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Performance Measurement of Flexible Manufacturing System in Context to Bareilly Camphor Industry

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ABSTRACT

FMS is a manufacturing system in which there is flexibility that allows the system to react to changes, whether predicted or unpredicted. It is a highly integrated manufacturing system. Oriental Aromatics Ltd. (Formerly Camphor & Allied Prod. Ltd.) is a completely integrated flavour, fragrance and aroma chemical manufacturing companies in the world today. Its three manufacturing centers are spread across the west and north of India, in Ambernath in Maharashtra, Baroda in Gujarat and Bareilly in Uttar Pradesh. It manufactures synthetic camphor, which can be utilised in several different ways. Camphor has several pharmaceutical uses. While it is most commonly used as an anti-inflammatory and decongestant, it also has several other therapeutic and healing effects. The World Health Organization's (WHO) Good Manufacturing Practice (GMP) is a system for ensuring that products are consistently produced and controlled according to quality standards. It is designed to minimize the risks involved in any pharmaceutical production that cannot be eliminated through testing the final product. In this paper, a concept and implementation of the measuring and analysis of performance measures of FMS is applied.

Keywords: *Camphor manufacturing; Synthesis of material; Process flexibility.*

1.0 Introduction

Camphor is one of the products used during religious prayers. This is a part of worship since ancient days. These are available in different size and shape. Camphor Tablets is a mass consumption item and is practically being consumed in all religious festivals in temples.

The consumption is directly proportional to the persons visiting any religious place. Hence, consumption will increase with the increase in faith in "GOD" and propose concern can sell its product very easily. In addition to the religious demand, it is also required in Ayurveda medicines. The overall properties of camphor differ to a large extent from thermoplastics and other materials. Therefore, it is important to consider properties while designing the mould which will affect mould parameters.

2.0 Manufacturing Process

The brief description of the manufacturing process of camphor tablet is given below:

a) Firstly preparation of bornyl chloride by the action of dry hydrogen chloride on α-pinene.
b) Isomerization of α-pinene to camphene.
c) Camphor synthesis is hydrolysis of isobornyl acetete with aqueous solution of sodium hydroxide. Then resulting isoborneol subjected to dehydrogenation under catalysts and target camphor is obtained.
d) Camphor powder is given heat treatment to remove the dampness available in the powder.
e) Treated powder is filled into the hopper of the tablet machine.
f) Tablet machine produce the tablet of specific shape and weight. The shape & weight of tablet will be according to the dies.
g) Five tablets are packed in one wax wrapper.
h) These box are packed in the cartoon boxes and dispatched.

Quality of the product must be as per customers demand and according to BIS standards.

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Table 1: Conversion of α-pinene and Selectivity to Camphene with TCA/Neutral Zeolite Catalyst

Catalysts	Reaction time (min)	320 W		480 W		640 W		800 W	
		X (%)	S (%)	X (%)	S (%)	X (%)	S (%)	X (%)	S (%)
TCA/ H-Natural zeolite	15	3,47	33,97	12,26	27,73	23,25	28,26	29,83	22,90
	30	3,11	41,73	18,13	26,86	35,60	27,78	70,85	23,60
	45	5,40	33,88	29,75	26,35	66,88	26,30	88,48	19,43
	60	8,68	26,27	42,37	26,22	84,97	24,88	97,05	13,73
	90	13,46	22,43	76,01	24,26	98,99	16,90	98,85	6,59

X =Conversion of α-pinene, S = selectivity to camphene

Table 1 presents α-pinene conversion values (%X) and selectivities to camphene for the different treatments performed. When the TCA/Natural zeolite is exposed to a more severe power of microwave treatment, 320, 480, 640, 800 W the conversion increases but selectivities to camphene is decreases. The main product were camphene, α-terpinene, limonene, p-cimene, γ-terpinene, and terpinolene.

3.0 Working Standards of the Camphor Industry

Table 2: Area Used for FMS Camphor Industry in Bareilly

1.	Covered area	Sq. Ft.	500
2.	Uncovered area	Sq. Ft.	500
3.	Total area	Sq. Ft.	1000
4.	Whether constructed or		Rented
	Rented		
5.	If constructed, constructed	Rs	N.A.
	Value		
6.	If Rented, Rental value	Rs	2000
	(per month)		

Table 3: Types of Machines and Equipments Used

S.N	Description	Qty.		Value (Rs.)
1.	S.S.Mixer		1	125000
2.	Multi Punch Tablet Machine		1	
3.	Dies		L.S.	
4.	Wax wrapping machine		1	
5.	Weighing Balance		1	
6.	Hand Tools		L.S.	
7.	Sales Tax, Freight & Insurance			12500
	etc.			
	Total			137500

Table 4: Raw Material

S.N	Particulars	Quantity (Kg)	Value (Rs)
1.	Camphor Powder	1000	100000
2.	Packaging Material		2000
		Total	102000

Table 5: The Staff and Labour Per Month

S.N	Particulars	Qty	Rate	Value (Rs)
A	Administrative And Supervisory			
(i)	Manager	1	3000	3000
(ii)	Peon/ Chowkidar	1	2000	2000
B	Technical (Skilled-Unskilled)			
(i)	Skilled Worker	1	3000	3000
(ii)	Unskilled Worker	2	2000	4000
	Sub-Total			12000
	Plus perquisites @ 30% of salaries			3600
	TOTAL			15600

Table 2, 3, 4 and 5 presents the working standards of the camphor industry visited for the reference of FMS study. Table 2 represents area used for FMS camphor industry in Bareilly and table 3 represents types of Machines and equipment's used. Table 4 reprrsents Raw material used in the camphor industry of Bareilly and table 5 represents staff and Labour per month working in the factory and the salaries.

4.0 Controlling Parameters

Compression molding method is used to develop superior and desired properties of the composite. All the three dimensions of the model (pressure, temperature and time of application) are critical and have to be optimized effectively to achieve tailored product as every dimension of the model is equally important to other one. If time of application of these factors (pressure and temperature) is not sufficient (high or low), it may cause any of defects associated with insufficient pressure or temperature.

The other manufacturing factors such as mold wall heating, closing rate of two matched plates of the plates and de- molding time also affect the production process. The overall properties of camphor differ to a large extent from thermoplastics and other materials. Therefore, it is important to consider properties while designing the mould which will affect mould parameters. Dimensional accuracy of molded camphor parts is very important and in such cases, the design of the mould must allow for shrinkage of the parts. For analyzing the above properties of given camphor sample and mould

parameters, camphor compression mould is specifically designed. Hydraulic system should be avoided because hydraulic oil leakage may affect the production vigorously. Hydraulic oil may react with camphor and it is highly undesirable.

As the camphor is chemically reactive towards the hydraulic oil thus we cannot use hydraulic press for the operation which is generally prefer for press operation on the other hand we have option of pneumatic press but as the camphor is sublimatory substance which will vaporize the camphor material when come in contact with air and pneumatic system also have high initial investment as well as complicated components like pump ,direction control valve, actuators etc. and those are need to be handled with skilled and experience operator so the press operation must be carried out using the mechanical system which includes the various mechanisms like cam and follower, speed reduction using gears, reciprocating motion for press operation uses the slider crank mechanism.

4.1 Working capital (for one month)

Table 6: Working Capital of Industry

Sl.No.	Description	Amount(Rs)
1	Raw material	102000
2	Salaries & Wages	15600
3	Other Expenses	11500
	Total	129100

4.2 Total capital investment

Table 7: Total Capital Investment

Building & Other Civil Works	-
Machinery & Equipment	137500
Working capital for one month	129100
Total	266600

4.3 Cost of production (per annum)

Table 8: Cost of Production (Per Annum)

Total recurring cost per year	1549200
Depreciation on machinery &	13000
Equipment	
Interest on total investment @ 10%	27000
Total	1589200

4.4 Sales proceeds(per annum)

Table 9: Sales Proceeds Per Annum

S.N.	Item	Quantity(Kg)	Value (Rs.)
1.	Camphor Tablets	12000	1800000
	Total		1800000

4.5 Profitability

Table 10: Profitability (Before Income Tax)

1.	Annual Gross Profit	210800
2.	% of Profit on Sales	11.71%
3.	Break Even Analysis	
3.1	Annual Fixed Cost	325200
3.2	Annual Sales	1800000
3.3	Annual Variable Cost	1224000
3.4	Break Even Point	56.46%

Table 6.7.8.9 and 10 represents the controlling parameters taken by industry to optimally to achieve the efficient product.

4.5.1 Break-even analysis

(% of Total Production envisaged)

Annual fixed cost X 100 = %

Annual sales – Annual variable costs

4.5.2 Production targets

The final product of camphor are of two types. Basis of estimation: Single Shift basis (6 hours per shift)

Type 1 Camphor: 96% purity

Type 2 Camphor: 90% purity

According to the desired properties of product, mechanical drive system is preferable for machine.

5.0 Assumption for Generating Project Profitably

Table 11: Assumptions for Generating Project

1	Number of Working Days in a year	300 Days
2	Number of Shifts in a day	1 One
3	Hours in a Shift	8 hours
4	Plant Capacity	Consider on Average production capacities of plant.
5	Raw material Estimates	Based upon product Mix
6	Depreciation	Straight Line Method
7	Manpower	According to project Requirement
8	Rent estimate	On the basis of current market price of the area.
9	Potential Area of Marketing the products	Households & related industries of the area.
10	If project is funded, term loan would be	60-80% of Total investment
11	Moratorium Period	6- 12 months
12	Repayment Period	5-7 years

Table 11 represents the further assumptions that could generate more profit to the industry concerning

with working hours and output generated with respect to time.

6.0 Conclusions

Using various design software we can conclude that punch for the desired tablet product is withstanding in all the working conditions. In this various moulding techniques used for manufacturing of polymer products are studied. Concept and implementation of the measuring and analysis of performance measures of FMS is satisfied in Bareilly camphor industry.

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