

Self-diffusion of erythrocytes in Couette flow  
studied by elastic light-scattering

Tatiana A. Astakhova

Moscow State University, Department of Physics,  
Moscow 119899

A gradient of erythrocytes concentration is known to exist in the cross-section of a blood vessel as well as of a model tube. The cell concentration redistribution in shear flow takes place due to self-diffusion, as it was demonstrated on suspensions of inorganic particles<sup>1</sup>. Similar effects are expected to occur in the sedimented fraction of RBC suspension along the vertical gap of Couette viscosimeter after the induction of shear stress. In our work the elastic light scattering was used to estimate the efficiency of non-aggregating erythrocytes self-diffusion in Couette flow by analyzing the disappearance of distinct boundary between erythrocyte continuum and saline.

The distribution of single cell concentration in Couette flow was measured after the sedimentation in the cylindrical gap had accomplished. To analyze local concentrations the dependence of backscattered light intensity from hematocrit was measured on single diskocytes suspensions during their mixing. Experimental data were approximated by parabolic function given the nonlinear dependence of macroscopic scattering cross-section on hematocrit<sup>3</sup>. The regression curves for non-aggregating erythrocytes of different blood samples corresponded to a narrow range of regression parameters. The major concentration changes occurred in vertical direction. The boundary between red cells and saline was shown to rise at  $\dot{\gamma} = 25 \text{ s}^{-1}$  and above while it descended at  $\dot{\gamma} = 0 - 20 \text{ s}^{-1}$ . The concentration profile at some shear rates was distorted by the increase in the optical contact area of the erythrocytes.

The steepness of the curve in the region of transition from high to low hematocrits may be a quantitative parameter of the efficiency of cell redistribution in Couette flow. The shear self-diffusion coefficient  $D_s$  can be estimated<sup>2</sup>. At shear rates of  $0 - 25 \text{ s}^{-1}$  the  $D_s$  values were comparable with the coefficient of erythrocytes Brownian diffusion  $D_b$ . Hence, self-diffusion at this range of shear rates can be neglected. Meanwhile its role grows up at higher values of shear rates, for example, at  $\dot{\gamma} = 125 \text{ s}^{-1}$   $D_s \approx 100 D_b$ .

Thus, the efficiency of RBC's fluctuational movements is the greatest at high shear rates, which correspond to near-the-wall regions of blood vessels. This efficiency determines the most rational distribution of cells concentration in blood vessel.

REFERENCES

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