Poiseuille Flow of a Smectic A Liquid Crystal

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We consider the dynamics of a smectic A liquid crystal subjected to an applied pressure gradient down an annular region $R_1<r<R_2$ between two concentric cylinders. Governing equations describing pressure, flow and smectic layer undulations are derived for this Poiseuille flow in cylindrical coordinates using the smectic A dynamic theory of Stewart [1]. Exact solutions for the form of the layer undulations, velocity and pressure are derived, as well as information on any Lagrange multipliers and the possible angle between the layer normal and the director. Plots of the solutions considering experimental data [2, 3] are included. A discussion follows on the dependencies of the flow on the spatial components and subsequent mathematical problems.

References

(1) I. W. Stewart, Continuum Mech. Thermodyn., ***2007***, *18*, 343-360
(2) I. W. Stewart, *The Static and Dynamic Continuum Theory of Liquid Crystals*, 2004, Taylor and Francis
(3) S. Meiboom and R. C. Hewitt, Physical Review Letters, ***1973***, *30(7)*, 261-263