

## Lightness $L^*$ and differences $\Delta Y$ or $dY$ in the colour space CIELAB

The lightness  $L^*$  is defined by the equation:

$$L^* = 116 (Y/Y_n)^{1/3} - 16, \quad Y_n=100, Y_u=18, 1 \leq Y \leq 100 \quad [1]$$

This CIELAB equation as function of relative tristimulus values is

$$L^* = k_u (Y/Y_u)^{1/3} - 16, \quad k_u = 116 [Y_u/Y_n]^{1/3} = 65,50 \quad [2]$$

The tristimulus values difference  $dY$  is for  $dL^*=1$

$$dY = (3/116) \cdot (Y/Y_n)^{2/3} = a \cdot (Y/Y_n)^{2/3} = b \cdot (Y/Y_u)^{2/3} \quad [3]$$

$$a = 0,557 \quad b = 6,516 \quad [4]$$

Relative normalized differences are  $dY/dY_u$  and  $[Y/dY] / [(Y/dY)_u]$

$$dY/dY_u = (Y/Y_u)^{2/3} = [(Y/Y_n)^{2/3}] / [(Y_u/Y_n)^{2/3}] \quad [5]$$

$$(Y/dY) / (Y/dY)_u = [Y/Y_u]^{1/3} \quad [6]$$