JETIR.ORG ISSN: 2349-5162 | ESTD Year : 2014 | Monthly Issue
JOURNAL OF EMERGING TECHNOLOGIES AND INNOVATIVE RESEARCH (JETIR)
An International Scholarly Open Access, Peer-reviewed, Refereed Journal

PROFIT MAXIMIZATION STRATEGIES IN CHEMICAL FACTORIES: A LINEAR PROGRAMMING FRAMEWORK.

[1]Nishchal.N, [2]Dr Anitha Jandhyala

[1] Student, [2] Associate professor

BBA Department

PES university, Bangalore, Karnataka, India

ABSTRACT

This study investigates the use of linear programming (LP) techniques to improve production processes inside a chemical plant, with a special focus on the manufacture of home cleaning items such as floor cleaner, glass cleaner, and cleaning liquid. It explores the effective use of chemicals and time. To acquire results, the solver approach is employed. Using the approaches, the study indicates that producing 8 cases of floor cleaner, 10 cases of glass cleaner, and about 3.33 cases of cleaning liquid yields a profit of 51,667 rupees per day. It also discusses profit maximization strategies and the best way to use raw materials.

Keywords: Linear programming, Chemical factory, cleaning products, Efficient utilization, Solver method, Profit maximization, Raw materials.

INTRODUCTION

The chemical industry plays a critical role in producing a diverse range of goods that touch our everyday lives in the ever-changing environment of manufacturing and production. Among these items, the manufacture of home cleaning products stands out as an essential component of modern living. The need for effective and ecologically friendly cleaning solutions is increasing, offering both possibilities and problems for chemical manufacturers that specialize in this field.

Manufacturers of household cleaning products face a unique set of obstacles. They must adhere to severe regulatory criteria to assure the safety and efficacy of their goods while remaining competing in a market influenced by consumer preferences, concerns about the environment, and cost-effectiveness. Because of this changing environment, there is a greater emphasis on optimization tactics that can enhance efficiency in manufacturing and profitability.

Linear programming, a sophisticated mathematical approach, has emerged as a significant tool in meeting the diverse demands of chemical manufacturing facilities making home cleaning goods. Linear programming, by optimizing resource allocation, production schedules, and supply chain management, provides a way to increase profit margins while preserving product quality and compliance with industry requirements. The ability to manage these vital aspects is especially important in an industry that necessitates a careful balance of effectiveness, environmental responsibility, and profitability.

The current research dives into the utilization of linear programming techniques in chemical companies that specialize in home cleaning goods. It aims to investigate how these manufacturers may use this

mathematical technique to handle the issues they confront and optimize profits while fulfilling regulatory norms and consumer expectations. This study intends to illustrate how chemical companies may gain a competitive advantage in the market, assure that consumers have access

of excellent cleaning products, and improve their bottom line by improving resource allocation, manufacturing processes, and supply chain management.

The research presented here will throw light on the operational benefits that linear programming offers to the forefront, supplying chemical factories and the skills needed to negotiate the convoluted environment of home cleaning product development.

OBJECTIVES

1. To maximize the profit in the chemical factories.
2. To reduce production time in chemical factories.
3. To optimize the utilization of raw materials in the chemical factories.

LITERATURE REVIEW

This paper is a revelation. Linear Programming challenge for PASVEP Chemicals Production Firm's many products and scarce resource allocation. The linear program model was created for this reason, with a specific target function and suitable restrictions provided to the Firm. The research was carried out since the company was experiencing production optimization challenges and hence required an optimal solution.

(Muhammad Atif, 2023)

This paper provides a method for obtaining simplex-interval equations, which can be used to regulate technical process parameters effectively. It considers chemical kinetics equation transformations, heterogeneous solid particle dissolving processes, and mathematical model transformations before applying the technique to modelling coke calcination in a tubular rotary kiln. The approach has a wide range of applications.

(Beloglazov, 2022)

Linear programming is a popular operational research approach for identifying and optimizing management decisions. Its use motivates enterprises to enhance their productivity. However, many firms prefer to use the trial-and-error technique. As a result, businesses find it difficult to divide scarce resources in a way that optimizes profit.

(Nur Zafira Mohd Azman, 2022)

Today, the problem of manual processing of the simplex linear programming algorithm has been overcome, as there are various programs from the world's top manufacturers of computer and electronic programs for the application of simplex and transport techniques of linear programming. Today, programmers are necessary to fine-tune the model - that is, professionally, appropriately - of the original matrix program, and everything else in a few minutes is a computer program from which the ideal answers should be selected.

(MIČIC ID, 2021)

This paper talks about the different methods of solving the LPP using engineering method to minimizing the cost of bakeries.

(Abdulhalim Musa Abubakar, 2021)

Component concentrations in chemical baths used in industrial applications must frequently fulfil certain standards. Production or evaporation may modify the relative quantities of the components, causing some concentrations to exceed their limitations and deteriorate production.

(Wieringa, 2000)

In this paper, we will look at how linear programming may be used to solve optimization issues with constraints. The simplex approach was used to find the optimum of an objective function. This strategy is applied to a real-world case. MatLab's "linprog" function was utilized to solve the problem. We demonstrated how to use the simplex approach on a real-world problem and solve it with linear programming. Finally, we look at the method's complexity by varying the computer time vs the number of control variables.

(Aleksandar Velinov, 2018)

In recent years, many procedures for relay coordination in power systems have been established, which entail the installation of relay and circuit breaker sets to provide dependable protection and smooth system functioning. Primary protection relays must work within a specific time frame, and backup protection is required in the event of a failure. The Electrical Transient Analysis Program (ETAP) software is used in chemical industrial facilities to acquire overcurrent relay coordination and compare its results to hand-calculated results. ETAP's primary attribute for proper coordination is the star view of relays.

(Berezina Natalia Aleksandrovna, 2017)

This paper of is to use a linear programming model to optimize the profits of an Ethiopian chemical firm located in Adama (Ethiopia). Our current study emphasizes the need of employing quantitative methodologies in Ethiopian businesses.

(Vishwa Nath Maurya, 2016)

In recent years, many procedures for relay coordination in power systems have been established, which entail the installation of relay and circuit breaker sets to provide dependable protection and smooth system functioning. Primary protection relays must work within a specific time frame, and backup protection is required in the event of a failure. The Electrical Transient Analysis Program (ETAP) software is used in chemical industrial facilities to acquire overcurrent relay coordination and compare its results to hand-calculated results. ETAP's primary attribute for proper coordination is the star view of relays.

(Prof. Vipul N. Rajput, 2014)

The goal of this study is to offer an optimization model and solution approach for the short-term scheduling of batch plants with many stages that may comprise equipment running concurrently. The usage of parallel time axes for units and tasks is presented in a large-scale mixed integer linear programming (MILP) paradigm with continuous time domain representation. Although an LP-based branch and bound approach may be used to tackle the problem in principle, there is a restriction as the instances get large.

(Grossmann, 1995)

This paper talks about multi-period planning issues in the oil and refining industries are often big, sparse, staircase/band diagonal organized, and nonlinear optimization problems. Successive linear programming (SLP) approaches have been widely employed to solve these planning challenges.

(Kumaraswamy Ponnambalam, 1992)

This paper discusses the traditional simplex technique and its most common enhancements before demonstrating how this simplex approach may be modified to incorporate the existence of constraints.

(R. Hanus, 1984)

Linear programming issue, tahdit salary ve gaye function karakteristikleri esas alınarak bir kaç tipe ayrılmış, ve her tipe uygulanabilen simpleks metotda bir direkt yaklaşım gösterilmiş bu yaklaşım Amundson'dan alman bir örnekle kontrol edilmiştir. The classification of linear programming into several thypes based on the characteristics of the objective function and the constraints, as well as a direct approach in the simplev method that can be applicable for the ali types, has been presented and examined with the illustration carried out by Amundson, has been presented and examined.

(Büyükkoca & Yamada, 1976)

The goal of this study is to demonstrate a direct approach logic for the simplex technique on L.P. L.P. issues are classed as follows based on the properties of the objective function and the constraints:

(EDIP BUYUKKOCA, 1974)

RESEARCH METHODOLOGY

Primary data was collected from the owner of the company.

The data about time, profit, raw materials (chemicals) was taken from the company.

The data of the company’s production was per month it was converted into per day to simplify the solution.

DATA ANALYSIS

DECISION VARIABLES

Let

- X1 be the number of floor cleaner cases produced per day.
- X2 be the number of glass cleaner cases produced per day.
- X3 be the number of cleaning liquid cases produced per day.

Note:- one case consists of 50 units

COEFFECIENTS

- This is profit for one case of X1.
- The profit for one unit of X1 is 60 when it is converted it into one case it is 3012.5.
- This is profit for one case of X2.

- ❖ The profit for one unit of X2 is 45.89 when it is converted it into one case it is 2294.5.
- ➢ This is profit for one case of X3.
- ❖ The profit for one unit of X1 is 27.45 when it is converted it into one case it is 1372.5.

the profit of X1, X2, X3 are rounded off.

MAXIMISE Z = 3000 X1 + 2300 X2 + 1400 X3

SUBJECT TO CONSTRAINTS

Time constraint

- X1 requires 40 minutes of processing time.
- X2 requires 30 minutes of processing time.
- X3 requires 30 minutes of processing time.
- ❖ In total there is 720 minutes of processing time.

40 X1 + 30 X2 + 30 X3 ≤ 720

Chemical constraints

- X1 requires 2.5 Kilograms of STPP per day.
- ❖ In total the availability of STPP per month is 600 kilos when it is converted per day it is 20 kilos.

2.5 X1 ≤ 20

- X2 requires 0.5 Liters of 9.5 ev per day.
- ❖ In total the availability of 9.5 ev per month is 150 Liters when it is converted per day it is 5 Liters.

0.5 X2 ≤ 5

- X3 requires 1.5 Liters of HCL per day.
- ❖ In total the availability of HCL per month is 390 Liters when it is converted per day it is 13.

1.5 X3 ≤ 11

Non negative constraints : X1, X2, X3 ≥ 0

Table 1: This table shows the constraints formed by the data

DECISION VARIABLES	X1	X2	X3		OBJECTIVE FUNTION	
VALUE	0	0	0		0	
COFFECIENTS	3000	2300	1400			
	X1	X2	X3	LHS		RHS
C1 TIME	40	30	30	0	≤	720
C2 STPP	2.5	0	0	0	≤	20
C3 9.5 ev	0	0.5	0	0	≤	5
C4 HCL	0	0	1.5	0	≤	13

Table 2: This table shows the solution obtained through simplex LP

DECISION VARIABLES	X1	X2	X3		OBJECTIVE FUNTION	
VALUE	8	10	3.333333		51666.66667	
COFFECIENTS	3000	2300	1400			
	X1	X2	X3	LHS		RHS
C1 TIME	40	30	30	720	≤	720
C2 STPP	2.5	0	0	20	≤	20
C3 9.5 ev	0	0.5	0	5	≤	5
C4 HCL	0	0	1.5	5	≤	13

MAXIMISE Z = 51,667

When

X1= 8

X2= 10

X3= 3.33

So, the profit of the company will be 51,667 if they produce 8 cases of X1, 10 cases of X2, 3.33 cases of X3.

CONCLUSION

This investigation concludes that using Linear Programming problem (LPP) to improve production in chemical plants producing home cleaning goods provides considerable benefits. The research proposes a realistic paradigm for improving operational efficiency and profitability by emphasizing profit maximization while respecting time and resource constraints. To meet shifting restrictions, continuous monitoring and

flexibility are required. The project emphasizes the importance of LP in managing efficiency, compliance, with profitability in this fast-paced business. It offers advice on how to improve manufacturing processes while maintaining competitiveness, financial sustainability, or environmental responsibility. Finally, this project provides a vital blueprint to the household cleaning product sector to prosper in an ever-changing market.

REFERENCES

Abdulhalim Musa Abubakar, O. C. (2021). Simplex C++ Syntax for Solving Chemical Engineering Cost Optimization Problems. *International Journal of Engineering And Science*.

Aleksandar Velinov, V. G. (2018). Practical application of simplex method for solving linear programming problems. *Balkan Journal of Applied Mathematics and Informatics*.

Beloglazov, I. (2022). An Interval-Simplex Approach to Determine Technological Parameters from Experimental Data. *MDPI Journals*.

Berezina Natalia Aleksandrovna, A. A. (2017). The Use of a Simplex Method with an Artificial basis. *International Journal of Advanced Computer Science and Applications, Zavalishin Igor Vladimirovich*.

Büyükkoca, E., & Yamada, I. (1976). A Direct Approach in the Simplex Method of Linear Programming of Degeneracy Case. *SAKARYA UNIVERSITY* .

EDIP BUYUKKOCA, I. Y. (1974). A LOGIC APPROACH IN THE SIMPLEX METHOD OF LINEAR PROGRAMMING*. *JOURNAL OF CHEMICAL ENGINEERING OF JAPAN*.

Grossmann, J. M. (1995). A Continuous Time Mixed Integer Linear Programming Model for Short Term Scheduling of Multistage Batch Plants. *ACS Publications.* .

Kumaraswamy Ponnambalam, A. V. (1992). An interior point method implementation for solving large planning problems in the oil refinery industry. *The Canadian Journal of Chemical Engineering*.

MIČIC ID, M. M. (2021). STRATEGIC APPLICATION OF THE SIMPLEX METHOD IN CHICKEN FEEDING IN AGRICULTURAL CONDITIONS. *science index*.

Muhammad Atif, Z. U. (2023). Optimizing Production of Chemicals Firm using Linear Programming Technique. *Research Square*.

Nur Zafira Mohd Azman, N. A. (2022). Application Of The Simplex Method On Profit Maximization In Baker's Cottage. *Indonesian Journal of Electrical Engineering and Computer Science*.

Prof. Vipul N. Rajput, P. T. (2014). Co-ordination of Overcurrent Relay for Chemical Industrial Plant using ETAP . *International Journal of Futuristic Trends in Engineering and Technology*.

R. Hanus, I. C. (1984). THE SIMPLEX TECHNIQUE AS A GENERAL OPTIMIZATION METHOD. *Applications of Nonlinear Programming to Optimization and Control*.

Vishwa Nath Maurya, R. B. (2016). Profit Optimization Using Linear Programming Model: A Case Study of Ethiopian Chemical Company . *American Journal of Biological and Environmental Statistics*.

Wieringa, J. E. (2000). Cost-optimal replenishment of chemical baths: an application of linear programming. *Journal of Chemometrics*.