|  |  |  |
| --- | --- | --- |
| Przedmiot: **Kinetyka kwalimetryczna**  Prowadzący: dr inż. Lidia Ostasz | | 2017/2018, sem. II |
| **Sprawozdanie 2**  **Temat: 2. Analiza kinetyczna funkcji liniowych metodą najmniejszych kwadratów.** | | |
| **Tomasz Michalczyk** | Nr indeksu: 181058 | Grupa: KrDUTo 1111Ma. |
| **Data ćwiczeń: 2017-01-09** | | Oddano: |
| **Uwagi:** | | Ocena: |

1. **Wstęp teoretyczny**

Metoda statystycznych estymacji i wyznaczania linii trendu na podstawie zbioru danych w postaci par liczb.

Funkcja liniowa:

Jt = ko\*t+Jo

Jt = ko\*t+Jo / \*t

Jt\*t = ko\*t²+Jo\*t

Najczęściej stosowana metoda przy regresji liniowej, ale też może być stosowana do statystycznego wyznaczania parametrów nieliniowych linii trendu.

Ta metoda wyprowadza taką linię prostą, dla której suma kwadratów tych błędów będzie najniższa.

**2. Część doświadczalna**

dw=

Vw=

Vw= gęstość wody = 1g/cm³ Vw=

Vw=146,4575g/cm³ Vw=146,22g/cm³

Podsumowanie:

ms=10,60g ms=11,26g

mw=146,45g mw=146,22g

dx= 1,04705g/cm³ dx= 1,0499g/cm³

Badanie gęstości otrzymanego roztworu za pomocą areometru:

dx=1,047g/cm³ dx= 1,05g/cm³

Wniosek: Roztwory zostały sporządzone z bardzo dużą dokładnością.

**W tabeli 1** przedstawiono wyniki dla badania metodą uśrednionego Ko.

Tabela 1

|  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **Lp** | **c, %** | **d, g/cm3** | **d^, g/cm3** | **Dc-d0** | **k0 (g\*cm3\*%)** | **d^** | **|d-d^|** | **em** |
| **1** | 0.00000 | 1.000 | 1.00000 | 0.00000 | - | 1.00640 | 0.00640 | 0.6361 |
| **2** | 0.92000 | 1.006 | 1.00485 | 0.00485 | 0.00527 | 1.00644 | 0.00159 | 0.1580 |
| **3** | 1.17000 | 1.008 | 1.01100 | 0.01100 | 0.00940 | 1.00645 | 0.00455 | 0.4518 |
| **4** | 1.84000 | 1.013 | 1.01137 | 0.01137 | 0.00618 | 1.00648 | 0.00489 | 0.4854 |
| **5** | 2.21000 | 1.016 | 1.01137 | 0.01137 | 0.00514 | 1.00650 | 0.00487 | 0.4834 |
| **6** | 2.78000 | 1.020 | 1.01373 | 0.01373 | 0.00494 | 1.00653 | 0.00720 | 0.7154 |
| **7** | 3.03000 | 1.021 | 1.01789 | 0.01789 | 0.00590 | 1.00654 | 0.01135 | 1.1280 |
| **8** | 3.55000 | 1.026 | 1.01972 | 0.01972 | 0.00555 | 1.00657 | 0.01315 | 1.3066 |
| **9** | 3.92000 | 1.028 | 1.02352 | 0.02352 | 0.00600 | 1.00658 | 0.01694 | 1.6828 |
| **10** | 4.14000 | 1.028 | 1.02622 | 0.02622 | 0.00633 | 1.00658 | 0.01964 | 1.9511 |
| **11** | 4.87000 | 1.036 | 1.03310 | 0.03310 | 0.00680 | 1.00663 | 0.02647 | 2.6293 |
| **12** | 5.06000 | 1.036 | 1.03449 | 0.03449 | 0.00682 | 1.00663 | 0.02786 | 2.7674 |
| **13** | 5.48000 | 1.039 | 1.03753 | 0.03753 | 0.00685 | 1.00665 | 0.03088 | 3.0675 |
| **14** | 6.02000 | 1.045 | 1.04145 | 0.04145 | 0.00689 | 1.00669 | 0.03476 | 3.4529 |
| **15** | 6.75000 | 1.047 | 1.04705 | 0.04705 | 0.00697 | 1.00670 | 0.04035 | 4.0079 |
| **16** | 7.15000 | 1.050 | 1.04990 | 0.04990 | 0.00698 | 1.00672 | 0.04318 | 4.2890 |
| **suma** | 58.89000 | 16.419 | 16.38319 | 0.38319 | 0.09603 | 16.10511 | 0.29406 | 29.2126 |
| **sr** | 3.68063 | 1.026 | 1.02395 | 0.02395 | 0.00640 | 1.00657 | 0.01838 | 1.8258 |

ko=

ko=0,09603

ko>0,09603

do=1

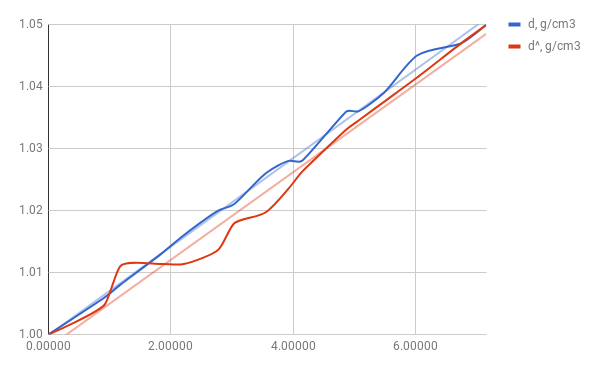
=kśr\*C+do

=16,10511

dc= ko\*C+do

dc=0,00640\*C+1

Rysunek 1



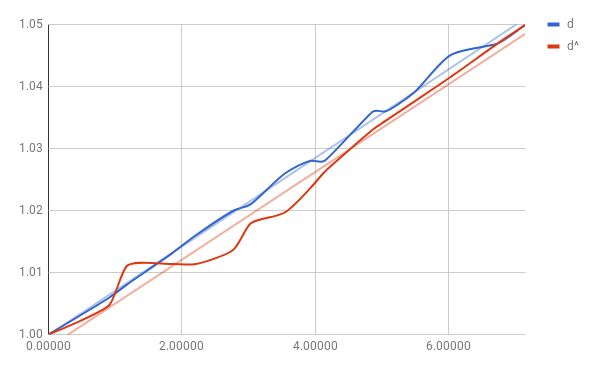
**W tabeli 2** przedstawiono wyniki dla badania metodą najmniejszych kwadratów.

Tabela 2

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| **Lp** | **C** | **d** | **C\*C** | **d\*C** | **d^** | **|d-d^|** | **em** |
| **1** | 0.00000 | 1.000 | 0 | 0.0000 | 1.00000 | 0.00000 | 0.0000 |
| **2** | 0.92000 | 1.006 | 0.8464 | 0.9255 | 1.00485 | 0.00115 | 0.1144 |
| **3** | 1.17000 | 1.008 | 1.3689 | 1.1794 | 1.01100 | 0.00300 | 0.2967 |
| **4** | 1.84000 | 1.013 | 3.3856 | 1.8639 | 1.01137 | 0.00163 | 0.1612 |
| **5** | 2.21000 | 1.016 | 4.8841 | 2.2454 | 1.01137 | 0.00463 | 0.4578 |
| **6** | 2.78000 | 1.020 | 7.7284 | 2.8356 | 1.01373 | 0.00627 | 0.6185 |
| **7** | 3.03000 | 1.021 | 9.1809 | 3.0936 | 1.01789 | 0.00311 | 0.3055 |
| **8** | 3.55000 | 1.026 | 12.6025 | 3.6423 | 1.01972 | 0.00628 | 0.6159 |
| **9** | 3.92000 | 1.028 | 15.3664 | 4.0298 | 1.02352 | 0.00448 | 0.4377 |
| **10** | 4.14000 | 1.028 | 17.1396 | 4.2559 | 1.02622 | 0.00178 | 0.1735 |
| **11** | 4.87000 | 1.036 | 23.7169 | 5.0453 | 1.03310 | 0.00290 | 0.2807 |
| **12** | 5.06000 | 1.036 | 25.6036 | 5.2422 | 1.03449 | 0.00151 | 0.1460 |
| **13** | 5.48000 | 1.039 | 30.0304 | 5.6937 | 1.03753 | 0.00147 | 0.1417 |
| **14** | 6.02000 | 1.045 | 36.2404 | 6.2909 | 1.04145 | 0.00355 | 0.3409 |
| **15** | 6.75000 | 1.047 | 45.5625 | 7.0673 | 1.04705 | 0.00005 | 0.0048 |
| **16** | 7.15000 | 1.050 | 51.1225 | 7.5075 | 1.04990 | 0.00010 | 0.0095 |
| **suma** | 58.89000 | 16.419 | 284.7791 | 60.9182 | 16.38319 | 0.04191 | 4.1047 |
| **sr** | 3.68063 | 1.026 | 17.79869375 | 3.8074 | 1.02395 | 0.00262 | 0.2565 |

|  |  |
| --- | --- |
| **dsr\*csr=** | 3.777011367 |
| **(d\*c)sr - dsr \* csr** | 0.0304 |
| **c2sr-csr2** | 4.251693359 |
| **K0** | 0.00714477274 |
|  |  |
| **d0=dsr-k0-csr** | 0.9998903 |

Rysunek 2



**W tabeli 3** przedstawiono wyniki badania dla H2SO4

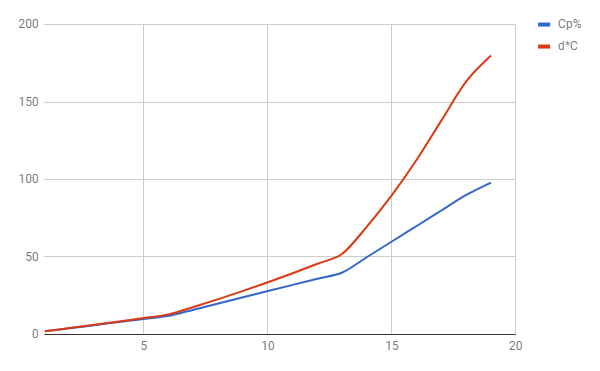
Tabela 3

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **Lp** | **Cp%** | **d20 g/cm3** | **C2** | **d\*C** |
| **1** | 1 | 1,0049 | 1 | 1,0049 |
| **2** | 2 | 1,0116 | 4 | 2,0232 |
| **3** | 4 | 1,025 | 16 | 4,1 |
| **4** | 6 | 1,0385 | 36 | 6,231 |
| **5** | 8 | 1,0522 | 64 | 8,4176 |
| **6** | 10 | 1,0661 | 100 | 10,661 |
| **7** | 12 | 1,0802 | 144 | 12,9624 |
| **8** | 16 | 1,1094 | 256 | 17,7504 |
| **9** | 20 | 1,1394 | 400 | 22,788 |
| **10** | 24 | 1,1704 | 576 | 28,0896 |
| **11** | 28 | 1,2023 | 784 | 33,6644 |
| **12** | 32 | 1,2349 | 1024 | 39,5168 |
| **13** | 36 | 1,2684 | 1296 | 45,6624 |
| **14** | 40 | 1,3028 | 1600 | 52,112 |
| **15** | 50 | 1,3951 | 2500 | 69,755 |
| **16** | 60 | 1,4983 | 3600 | 89,898 |
| **17** | 70 | 1,6105 | 4900 | 112,735 |
| **18** | 80 | 1,7272 | 6400 | 138,176 |
| **19** | 90 | 1,8144 | 8100 | 163,296 |
| **20** | 98 | 1,8365 | 9604 | 179,977 |
| **suma** | 687 | 25,5881 | 41405 | 1038,8207 |
| **sr** | 34,35 | 1,279405 | 2070,25 | 51,941035 |

|  |  |
| --- | --- |
| **dsr\*cs=** | 43,94756175 |
| **d\*csr - dsr \* csr** | 7,99347325 |
| **c2sr-csr2** | 890,3275 |
| **K0** | 0,008978126869 |
|  |  |
| **d0=dsr-k0-csr** | 0,9710063 |

Wykres Cp od d\*C.

Rysunek 3



**W tabeli 4** przedstawiono wyniki badania dla H3PO4.

Tabela 4

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **Lp** | **Cp%** | **d20 g/cm3** | **C2** | **d\*C** |
| **1** | 1 | 1,0038 | 1 | 1,0038 |
| **2** | 2 | 1,0092 | 4 | 2,0184 |
| **3** | 4 | 1,02 | 16 | 4,08 |
| **4** | 6 | 1,0309 | 36 | 6,1854 |
| **5** | 8 | 1,042 | 64 | 8,336 |
| **6** | 10 | 1,0532 | 100 | 10,532 |
| **7** | 12 | 1,0647 | 144 | 12,7764 |
| **8** | 14 | 1,0764 | 196 | 15,0696 |
| **9** | 16 | 1,0884 | 256 | 17,4144 |
| **10** | 18 | 1,1008 | 324 | 19,8144 |
| **11** | 20 | 1,1134 | 400 | 22,268 |
| **12** | 24 | 1,1395 | 576 | 27,348 |
| **13** | 28 | 1,1665 | 784 | 32,662 |
| **14** | 30 | 1,1805 | 900 | 35,415 |
| **15** | 35 | 1,216 | 1225 | 42,56 |
| **16** | 40 | 1,254 | 1600 | 50,16 |
| **17** | 45 | 1,293 | 2025 | 58,185 |
| **18** | 50 | 1,335 | 2500 | 66,75 |
| **19** | 55 | 1,379 | 3025 | 75,845 |
| **20** | 60 | 1,426 | 3600 | 85,56 |
| **suma** | 478 | 22,9923 | 17776 | 593,9834 |
| **sr** | 23,9 | 1,149615 | 888,8 | 29,69917 |

|  |  |
| --- | --- |
| **dsr\*cs=** | 27,4757985 |
| **d\*csr - dsr \* csr** | 2,2233715 |
| **c2sr-csr2** | 317,59 |
| **K0** | 0,007000760414 |
|  |  |
| **d0=dsr-k0-csr** | 0,9822968 |

Wykres Cp od d\*C.

Rysunek 4

