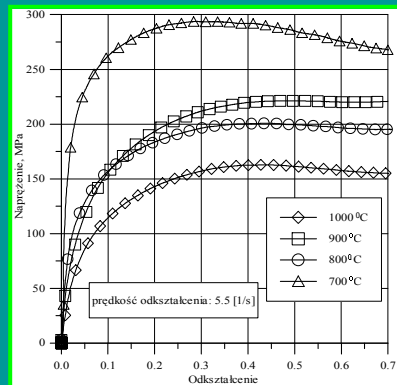
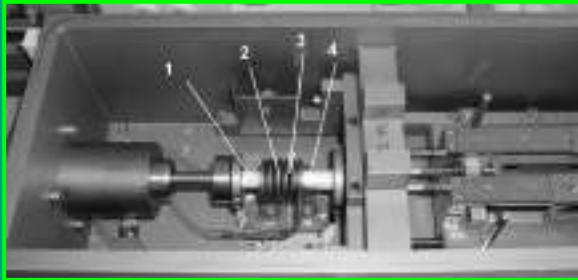


Aproksymacja wyników badań plastometrycznych



$$\sigma_p = \alpha_1 + \alpha_2 \varepsilon$$

$$\sigma_p = \alpha_1 \varepsilon^{\alpha_2}$$

$$\sigma_p = \alpha_1 + \alpha_2 \varepsilon + \alpha_3 \varepsilon^2$$

Metoda najmniejszych kwadratów

$$\varphi(x) = \sum_{i=0}^n C_i \varphi_i(x)$$

$$C_0, C_1, \dots, C_n$$



$$\Phi(C_0, C_1, \dots, C_n) = \sum_{j=1}^m p_j [\varphi(x_j) - y(x_j)]^2 \rightarrow \min$$

$$\frac{\partial \Phi(C)}{\partial C_i} = 0$$



$$C_0, C_1, \dots, C_n$$

$$\sigma = \sqrt{\frac{\sum_{j=1}^m [y(x_j) - \varphi(x_j)]^2}{m}}$$

Funkcja liniowa

$$\varphi(x) = C_0 + C_1 x$$

$$\Phi(C_0, C_1) = \sum_{j=1}^m p_j [C_0 + C_1 x_j - y(x_j)]^2 \rightarrow \min$$

$$\left. \begin{aligned} \frac{\partial \Phi}{\partial C_0} &= \sum_{j=1}^m 2(C_0 + C_1 x_j - y(x_j)) = 0 \\ \frac{\partial \Phi}{\partial C_1} &= \sum_{j=1}^m 2(C_0 + C_1 x_j - y(x_j)) x_j = 0 \end{aligned} \right\}$$

$$\left. \begin{aligned} mC_0 + C_1 \sum_{j=1}^m x_j - \sum_{j=1}^m y(x_j) &= 0 \\ C_0 \sum_{j=1}^m x_j + C_1 \sum_{j=1}^m x_j^2 - \sum_{j=1}^m y(x_j) x_j &= 0 \end{aligned} \right\}$$

$$C_1 = \frac{m \sum_{j=1}^m y(x_j) x_j - \sum_{j=1}^m y(x_j) \sum_{j=1}^m x_j}{m \sum_{j=1}^m x_j^2 - \sum_{j=1}^m x_j \sum_{j=1}^m x_j}$$

$$C_0 = \frac{\sum_{j=1}^m y(x_j) - \sum_{j=1}^m x_j}{m}$$

$$\sum_{j=1}^3 x_j^2 = 1 + 4 + 9 = 14$$

$$\sum_{j=1}^3 x_j = 1 + 2 + 3 = 6$$

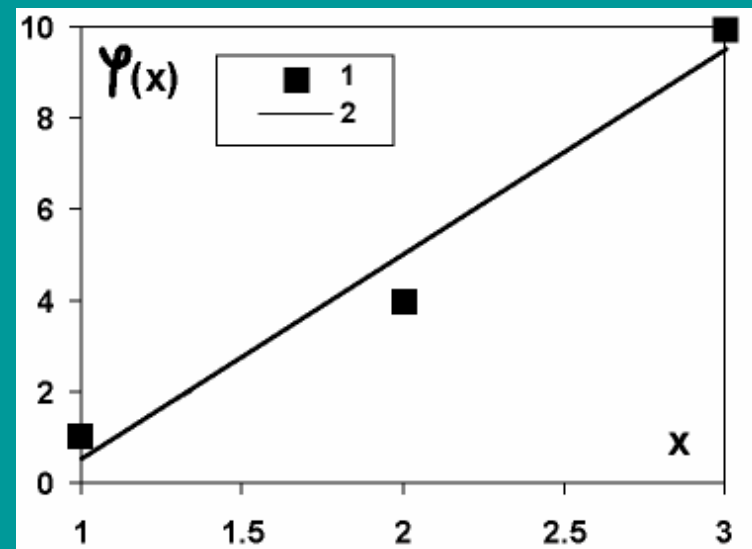
$$\sum_{j=1}^3 f(x_j) = 1 + 4 + 10 = 15$$

$$\sum_{j=1}^3 f(x_j)x_j = 1 + 8 + 30 = 39$$

$$\left. \begin{array}{l} 3C_0 + 6C_1 = 15 \\ 6C_0 + 14C_1 = 39 \end{array} \right\}$$

$$C_0 = -4, C_1 = 4,5$$

$y(x_j)$	1	4	10
x_j	1	2	3



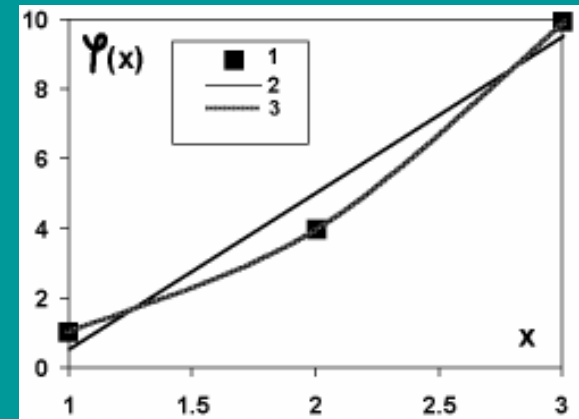
Funkcja 2-go stopnia

$$\varphi(x) = C_0 + C_1x + C_2x^2$$

$$\Phi(C_0, C_1, C_2) = \sum_{j=1}^m [C_0 + C_1x_j + C_2x_j^2 - y(x_j)]^2 \rightarrow \min$$

$$\left. \begin{aligned} \frac{\partial \Phi}{\partial C_0} &= \sum_{j=1}^m 2(C_0 + C_1x_j + C_2x_j^2 - y(x_j)) = 0 \\ \frac{\partial \Phi}{\partial C_1} &= \sum_{j=1}^m 2(C_0 + C_1x_j + C_2x_j^2 - y(x_j))x_j = 0 \\ \frac{\partial \Phi}{\partial C_2} &= \sum_{j=1}^m 2(C_0 + C_1x_j + C_2x_j^2 - y(x_j))x_j^2 = 0 \end{aligned} \right\}$$

$$\left. \begin{aligned} mC_0 + C_1 \sum_{j=1}^m x_j + C_2 \sum_{j=1}^m x_j^2 - \sum_{j=1}^m y(x_j) &= 0 \\ C_0 \sum_{j=1}^m x_j + C_1 \sum_{j=1}^m x_j^2 + C_2 \sum_{j=1}^m x_j^3 - \sum_{j=1}^m y(x_j)x_j &= 0 \\ C_0 \sum_{j=1}^m x_j^2 + C_1 \sum_{j=1}^m x_j^3 + C_2 \sum_{j=1}^m x_j^4 - \sum_{j=1}^m y(x_j)x_j^2 &= 0 \end{aligned} \right\}$$



$$C_0=1, C_1=-1,5, C_2=1,5$$

Funkcja potęgowa

$$\varphi(x) = C_0 x^{C_1}$$

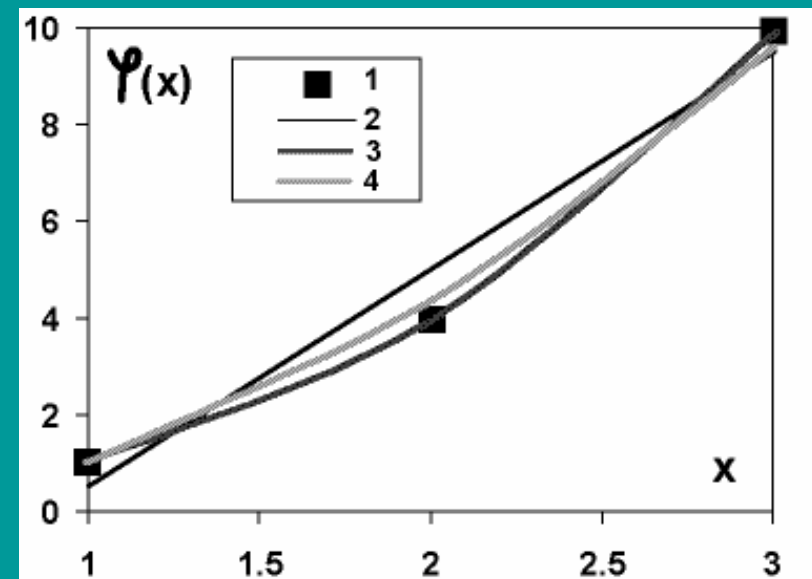
$$\ln(\varphi(x)) = C_1 \ln x + \ln C_0$$

$$\bar{\varphi}(x) = \ln \varphi(x)$$

$$\bar{x} = \ln x$$

$$\bar{\varphi}(x) = \bar{C}_0 + C_1 \bar{x}$$

$y(x_j)$	1	4	10
$\bar{x} = \ln x$	0	1,39	2,30
x_j	1	2	3
$\bar{\varphi}(x)$	0	0,69	1,10
$\varphi(x)$	0,984	4,18	9,72



Funkcja 2-wymiarowa

$$\varphi(x_1, x_2) = C_0 + C_1 x_1 + C_2 x_2.$$

$$\Phi(C_0, C_1, C_2) = \sum_{j=1}^m [C_0 + C_1 x_{1j} + C_2 x_{2j} - y(x_j)]^2 \rightarrow \min$$

$$\left. \frac{\partial \Phi}{\partial C_0} = \sum_{j=1}^m 2(C_0 + C_1 x_{1j} + C_2 x_{2j} - y(x_j)) = 0 \right\}$$

$$\left. \frac{\partial \Phi}{\partial C_1} = \sum_{j=1}^m 2(C_0 + C_1 x_{1j} + C_2 x_{2j} - y(x_j)) x_{1j} = 0 \right\}$$

$$\left. \frac{\partial \Phi}{\partial C_2} = \sum_{j=1}^m 2(C_0 + C_1 x_{1j} + C_2 x_{2j} - y(x_j)) x_{2j} = 0 \right\}$$

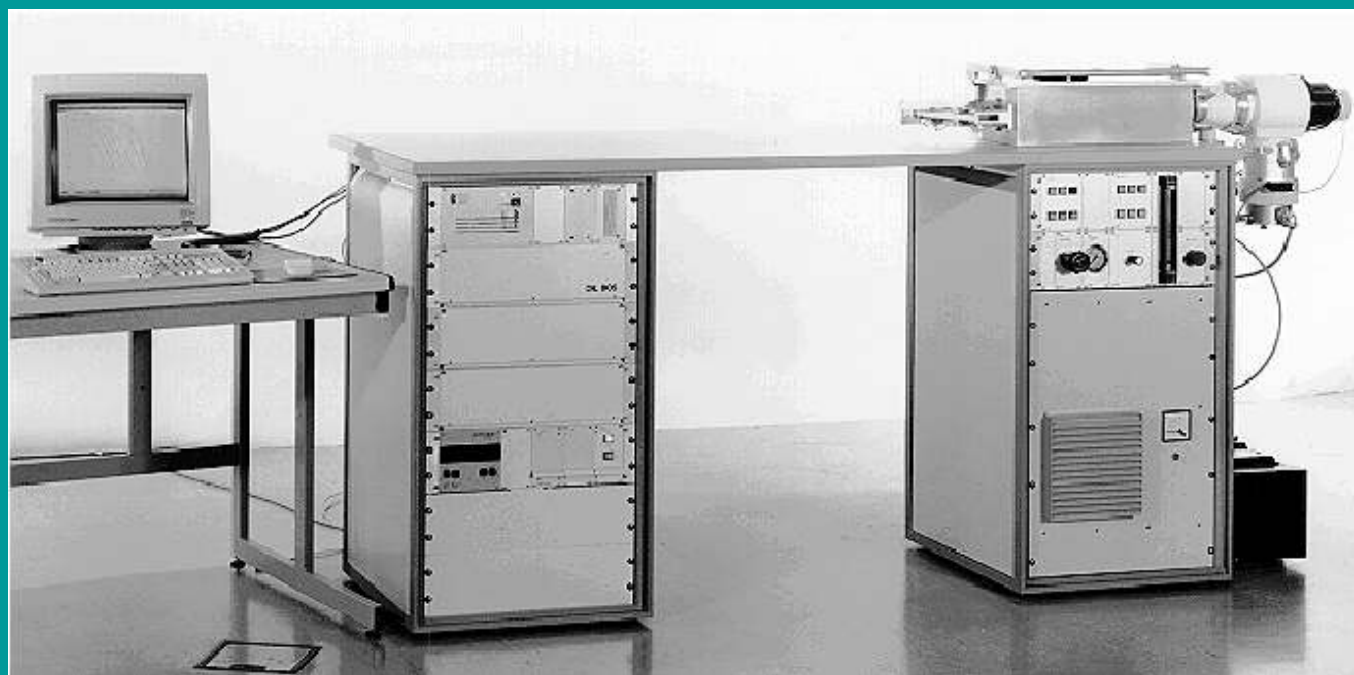
$$\left. mC_0 + C_1 \sum_{j=1}^m x_{1j} + C_2 \sum_{j=1}^m x_{2j} - \sum_{j=1}^m y = 0 \right\}$$

$$\left. C_0 \sum_{j=1}^m x_{1j} + C_1 \sum_{j=1}^m x_{1j}^2 + C_2 \sum_{j=1}^m x_{1j} x_{2j} - \sum_{j=1}^m y x_{1j} = 0 \right\}$$

$$\left. C_0 \sum_{j=1}^m x_{2j} + C_1 \sum_{j=1}^m x_{1j} x_{2j} + C_2 \sum_{j=1}^m x_{2j}^2 - \sum_{j=1}^m y x_{2j} = 0 \right\}$$

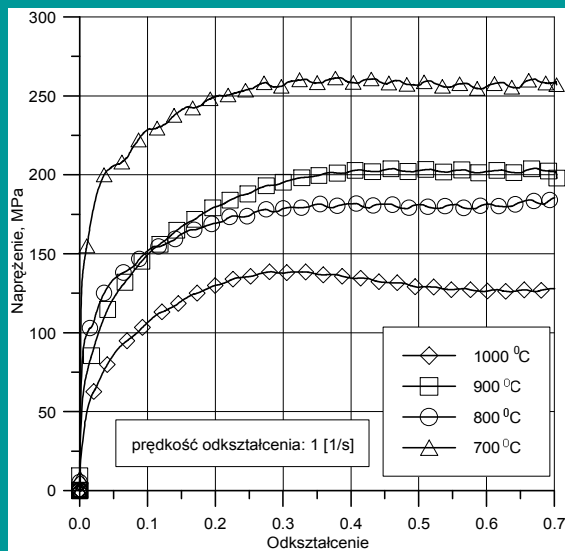
Modelowanie naprężenia uplastyczniającego

Własności reologiczne odkształcanego metalu mają istotny wpływ na jego płynięcie

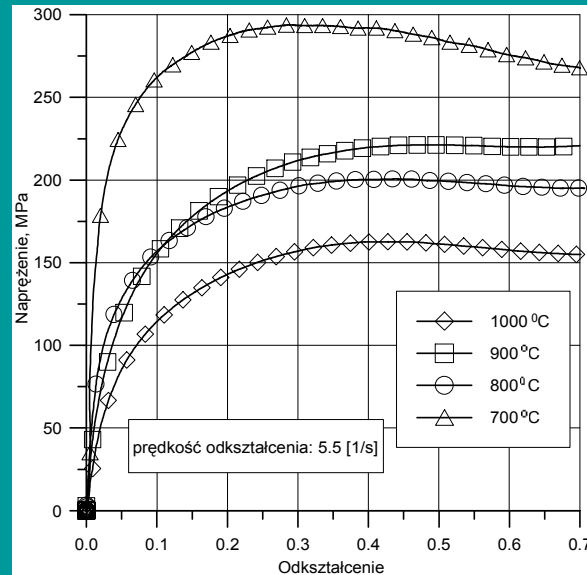


Widok plastometru typu DIL 805 A/D

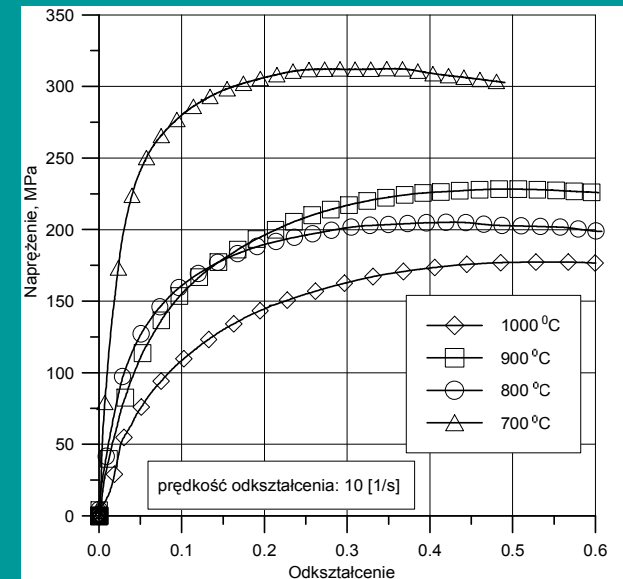
Wyniki badań plastometrycznych w postaci krzywych umocnienia dla stali St3S



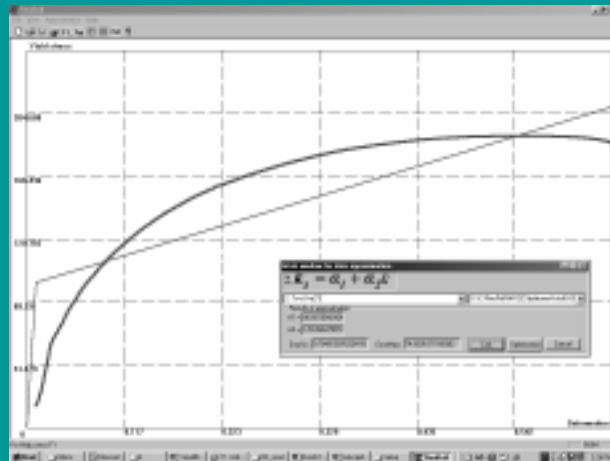
Krzywa umocnienia stali St3S odkształcanej z prędkością 1 s^{-1}



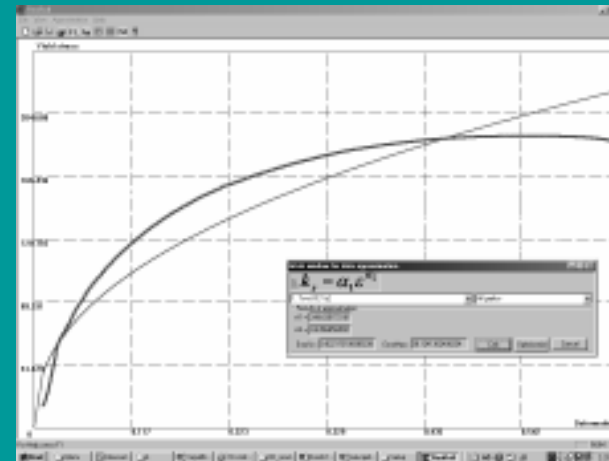
Krzywa umocnienia stali St3S odkształcanej z prędkością $5,5 \text{ s}^{-1}$



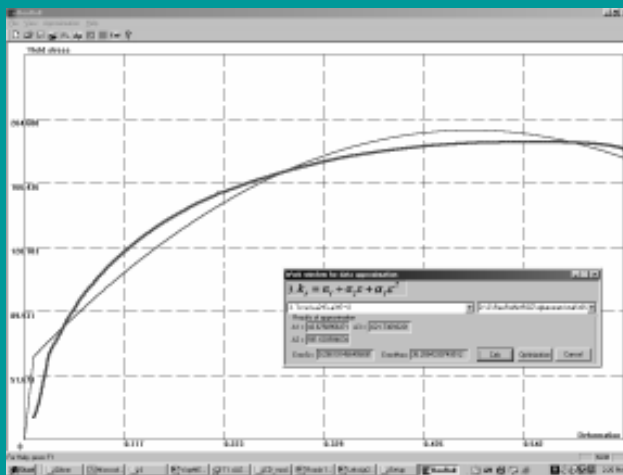
Krzywa umocnienia stali St3S odkształcanej z prędkością 10 s^{-1}



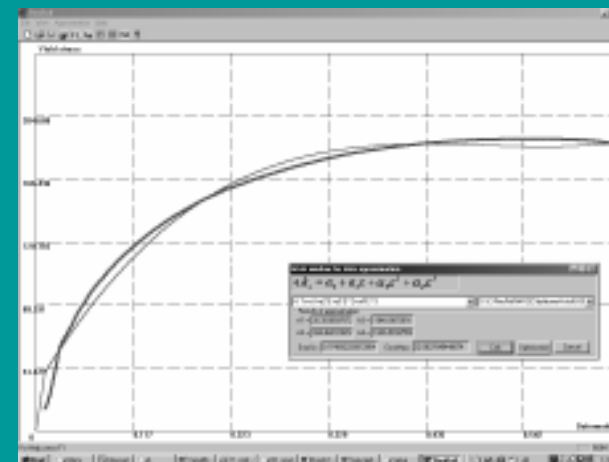
Liniowa funkcja



Funkcja potęgowa



Funkcja 2-go stopnia



Funkcja 3-go stopnia