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Oil droplet behavior at a pore entrance in the presence of crossflow: Implications for microfiltration of oil-water dispersions TOHID DARVISHZADEH, VOLODYMYR TARABARA, Michigan State University, NIKOLAI PRIEZJEV, Wright State University — The behavior of an oil droplet pinned at the entrance of a micropore and subject to clossflow-induced shear is investigated numerically by solving the Navier-Stokes equation. We found that in the absence of crossflow, the critical transmembrane pressure required to force the droplet into the pore is in excellent agreement with a theoretical prediction based on the Young-Laplace equation. With increasing shear rate, the critical pressure of permeation increases, and at sufficiently high shear rates the oil droplet breaks up into two segments. The results of numerical simulations indicate that droplet breakup at the pore entrance is facilitated at lower values of the surface tension coefficient, higher oil-to-water viscosity ratio and larger droplet size but is insensitive to the value of the contact angle. Using simple force and torque balance arguments, an estimate for the increase in critical pressure due to crossflow and the breakup capillary number is obtained and validated for different viscosity ratios, surface tension coefficients, contact angles, and drop-to-pore size ratios.

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