International Research Journal of Engineering and Technology (IRJET) e-ISSN: 2395-0056
Volume: 08 Issue: 03 | Mar 2021 www.irjet.net p-ISSN: 2395-0072

DESIGN OF FLUIDIZED BED DRYER

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Abstract – *In this paper we have briefly discussed about the design of a fluidized bed dryer with the help of CAD tool , for our design we have preferred CATIA tool for design of dryer. This type of fluidized dryer can be used for industrial or home application We have provided the design consideration and design details of the dryer , and calculation has been done for easier understanding of design.*

Key Words: **Dryer , Fluidization, Truncated Pyramid, CATIA V5 , CAD tool.**

1.INTRODUCTION

A fluidized bed is a physical phenomenon occurring when a quantity of a solid particulate substance (usually present in a holding vessel) is placed under appropriate conditions to cause a solid/fluid mixture to behave as a fluid. This is usually achieved by the introduction of pressurized fluid through the particulate medium. This results in the medium then having many properties and characteristics of normal fluids, such as the ability to free-flow under gravity, or to be pumped using fluid type technologies.

The resulting phenomenon is called fluidization. Fluidized beds are used for several purposes, such as fluidized bed reactors(types of chemical reactors), solids separation ,fluid catalytic cracking, fluidized bed combustion, heat or mass transfer or interface modification, such as applying a coating onto solid items. This technique is also becoming more common in aquaculture for the production of shellfish in integrated multi-tropic aquaculture systems.

In fluidized beds, the contact of the solid particles with the fluidization medium (a gas or a liquid) is greatly enhanced when compared to packed beds . This behaviour in fluidized combustion beds enables good thermal transport inside the system and good heat transfer between the bed and its container. Similarly to the good heat transfer, which enables thermal uniformity analogous to that of a well mixed gas, the bed can have a significant heat-capacity whilst maintaining a homogeneous temperature field.

1.1 what is fluidization

Fluidization is the state at which all the particles come in the suspended form. When a fluid is passed upwards through a bed of particles the pressure loss in the fluid due to frictional resistance increase with the increasing fluid flow. A point is reached when the upward drag force exerted by the fluid on the particle in the bed. At this point the particles are lifted by the fluids separation of the particle increases and

becomes fluidized therefore the fluidization is the operation by which fine particles are transformed into a fluid like state through gas or liquid.

1.2 Fluidized bed dryers

Fluidized bed dryers are found throughout all industries, from heavy mining through food, fine chemicals and pharmaceuticals. They provide an effective method of drying relatively free flowing particles with a reasonably narrow particle size distribution. In general, fluid bed dryers operate on a through-the-bed flow pattern with the gas passing through the product perpendicular to the direction of travel.

1.3 Objective of the work

- The main objective of this project is to removal of moisture content from solid food particles.
- To develop the model of fluidized bed dryer.
- To test the developed model and compare the result with normal conventional sun drying technique.

2. METHODOLOGY

In this paper we have discussed about the fabrication and design of bed dryer. The various steps involved in the fabrication process has been shown in the flowchart.

Food drying is a method of food preservation, in which food is dried. Drying inhibits the growth of bacteria, yeasts and mold through the removal of water. Sun drying is a seasonal and time consuming and this promotes one to look for other methods of drying food. By this fluidization technology food particles can be dried in minimum time and this process is faster than the normal conventional open sun drying process.

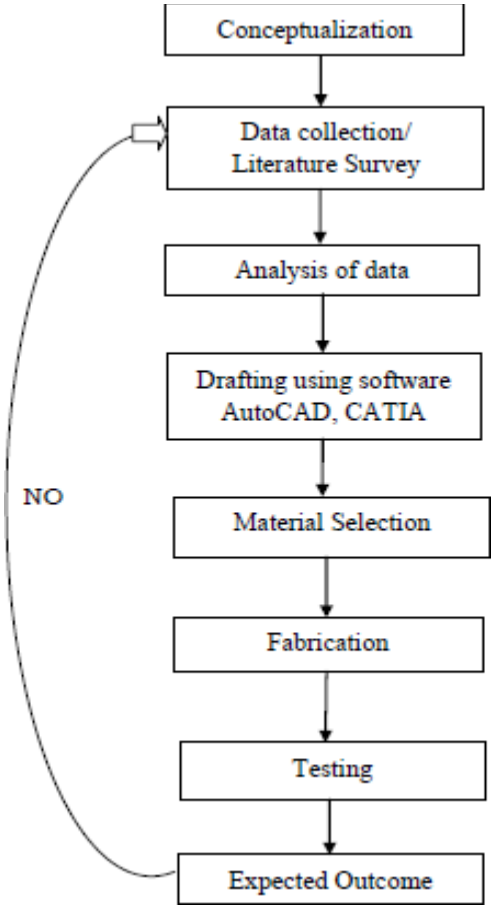


Fig 1:- Shows the steps in fabrication process

2.1 Working principle of bed dryer

Fluid bed dryer works on a principle of fluidization process. In fluidization process, hot air or gas flow is introduced through the bed of solid particulates. This gas or air will move upwards through the spaces between the particles. As the velocity increases, upward drag forces on the particles increase and at a stage become equal to the gravitational forces beneath. Hence the bed is said to be fluidized and the particles are suspended in the fluid.

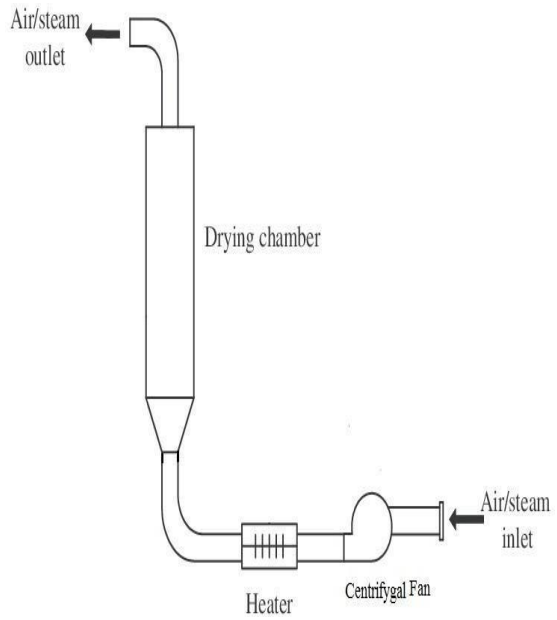


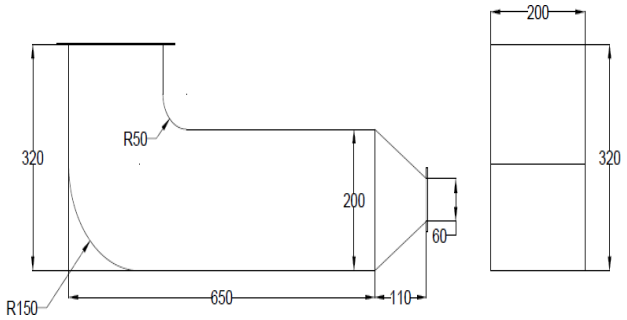
Fig 2.1:- Shows the Working of Fluidized Bed Dryer

made to flow through bed of the moist food materials that are laid on the perforated trays.

3. DESIGN OF FLUID BED DRYER

In this step we have discussed about design of dryer with the help of CATIA design tool.

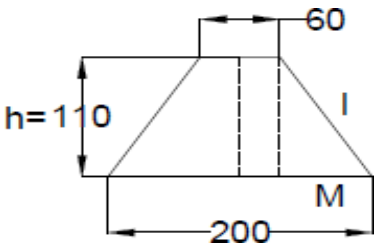
3.1 Design of Air Duct



All dimensions in mm

Fig 3.1:- shows 2D Drawing of Square Air Duct

3.2 Truncated Pyramid Calculation:



All dimensions in mm

Fig 3.2:- shows 2 D Drawing of Truncated Pyramid

- **Slant height Calculation:**

$$l^2 = h^2 + m^2$$

$$l^2 = 110^2 + 70^2$$

$$l^2 = 17000\text{mm}^2$$

$$l = 130\text{mm}^2$$

- **Volume Calculation:**

$$V = \frac{h}{3} * (A_1 + A_2 + \sqrt{A_1 * A_2})$$

Where,

$$A_1 = (200 * 200) = 40000\text{mm}^2$$

$$A_2 = (60 * 60) = 3600\text{mm}^2$$

$$V = \frac{110}{3} * (40000 + 3600 + \sqrt{(40000 + 3600)}$$

$$V = 2038666.667\text{mm}^3$$

3.3 Design of Drying Chamber

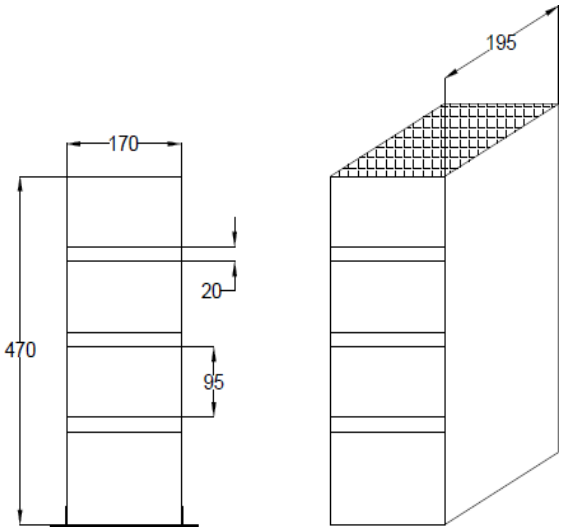


Fig 3.3:- shows 2D Drawing of Drying Chamber

3.4 Design of Trays

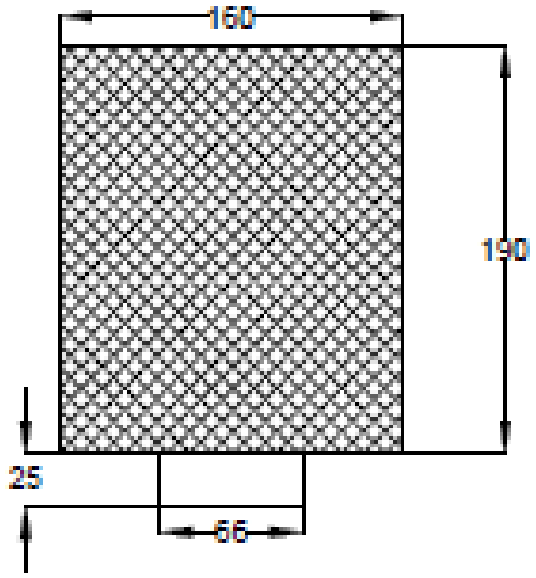


Fig 3.4.1 :- shows top view Drawing of Tray

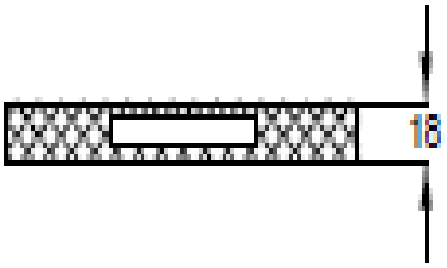


Fig 3.4.2:- shows 2D Drawing of Tray

- **Tray Area Calculation:**

$$A = l * b$$

$$A = 190 * 160$$

$$A = 30400mm^2$$

- **Volume Calculation:**

$$V = l * b * h$$

$$V = 190 * 160 * 18$$

$$V = 456000mm^2$$

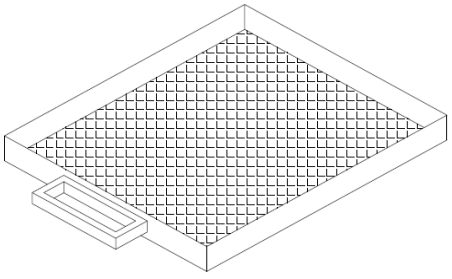


Fig 3.5:- shows 2D Drawing of Tray

3.5 Individual parts 3d model

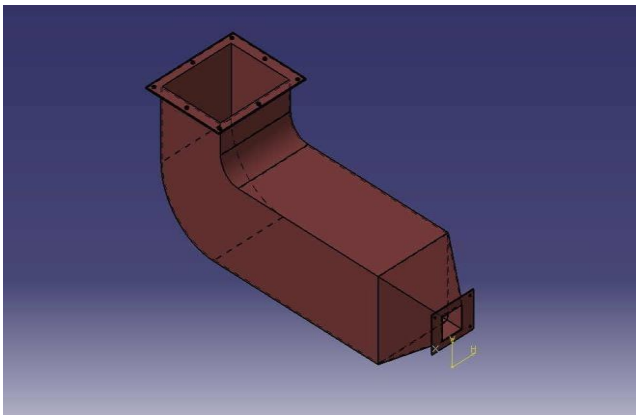


Fig 3.6:- shows square air duct

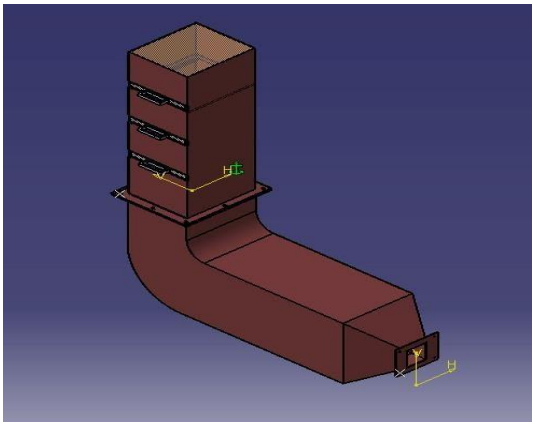


Fig 3.9:- shows Isometric View

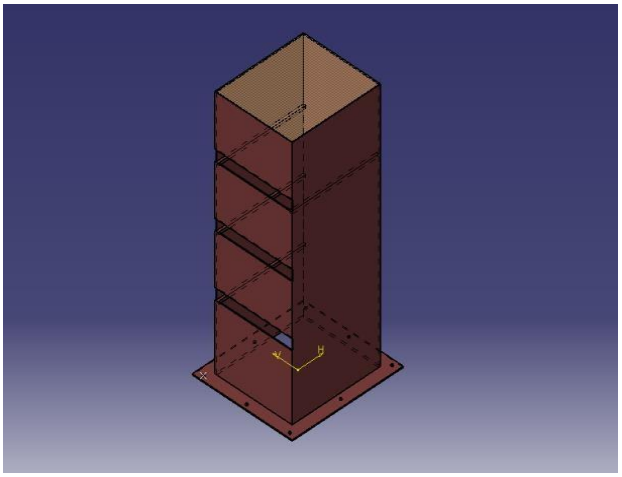


Fig 3.7:- shows Dr*ying Chamber*

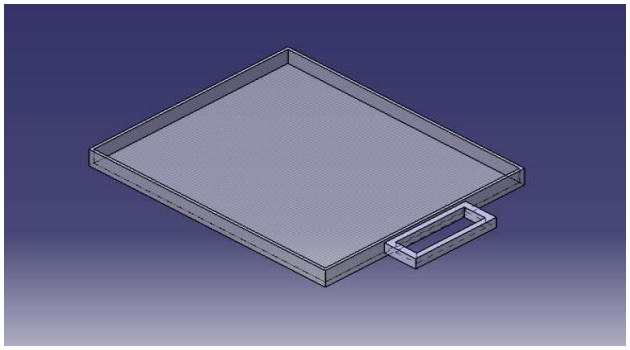


Fig 3.8:- shows 3D Model of Individual Part

4. CONCLUSION

The technique of fluidized bed drying for solid food particles is workable and viable. The product from the fluidized bed dryer is fine and uniformly dried. To ensure the product is hygienic for eating with reduced starch content, the dryer must be covered after the product is introduced for about 20 minute depending on the drying temperature. A lower air flow rate is required at the initial stage when the product is undergoing a constant drying period. Beyond the constant drying period, the air flow rate must be increased to ensure particle mixing and to prevent localized heating of the solid food particles. This work so far has opened up an alternative technology for drying solid food particles. The design and the operation methods is simple and can be developed and mass produced to boost food production.

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