.12	.245115
19728.8	20.2	-.1437	.49	.246919
19859.6	20.5	-.1396	.89	.247563
20384.5	20.4	-.1135	3.94	.244755
20806.1	19.5	-.0812	8.00	.240933
21809.7	18.6	-.0476	12.72	.249376
21637.1	18.4	-.0372	13.94	.239498
20675.6	18.5	-.0298	14.17	.216679
19565.3	18.7	-.0139	15.11	.193733
18565	19	.0058	16.35	.175976

PL-13-3 D = 1 mm L =10 cm

G [kg/m²s]	T_{in} [°C]	x_{ex}	q_c [MW/m²]	ΔP_F [MPa]
19188.6	61.4	-.0718	0	.19211
19290.9	59.1	-.0742	.20	.195344
19411.8	58.5	-.0720	.56	.197131
19563.7	58.7	-.0679	.98	.196763
20675.2	58.9	-.0398	4.26	.210063
21989.3	57.5	-.0030	9.43	.222386
19476.7	57.3	.0084	9.65	.17336
18949.1	57.7	.0179	10.33	.17228
18103.6	58.3	.0174	9.70	.166657

PL-3-1 D = 1 mm L = 1 cm

G [kg/m²s]	T_{in} [°C]	x_{ex}	q_c [MW/m²]	ΔP_F [MPa]
14752.3	56	-.0818	0	.0636314
14599.2	56	-.0818	0	.0614901
14877.4	57.9	-.0694	7.47	.0636876
15150.3	58.6	-.0567	17.28	.0669687
15106.3	58.9	-.0515	21.19	.0662632
14798.4	59.2	-.0445	26.19	.0661325
13602	59.4	-.0346	31.36	.0809762
13044.4	59.7	-.0242	37.33	.094821
12236.1	60.1	-.0147	41.07	.0990384

3. 圧力を上げた場合の限界熱流束実験データリスト

No.	P [MPa]	D [mm]	L [cm]	G [kg/m²s]	T_{in} [°C]	x_{ex}	q_c [MW/m²]
1	.392	3	10	5619.4	26.0	-.105	11.3
2	.313	3	10	6679.5	54.2	-.061	10.5
3	.333	3	10	4317.6	62.8	-.042	7.2
4	.294	3	10	11696.8	26.3	-.104	19.6
5	.353	3	10	11465.6	50.4	-.087	16.2
6	.362	3	10	11346.7	68.3	-.053	16.3
7	.294	3	10	17927.0	28.5	-.119	24.4
8	.323	3	10	19775.7	47.3	-.102	23.0
9	.353	3	10	24858.1	55.7	-.105	23.6
10	.372	3	10	24510.9	77.6	-.073	20.9
11	.372	3	10	29435.3	34.0	-.131	37.6
12	.617	3	10	6372.8	25.4	-.145	12.7
13	.637	3	10	4662.4	46.1	-.084	10.9
14	.637	3	10	6235.7	60.1	-.122	8.2
15	.666	3	10	10542.7	28.2	-.141	21.9
16	.657	3	10	12275.2	50.5	-.133	18.2
17	.715	3	10	10841.9	73.3	-.093	16.5
18	.588	3	10	18460.2	29.2	-.160	29.0
19	.745	3	10	18348.8	51.9	-.144	26.7
20	.735	3	10	18379.3	75.0	-.104	24.4
21	.696	3	10	24567.1	52.3	-.150	30.8
22	.676	3	10	29848.3	30.7	-.175	44.4
23	.912	3	10	5480.9	28.2	-.122	15.5
24	.921	3	10	11633.2	26.0	-.178	24.2
25	.970	3	10	11714.5	46.1	-.172	19.0
26	.990	3	10	10367.8	66.6	-.126	17.6
27	.882	3	10	17658.5	31.4	-.182	31.2
28	1.049	3	10	17567.6	74.0	-.136	24.9
29	1.029	3	10	23748.2	50.8	-.183	33.2
30	.980	3	10	30166.5	33.7	-.201	48.0

4. 捩りテープ挿入管限界熱流束実験データリスト

No.	P [MPa]	D [mm]	L [cm]	G [kg/m²s]	x_{ex}	q_c [MW/m²]	y
1	.114	6	10	6520.4	-.0813	8.20	∞
2	.105	6	10	6520.9	-.0774	8.23	8.66
3	.105	6	10	6521.7	-.0781	8.66	4.27
4	.108	6	10	6520.1	-.0784	10.71	2.67
5	.105	6	10	9304.4	-.0829	9.28	∞
6	.107	6	10	9302.2	-.0831	10.09	8.66
7	.107	6	10	9305.5	-.0844	11.97	4.27
8	.107	6	10	9306.2	-.0849	13.06	2.67
9	.106	6	10	11287.7	-.0880	10.07	∞
10	.105	6	10	11285.1	-.0867	10.64	8.66
11	.107	6	10	11283.0	-.0868	11.95	4.27
12	.111	6	10	13181.7	-.0889	14.39	3.62
13	.104	6	10	6522.7	-.0779	7.28	∞
14	.104	6	10	6520.9	-.0772	7.84	9.22
15	.105	6	10	6521.9	-.0782	8.38	3.92
16	.107	6	10	6521.7	-.0788	10.39	2.67
17	.105	6	10	9305.8	-.0836	9.42	∞
18	.106	6	10	9304.4	-.0836	10.95	8.66
19	.107	6	10	9307.3	-.0852	11.43	4.27
20	.108	6	10	9302.2	-.0836	14.21	2.67
21	.105	6	10	11285.1	-.0864	9.62	∞
22	.106	6	10	11284.7	-.0871	10.05	8.66
23	.112	6	10	11282.5	-.0891	13.40	4.27
24	.112	6	10	13177.0	-.0885	13.83	3.62
25	.107	6	10	11279.0	-.0855	11.2	∞
26	.107	6	10	11283.8	-.0873	11.36	9.22
27	.111	6	10	11280.3	-.0878	13.69	4.27
28	.107	6	10	11363.6	-.0893	10.52	∞
29	.107	6	10	11343.6	-.0831	12.20	3.62
30	.106	6	10	6396.1	-.0785	9.34	2.94
31	.106	6	10	6393.6	-.0772	9.91	2.94
32	.115	6	10	14644.0	-.0918	15.42	3.62
33	.113	6	10	14664.9	-.0964	15.02	3.91
34	.117	6	10	14644.6	-.0926	16.64	3.62
35	.114	6	10	14659.9	-.0954	15.88	3.91
36	.118	6	10	15625.2	-.0944	17.14	2.94
37	.118	6	10	16108.4	-.0945	18.22	3.62
38	.116	6	10	16109.1	-.0936	17.81	3.62
39	.115	6	10	16131.4	-.0987	16.53	3.91
40	.122	6	10	15628.3	-.0973	18.64	2.94
41	.123	6	10	16017.0	-.0918	19.54	2.71
42	.127	6	10	16043.7	-.0997	19.14	2.71
43	.118	6	10	14583.5	-.0942	17.62	2.71
44	.122	6	10	17502.2	-.0986	23.07	2.71
45	.132	6	10	17526.7	-.1083	22.35	2.71
46	.126	6	10	17425.0	-.0846	21.17	2.71
47	.129	6	10	17046.3	-.1006	20.85	2.94
48	.135	6	10	17090.4	-.1137	22.90	2.94
49	.117	6	10	14562.1	-.0882	18.06	2.71
50	.117	6	10	14574.2	-.0912	17.64	2.71
51	.116	6	10	14589.2	-.0946	17.61	2.71

No.	P [MPa]	D [mm]	L [cm]	G [kg/m²s]	x_{ex}	q_c [MW/m²]	y
52	.127	6	10	15565.5	-.0848	20.99	2.94
53	.696	6	10	6579.7	-.1691	16.14	3.92
54	1.078	6	10	8089.9	-.2112	18.75	2.61
55	1.078	6	10	7970.8	-.2203	18.82	2.94
56	1.078	6	10	8300.9	-.2255	15.98	∞
57	1.078	6	10	8148.3	-.2218	15.86	8.66
58	1.078	6	10	8052.2	-.2107	18.17	3.62
59	1.078	6	10	7873.8	-.2113	18.30	2.71
60	1.078	6	10	8096.0	-.2140	18.39	2.64
61	1.470	6	10	7699.6	-.2406	17.23	∞
62	1.470	6	10	7682.5	-.2324	16.96	9.44
63	1.470	6	10	7774.9	-.2421	17.87	3.91
64	1.470	6	10	7517.7	-.2388	18.93	2.61
65	.588	6	10	7854.6	-.1786	16.34	∞
66	.588	6	10	7483.9	-.1752	15.53	8.66
67	.588	6	10	7527.4	-.1773	19.74	2.71
68	.588	6	10	7716.9	-.1640	19.13	2.64
69	.294	6	10	7932.6	-.1413	12.81	∞
70	.294	6	10	7552.4	-.1334	14.15	8.66
71	.294	6	10	7958.0	-.1351	14.92	2.71
72	.294	6	10	7590.7	-.1329	15.37	2.64
73	.196	6	10	7858.6	-.1186	12.11	∞
74	.196	6	10	7782.6	-.1170	13.05	9.44
75	.196	6	10	7709.1	-.1168	12.89	3.91
76	.196	6	10	7739.5	-.1126	13.37	2.71
77	.196	6	10	7672.2	-.1153	13.32	2.71
78	.196	6	10	9767.0	-.0957	14.00	∞
79	.196	6	10	9956.6	-.0873	12.80	8.66
80	.196	6	10	9706.5	-.0776	13.68	3.62
81	.196	6	10	10128.9	-.0679	13.90	2.71
82	.294	6	10	9952.5	-.1089	14.74	∞
83	.294	6	10	9854.6	-.1015	13.75	9.44
84	.294	6	10	9426.5	-.1027	16.32	3.91
85	.294	6	10	10071.6	-.1233	15.75	8.66
86	.294	6	10	9068.4	-.1034	18.23	3.62
87	1.078	6	10	9530.0	-.1752	21.04	3.91
88	1.078	6	10	9617.8	-.1923	20.04	2.64