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Design and Fabrication of Incense Stick Drying Chamber

Prof. S. R. Bobde[1], Yash Meher[2], Vikas Yadav[3], Saurabh Meshram[4], Ravi Yale[5], Aniket Dhandre[6], Rohan Tamgadge[7], Shivani Tripathi[8], Vrushal Kukde[9]
Assistant Professor, Department of Mechanical Engineering[1]
Research Scholar, Department of Mechanical Engineering[2,3,4,5,6,7,8,9]
Dr. Babasaheb Ambedkar College of Engineering & Research, Nagpur, Maharashtra, India.
aniketdhandre40922@gmail.com

Abstract: *Incense and joss stick are generally used in the world. Most products were made in small household factories. There are many environmental and occupational hazards in these factories. Objective is to evaluate the workplace environmental and occupational hazards in small household incense and joss stick factories. Nine small household factories in rural areas, were studied. Dust concentration and small aerosol particles were counted through real time exposure monitoring. The inductively coupled plasma optical emission spectrometry (ICP-OES) was used for quantitative measurement of heavy metal residue in incense products. Several heavy metals were found in dissolved dye and joss sticks. Those included barium, manganese, and lead. Rolling and shaking processes produced the highest concentration of dust and aerosols. Only 3.9% of female workers used personal protection equipment. Dust and chemicals were major threats in small household incense and joss stick factories in Industrial Areas..*

Keywords: Stick Drying Chamber

I. INTRODUCTION

Incense stick have been used for various rituals throughout the world. The Egyptians and Babylonians started using incense for praying and re-ligious ceremonies around586–538 BC. Both the ancient Greeks and Romans used incense to drive away demons and to attract the Gods used incense sticks of various types at different occasions.

Chemicals, and extensively used for room deodorizers and repellents. Most of the incense products come from INDIA, Vietnam, China, Cambodia, Bangladesh, and Thailand. The northern and northeastern parts of india are among the largest centers for incense and joss stick production.

Incense sticks are normally made in small household factories; the process needs no advanced technology. In India, many rural areas are suitable for incense making especially for incense dry

The main ingredients used in making incense are wood powders including coarse sawdust, sandal wood, glutinous in-cense powder, fragrance powders, dye colors, and perfume oils. The small incense factories in the villages are usually operated in or near the house. Wood dust, the major hazard produced from the process, diffuses around the house and contaminates the environment. The dust may affect the health of workers and their family members residing in the house. Previous studies showed that chronic exposure to wood dust can affect the respiratory tract and cause asthma, and skin and eye irri-tation.3-7 Occupational exposure to wood is a well-established cause of various respiratory diseases and nasal cancer.

II. LITERATURE SURVEY

Literature survey and review has been carried out based on the reference gathered, on Incense Stick manufacturing, and discuss about the aspects of technical, economic, safety and ergonomic aspects from the project materials collected. Besides, this chapter will also explain about data requirement and the basic concept in designing machine, the required functions and finally obtain details of manufacturing specifications sufficient for fabricating and assembling the desired project.

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III. COMPONENT

- Stand
- Frame
- Chamber
- Power(temperature regulator)
- Heating coil
- Thermostat

IV. PROBLEM STATEMENT

In the present scenario most of the countries do not have sufficient skilled man power in manufacturing sector and that affects the growth of developing countries. Therefore community has to upgrade the machine and technology in every sector. etc.). So it's a time to automate the sector to overcome this problem which inturn will also eliminate the requirement of Labors and also avoid the wastage of materials.

4.1 Manufacturing Process Sheet

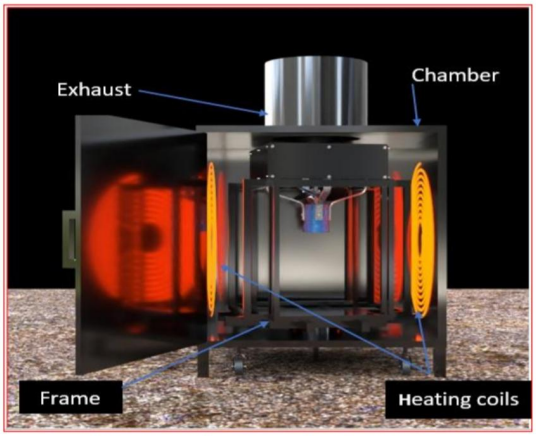
The following figure shows the Manufacturing Process sheet which used in this paper.

Sr. No	Particular	Material/Specification	Size & Quantity
1)	Frame	M.S	2.5ft×2.5ft×3ft
2)	Chamber	Stainless Steel Angle 1.5" 50 Feet	7.5ft×7.5ft×4ft
3)	Insulator	Asbestos Sheets 6mm	7.5ft×4ft 4 Sheets and 7.5ft×7.5ft 1 Sheet
4)	Bearing	Chrome Steels	8inch, Tapered roller bearing.
5)	Heating coil	Nichrome	3×4.5kw
6)	Stand	2.5" Hollow MS pipe	300KgLoad Capacity
7)	Thermostat	Digital STC-1000 110V AC	-50 to 150deg

Fig. 4.1: Process Sheet 1

V. ASSEMBLY DRAWING

FINAL ASSEMBLY OF OUR DESIGNED CHAMBER



FINAL ASSEMBLY OF OUR DESIGNED CHAMBER

Fig, 5.1 Final Assembly of Our Designed Chamber

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VI. CALCULATIONS

6.1 Mechanical Calculation

Minimum force required to rotate the loaded frame placed on the stand

Material weight (Wet Sticks) = 150~170Kg

Weight of the frame = 60~70Kg

Total Load on Stand (m) ≈ 170+70=240 ≈ 250Kg (Approx.)

Rpm (N) = 10(Approx.)

Maximum span of rotation of frame (D) = 2'6" = 0.75m

Radius of Span (r) = $\frac{D}{2} = \frac{0.75}{2} = 0.375$m

Angular Velocity (ω)

$$\omega = \frac{\pi DN}{60}$$

$$\omega = \frac{\pi \times 0.75 \times 10}{60}$$

$$\omega = 0.3925 \text{ m/s}$$

Velocity (V)

$$V = r\,\omega$$

$$V = 0.375 \times 0.3925$$

$$V = 0.1471 \text{ m/s}$$

Force required to rotate the system (F)

$$F = m\frac{V^2}{r}$$

$$F = 250 \times \frac{0.1417^2}{0.375}$$

$$F = 14.4256\text{N}$$

$$F = \frac{14.4256}{9.81}$$

$$F = 1.47 \approx 1.5\text{Kg}$$

Force required to rotate the system along with the load is 14.4256N or 1.5Kg

Drying Time Calculation

In rainy season at 28℃ and 80% moisture content present in air.

$$T = \frac{M_s}{N_c}(X_0 - X_1)$$

Where, T = Time required to dry solids

X_0= Initial moisture content (Kg/Kg)

X_1= Final moisture content (Kg/Kg)

h_v= Latent heat of vaporization (For water at 28℃ = 2435.4KJ/Kg)

h = Convective heat transfer Coefficient

M_s= Mass of dry solids (Kg)

N_c= Constant drying rate (Kg/Sec)

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Ms= 25 Kg of dry solid

Δt= Temperature Difference (chamber temp – ambient temp)

The initial and final moisture contents on a wet basis must be converted to a dry basis [1]

We have 70% of water measured on a wet basis in a drier under constant drying conditions

The critical moisture content is 8% dry basis

The area available for drying is A= 0.762 X 0.457 = 0.348 m2

The air temperature in the drier is 70oC.

At the air humidity used, the surface temperature of the wet solid is 28℃.

The heat transfer coefficient is 500 W/m^2 K for air (forced convection)

Find the drying time required to reduce the moisture content to 10% wet basis

Solution: [1]

$$70\%\text{ wet basis} = \frac{70g\ water}{100g\ wet\ solid}$$

$$= \frac{70g\ water}{70g\ water + 30g\ dry\ solid}$$

$$X_0 = \frac{70g\ water}{30g\ dry\ solid} = 2.33\ \frac{Kg}{Kg}$$

Similarly,

$$10\%\text{ wet basis} = \frac{10g\ water}{10g\ water + 90g\ dry\ solid}$$

$$X_1 = \frac{10g\ water}{90g\ water} = 0.11\ \frac{Kg}{Kg}$$

As, $X_1 > X_c$(0.08) the entire drying operation takes place with constant drying rate.

Therefore,

$$N_c = \frac{hA\Delta t}{\Delta h_r}$$

Where, A= 0.348m^2

Δt= (70-28) ℃= 42℃

$$N_c = \frac{500 \times 0.348 \times 42}{2435.4 \times 10}$$

$$N_c = 3 \times 10^{-3} \frac{Kg}{s}$$

$$T = \frac{25}{3 \times 10^{-3}} \times (2.33 - 0.11) \times \frac{1}{3600}$$

T= 5.138 Hr.≈ 5 Hr.

This is for one coil at one side of the chamber, we are using two coils on two opposite sides. So that at a time these two sides having 25kg of sticks each will take 5Hr time.

Accordingly, after 5 Hr. the frame rotates up to 90degrees manually to introduce remaining two sides of frame to the coils and it also takes another 5 Hr. for drying theoretically.

Total Drying time in Rainy Season = 5 + 5 = 10Hrs

Drying time calculations in winter season at 20℃

Temperature difference Δt= (70℃-20℃) = 50℃

$$N_c = \frac{hA\Delta t}{\Delta h_r}$$

$$N_c = \frac{500 \times 0.348 \times 50}{2435.4 \times 10^3}$$

$$N_c = 3.57 \times 10^{-3}\ \frac{Kg}{s}$$

$$T = \frac{M_s}{N_c}(X_0 - X_1)$$

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$$T = \frac{25}{3.57 \times 10^{-3}}(2.33 - 0.11) \times \frac{1}{3600}$$

T= 4.3Hr ≈ 4Hr

Total Drying time in Winter Season = 4 + 4 = 8Hrs

VII. RESULT

The Incense Sticks were processed to dry in the Drying Chamber and the results were standing out to be very Efficient and fulfilling. They stood out to be very close to the Calculated aspects. Looking forward to the future perspective, additional Automated mechanisms along with some Sensor Mechanisms can be installed to facilitate the Heating procedure and Result in Efficient Drying of the Incense Sticks

VIII. CONCLUSION AND FUTURE SCOPE

The main objective of our project is to prepare incense stick drying machine. The fabrication cost of our machine is cheaper in terms of the amount of workload it carries. The fabrication of the machine is done in such a way that it is easily portable from one place to other. This machine can be used in small villages of India where mostly Small Scale Industries are prevailing so as to facilitate the production of Incense Sticks accordingly.

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