

TABLE

Experimental results for surface feature geometry (both orientations) and smooth channel geometry

Device Type	Flow rate (SLPM)	Wall T - 1 (TC2)	Wall T - 2 (TC3)	Inlet T (TC1)	Outlet T (TC4)	Bath T (TC5)	Inlet pressure (PT1)	Outlet pressure
Orientation 1 - SF in the direction of flow	4.64	67.7	65.1	196.9	72.8	61.7	103.1	101.8
	9.28	74.0	68.7	239.6	88.4	62.6	107.8	102.7
	15.00	82.1	73.5	298.1	109.8	62.0	115.4	104.7
	20.00	88.9	80.2	319.7	129.6	64.7	126.2	107.5
Orientation 2 - SF in the direction away from the flow	25.00	95.2	85.6	333.1	144.4	65.5	139.4	110.9
	3.02	65.6	63.9	165.1	66.6	63.0	102.2	101.7
	4.64	64.5	61.7	203.3	73.6	59.7	103.0	101.9
	9.28	73.1	67.6	251.7	91.5	61.6	107.5	102.7
Smooth channel - No surface features	15.00	81.4	74.1	301.4	114.7	62.5	117.2	104.8
	20.00	89.9	83.1	326.0	137.0	66.6	129.4	107.5
	28.80	99.4	91.7	350.2	165.3	68.8	156.1	114.2
	3.02	64.1	63.0	166.0	97.6	62.3	101.9	101.7
Smooth channel - No surface features	4.64	65.7	63.5	200.5	118.6	61.7	102.5	101.8
	9.28	71.6	68.9	247.7	138.9	64.1	105.5	102.8
	15.00	78.7	74.1	300.0	163.5	64.8	112.0	104.9
	20.00	83.8	78.9	322.6	183.8	66.5	120.3	107.7
Smooth channel - No surface features	20.00	74.7	71.3	204.0	130.7	64.3	118.5	107.5
	25.00	87.7	82.9	337.7	200.9	68.3	130.4	111.3
	28.80	88.6	84.1	347.7	212.0	66.1	138.9	114.7

[0380] The experimental data (temperature and pressures) and the channel geometry were used to determine the heat transfer coefficient in the channel. All the calculations were based on smooth channel surface area. The smooth channel heat transfer surface area was approximately 6.43 cm² while the heat transfer surface area for surface feature channel was 19.41 cm². The increase in heat transfer surface area due to surface features was 2.06 times over the smooth channel heat transfer surface area. Heat transfer coefficient and pressure drop was also predicted for smooth channel based on correlations available in the literature.

[0381] The table below gives estimation of heat transfer coefficient and pressure drop from experimental data for channel with surface feature and channel without surface features. It also gives the predictions for smooth channel.

TABLE

Heat transfer coefficient and pressure drop estimation from experimental data, prediction of heat transfer coefficient and pressure drop for smooth channel

Device Type	Experimental				
	Reynolds number	Total Q (W)	LMTD (° C.)	HTC (W/m ² /K)	DP (kPa)
Orientation 1 - SF in the direction of flow	1628	12.5	49.6	267.4	1.2
	3100	30.6	78.5	413.2	5.0
	4714	61.9	117.9	557.0	10.7
	6094	83.6	138.9	638.4	18.7
Orientation 2 - SF in the direction away from the flow	7465	104.0	154.5	713.9	28.5
	1096	6.5	29.5	232.6	0.5
	1618	13.1	55.5	249.9	1.1
	3063	32.4	86.6	397.2	4.8
Smooth channel - No surface features	4683	61.4	122.8	530.7	12.4
	6034	83.2	144.9	609.1	22.0
	8377	117.8	172.8	723.2	41.4
	1061	4.5	63.5	75.0	0.3
Smooth channel - No surface features	1553	8.3	91.8	95.5	0.7
	2945	22.1	121.2	193.2	2.8
	4506	45.1	157.2	304.0	7.2

TABLE-continued

Heat transfer coefficient and pressure drop estimation from experimental data, prediction of heat transfer coefficient and pressure drop for smooth channel

Device Type	Experimental				
	Reynolds number	Total Q (W)	LMTD (° C.)	HTC (W/m ² /K)	DP (kPa)
Orientation 1 - SF in the direction of flow	5835	61.3	177.8	365.9	12.6
	6605	31.9	98.6	343.7	11.0
	7141	75.8	193.0	416.6	19.0
	8117	86.8	206.4	446.1	3.51

Where Q = Total heat transfer estimated, W
 LMTD = Log Mean Temperature Difference, ° C.
 HTC = Estimated heat transfer coefficient, W/m²/K
 DP = Experimental pressure drop, kPa

[0382] The table below shows the heat transfer coefficient enhancement and pressure drop increase in surface feature channel over smooth wall channel.

TABLE

Heat transfer coefficient enhancement and pressure drop increase in surface feature channel over smooth wall channel

Device Type	HTC Enhancement		
	Reynolds number	Enhancement	DP Increase
Orientation 1 - SF in the direction of flow	1591	2.80	1.80
	3023	2.14	1.83
	4610	1.83	1.49
	5965	1.74	1.48
Orientation 2 - SF in the direction away from the flow	7303	1.71	1.50
	1079	3.10	1.75
	1586	2.62	1.60
	3004	2.06	1.75
4595	1.75	1.73	