

## ภาคผนวก ข

ตารางไอน้ำ และตารางค่าความร้อน

ตารางที่ ข.1 ตารางไอน้ำ [21]

| Press.        | Sat.             | Specific volume    |                |                | Enthalpy        |                |                | Entropy         |                |
|---------------|------------------|--------------------|----------------|----------------|-----------------|----------------|----------------|-----------------|----------------|
| kPa           | Temp.            | m <sup>3</sup> /kg |                |                | kJ/kg           |                |                | kJ/kg           |                |
| P             | °C               | Sat.               | Sat.           | Sat.           | Evap.           | Sat.           | Sat.           | Evap.           | Sat.           |
|               | T <sub>sat</sub> | Liquid             | Vapor          | Liqui          | h <sub>fg</sub> | Vapor          | Liqui          | S <sub>fg</sub> | Vapor          |
|               |                  | V <sub>f</sub>     | V <sub>g</sub> | h <sub>f</sub> |                 | h <sub>g</sub> | S <sub>f</sub> |                 | S <sub>g</sub> |
| 0.6113        | 0.01             | 0.001000           | 206.14         | 0.01           | 2501.3          | 2501.4         | 0.0000         | 9.1562          | 9.1562         |
| 1.0           | 6.98             | 0.001000           | 129.21         | 29.30          | 2484.9          | 2514.2         | 0.1059         | 8.8697          | 8.9756         |
| 1.5           | 13.03            | 0.001001           | 87.98          | 54.71          | 2470.6          | 2525.3         | 0.1957         | 8.6322          | 8.8279         |
| 2.0           | 17.50            | 0.001001           | 67.00          | 73.48          | 2400.0          | 2533.5         | 0.2607         | 8.4629          | 8.7237         |
| 2.5           | 21.08            | 0.001002           | 54.25          | 88.49          | 2451.6          | 2540.0         | 0.3120         | 8.3311          | 8.6432         |
| 3.0           | 24.08            | 0.001003           | 45.67          | 101.05         | 2444.5          | 2545.5         | 0.3545         | 8.2231          | 8.5776         |
| 4.0           | 28.96            | 0.001004           | 34.80          | 121.46         | 2432.9          | 2554.4         | 0.4226         | 8.0520          | 8.4746         |
| 5.0           | 32.88            | 0.001005           | 28.19          | 137.82         | 2423.7          | 2561.5         | 0.4764         | 7.9187          | 8.3951         |
| 7.5           | 40.29            | 0.001008           | 19.24          | 168.79         | 2406.0          | 2574.8         | 0.5764         | 7.6750          | 8.2515         |
| 10            | 45.81            | 0.001010           | 14.67          | 191.83         | 2392.8          | 2584.7         | 0.6493         | 7.5009          | 8.1502         |
| 15            | 53.97            | 0.001014           | 10.02          | 225.94         | 2373.1          | 2599.1         | 0.7549         | 7.2536          | 8.0085         |
| 20            | 60.06            | 0.001017           | 7.649          | 251.40         | 2358.3          | 2609.7         | 0.8320         | 7.0766          | 7.9085         |
| 25            | 64.97            | 0.001020           | 6.204          | 271.93         | 2346.3          | 2616.2         | 0.8931         | 6.9383          | 7.8314         |
| 30            | 69.10            | 0.001022           | 5.229          | 283.23         | 2336.1          | 2625.3         | 0.9439         | 6.8247          | 7.7686         |
| 40            | 75.87            | 0.001027           | 3.993          | 317.58         | 2319.2          | 2636.8         | 1.0259         | 6.6441          | 7.6700         |
| 50            | 81.33            | 0.001030           | 3.240          | 340.49         | 2305.4          | 2645.9         | 1.0910         | 6.5029          | 7.5939         |
| 75            | 91.78            | 0.001037           | 2.217          | 384.39         | 2278.6          | 2663.0         | 1.2130         | 6.2434          | 7.4564         |
| <b>Press.</b> |                  |                    |                |                |                 |                |                |                 |                |
| <b>MPa</b>    |                  |                    |                |                |                 |                |                |                 |                |
| 0.100         | 99.63            | 0.001043           | 1.6940         | 417.46         | 2558.0          | 2675.5         | 1.3206         | 6.0568          | 7.3594         |
| 0.125         | 105.99           | 0.001048           | 1.3749         | 444.32         | 2241.0          | 2685.4         | 1.3740         | 5.9104          | 7.2844         |
| 0.150         | 111.37           | 0.001053           | 1.1593         | 467.11         | 2226.5          | 2693.6         | 1.4336         | 5.7897          | 7.2233         |
| 0.175         | 116.06           | 0.001057           | 1.0036         | 486.99         | 2213.6          | 2700.6         | 1.4849         | 5.6867          | 7.1717         |
| 0.200         | 120.23           | 0.001061           | 0.8857         | 504.70         | 2201.9          | 2706.7         | 1.5301         | 5.5970          | 7.1271         |
| 0.225         | 124.00           | 0.001064           | 0.7933         | 520.72         | 2191.3          | 2712.1         | 1.5706         | 5.5173          | 7.0878         |
| 0.250         | 127.44           | 0.001067           | 0.7187         | 535.37         | 2181.5          | 2716.9         | 1.6072         | 5.4455          | 7.0527         |
| 0.275         | 130.60           | 0.001070           | 0.6573         | 548.89         | 2172.4          | 2721.3         | 1.6408         | 5.3801          | 7.0209         |

ตารางที่ ข.1 ตารางไอน้ำ(ต่อ) [21]

| Press.<br>MPa<br>P | Sat.<br>Temp.<br>°C<br>$T_{sat}$ | Specific volume<br>$m^3/kg$ |                | Enthalpy<br>kJ/kg |          |                | Entropy<br>kJ/kg |          |                |
|--------------------|----------------------------------|-----------------------------|----------------|-------------------|----------|----------------|------------------|----------|----------------|
|                    |                                  |                             |                |                   |          |                |                  |          |                |
|                    |                                  | Sat.                        | Sat.           | Sat.              | Evap.    | Sat.           | Sat.             | Evap.    | Sat.           |
|                    |                                  | Liquid<br>$V_f$             | Vapor<br>$V_g$ | Liqui<br>$h_f$    | $h_{fg}$ | Vapor<br>$h_g$ | Liqui<br>$S_f$   | $S_{fg}$ | Vapor<br>$S_g$ |
| 0.300              | 133.55                           | 0.001073                    | 0.6058         | 561.47            | 2163.8   | 2725.3         | 1.6718           | 5.3201   | 6.9919         |
| 0.325              | 136.30                           | 0.001076                    | 0.5620         | 573.25            | 2155.8   | 2729.0         | 1.7006           | 5.2546   | 6.9652         |
| 0.350              | 138.88                           | 0.001079                    | 0.5243         | 584.33            | 2148.1   | 2732.4         | 1.7275           | 5.2130   | 6.9405         |
| 0.375              | 141.32                           | 0.001081                    | 0.4914         | 594.81            | 2140.8   | 2735.6         | 1.7528           | 5.1647   | 6.9175         |
| 0.40               | 143.63                           | 0.001084                    | 0.4625         | 604.74            | 2133.8   | 2738.6         | 1.7766           | 5.1193   | 6.8959         |
| 0.45               | 147.93                           | 0.001088                    | 0.4140         | 623.25            | 2120.7   | 2743.9         | 1.8207           | 5.0359   | 6.8565         |
| 0.50               | 151.86                           | 0.001093                    | 0.3749         | 640.23            | 2108.5   | 2748.7         | 1.8607           | 4.9606   | 6.8213         |
| 0.55               | 155.48                           | 0.001097                    | 0.3427         | 665.93            | 2097.0   | 2753.0         | 1.8973           | 4.8620   | 6.7893         |
| 0.60               | 158.85                           | 0.001101                    | 0.3157         | 670.56            | 2086.3   | 2756.8         | 1.9312           | 4.8288   | 6.7600         |
| 0.65               | 162.01                           | 0.001104                    | 0.2927         | 684.28            | 2076.0   | 2760.3         | 1.9627           | 4.7703   | 6.7331         |
| 0.70               | 164.97                           | 0.001108                    | 0.2729         | 697.22            | 2066.3   | 2763.5         | 1.9922           | 4.7158   | 6.7080         |
| 0.75               | 167.78                           | 0.001112                    | 0.2556         | 709.47            | 2057.0   | 2766.4         | 2.0200           | 4.6647   | 6.6847         |
| 0.80               | 170.43                           | 0.001115                    | 0.2404         | 721.11            | 2048.0   | 2769.1         | 2.0462           | 4.6166   | 6.6628         |
| 0.85               | 172.96                           | 0.001118                    | 0.2270         | 732.22            | 2039.4   | 2771.6         | 2.0710           | 4.5711   | 6.6421         |
| 0.90               | 175.38                           | 0.001121                    | 0.2150         | 742.83            | 2031.1   | 2773.9         | 2.0946           | 4.5280   | 6.6226         |
| 0.95               | 177.69                           | 0.001124                    | 0.2042         | 753.02            | 2023.1   | 2778.1         | 2.1172           | 4.4869   | 6.6041         |
| 1.00               | 179.91                           | 0.001127                    | 0.1944         | 762.81            | 2015.3   | 2781.7         | 2.1387           | 4.4478   | 6.5865         |
| 1.10               | 184.09                           | 0.001133                    | 0.1775         | 781.34            | 2000.4   | 2784.8         | 2.1792           | 4.3744   | 6.5536         |
| 1.20               | 187.99                           | 0.001139                    | 0.1633         | 798.65            | 1986.2   | 2784.8         | 2.2166           | 4.3067   | 6.5233         |
| 1.30               | 191.64                           | 0.001144                    | 0.1512         | 814.93            | 1972.7   | 2787.6         | 2.2515           | 4.2438   | 6.4953         |
| 1.40               | 195.07                           | 0.001149                    | 0.1408         | 830.30            | 1959.7   | 2790.0         | 2.2842           | 4.1850   | 6.4693         |
| 1.50               | 198.32                           | 0.001154                    | 0.1317         | 844.89            | 1947.3   | 2792.2         | 2.3150           | 4.1298   | 6.4448         |
| 1.75               | 205.76                           | 0.001166                    | 0.1134         | 878.50            | 1917.9   | 2796.4         | 2.3851           | 4.0044   | 6.3896         |
| 2.00               | 212.42                           | 0.001177                    | 0.0996         | 908.79            | 1890.7   | 2799.5         | 2.4474           | 3.8935   | 6.3409         |
| 2.25               | 218.45                           | 0.001187                    | 0.0887         | 936.49            | 1865.2   | 2801.5         | 2.5035           | 3.7937   | 6.2972         |

ตารางที่ ข.1 ตารางไอน้ำ(ต่อ) [21]

| Press.<br>MPa<br>P | Sat. Temp.<br>°C<br>T <sub>sat</sub> | Specific volume<br>m <sup>3</sup> /kg |                         | Enthalpy<br>kJ/kg        |                 |                         | Entropy<br>kJ/kg         |                 |                         |
|--------------------|--------------------------------------|---------------------------------------|-------------------------|--------------------------|-----------------|-------------------------|--------------------------|-----------------|-------------------------|
|                    |                                      | Sat.                                  | Sat.                    | Sat.                     | Evap.           | Sat.                    | Sat.                     | Evap.           | Sat.                    |
|                    |                                      | Liquid<br>V <sub>f</sub>              | Vapor<br>V <sub>g</sub> | Liquid<br>h <sub>f</sub> | h <sub>fg</sub> | Vapor<br>h <sub>g</sub> | Liquid<br>S <sub>f</sub> | S <sub>fg</sub> | Vapor<br>S <sub>g</sub> |
| 2.5                | 223.39                               | 0.001197                              | 0.07998                 | 962.11                   | 1841.0          | 2803.1                  | 2.5547                   | 3.7028          | 6.2575                  |
| 3.0                | 233.90                               | 0.001217                              | 0.06668                 | 1008.42                  | 1795.7          | 2804.2                  | 2.6457                   | 3.5412          | 6.1869                  |
| 3.5                | 242.60                               | 0.001235                              | 0.05707                 | 1049.75                  | 1753.7          | 2803.4                  | 2.7253                   | 3.4000          | 6.1253                  |
| 4                  | 250.40                               | 0.001252                              | 0.04978                 | 1087.31                  | 1714.1          | 2801.4                  | 2.7964                   | 3.2737          | 6.0701                  |
| 5                  | 263.99                               | 0.001286                              | 0.03944                 | 1154.23                  | 1640.1          | 2794.3                  | 2.9202                   | 3.0532          | 5.9734                  |
| 6                  | 275.64                               | 0.001319                              | 0.03244                 | 1213.35                  | 1571.0          | 2784.3                  | 3.0267                   | 2.8625          | 5.8895                  |
| 7                  | 285.88                               | 0.001351                              | 0.02737                 | 1267.00                  | 1505.1          | 2772.1                  | 3.1211                   | 2.6922          | 5.8133                  |
| 8                  | 295.06                               | 0.001384                              | 0.02352                 | 1316.64                  | 1441.3          | 2758.0                  | 3.2069                   | 2.3364          | 5.7432                  |
| 9                  | 303.40                               | 0.001418                              | 0.02048                 | 1363.26                  | 1378.9          | 2742.1                  | 3.2858                   | 2.3915          | 5.6722                  |
| 10                 | 311.06                               | 0.001452                              | 0.018026                | 1407.56                  | 1317.1          | 2724.7                  | 3.3596                   | 2.2544          | 5.6141                  |
| 11                 | 318.15                               | 0.001489                              | 0.015987                | 1450.1                   | 1255.5          | 2705.6                  | 3.4295                   | 2.1233          | 5.5527                  |
| 12                 | 324.75                               | 0.001527                              | 0.014263                | 1491.3                   | 1193.3          | 2684.9                  | 3.4962                   | 1.9962          | 5.4924                  |
| 13                 | 330.93                               | 0.001567                              | 0.012780                | 1531.5                   | 1130.7          | 2662.2                  | 3.5606                   | 1.8718          | 5.4323                  |
| 14                 | 336.75                               | 0.001611                              | 0.011485                | 1571.1                   | 1066.5          | 2637.6                  | 3.6232                   | 1.7485          | 5.3717                  |
| 15                 | 342.24                               | 0.001658                              | 0.010337                | 1610.5                   | 1000.0          | 2610.5                  | 3.6848                   | 1.6249          | 5.3098                  |
| 16                 | 347.44                               | 0.001711                              | 0.009306                | 1650.1                   | 930.6           | 2580.6                  | 3.7461                   | 1.4994          | 5.2455                  |
| 17                 | 352.37                               | 0.001770                              | 0.008364                | 1690.3                   | 856.9           | 2547.2                  | 3.8079                   | 1.3698          | 5.1777                  |
| 18                 | 357.06                               | 0.001840                              | 0.007489                | 1732.0                   | 777.1           | 2509.1                  | 3.8715                   | 1.2329          | 5.1844                  |
| 19                 | 361.54                               | 0.001924                              | 0.006657                | 1776.5                   | 688.0           | 2464.5                  | 3.9388                   | 1.0839          | 5.0228                  |
| 20                 | 365.81                               | 0.002036                              | 0.005834                | 1826.3                   | 583.4           | 2409.7                  | 4.0139                   | 0.9130          | 4.9269                  |
| 21                 | 369.89                               | 0.002207                              | 0.004952                | 1888.4                   | 446.2           | 2334.6                  | 4.1075                   | 0.6938          | 4.8013                  |
| 22                 | 373.80                               | 0.002742                              | 0.003568                | 2022.2                   | 143.4           | 2165.6                  | 4.3110                   | 0.2216          | 4.5327                  |
| 22.09              | 374.14                               | 0.003155                              | 0.003155                | 2099.3                   | 0               | 2099.3                  | 4.4296                   | 0               | 4.4298                  |

ตารางที่ ข.2 ค่าความร้อนของเชื้อเพลิง [21]

| ประเภท         | ชนิดเชื้อเพลิง     | ค่าความร้อน (หน่วยอังกฤษ)     | ค่าความร้อน (หน่วย SI)       |
|----------------|--------------------|-------------------------------|------------------------------|
| เชื้อเพลิงแข็ง | ถ่านหินบิทูมินัส   | 6,297.16 kcal/kg              | 26,366.21 kJ/kg              |
|                | ถ่านหินลิกไนท์     | 2,500.24 kcal/kg              | 10,468.50 kJ/kg              |
|                | ขี้เลื่อย          | 2,598.14 kcal/kg              | 10,878.41 kJ/kg              |
|                | แกลบ               | 3,438.72 kcal/kg              | 14,397.92 kJ/kg              |
|                | ขานอ้อย            | 1,798.16 kcal/kg              | 7,528.90 kJ/kg               |
|                | กะลาปาล์ม          | 4,410.00 kcal/kg              | 18,460.00 kJ/kg              |
|                | ไม้                | 3,818.41 kcal/kg              | 15,990.00 kJ/kg              |
|                | ถ่าน               | 6,900.00 kcal/kg              | 28,880.00 kJ/kg              |
| เชื้อเพลิงเหลว | ขยะ                | 1,160.00 kcal/kg              | 4,860.00 kJ/kg               |
|                | น้ำมันเบนซิน       | 8,245.76 kcal/L               | 34,525.00 kJ/L               |
|                | น้ำมันดีเซล        | 8,697.10 kcal/L               | 36,414.76 kJ/L               |
|                | น้ำมันเตาเอ        | 9,857.66 kcal/L               | 41,274.02 kJ/L               |
| เชื้อเพลิงก๊าซ | น้ำมันเตาซี        | 9,117.38 kcal/L               | 38,174.47 kJ/L               |
|                | ก๊าซธรรมชาติ       | 8,763.96 kcal/Nm <sup>3</sup> | 36,694.47 kJ/Nm <sup>3</sup> |
|                | ก๊าซปิโตรเลียมเหลว | 11,992.53 kcal/kg             | 50,220 kJ/kg                 |