



# Single hoist cyclic scheduling with multiple tanks: a material handling solution

Zhili Zhou<sup>a,\*</sup>, Ling Li<sup>b</sup>

<sup>a</sup>*Department of Industrial Engineering, Xian Jiaotong University, Xian 710049, China*

<sup>b</sup>*Department of Information Systems & Decision Sciences, College of Business and Public Administration,  
Old Dominion University, Norfolk, VA 23529, USA*

---

## Abstract

A hoist controlled by a computer is widely used for moving electroplates which is chemically treated in a sequence of tanks. The hoist scheduling directly affects the throughput of a production system. The objective of the hoist scheduling problem is to schedule the moves to maximize the throughput. This paper investigates the hoist scheduling problem, a specific material handling issue, in a manufacturing environment. The *scope* of the study is in the area of single hoist cyclic scheduling with multiple tanks. The *purpose* of the study is to develop a mixed integer linear programming model that can be used to schedule multiple tanks and improve throughput in a process industry. Specifically, a method has been proposed to estimate the processing time in a bottleneck stage with multiple tanks. © 2002 Elsevier Science Ltd. All rights reserved.

*Keywords:* Material handling; Manufacturing processes; Hoist scheduling problem; Mixed integer linear programming; Bottleneck control; Industrial engineering; Operations management

---

## 1. Introduction

This paper investigates the hoist scheduling problem, a specific material handling issue, in a manufacturing environment. The *scope* of the study is in the area of single hoist cyclic scheduling with multiple tanks. The *purpose* of the study is to develop a mixed integer linear programming model that can be used to schedule hoist moves and multiple tanks and improve throughput in a production system. In this research, a multi-tank sequencing procedure is proposed for the single hoist scheduling problem (HSP). Specifically, a solution procedure has been suggested to estimate the processing time in a bottleneck stage with multiple tanks.

---

\* Corresponding author. Tel.: +86-29-2667833; fax: +86-29-3237910.

*E-mail address:* sqzhou@xjtu.edu.cn (Z. Zhou).

Material handling includes packaging, moving, and storing materials and it consumes labor, space, and facilities. Material handling during a production process adds very little value to the product. Although, the choice of how the material is moved and when the material is moved is an important technological decision, this decision can affect a manufacturing company's overall performance such as profitability and customer service level. Therefore, both researchers and practitioners have been searching for solutions and new ways to reduce material handling costs.

The scheduling of material handling devices such as hoist directly affects the throughput of a production system. In the printed circuit boards industry, electroplating is an important material handling process. Scheduling the movement of material handling hoist for electroplating processes is generally known as the HSP problem and has been proven to be an NP-complete problem [1]. The objective of hoist scheduling problem is to find a cyclic sequence of hoist moves that minimizes the cycle time or maximize the throughput of a production system. In this study, a mixed integer model is proposed to solve single hoist scheduling problem with multiple tanks at a bottleneck stage.

The paper is organized as follows. Section 2 provides the background information for the single hoist scheduling problem. Section 3 models the single hoist cyclic scheduling problem with multiple tanks. An illustrative example is presented in Section 4. Conclusions are given in Section 5.

## 2. Problem background

Scheduling hoists that are controlled by computers in automated electroplating production line is a typical example of HSP. Fig. 1 presents a general structure of HSP problem. An electroplating line usually consists of a loading station, an unloading station, and a number of chemical processing tanks arranged in a row. Sometimes, loading and unloading are conducted at the same station. After it is loaded onto hoist at the loading station, the product is moved to the process tanks in sequence for processing. In each tank, the product needs to be processed for a period within an allowable time range. There is no buffer between tanks. When it finishes processing in the last processing tank, the product is moved to the unloading station where the product is unloaded from the hoist. The moves of products between tanks are performed by a computer-controlled hoist which is mounted to the track. After completing a move, the hoist travels to another tank to perform another move. When there is only one product in the system, the production is usually cyclic. The purpose of HSP is to schedule the moves so that the production cycle is minimized or throughput of the system is maximized.

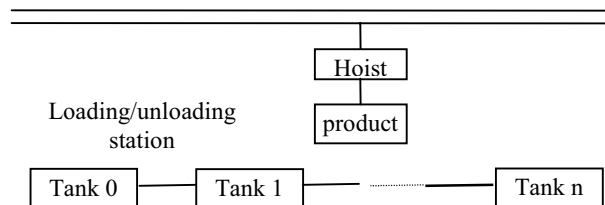


Fig. 1. An electroplating line.

متن کامل مقاله

دریافت فوری ←

**ISI**Articles

مرجع مقالات تخصصی ایران

- ✓ امکان دانلود نسخه تمام متن مقالات انگلیسی
- ✓ امکان دانلود نسخه ترجمه شده مقالات
- ✓ پذیرش سفارش ترجمه تخصصی
- ✓ امکان جستجو در آرشیو جامعی از صدها موضوع و هزاران مقاله
- ✓ امکان دانلود رایگان ۲ صفحه اول هر مقاله
- ✓ امکان پرداخت اینترنتی با کلیه کارت های عضو شتاب
- ✓ دانلود فوری مقاله پس از پرداخت آنلاین
- ✓ پشتیبانی کامل خرید با بهره مندی از سیستم هوشمند رهگیری سفارشات