RELATIVE VISCOSITY OF WEAK SOLUTION FOR TWO INTERREACTIVE POLYMERS

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In colloid chemistry solution viscosity of polymer up to its mass concentration of the order of 20 % is well described by the Martin's equation:

$$(\mu-\mu_0)/\mu_0 = [\mu]\cdot\exp(K_M\cdot[\mu]\cdot c) \quad ,$$

where: μ – solution viscosity; μ_0 – dissolving agent viscosity; c – mass concentration of polymer in a solution; $[\mu]$ – characteristic viscosity; intrinsic viscosity; K_M – Martin constant.

The equation for definition of viscosity of a solution of two polymers cooperating among themselves has been deduced. Thus mass concentration of each polymers can change from zero and up to c_H, but their total concentration (mass concentration of weighed amount) is always equal c_H. It was a condition:

$$c_H = c_A + c_B = c_{AH} \quad ,$$

где: c_H – mass concentration of weighed amount; c_A – mass concentration of polymer A; c_B – mass concentration of polymer B.

We enter relative variables:

$$x = \frac{c_B}{c_H} \qquad \text{and} \qquad y = \frac{\mu_{A+B}-\mu_0}{\mu_{AH}-\mu_0} \approx \frac{\mu_{A+B}}{\mu_{AH}}.$$

We accept, that research begins, when mass concentration of polymer A is equal to mass concentration of weighed amount ($c_{AH} = c_H$). At each subsequent measurement the solution with addition of polymer B due to reduction of polymer of A. Then polymer prepares B responds without the rest and the equation for definition of relative viscosity becomes:

$$y_1(x) = \left(1-\frac{n+1}{n}x\right)\cdot\exp\left(-a_1\frac{n+1}{n}x\right) + a_5\frac{n+1}{n}x\cdot\exp\left(a_4\frac{n+1}{n}x - a_1\right) \quad .$$

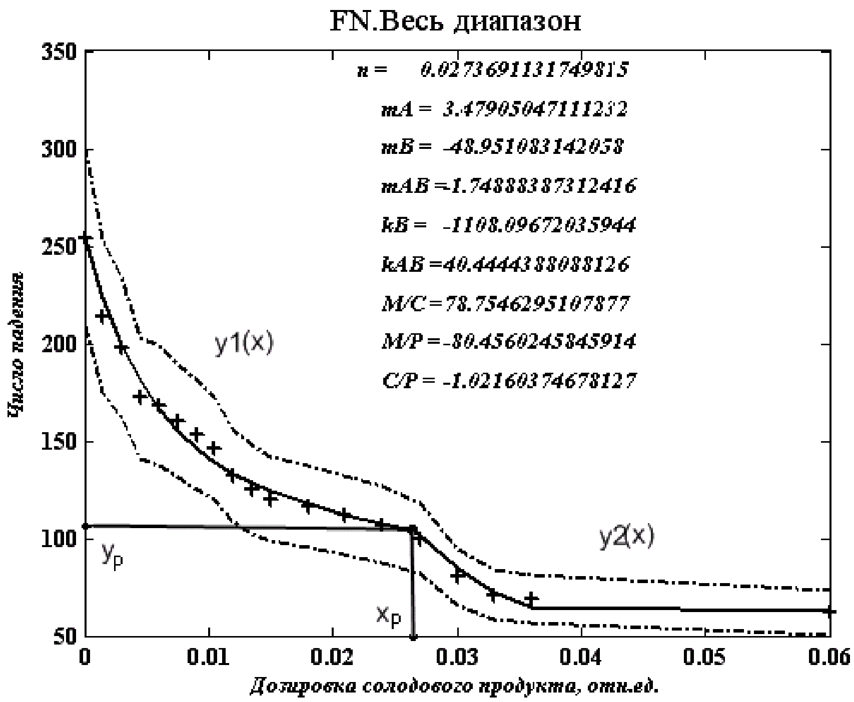
At concentration $x_p = n/(n+1)$ polymers A and B will react completely and in a solution there will be only a product of their reaction, and viscosity will be equal:

$$y_{1P} = a_5\cdot\exp(a_4 - a_1) \quad .$$

After the further increase of mass concentration of polymer B polymer A will respond without the rest and the equation for definition of relative viscosity becomes:

$$y_2(x) = [1-n(1-x)]\cdot a_3\cdot\exp\left(a_2\cdot[1-n(1-x)]-a_1\right) + a_5(1-x)(n+1)\exp[a_4(1-x)(n+1)-a_1] \, .$$

After computer processing experimental data factors $a_1 - a_6$ allow to define parities characteristic viscosity and Martin's constants for polymers A and B and for a product of their reaction.



In picture the result of processing of experimental data after definition of "falling number" for a mixture of wheat flour and malt is resulted.