VI - Fabrication and testing

CHAPTER VI

FABRICATION AND TESTING

6.1 INTRODUCTION:

In the traditional method of turmeric processing, farmers use open shallow mild steel pan for turmeric processing. Because of shallow open pan, heat losses are more and it is time consuming. It takes 40 to 50 minutes to boil water and 40 to 50 minutes to boil the turmeric Rhizomes. The traditional handling of boiled Rhizomes like piercing, trampling, scorching, mud mixing and transportation of hot Rhizomes results in quality and quantity loss. Also there is loss of quality of Rhizomes due to uneven heating, water boiling and using mild steel open pan for boiling.

Taking into consideration the drawbacks of traditional method and objectives of the research work, turmeric processing device called blancher is designed. The design is completed with more than double margin of safety, taking into consideration handled by unskilled labors and farmers. The blancher is software tested for high temperature limits between $120^\circ\text{C}$ to $210^\circ\text{C}$ and high pressure limits between 3 bar to 9 bar. After satisfactory testing of blancher for uniform distribution of heat flux, deflection, thermal and structural stresses, blancher is fabricated for testing.

6.2 FABRICATION OF BLANCHER:

It is decided to fabricate the blancher from high quality (SS 304L) stainless steel instead of mild steel as in traditional method, to improve the quality of the Rhizomes. Figure 6.1 show the experimental setup of fabricated blancher. The blancher is fabricated to handle 50 kg of turmeric Rhizomes per batch.
Figure 6.1 Experimental setup of fabricated blancher model

Figure 6.2 Stainless Steel Housing used for fabrication
Figure 6.3 Cylindrical Housing with cavity

Figure 6.4 Cylindrical Housing with opening for loading and unloading
To start with fabrication of blancher a steel cylindrical tank of size 500 mm diameter, 750 mm length and thickness 3 mm is chosen for blancher housing as shown in Figure 6.2. The stainless steel used for fabrication of the blancher is laboratory tested.

The housing of the blancher is chosen to be a hollow cylindrical shape to avoid the joints, gaps and to maintain the isotropic properties of the material. For aesthetic view, the housing can be manufactured in hexagonal shape, but it is difficult to manufacture hexagonal casing of uniform isotropic material without joints made of the stainless steel. For the housing a 65 mm diameter cavity is drilled to fix the steam receiver and an opening is kept for loading and unloading the Rhizomes as shown Figure 6.3 and Figure 6.4 respectively. A hollow cylindrical stainless steel pipe of diameter 55 mm with thickness 5 mm is chosen to fabricate a steam receiver. One end of the steam receiver is closed and the other end is kept open to supply steam from the boiler. The steel pipes of diameter 18.75 mm and 2 mm thickness were used as steam pipes, six steam pipes are installed on the steam receiver and inside the housing as shown in Figure 6.5. On the steam pipes and steam receiver 5 mm diameter holes are drilled at equidistance of 25 mm, to distribute the steam uniformly throughout the blancher. The complete steam receiver mounted with steam pipes is rigidly fixed inside the housing as shown in Figure 6.6. The assembly with housing is then installed on the trolley of the mobile blancher supported by a stand and the plummer block for rotation of the blancher with the help of hand wheel. Figure 6.7 shows complete assembly, housing, hand wheel, plummer block, stand and a trolley.

The fabricated model is taken to the farm house of one of the leading farmers in this region. A baby boiler unit which supply steam at the rate of 60 kg/hr, pressure 2 bar is used for testing. The boiler and blancher is mounted with temperature measuring device, pressure measuring device and safety valves, one on the blancher and second on boiler. Figure 6.8 shows the details of the baby boiler used for testing. The accessories and components of the blancher and boiler unit are as listed below:
VI - Fabrication and testing

Figure 6.5 Assembly of steam pipes

Figure 6.6 Installation of Steam pipes in Steam receiver
**Figure 6.7** Blancher Assembly.

**Figure 6.8** Baby Boiler Used for Testing.
• Baby boiler of evaporation capacity 50 kg/hr, working pressure 1.5 bar to 2 bar, steam capacity 20 to 25 liter with furnace and accessories like control valve, safety valve, flash valve, pressure indicator, temperature and water level indicator.

• A blancher unit of size 750 x 50 mm with handling capacity of 50 kg with steam pipes uniformly placed in it.

• Main shaft and hand wheel.

• Housing and a trolley made of mild steel.

• A water tank of capacity 3500 liters.

• A furnace of volume 0.4 to 0.5 m³.

6.3 OPERATION OF THE BLANCHER:

The fabricated mobile blancher is loaded with the turmeric Rhizomes for boiling and processing. Usually doctor Rhizomes require more time for processing compared with finger Rhizomes, hence they are separately boiled. Figure 6.9 show the finger turmeric Rhizomes and Figure 6.10 show the doctor Rhizomes kept ready for processing.

After installation of the boiler and blancher assembly with accessories for temperature measurement, pressure measurement, flow measurement and safety valves, it is loaded with 50 kg of turmeric Rhizomes. Figure 6.11 show the opening of the blancher for loading and unloading. The opening of the blancher is closed tightly to avoid leakage of steam. Figure 6.12 show the boiler and blancher assembly for experimentation. The temperature of steam coming out from the outlet valve is measured. The steam is monitored for constant flow rate. After confirming the constant steam flow rate, it is supplied to the blancher by operating the valve. Steam is supplied to the blancher until white fumes are developed. From mathematical model it is found that 18.25 minute times is sufficient to boil the Rhizomes, hence 15 minutes, 20 minutes and 25 minutes time is chosen for test. Figure 6.13 and Figure 6.14 show the testing of turmeric Rhizomes after boiling. To increase the thermal efficiency of plant and total time of processing two blancher are required since there is continuous supply of steam from the boiler. When Rhizomes are boiled in the first blancher, second blancher is used to load the Rhizomes and kept ready for further processing to save loading time.
Figure 6.9 Finger Turmeric Rhizomes

Figure 6.10 Doctor Turmeric Rhizomes
VI - Fabrication and testing

Figure 6.11 Opening of Blancher for Loading and Unloading

Figure 6.12 Boiler and Blancher Assembly for Experimentation
When first blancher is disconnected from steam supply after processing Rhizomes, the second blancher is connected to steam supply for processing. During processing the turmeric Rhizomes in second blancher, the processed Rhizomes from first blancher are transferred to the drying platform, they are unloaded on the drying platform by rotating the hand wheel as shown in Figure 6.15 and it is loaded further with the fresh Rhizomes and kept ready for processing. The same process is repeated to save time consumption and to increase the efficiency of the plant by avoiding wastage of steam. Total three labors are required to operate the plant, one labor to operate the steam supply valve, to supply fuel to the boiler, to observe processing unit and two labors are required to transfer the processed hot Rhizomes on drying platform with the help of trolley, to unload on drying platform and load the fresh Rhizomes kept ready for further processing in next batch. Hence the time required for loading and unloading is saved and within 20 to 25 minutes one batch of turmeric Rhizomes is processed. The capacity of the plant is increased by operating the plant in three shifts per day. It is proposed to use 100 kg of turmeric Rhizomes per batch so that 6000 kg of Rhizomes are processed in a day. It is possible to save minimum Rs. 60000/- by processing 6000 kg of Rhizomes per day and the blancher cost is made free maximum within one or two days by availing facility of government subsidy. Table 6.1 show the specifications of blancher.

<table>
<thead>
<tr>
<th>S.No</th>
<th>Name of Item</th>
<th>Specifications</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Capacity</td>
<td>50 Kg per batch</td>
</tr>
<tr>
<td>2</td>
<td>Size</td>
<td>750 x 500 mm</td>
</tr>
<tr>
<td>3</td>
<td>Ambient Temperature</td>
<td>25°C TO 40°C</td>
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<tr>
<td>4</td>
<td>Steam Temperature</td>
<td>110°C TO 120°C</td>
</tr>
<tr>
<td>5</td>
<td>Steam Pressure</td>
<td>1 bar TO 1.2 bar</td>
</tr>
<tr>
<td>6</td>
<td>Steam Flow Rate</td>
<td>50 To 60 Kg/hr</td>
</tr>
<tr>
<td>7</td>
<td>Loading Time</td>
<td>10 minutes</td>
</tr>
<tr>
<td>8</td>
<td>Unloading Time</td>
<td>5 minutes</td>
</tr>
<tr>
<td>9</td>
<td>Cooking Time</td>
<td>15 To 20 minutes</td>
</tr>
<tr>
<td>10</td>
<td>Total Time</td>
<td>30 To 35 minutes</td>
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<tr>
<td>11</td>
<td>Fuel</td>
<td>Wood/Agriculture Waste</td>
</tr>
<tr>
<td>12</td>
<td>Calorific Value</td>
<td>12000 to 15000 KJ/kg</td>
</tr>
</tbody>
</table>
6.4 EXPERIMENTATION AND TESTING :

In the test of turmeric processing for the first batch, steam is supplied for 15 minutes. It was observed that the quality of turmeric Rhizomes by steam boiling is better as compared to boiling by traditional method. The curcumin and oleoresin content of turmeric, which is one of the quality parameter was found better by general observation of the experienced farmers. It was found that the Rhizomes if boiled for 15 minutes or below 15 minutes, they remain hard and it is difficult for skin removal, [K.J.Kamble, (2009)].

In the test of turmeric processing for second batch, steam is supplied for 20 minutes. It was observed that the quality of turmeric Rhizomes by steam boiling is better as compared to boiling in the first batch. The level of curcumin and oleoresin content of turmeric, which is one of the quality parameter was found still better by general observation of the experienced farmers. The Rhizomes are sufficiently boiled and become softer for skin removal.

In the test of turmeric for the third batch, steam is supplied for 25 minutes. It was observed that the quality of turmeric Rhizomes by steam boiling is better but the Rhizomes got overheated. The quality parameter curcumin and oleoresin of the turmeric was adversely affected. Due to overheating of the Rhizomes the level of quality parameters got reduced and the Rhizomes become more softer and difficult to handle for skin removal and further processing.

Hence it is suggested for 15 to 20 minutes steam boiling for turmeric Rhizomes in the blancher. Figure 6.13 shows the turmeric Rhizomes after boiling, the boiled Rhizomes were observed and tested by experienced farmers. Fig 6.14 show the tested Rhizome and its quality, it was found that the content curcumin is much better when the Rhizomes are boiled for 15 to 20 minutes. Also the fiber layers developed in the Rhizomes are more stronger and better compared with the first and third batch, which is one of the indication for better quality of the boiled Rhizomes. Rhizomes after steam boiling, observation and testing they were transferred to the drying platform. Figure 6.16 show the boiled hot Rhizomes after unloading on the drying platform.
The following reading were noted during experimentation and processing of turmeric Rhizomes.

Atmospheric temperature 30°C and pressure 1.013 bar.
Temperature of water supplied to boiler 20°C,
blancher surface temperature 50°C, boiling time of Rhizomes 15 minutes, 20 minutes and 25 minutes.
The amount of water drained out from the blancher is 2 kg at temperature 80°C.
The amount of fuel (wood) supplied to the boiler is 20 kg.
Surface temperature of steam receiver is 100°C and average steam pressure 1.5 bar.
Time required to load the Rhizomes is less than 5 minutes and to unload the hot Rhizomes 5 to 8 minutes.
Figure 6.13 Testing of turmeric Rhizomes after boiling.

Figure 6.14 Tested Turmeric Rhizome.
VI - Fabrication and testing

Figure 6.15 Unloading of Boiled Turmeric Rhizomes.

Figure 6.16 Boiled Hot Rhizomes on drying platform