

Analysis of heat flow in scraped surface heat exchangers

A. D. Fitt (a.d.fitt@maths.soton.ac.uk), M. E. M. Lee
(lee@soton.ac.uk) and C. P. Please
(c.p.please@maths.soton.ac.uk)
School of Mathematics, University of Southampton, SO17 1BJ, UK

Abstract. Scraped-surface heat exchangers are widely used in industries that manufacture and thermally process fluids, in particular food. The understanding of the heat and fluid dynamics within these devices is predominantly based on empirical evidence. A theoretical, asymptotic, approach is presented for a Newtonian fluid within a cylindrical annulus with scraping blades and includes parameters for blade configuration, pumping rates, annular shear velocity and material properties; the high Peclet numbers and small aspect ratios that are encountered in practice are utilised in the analysis. The resulting models greatly reduce the computational effort required to simulate the steady-state behaviour of these heat exchangers and the results are shown to compare well with full numerical simulations. An extensive parametric study is presented that predicts the possibility of “channelling”, where fluid passes through the exchanger relatively unchanged in temperature.

Keywords: lid-driven cavity, advection driven thermal flow, averaging.



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