Appendix A:

TLC and HPLC results for Orange Reactive Dye-Stuff (Chapter 6)
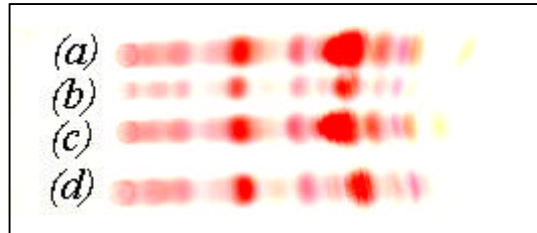

Figure A.1: Thin Layer Chromatography results for orange reactive dye, where *(a)* and *(c)* are the BASF standard samples, and *(b)* and *(d)* are the 9% and 30% samples respectively.
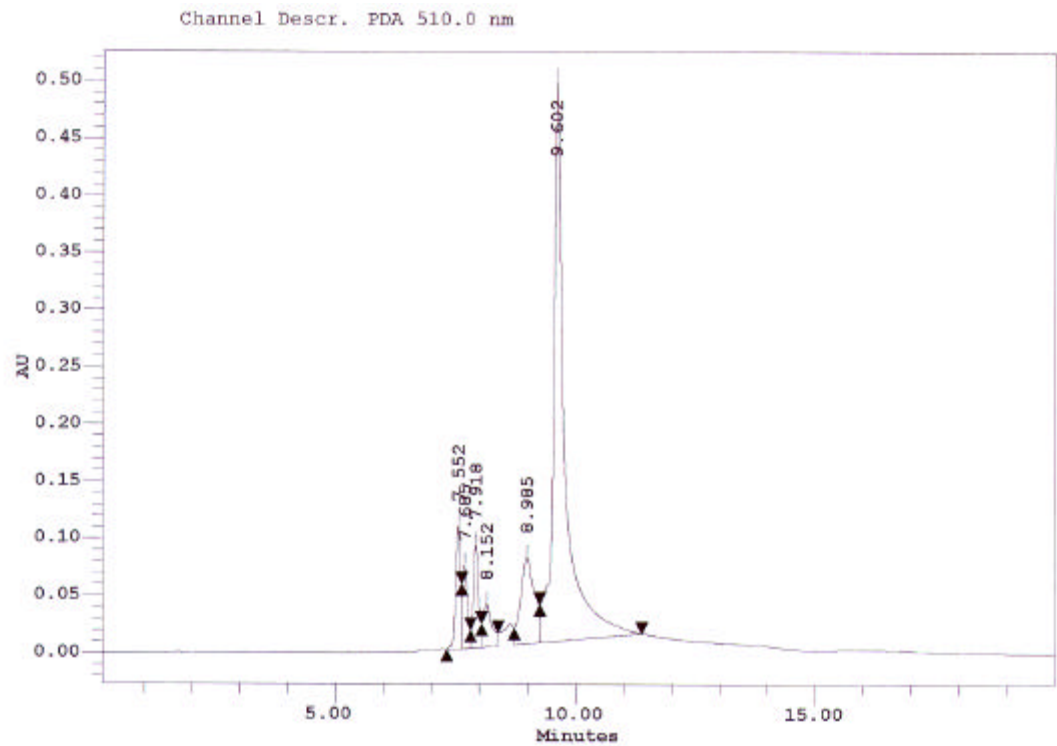

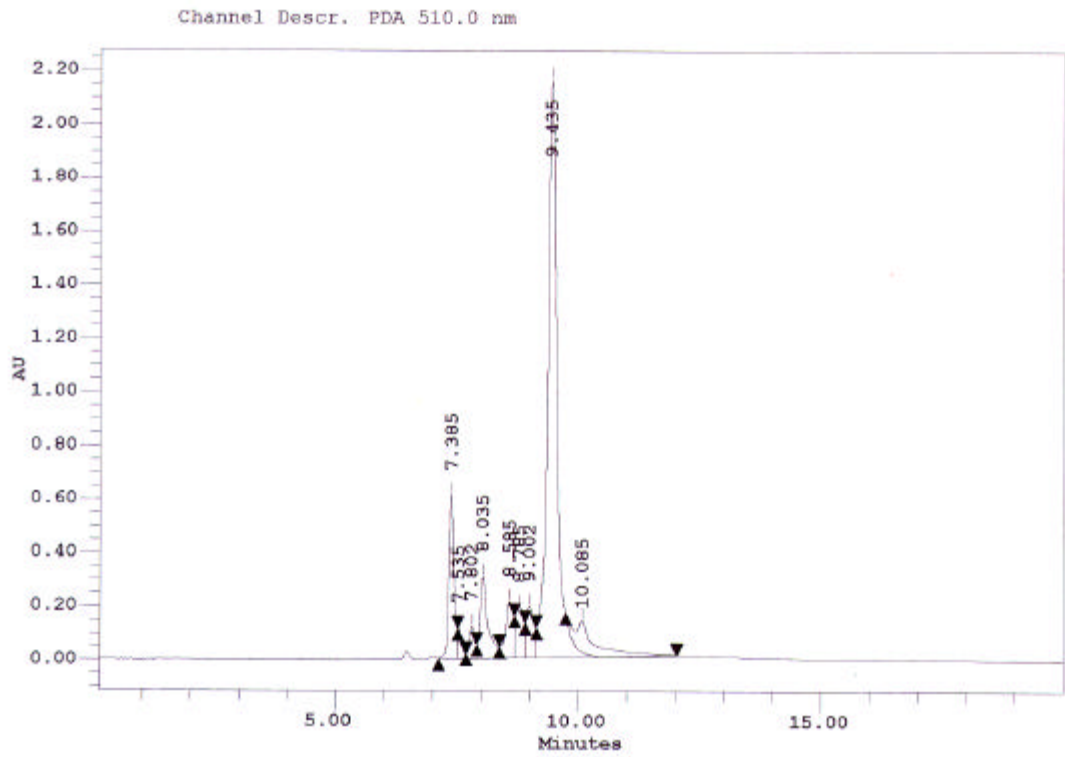**Figure A.2:** HPLC measurement of orange reactive dye, BASF standard.

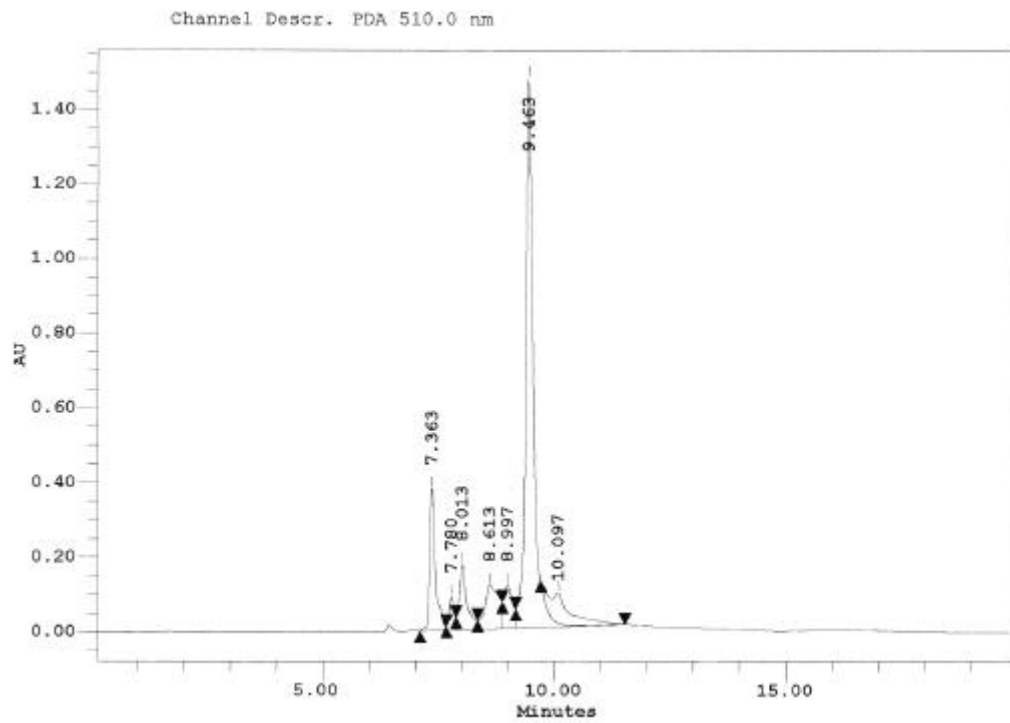**Figure A.3:** HPLC measurement of orange reactive dye, 9% colour concentration supplied.

Figure A.4: HPLC measurement of orange reactive dye, 30% colour concentration examined ultrasonically.

Additional thermophysical data for the modelling of $CuSO_4.5H_2O$ crystallization from solution. (Chapter 4)

Physical parameter	$CuSO_4.5H_2O_{(s)}$ Crystals
Velocity @ 5 MHz [1] (ms^{-1})	4550.0
Attenuation @ 5 MHz [1] (α/f^2)	2.0×10^{-16}
Density[2] (kgm^{-3})	2284.0
Shear modulus[3] (Nm^{-2})	1.18×10^{10}
Thermal conductivity [4] ($Wm^{-1}K^{-1}$)	0.73
Specific heat capacity[4] ($Jkg^{-1}K^{-1}$)	1193.2
Thermal expansion coefficient[5] (K^{-1})	1.65×10^{-4}

Table A.1: Physical parameters for the dispersed phase, used to model acoustic propagation in Copper (II) Sulphate crystallization.

[1]   Measured value.

[2]   Kaye, G.W.C., Laby, T.H. *Tables of physical and chemical constants*, 16th ed.; Longman: Harlow UK, 1995.

[3]   Calculated from measured values of shear wave velocity.

[4]   Washburn, E.W., Ed.; *International critical tables of numerical data*; NRC: Washington, 1926.

[5]   Mellor, J.W., *A comprehensive treatise on inorganic and theoretical chemistry: vol III*; Longmans: London, 1946.

Physical parameter	CuSO$_4$ (aq) 45.6°C	CuSO$_4$ (aq) 43°C	CuSO$_4$ (aq) 41°C	CuSO$_4$ (aq) 39°C	CuSO$_4$ (aq) 37°C	CuSO$_4$ (aq) 35°C
Velocity 5 MHz [1] (ms^{-1})	1658.15	1652.52	1648.04	1643.53	1638.96	1634.35
Attenuation 5 MHz [1] (α/f^2)	2x10^{-13}	2x10^{-13}	2x10^{-13}	2x10^{-13}	2x10^{-13}	2x10^{-13}
Density[2] (kgm^{-3})	1272.8	1264.36	1257.83	1251.3	1244.77	1238.25
Shear viscosity[3] (Pa.S)	1.35x10^{-3}	1.4x10^{-3}	1.45x10^{-3}	1.5x10^{-3}	1.54x10^{-3}	1.6x10^{-3}
Thermal conductivity [4] (Wm^{-1}K^{-1})	0.5724	0.5718	0.5709	0.5702	0.5686	0.5695
Specific heat capacity[4] (Jkg^{-1}K^{-1})	3058.5	3093.2	3128.0	3151.2	3174.4	3244.3
Thermal expansion coefficient[5] (K^{-1})	4.26x10^{-4}	4.1x10^{-4}	3.94x10^{-4}	3.8x10^{-4}	3.58x10^{-4}	3.4x10^{-4}

Table A.2: Physical parameters for the continuous phase, used to model acoustic

propagation in Copper (II) Sulphate crystallization.

[1]   Measured values.

[2]   Söhnel, O., Novotný, P. *Densities of aqueous solutions of inorganic substances*; Elsevier: Amsterdam, 1985.

[3]   Stokes, R.H., Mills, R. *Viscosity of electrolytes and related properties*, 1965.

[4]   Calculated from mass averaged values of solute in water.

[5]   Data for water used at relevant temperature from [2] above.