UNIT-SPECIFIC EVENT-BASED MODELS FOR SHORT-TERM SCHEDULING OF BATCH PLANTS

by

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Dedicated

to

My Parents

CERTIFICATE

I am satisfied that the thesis presented by **Mr Ramsagar Vooradi** on "***Unit-Specific Event-Based Models for Short-Term Scheduling of Batch Plants***" is worthy of consideration for the award of the degree of Doctor of Philosophy and is a record of the original bonafide research work carried out under my guidance and supervision and that the results contained in it have not been submitted in part or full to any other university or institute for award of any degree/diploma.

I certify that he has pursued the prescribe course of research.

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ABSTRACT

Short-term scheduling of batch plants has been an important research area in the past two decades for achieving industrial objectives such as maximization of profit, minimizing unit idle times, minimization of makespan, and efficient use of limited resources. Numerous formulations have been proposed in the literature based on different time representations: discrete-time and continuous-time models. Among the continuous-time models, unit-specific event-based (USEB) models have evolved as a better alternative. In this work better modelling approaches are explored for efficient solution of short-term scheduling of batch plants. Initially, an improved version of a three-index USEB model from literature is proposed by taking advantage of the three-index variables and effectively incorporating the concept of active task. The improved model gives better results for literature examples including the challenging Westenberger-Kallrath benchmark scheduling problem. Then, novel resource balances are presented for uniform treatment of utility resources similar to material states based on unit-specific sequencing. The framework additionally offers unification of the state-task-network (STN) and resource-task-network (RTN) based models. Then, a rigorous USEB model is proposed that allows conditional sequencing of production and consumption tasks, only if the material produced by given production task is used by given consumption task. The model leads to reduction in number of events, and it can effectively handle different storage and unit-wait policies, and utility resources thus resulting in further reduction in number of events required compared to published literature. Unlike the conventional batch scheduling models in the literature, a novel concept is proposed that allows production and consumption tasks to occur at the same event, leading to significant reduction in number of events. Then, the USEB model is extended for handling of storage capacity and time limitations, resulting in mixed-

integer linear programming (MILP) formulation. Several examples from literature are proposed to demonstrate the efficacy of the proposed models.

Keywords: Optimization, Scheduling, Batch Plants, Unit–Specific Events, Storage, Resources, Unit-wait.

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