

Приложение к рукописи статьи:

Л.Р. Фокин, А.Н. Калашников “Транспортные свойства смеси разреженных газов N₂- H₂ в базе данных ЭПИДИФ “, представленной в журнал Теплофизика высоких температур, сентябрь 2008 г

Из-за ограниченного объема статьи в нее не были включены

- 1) матрица ошибок параметров использованных трехпараметрических потенциалов Леннарда - Джонса m -6 (три потенциала U_{11} (N₂-N₂), U_{12} (N₂-H₂) , U_{22} (H₂-H₂), 9 параметров: диаметр столкновения d_{ij} , глубина ямы ϵ_{ij} и показатель степени отталкивательной ветви m_{ij} , соответственно;
- 2) расширенные по температуре до 2500 К с шагом 50 К таблицы вязкости чистых компонентов и смеси (Таблица 4а), коэффициентов взаимной диффузии и самодиффузии при $x=0,1$ (Таблица 5а) и термодиффузионного фактора (Таблица 6а).

Таблица

Вариационно-ковариационная матрица ошибок параметров

| | d_{11} | ϵ_{11} | m_{11} | d_{12} | ϵ_{12} | m_{12} | d_{22} | ϵ_{22} | m_{22} |
|-----------------|--------------------|--------------------|--------------------|--------------------|--------------------|--------------------|--------------------|--------------------|--------------------|
| d_{11} | 3,02300E-04 | -5,36350E-02 | -6,43938E-03 | 4,10560E-06 | -2,55676E-04 | -6,87961E-05 | -1,00954E-07 | 3,77965E-05 | -6,75382E-06 |
| ϵ_{11} | -9,94254E-01 | 9,62643E+00 | 1,11919E+00 | -1,20110E-03 | 7,91756E-02 | 1,90785E-02 | 1,99819E-05 | -9,43720E-03 | 1,65619E-03 |
| m_{11} | -9,55332E-01 | 9,30463E-01 | 1,50294E-01 | -4,18970E-05 | 2,35158E-03 | 7,60607E-04 | 1,54014E-06 | -3,86918E-04 | 7,15526E-05 |
| d_{12} | 1,30969E-02 | -2,14713E-02 | -5,99408E-03 | 3,25071E-04 | -2,87764E-02 | -4,49189E-03 | 1,46939E-07 | -1,44235E-03 | 2,35047E-04 |
| ϵ_{12} | -8,74225E-03 | 1,51709E-02 | 3,60613E-03 | -9,48855E-01 | 2,82940E+00 | 3,53585E-01 | 6,32860E-05 | 6,82100E-02 | -1,12653E-02 |
| m_{12} | -1,43887E-02 | 2,23609E-02 | 7,13456E-03 | -9,05977E-01 | 7,64404E-01 | 7,56215E-02 | -1,65407E-05 | 2,87193E-02 | -4,65474E-03 |
| d_{22} | -6,25995E-04 | 6,94341E-04 | 4,28308E-04 | 8,78648E-04 | 4,05628E-03 | -6,48485E-03 | 8,60328E-05 | -8,17158E-03 | 1,20298E-04 |
| ϵ_{22} | 1,83158E-03 | -2,56274E-03 | -8,40895E-04 | -6,74022E-02 | 3,41660E-02 | 8,79923E-02 | -7,42279E-01 | 1,40868E+00 | -1,48016E-01 |
| m_{22} | -2,16195E-03 | 2,97093E-03 | 1,02723E-03 | 7,25572E-02 | -3,72744E-02 | -9,42079E-02 | 7,21842E-02 | -6,94092E-01 | 3,22828E-02 |

На диагонали матрицы — оценки дисперсий параметров потенциалов $D(a_i)$.

Верхняя треугольная часть матрицы содержит ковариации $\text{cov}(a_i a_j)$.

Ниже диагонали приведены коэффициенты корреляции $r_{ij} = \text{cov}(a_i a_j) / [D(a_i) D(a_j)]^{0,5}$.

Таблица 4а

Вязкость $[\eta]_2$, мкПа · с и оценки погрешности δ , %

| T , К | | Мольная доля $x(\text{N}_2)$ | | | | | | |
|---------|----------|------------------------------|---------|---------|---------|---------|---------|-------|
| | | $x=0$ | $x=0.2$ | $x=0.4$ | $x=0.5$ | $x=0.6$ | $x=0.8$ | $x=1$ |
| 100 | η | 4.05 | 5.69 | 6.33 | 6.49 | 6.59 | 6.69 | 6.71 |
| | δ | 3.6 | 1.5 | 1.3 | 1.4 | 1.5 | 1.8 | 2.0 |
| 150 | η | 5.49 | 8.04 | 9.14 | 9.43 | 9.64 | 9.87 | 9.96 |
| | δ | 2.2 | 1.0 | 0.9 | 1.0 | 1.1 | 1.3 | 1.4 |
| 200 | η | 6.75 | 10.09 | 11.60 | 12.03 | 12.33 | 12.69 | 12.87 |
| | δ | 1.5 | 0.7 | 0.7 | 0.7 | 0.7 | 0.8 | 0.8 |
| 250 | η | 7.89 | 11.93 | 13.81 | 14.35 | 14.75 | 15.23 | 15.48 |

| | | Мольная доля $x(\text{N}_2)$ | | | | | | |
|---------------|----------|------------------------------|---------|---------|---------|---------|---------|-------|
| T, K | | $x=0$ | $x=0.2$ | $x=0.4$ | $x=0.5$ | $x=0.6$ | $x=0.8$ | $x=1$ |
| | δ | 1.2 | 0.6 | 0.6 | 0.5 | 0.5 | 0.5 | 0.5 |
| 300 | η | 8.96 | 13.63 | 15.83 | 16.48 | 16.95 | 17.55 | 17.87 |
| | δ | 1.0 | 0.6 | 0.5 | 0.5 | 0.4 | 0.4 | 0.4 |
| 350 | η | 9.96 | 15.21 | 17.71 | 18.46 | 19.00 | 19.70 | 20.08 |
| | δ | 0.9 | 0.6 | 0.5 | 0.4 | 0.4 | 0.3 | 0.4 |
| 400 | η | 10.92 | 16.70 | 19.48 | 20.32 | 20.93 | 21.71 | 22.15 |
| | δ | 0.8 | 0.6 | 0.5 | 0.4 | 0.4 | 0.3 | 0.4 |
| 450 | η | 11.84 | 18.13 | 21.16 | 22.08 | 22.75 | 23.62 | 24.10 |
| | δ | 0.8 | 0.5 | 0.5 | 0.4 | 0.4 | 0.3 | 0.4 |
| 500 | η | 12.73 | 19.49 | 22.77 | 23.76 | 24.48 | 25.43 | 25.96 |
| | δ | 0.8 | 0.5 | 0.5 | 0.4 | 0.4 | 0.4 | 0.4 |
| 550 | η | 13.59 | 20.81 | 24.31 | 25.37 | 26.15 | 27.17 | 27.73 |
| | δ | 0.8 | 0.5 | 0.5 | 0.4 | 0.4 | 0.4 | 0.4 |
| 600 | η | 14.43 | 22.08 | 25.80 | 26.92 | 27.75 | 28.84 | 29.44 |
| | δ | 0.8 | 0.5 | 0.4 | 0.4 | 0.4 | 0.4 | 0.5 |
| 650 | η | 15.25 | 23.32 | 27.24 | 28.43 | 29.31 | 30.45 | 31.09 |
| | δ | 0.8 | 0.5 | 0.4 | 0.4 | 0.4 | 0.4 | 0.5 |
| 700 | η | 16.05 | 24.52 | 28.64 | 29.89 | 30.81 | 32.01 | 32.69 |
| | δ | 0.9 | 0.5 | 0.4 | 0.4 | 0.4 | 0.4 | 0.5 |
| 750 | η | 16.83 | 25.70 | 30.00 | 31.31 | 32.27 | 33.53 | 34.24 |
| | δ | 0.9 | 0.5 | 0.4 | 0.4 | 0.4 | 0.4 | 0.5 |
| 800 | η | 17.60 | 26.84 | 31.33 | 32.69 | 33.70 | 35.01 | 35.74 |
| | δ | 1.0 | 0.5 | 0.5 | 0.4 | 0.4 | 0.5 | 0.5 |
| 850 | η | 18.35 | 27.97 | 32.63 | 34.04 | 35.09 | 36.45 | 37.21 |
| | δ | 1.0 | 0.5 | 0.5 | 0.5 | 0.5 | 0.5 | 0.6 |
| 900 | η | 19.09 | 29.07 | 33.90 | 35.37 | 36.45 | 37.86 | 38.65 |
| | δ | 1.0 | 0.5 | 0.5 | 0.5 | 0.5 | 0.5 | 0.6 |
| 950 | η | 19.82 | 30.15 | 35.15 | 36.66 | 37.78 | 39.24 | 40.06 |
| | δ | 1.1 | 0.6 | 0.5 | 0.5 | 0.5 | 0.6 | 0.6 |
| 1000 | η | 20.54 | 31.21 | 36.37 | 37.94 | 39.09 | 40.59 | 41.43 |
| | δ | 1.1 | 0.6 | 0.5 | 0.5 | 0.5 | 0.6 | 0.7 |
| 1050 | η | 21.25 | 32.26 | 37.58 | 39.19 | 40.37 | 41.92 | 42.78 |
| | δ | 1.1 | 0.6 | 0.5 | 0.5 | 0.6 | 0.6 | 0.7 |
| 1100 | η | 21.95 | 33.29 | 38.76 | 40.42 | 41.64 | 43.22 | 44.11 |
| | δ | 1.2 | 0.6 | 0.6 | 0.6 | 0.6 | 0.7 | 0.8 |

| T, K | | Мольная доля $x(\text{N}_2)$ | | | | | | |
|------|----------|------------------------------|---------|---------|---------|---------|---------|-------|
| | | $x=0$ | $x=0.2$ | $x=0.4$ | $x=0.5$ | $x=0.6$ | $x=0.8$ | $x=1$ |
| 1150 | η | 22.64 | 34.30 | 39.92 | 41.62 | 42.88 | 44.50 | 45.41 |
| | δ | 1.2 | 0.6 | 0.6 | 0.6 | 0.6 | 0.7 | 0.8 |
| 1200 | η | 23.32 | 35.30 | 41.07 | 42.81 | 44.10 | 45.76 | 46.69 |
| | δ | 1.3 | 0.7 | 0.6 | 0.6 | 0.6 | 0.7 | 0.8 |
| 1250 | η | 23.99 | 36.29 | 42.20 | 43.99 | 45.30 | 47.00 | 47.96 |
| | δ | 1.3 | 0.7 | 0.6 | 0.6 | 0.7 | 0.8 | 0.9 |
| 1300 | η | 24.66 | 37.26 | 43.32 | 45.15 | 46.49 | 48.23 | 49.20 |
| | δ | 1.3 | 0.7 | 0.6 | 0.7 | 0.7 | 0.8 | 0.9 |
| 1350 | η | 25.32 | 38.22 | 44.42 | 46.29 | 47.66 | 49.43 | 50.43 |
| | δ | 1.4 | 0.7 | 0.7 | 0.7 | 0.7 | 0.9 | 1.0 |
| 1400 | η | 25.97 | 39.18 | 45.51 | 47.41 | 48.81 | 50.63 | 51.63 |
| | δ | 1.4 | 0.7 | 0.7 | 0.7 | 0.8 | 0.9 | 1.0 |
| 1450 | η | 26.62 | 40.12 | 46.58 | 48.53 | 49.96 | 51.80 | 52.83 |
| | δ | 1.4 | 0.8 | 0.7 | 0.8 | 0.8 | 0.9 | 1.1 |
| 1500 | η | 27.26 | 41.05 | 47.64 | 49.63 | 51.08 | 52.96 | 54.01 |
| | δ | 1.5 | 0.8 | 0.8 | 0.8 | 0.8 | 1.0 | 1.1 |
| 1550 | η | 27.89 | 41.97 | 48.70 | 50.72 | 52.20 | 54.11 | 55.17 |
| | δ | 1.5 | 0.8 | 0.8 | 0.8 | 0.9 | 1.0 | 1.2 |
| 1600 | η | 28.52 | 42.88 | 49.73 | 51.79 | 53.30 | 55.24 | 56.32 |
| | δ | 1.5 | 0.8 | 0.8 | 0.8 | 0.9 | 1.0 | 1.2 |
| 1650 | η | 29.15 | 43.78 | 50.76 | 52.86 | 54.39 | 56.37 | 57.46 |
| | δ | 1.6 | 0.9 | 0.8 | 0.9 | 0.9 | 1.1 | 1.3 |
| 1700 | η | 29.76 | 44.68 | 51.78 | 53.91 | 55.47 | 57.48 | 58.59 |
| | δ | 1.6 | 0.9 | 0.9 | 0.9 | 1.0 | 1.1 | 1.3 |
| 1750 | η | 30.38 | 45.56 | 52.79 | 54.95 | 56.54 | 58.57 | 59.70 |
| | δ | 1.6 | 0.9 | 0.9 | 0.9 | 1.0 | 1.2 | 1.3 |
| 1800 | η | 30.99 | 46.44 | 53.79 | 55.99 | 57.60 | 59.66 | 60.80 |
| | δ | 1.7 | 0.9 | 0.9 | 1.0 | 1.0 | 1.2 | 1.4 |
| 1850 | η | 31.59 | 47.31 | 54.78 | 57.01 | 58.64 | 60.74 | 61.89 |
| | δ | 1.7 | 0.9 | 0.9 | 1.0 | 1.1 | 1.2 | 1.4 |
| 1900 | η | 32.19 | 48.18 | 55.76 | 58.03 | 59.68 | 61.81 | 62.98 |
| | δ | 1.7 | 1.0 | 1.0 | 1.0 | 1.1 | 1.3 | 1.5 |
| 1950 | η | 32.79 | 49.04 | 56.73 | 59.03 | 60.71 | 62.86 | 64.05 |
| | δ | 1.8 | 1.0 | 1.0 | 1.0 | 1.1 | 1.3 | 1.5 |
| 2000 | η | 33.38 | 49.89 | 57.70 | 60.03 | 61.73 | 63.91 | 65.11 |

| | | Мольная доля $x(\text{N}_2)$ | | | | | | |
|---------------|----------|------------------------------|---------|---------|---------|---------|---------|-------|
| T, K | | $x=0$ | $x=0.2$ | $x=0.4$ | $x=0.5$ | $x=0.6$ | $x=0.8$ | $x=1$ |
| | δ | 1.8 | 1.0 | 1.0 | 1.1 | 1.1 | 1.3 | 1.6 |
| 2050 | η | 33.96 | 50.73 | 58.66 | 61.02 | 62.74 | 64.95 | 66.16 |
| | δ | 1.8 | 1.0 | 1.0 | 1.1 | 1.2 | 1.4 | 1.6 |
| 2100 | η | 34.55 | 51.57 | 59.61 | 62.00 | 63.75 | 65.98 | 67.21 |
| | δ | 1.9 | 1.0 | 1.1 | 1.1 | 1.2 | 1.4 | 1.6 |
| 2150 | η | 35.13 | 52.40 | 60.55 | 62.98 | 64.74 | 67.00 | 68.24 |
| | δ | 1.9 | 1.1 | 1.1 | 1.1 | 1.2 | 1.4 | 1.7 |
| 2200 | η | 35.70 | 53.23 | 61.49 | 63.94 | 65.73 | 68.02 | 69.27 |
| | δ | 1.9 | 1.1 | 1.1 | 1.2 | 1.3 | 1.5 | 1.7 |
| 2250 | η | 36.28 | 54.05 | 62.41 | 64.90 | 66.71 | 69.03 | 70.29 |
| | δ | 1.9 | 1.1 | 1.1 | 1.2 | 1.3 | 1.5 | 1.8 |
| 2300 | η | 36.85 | 54.86 | 63.34 | 65.85 | 67.69 | 70.02 | 71.30 |
| | δ | 2.0 | 1.1 | 1.1 | 1.2 | 1.3 | 1.5 | 1.8 |
| 2350 | η | 37.41 | 55.67 | 64.25 | 66.80 | 68.65 | 71.01 | 72.30 |
| | δ | 2.0 | 1.1 | 1.2 | 1.2 | 1.3 | 1.6 | 1.8 |
| 2400 | η | 37.98 | 56.47 | 65.16 | 67.74 | 69.61 | 72.00 | 73.29 |
| | δ | 2.0 | 1.2 | 1.2 | 1.3 | 1.4 | 1.6 | 1.9 |
| 2450 | η | 38.54 | 57.27 | 66.06 | 68.67 | 70.56 | 72.98 | 74.28 |
| | δ | 2.1 | 1.2 | 1.2 | 1.3 | 1.4 | 1.6 | 1.9 |
| 2500 | η | 39.09 | 58.07 | 66.96 | 69.60 | 71.51 | 73.95 | 75.26 |
| | δ | 2.1 | 1.2 | 1.2 | 1.3 | 1.4 | 1.7 | 1.9 |

Таблица 5а

Коэффициент взаимной диффузии $[D]_2$, см²/с (1 атм) и оценки погрешности δ , %

| T, К | | Мольная доля $x(\text{N}_2)$ | | | | | | |
|------|----------|------------------------------|---------|---------|---------|---------|---------|-------|
| | | $x=0$ | $x=0.2$ | $x=0.4$ | $x=0.5$ | $x=0.6$ | $x=0.8$ | $x=1$ |
| 100 | D | 0.22 | 0.11 | 0.11 | 0.11 | 0.11 | 0.11 | 0.03 |
| | δ | 3.5 | 2.0 | 2.0 | 2.0 | 2.0 | 2.0 | 2.0 |
| 150 | D | 0.45 | 0.23 | 0.23 | 0.23 | 0.23 | 0.23 | 0.06 |
| | δ | 2.1 | 1.3 | 1.3 | 1.3 | 1.3 | 1.3 | 1.6 |
| 200 | D | 0.75 | 0.39 | 0.39 | 0.39 | 0.39 | 0.39 | 0.10 |
| | δ | 1.4 | 1.0 | 1.0 | 1.0 | 1.0 | 1.0 | 1.2 |
| 250 | D | 1.10 | 0.57 | 0.57 | 0.58 | 0.58 | 0.58 | 0.15 |
| | δ | 1.1 | 0.8 | 0.8 | 0.8 | 0.8 | 0.8 | 1.0 |
| 300 | D | 1.50 | 0.79 | 0.79 | 0.79 | 0.79 | 0.79 | 0.21 |
| | δ | 0.9 | 0.8 | 0.8 | 0.8 | 0.8 | 0.8 | 0.9 |
| 350 | D | 1.95 | 1.02 | 1.03 | 1.03 | 1.04 | 1.04 | 0.27 |
| | δ | 0.9 | 0.8 | 0.8 | 0.8 | 0.8 | 0.8 | 0.9 |
| 400 | D | 2.45 | 1.29 | 1.30 | 1.30 | 1.30 | 1.31 | 0.34 |
| | δ | 0.9 | 0.8 | 0.8 | 0.8 | 0.8 | 0.8 | 0.9 |
| 450 | D | 2.99 | 1.58 | 1.59 | 1.59 | 1.59 | 1.60 | 0.42 |
| | δ | 0.9 | 0.9 | 0.9 | 0.9 | 0.9 | 0.9 | 0.9 |
| 500 | D | 3.58 | 1.89 | 1.90 | 1.90 | 1.91 | 1.91 | 0.50 |
| | δ | 1.0 | 0.9 | 0.9 | 0.9 | 0.9 | 0.9 | 1.0 |
| 550 | D | 4.21 | 2.22 | 2.23 | 2.24 | 2.24 | 2.25 | 0.59 |
| | δ | 1.1 | 1.0 | 1.0 | 1.0 | 1.0 | 1.0 | 1.1 |
| 600 | D | 4.88 | 2.57 | 2.59 | 2.59 | 2.60 | 2.61 | 0.69 |
| | δ | 1.1 | 1.1 | 1.1 | 1.1 | 1.1 | 1.1 | 1.2 |
| 650 | D | 5.59 | 2.94 | 2.96 | 2.97 | 2.98 | 2.99 | 0.79 |
| | δ | 1.2 | 1.2 | 1.2 | 1.2 | 1.2 | 1.2 | 1.2 |
| 700 | D | 6.34 | 3.33 | 3.36 | 3.37 | 3.38 | 3.39 | 0.89 |
| | δ | 1.3 | 1.2 | 1.2 | 1.2 | 1.2 | 1.2 | 1.3 |
| 750 | D | 7.13 | 3.75 | 3.77 | 3.78 | 3.79 | 3.81 | 1.00 |
| | δ | 1.3 | 1.3 | 1.3 | 1.3 | 1.3 | 1.3 | 1.4 |
| 800 | D | 7.96 | 4.18 | 4.21 | 4.22 | 4.23 | 4.25 | 1.12 |
| | δ | 1.4 | 1.4 | 1.4 | 1.4 | 1.4 | 1.4 | 1.4 |
| 850 | D | 8.83 | 4.63 | 4.66 | 4.67 | 4.68 | 4.70 | 1.24 |
| | δ | 1.4 | 1.5 | 1.5 | 1.5 | 1.5 | 1.5 | 1.5 |
| 900 | D | 9.73 | 5.09 | 5.13 | 5.15 | 5.16 | 5.18 | 1.36 |

| | | Мольная доля $x(\text{N}_2)$ | | | | | | |
|---------------|----------|------------------------------|---------|---------|---------|---------|---------|-------|
| T, K | | $x=0$ | $x=0.2$ | $x=0.4$ | $x=0.5$ | $x=0.6$ | $x=0.8$ | $x=1$ |
| | δ | 1.5 | 1.5 | 1.5 | 1.5 | 1.5 | 1.5 | 1.6 |
| 950 | D | 10.67 | 5.58 | 5.62 | 5.64 | 5.65 | 5.67 | 1.49 |
| | δ | 1.6 | 1.6 | 1.6 | 1.6 | 1.6 | 1.6 | 1.7 |
| 1000 | D | 11.65 | 6.08 | 6.13 | 6.15 | 6.16 | 6.19 | 1.62 |
| | δ | 1.6 | 1.7 | 1.7 | 1.7 | 1.7 | 1.7 | 1.7 |
| 1050 | D | 12.66 | 6.60 | 6.65 | 6.67 | 6.69 | 6.71 | 1.76 |
| | δ | 1.7 | 1.8 | 1.8 | 1.8 | 1.8 | 1.8 | 1.8 |
| 1100 | D | 13.70 | 7.14 | 7.20 | 7.22 | 7.23 | 7.26 | 1.90 |
| | δ | 1.7 | 1.8 | 1.8 | 1.8 | 1.8 | 1.8 | 1.9 |
| 1150 | D | 14.78 | 7.70 | 7.76 | 7.78 | 7.80 | 7.83 | 2.05 |
| | δ | 1.8 | 1.9 | 1.9 | 1.9 | 1.9 | 1.9 | 1.9 |
| 1200 | D | 15.89 | 8.27 | 8.33 | 8.35 | 8.37 | 8.41 | 2.20 |
| | δ | 1.8 | 1.9 | 1.9 | 1.9 | 1.9 | 1.9 | 2.0 |
| 1250 | D | 17.04 | 8.86 | 8.92 | 8.95 | 8.97 | 9.01 | 2.35 |
| | δ | 1.9 | 2.0 | 2.0 | 2.0 | 2.0 | 2.0 | 2.1 |
| 1300 | D | 18.22 | 9.46 | 9.53 | 9.56 | 9.58 | 9.62 | 2.51 |
| | δ | 1.9 | 2.1 | 2.1 | 2.1 | 2.1 | 2.1 | 2.1 |
| 1350 | D | 19.43 | 10.08 | 10.16 | 10.19 | 10.21 | 10.25 | 2.68 |
| | δ | 2.0 | 2.1 | 2.1 | 2.1 | 2.1 | 2.1 | 2.2 |
| 1400 | D | 20.68 | 10.72 | 10.80 | 10.83 | 10.86 | 10.90 | 2.84 |
| | δ | 2.0 | 2.2 | 2.2 | 2.2 | 2.2 | 2.2 | 2.2 |
| 1450 | D | 21.96 | 11.37 | 11.45 | 11.49 | 11.52 | 11.56 | 3.01 |
| | δ | 2.0 | 2.2 | 2.2 | 2.2 | 2.2 | 2.2 | 2.3 |
| 1500 | D | 23.27 | 12.04 | 12.13 | 12.16 | 12.19 | 12.24 | 3.19 |
| | δ | 2.1 | 2.3 | 2.3 | 2.3 | 2.3 | 2.3 | 2.3 |
| 1550 | D | 24.61 | 12.72 | 12.82 | 12.85 | 12.88 | 12.93 | 3.37 |
| | δ | 2.1 | 2.4 | 2.4 | 2.4 | 2.4 | 2.4 | 2.4 |
| 1600 | D | 25.98 | 13.42 | 13.52 | 13.56 | 13.59 | 13.64 | 3.55 |
| | δ | 2.2 | 2.4 | 2.4 | 2.4 | 2.4 | 2.4 | 2.5 |
| 1650 | D | 27.39 | 14.13 | 14.24 | 14.28 | 14.31 | 14.37 | 3.74 |
| | δ | 2.2 | 2.5 | 2.5 | 2.5 | 2.5 | 2.5 | 2.5 |
| 1700 | D | 28.82 | 14.86 | 14.97 | 15.01 | 15.05 | 15.11 | 3.93 |
| | δ | 2.2 | 2.5 | 2.5 | 2.5 | 2.5 | 2.5 | 2.6 |
| 1750 | D | 30.29 | 15.60 | 15.72 | 15.76 | 15.80 | 15.86 | 4.12 |
| | δ | 2.3 | 2.6 | 2.6 | 2.6 | 2.6 | 2.6 | 2.6 |

| T, K | | Мольная доля $x(N_2)$ | | | | | | |
|--------|----------|-----------------------|---------|---------|---------|---------|---------|-------|
| | | $x=0$ | $x=0.2$ | $x=0.4$ | $x=0.5$ | $x=0.6$ | $x=0.8$ | $x=1$ |
| 1800 | D | 31.78 | 16.36 | 16.48 | 16.53 | 16.57 | 16.63 | 4.32 |
| | δ | 2.3 | 2.6 | 2.6 | 2.6 | 2.6 | 2.6 | 2.7 |
| 1850 | D | 33.31 | 17.13 | 17.26 | 17.31 | 17.35 | 17.42 | 4.52 |
| | δ | 2.4 | 2.7 | 2.7 | 2.7 | 2.7 | 2.7 | 2.7 |
| 1900 | D | 34.87 | 17.92 | 18.05 | 18.10 | 18.15 | 18.22 | 4.72 |
| | δ | 2.4 | 2.7 | 2.7 | 2.7 | 2.7 | 2.7 | 2.7 |
| 1950 | D | 36.45 | 18.72 | 18.86 | 18.91 | 18.96 | 19.03 | 4.93 |
| | δ | 2.4 | 2.7 | 2.7 | 2.7 | 2.7 | 2.7 | 2.8 |
| 2000 | D | 38.07 | 19.53 | 19.68 | 19.73 | 19.78 | 19.86 | 5.14 |
| | δ | 2.5 | 2.8 | 2.8 | 2.8 | 2.8 | 2.8 | 2.8 |
| 2050 | D | 39.71 | 20.36 | 20.51 | 20.57 | 20.62 | 20.70 | 5.36 |
| | δ | 2.5 | 2.8 | 2.8 | 2.8 | 2.8 | 2.8 | 2.9 |
| 2100 | D | 41.39 | 21.21 | 21.36 | 21.42 | 21.48 | 21.56 | 5.58 |
| | δ | 2.5 | 2.9 | 2.9 | 2.9 | 2.9 | 2.9 | 2.9 |
| 2150 | D | 43.09 | 22.06 | 22.23 | 22.29 | 22.34 | 22.43 | 5.80 |
| | δ | 2.6 | 2.9 | 2.9 | 2.9 | 2.9 | 2.9 | 3.0 |
| 2200 | D | 44.82 | 22.93 | 23.10 | 23.17 | 23.22 | 23.31 | 6.03 |
| | δ | 2.6 | 3.0 | 3.0 | 3.0 | 3.0 | 3.0 | 3.0 |
| 2250 | D | 46.58 | 23.82 | 24.00 | 24.06 | 24.12 | 24.21 | 6.26 |
| | δ | 2.6 | 3.0 | 3.0 | 3.0 | 3.0 | 3.0 | 3.1 |
| 2300 | D | 48.37 | 24.72 | 24.90 | 24.97 | 25.03 | 25.13 | 6.49 |
| | δ | 2.7 | 3.0 | 3.0 | 3.0 | 3.0 | 3.0 | 3.1 |
| 2350 | D | 50.19 | 25.63 | 25.82 | 25.89 | 25.95 | 26.05 | 6.72 |
| | δ | 2.7 | 3.1 | 3.1 | 3.1 | 3.1 | 3.1 | 3.1 |
| 2400 | D | 52.03 | 26.55 | 26.75 | 26.82 | 26.89 | 26.99 | 6.96 |
| | δ | 2.7 | 3.1 | 3.1 | 3.1 | 3.1 | 3.1 | 3.2 |
| 2450 | D | 53.91 | 27.49 | 27.70 | 27.77 | 27.84 | 27.95 | 7.21 |
| | δ | 2.7 | 3.2 | 3.2 | 3.2 | 3.2 | 3.2 | 3.2 |
| 2500 | D | 55.81 | 28.44 | 28.65 | 28.73 | 28.80 | 28.91 | 7.45 |
| | δ | 2.8 | 3.2 | 3.2 | 3.2 | 3.2 | 3.2 | 3 |

Таблица ба

Термодиффузионный фактор $[\alpha_T]_{cc1}$ и оценки погрешности δ , %

| T, К | | Мольная доля $x(N_2)$ | | | | | | |
|------|----------|-----------------------|---------|---------|---------|---------|---------|-------|
| | | $x=0$ | $x=0.2$ | $x=0.4$ | $x=0.5$ | $x=0.6$ | $x=0.8$ | $x=1$ |
| 100 | α | 0.340 | 0.150 | 0.122 | 0.112 | 0.103 | 0.089 | 0.002 |
| | δ | 21.2 | 23.7 | 24.0 | 24.1 | 24.2 | 24.3 | 879.2 |
| 150 | α | 0.412 | 0.281 | 0.230 | 0.211 | 0.195 | 0.170 | 0.151 |
| | δ | 11.9 | 9.3 | 9.4 | 9.5 | 9.5 | 9.6 | 15.9 |
| 200 | α | 0.443 | 0.348 | 0.287 | 0.264 | 0.244 | 0.213 | 0.258 |
| | δ | 8.5 | 5.8 | 5.8 | 5.8 | 5.8 | 5.9 | 8.5 |
| 250 | α | 0.458 | 0.387 | 0.320 | 0.294 | 0.273 | 0.238 | 0.331 |
| | δ | 6.8 | 4.4 | 4.4 | 4.4 | 4.4 | 4.4 | 5.4 |
| 300 | α | 0.465 | 0.412 | 0.341 | 0.314 | 0.291 | 0.254 | 0.381 |
| | δ | 5.9 | 3.9 | 3.8 | 3.8 | 3.8 | 3.8 | 3.9 |
| 350 | α | 0.469 | 0.429 | 0.355 | 0.327 | 0.303 | 0.265 | 0.417 |
| | δ | 5.3 | 3.8 | 3.7 | 3.6 | 3.6 | 3.5 | 3.2 |
| 400 | α | 0.471 | 0.440 | 0.365 | 0.336 | 0.312 | 0.273 | 0.443 |
| | δ | 5.0 | 3.9 | 3.7 | 3.6 | 3.6 | 3.5 | 3.1 |
| 450 | α | 0.472 | 0.449 | 0.372 | 0.343 | 0.318 | 0.278 | 0.463 |
| | δ | 4.8 | 4.0 | 3.8 | 3.7 | 3.6 | 3.5 | 3.3 |
| 500 | α | 0.472 | 0.455 | 0.378 | 0.348 | 0.323 | 0.282 | 0.478 |
| | δ | 4.6 | 4.2 | 3.9 | 3.8 | 3.7 | 3.6 | 3.5 |
| 550 | α | 0.472 | 0.460 | 0.382 | 0.352 | 0.327 | 0.286 | 0.490 |
| | δ | 4.6 | 4.4 | 4.0 | 3.9 | 3.8 | 3.7 | 3.7 |
| 600 | α | 0.471 | 0.464 | 0.385 | 0.355 | 0.329 | 0.288 | 0.500 |
| | δ | 4.5 | 4.5 | 4.2 | 4.0 | 3.9 | 3.8 | 4.0 |
| 650 | α | 0.471 | 0.467 | 0.388 | 0.357 | 0.332 | 0.290 | 0.508 |
| | δ | 4.5 | 4.7 | 4.3 | 4.2 | 4.0 | 3.9 | 4.2 |
| 700 | α | 0.470 | 0.470 | 0.390 | 0.359 | 0.333 | 0.291 | 0.514 |
| | δ | 4.5 | 4.9 | 4.4 | 4.3 | 4.2 | 4.0 | 4.4 |
| 750 | α | 0.469 | 0.472 | 0.391 | 0.361 | 0.335 | 0.293 | 0.520 |
| | δ | 4.5 | 5.0 | 4.6 | 4.4 | 4.3 | 4.0 | 4.6 |
| 800 | α | 0.468 | 0.473 | 0.393 | 0.362 | 0.336 | 0.294 | 0.524 |
| | δ | 4.6 | 5.2 | 4.7 | 4.5 | 4.4 | 4.1 | 4.7 |
| 850 | α | 0.467 | 0.475 | 0.394 | 0.363 | 0.337 | 0.294 | 0.528 |
| | δ | 4.6 | 5.3 | 4.8 | 4.6 | 4.5 | 4.2 | 4.9 |
| 900 | α | 0.466 | 0.476 | 0.395 | 0.364 | 0.337 | 0.295 | 0.531 |

| | | Мольная доля $x(\text{N}_2)$ | | | | | | |
|---------------|----------|------------------------------|---------|---------|---------|---------|---------|-------|
| T, K | | $x=0$ | $x=0.2$ | $x=0.4$ | $x=0.5$ | $x=0.6$ | $x=0.8$ | $x=1$ |
| | δ | 4.6 | 5.4 | 4.9 | 4.7 | 4.6 | 4.3 | 5.0 |
| 950 | α | 0.465 | 0.477 | 0.395 | 0.364 | 0.338 | 0.296 | 0.533 |
| | δ | 4.7 | 5.6 | 5.0 | 4.8 | 4.6 | 4.4 | 5.1 |
| 1000 | α | 0.464 | 0.477 | 0.396 | 0.365 | 0.339 | 0.296 | 0.536 |
| | δ | 4.7 | 5.7 | 5.1 | 4.9 | 4.7 | 4.4 | 5.3 |
| 1050 | α | 0.463 | 0.478 | 0.396 | 0.365 | 0.339 | 0.296 | 0.538 |
| | δ | 4.8 | 5.8 | 5.2 | 5.0 | 4.8 | 4.5 | 5.4 |
| 1100 | α | 0.462 | 0.479 | 0.397 | 0.366 | 0.339 | 0.297 | 0.539 |
| | δ | 4.8 | 5.9 | 5.3 | 5.1 | 4.9 | 4.6 | 5.5 |
| 1150 | α | 0.461 | 0.479 | 0.397 | 0.366 | 0.340 | 0.297 | 0.541 |
| | δ | 4.8 | 6.0 | 5.4 | 5.2 | 5.0 | 4.6 | 5.6 |
| 1200 | α | 0.460 | 0.479 | 0.397 | 0.366 | 0.340 | 0.297 | 0.542 |
| | δ | 4.9 | 6.1 | 5.5 | 5.2 | 5.0 | 4.7 | 5.6 |
| 1250 | α | 0.459 | 0.480 | 0.398 | 0.367 | 0.340 | 0.297 | 0.543 |
| | δ | 4.9 | 6.2 | 5.6 | 5.3 | 5.1 | 4.8 | 5.7 |
| 1300 | α | 0.459 | 0.480 | 0.398 | 0.367 | 0.340 | 0.297 | 0.544 |
| | δ | 5.0 | 6.3 | 5.6 | 5.4 | 5.2 | 4.8 | 5.8 |
| 1350 | α | 0.458 | 0.480 | 0.398 | 0.367 | 0.340 | 0.297 | 0.545 |
| | δ | 5.0 | 6.4 | 5.7 | 5.5 | 5.2 | 4.9 | 5.9 |
| 1400 | α | 0.457 | 0.481 | 0.398 | 0.367 | 0.340 | 0.297 | 0.545 |
| | δ | 5.1 | 6.5 | 5.8 | 5.5 | 5.3 | 4.9 | 5.9 |
| 1450 | α | 0.456 | 0.481 | 0.398 | 0.367 | 0.340 | 0.297 | 0.546 |
| | δ | 5.1 | 6.6 | 5.9 | 5.6 | 5.3 | 5.0 | 6.0 |
| 1500 | α | 0.456 | 0.481 | 0.398 | 0.367 | 0.340 | 0.297 | 0.547 |
| | δ | 5.2 | 6.7 | 5.9 | 5.6 | 5.4 | 5.0 | 6.0 |
| 1550 | α | 0.455 | 0.481 | 0.398 | 0.367 | 0.340 | 0.297 | 0.547 |
| | δ | 5.2 | 6.8 | 6.0 | 5.7 | 5.5 | 5.1 | 6.1 |
| 1600 | α | 0.454 | 0.481 | 0.398 | 0.367 | 0.340 | 0.297 | 0.547 |
| | δ | 5.3 | 6.9 | 6.1 | 5.8 | 5.5 | 5.1 | 6.2 |
| 1650 | α | 0.454 | 0.481 | 0.398 | 0.367 | 0.340 | 0.297 | 0.548 |
| | δ | 5.3 | 6.9 | 6.1 | 5.8 | 5.6 | 5.2 | 6.2 |
| 1700 | α | 0.453 | 0.481 | 0.398 | 0.367 | 0.340 | 0.297 | 0.548 |
| | δ | 5.3 | 7.0 | 6.2 | 5.9 | 5.6 | 5.2 | 6.2 |
| 1750 | α | 0.452 | 0.481 | 0.398 | 0.367 | 0.340 | 0.297 | 0.548 |
| | δ | 5.4 | 7.1 | 6.2 | 5.9 | 5.7 | 5.2 | 6.3 |

| | | Мольная доля $x(\text{N}_2)$ | | | | | | |
|---------------|----------|------------------------------|---------|---------|---------|---------|---------|-------|
| T, K | | $x=0$ | $x=0.2$ | $x=0.4$ | $x=0.5$ | $x=0.6$ | $x=0.8$ | $x=1$ |
| 1800 | α | 0.452 | 0.481 | 0.398 | 0.367 | 0.340 | 0.297 | 0.548 |
| | δ | 5.4 | 7.2 | 6.3 | 6.0 | 5.7 | 5.3 | 6.3 |
| 1850 | α | 0.451 | 0.481 | 0.398 | 0.367 | 0.340 | 0.297 | 0.549 |
| | δ | 5.5 | 7.2 | 6.4 | 6.0 | 5.8 | 5.3 | 6.4 |
| 1900 | α | 0.450 | 0.481 | 0.398 | 0.367 | 0.340 | 0.297 | 0.549 |
| | δ | 5.5 | 7.3 | 6.4 | 6.1 | 5.8 | 5.4 | 6.4 |
| 1950 | α | 0.450 | 0.481 | 0.398 | 0.367 | 0.340 | 0.297 | 0.549 |
| | δ | 5.5 | 7.4 | 6.5 | 6.1 | 5.8 | 5.4 | 6.5 |
| 2000 | α | 0.449 | 0.481 | 0.398 | 0.367 | 0.340 | 0.297 | 0.549 |
| | δ | 5.6 | 7.4 | 6.5 | 6.2 | 5.9 | 5.4 | 6.5 |
| 2050 | α | 0.449 | 0.481 | 0.398 | 0.367 | 0.340 | 0.297 | 0.549 |
| | δ | 5.6 | 7.5 | 6.6 | 6.2 | 5.9 | 5.5 | 6.5 |
| 2100 | α | 0.448 | 0.481 | 0.398 | 0.367 | 0.340 | 0.297 | 0.549 |
| | δ | 5.7 | 7.6 | 6.6 | 6.3 | 6.0 | 5.5 | 6.6 |
| 2150 | α | 0.448 | 0.481 | 0.398 | 0.367 | 0.340 | 0.296 | 0.549 |
| | δ | 5.7 | 7.6 | 6.7 | 6.3 | 6.0 | 5.5 | 6.6 |
| 2200 | α | 0.447 | 0.481 | 0.398 | 0.366 | 0.340 | 0.296 | 0.549 |
| | δ | 5.7 | 7.7 | 6.7 | 6.3 | 6.0 | 5.6 | 6.6 |
| 2250 | α | 0.447 | 0.481 | 0.398 | 0.366 | 0.340 | 0.296 | 0.549 |
| | δ | 5.8 | 7.7 | 6.8 | 6.4 | 6.1 | 5.6 | 6.7 |
| 2300 | α | 0.446 | 0.481 | 0.398 | 0.366 | 0.339 | 0.296 | 0.549 |
| | δ | 5.8 | 7.8 | 6.8 | 6.4 | 6.1 | 5.6 | 6.7 |
| 2350 | α | 0.446 | 0.481 | 0.398 | 0.366 | 0.339 | 0.296 | 0.549 |
| | δ | 5.8 | 7.9 | 6.8 | 6.5 | 6.2 | 5.7 | 6.7 |
| 2400 | α | 0.445 | 0.481 | 0.398 | 0.366 | 0.339 | 0.296 | 0.549 |
| | δ | 5.9 | 7.9 | 6.9 | 6.5 | 6.2 | 5.7 | 6.7 |
| 2450 | α | 0.445 | 0.481 | 0.398 | 0.366 | 0.339 | 0.296 | 0.549 |
| | δ | 5.9 | 8.0 | 6.9 | 6.5 | 6.2 | 5.7 | 6.8 |
| 2500 | α | 0.445 | 0.481 | 0.398 | 0.366 | 0.339 | 0.296 | 0.549 |
| | δ | 5.9 | 8.0 | 7.0 | 6.6 | 6.3 | 5.7 | 6.8 |

В Приложении приведем также информацию об отчете NASA 1966 г. Simon H.A., Liu C.S., Harnett J.P. Properties of hydrogen:nitrogen, hydrogen: carbon- dioxide, and carbon-dioxide: nitrogen mixtures, NASA CR-387, 1966, который содержит результаты расчета вязкости, теплопроводности и числа Шмидта для указанных бинарных смесей в интервале температур 100- 5000 К (без учета возможной диссоциации).

Для смеси N₂- H₂ расчет свойств проводился на базе стандартных зависимостей молекулярно-кинетической теории с использованием потенциалов Л-Дж 12-6 с параметрами для водорода $d=2.968 \text{ \AA}$, $\epsilon = 33.3 \text{ К}$, для азота $d= 3.749 \text{ \AA}$, $\epsilon = 79.8 \text{ К}$. В те годы появились только первые подозрения о том, что опытные данные Траутца и соавторов по вязкости газов при температурах более 500 С занижены, и только позже были получены экспериментальные доказательства этого обстоятельства (см. например работу Guevara et al. 1969 г. по вязкости водорода – ссылка [35] в статье). Кроме того, позже было четко показано, что для представления транспортных свойств молекулярного водорода предпочтительнее использовать более мягкие потенциалы нежели функция Л-Дж 12-6. В результате данные о вязкости чистых газов и смесей в отчете NASA при $T > 1000 \text{ К}$ явно занижены, что можно видеть из приводимой ниже таблицы при температуре 1500 К:

| | сравнение данных о вязкости η , мкПа·с | |
|-------------|---|----------------|
| | H ₂ | N ₂ |
| NASA CR-387 | 25.2 | 51.7 |
| статья | 27.26 ± 0.3 | 54.01 ± 0.6 |

Сравнительный анализ справочных данных о вязкости молекулярного водорода предполагается опубликовать отдельно.

Москва, ОИВТ РАН, 26.09.08, e-mail lfokin@mail.ru