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NUCLEATION AND GROWTH OF ALPHA LACTOSE MONOHYDRATE

**A Thesis presented in partial fulfilment of the requirements for the degree of
Doctor of Philosophy in Process Engineering at Massey University**

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ABSTRACT

Lactose represents approximately one third of the total solids in bovine milk. In the dairy industry, lactose is recovered from whey and whey permeates using a crystallisation process that involves both evaporation and a cooling stage. A good understanding of the lactose crystallisation kinetics enables both these processes to be operated at conditions that maximise the yield and minimise capital and processing costs.

This study has looked at the nucleation and growth kinetics of the lactose crystallisation process. A model has been produced that can accurately predict the changing concentration profile as lactose is removed, via growth, from an industrial solution. This model incorporated the available literature information and expanded on it where required.

The primary nucleation of alpha lactose monohydrate was investigated on the laboratory scale. The work identified the changing relationship, which occurs with increasing supersaturation, as lactose nucleation moves from being dominated by the heterogeneous mechanism to the homogenous mechanism. The absolute supersaturation at which the mechanism changes was found not to be affected by the solution temperature and agitation rate; however the presence of impurities lowered the supersaturation required for homogeneous nucleation.

The effect of mixing on the primary nucleation rate was studied in a Rushton turbine agitated vessel and through a Venturi. Increasing the agitation rate increased the frequency of activated molecular collisions but the critical nucleus size remained constant. A strong correlation was found, for both mixing systems, between the nucleation rate and the frequency of vortex shedding.

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