OPTIMIZATION OF DESIGN AND ANALYSING THE PARAMETERS OF TURMERIC PROCESSING UNIT

Mohankumar. A[1], Magibalan. S[2], Ajai Prakash. M[3], Nandhu. K. K[4], Paveenkumar. N[5].
[1,3,4,5] U.G Students, Department of Mechanical Engineering, K.S.R. College of Engineering, Tiruchengode.
[2]Assistant Professor, Department of Mechanical Engineering, K.S.R. College of Engineering, Tiruchengode.

ABSTRACT: ***In large scale turmeric boiling the conventional plants is used with multiple cooker and boiler assembly placed on trolley. The plant is provided with furnace, packed pressure vessels and mobile plant. Here in boiling, the turmeric rhizomes are placed in the cooker and the steam is supplied from the boiler to the pressure cooker and the turmeric is boiled. In traditional plants the boiling is done without maintaining the pressure in the vessel, so the boiling is inefficient. Along with that the leakage problems related with pressure vessel gives rise to heat loss. Overall the losses are much more and the process is not optimized. This is due to the lot of losses from every part of plant. The losses are very hard to control in minimum cost. So the objectives of this project are Reduce time for steam generation, Reduce labour effort and cost, Reduce fuel consumption and Reduce heat losses.***

Keywords: Reduce time for steam generation, Pre-Heating of water, Rock stone insulation, Steam distribution line.

INTRODUCTION

India is leading with 90% of turmeric production in the world with 2,07,570 ha of area with 1,09,22,630 tonnes (www.indianspices.com). Being a spice cash crop, medicinally and industrially important, the area under turmeric is increasing in Tamilnadu with a production of 8220 tons of turmeric from 2.04 million ha of area with 10.00 million tonnes in 2014-15 (www.agritech.tnau.ac.in). Primary processing of turmeric is still being done with traditional means leading to many losses and difficulties. Farmers use open shallow metal (Mild Steel) pan for turmeric boiling on open fire furnace. Water is added up to 3/4 of the heap height in the pan and covered by gunny bags or plastered. This conventional process of turmeric is heap height in the pan and covered by gunny bags or plastered. This conventional process of turmeric is time consuming, hazardous and less fuel efficient. To minimize processing time and hazardous associated with the conventional boiling plant; a steam based design is popular in the market from last 10 years. All the farmers are invariably using steam based turmeric processing on rental basis. The present design has evolved over last few years but still there are gaps in the areas of fuel economy, labour efforts and convenience of operation.

Botanical name of turmeric is curcutha longa L. It is an important spice which is used for yellow colour and special flavour. Rhizomes of turmeric are often found in violet yellow colour. Central rhizomes are like tubers and small rhizomes like fingers coming out from the central one. It contains 1.8 to 5.4% cur cumin due to this it has yellow colour. Some amount of starch and 2.5 to 7.2% oil is also obtained. It is used in the form of spices for colouration and flavour. In this very form it is used in medicine and cosmetic goods manufacturing. There are two types of turmeric produced in central India. One has solid and dark colour and the other long, soft and light colour.

LITERATURE SURVEY

1. Gopal shinde and kailas kamble has presented the work of designing, fabricating, installing turmeric steam cooker for optimization of turmeric heat treatment. Observation shows that in the steam cooking process material handling is cushy and comfortable. Fuel required is half of the traditional process that is 87 kg per 300 kg of mass batch. It is also found that loss of important turmeric quality ingredient reduced to 1%.
2. P. M. Patil and N. K. Chhapkhane have present the work to increasing the efficiency of turmeric cooking plant. Here in boiling steam is brought to cooker with pressure from the boiler for cooking turmeric rhizomes which are placed inside the cooker. Boiling is inefficient in traditional plant as it is done without maintaining pressure in the vessel. Leakage problems gives rise to heat loss related with pressure vessel. From this it is proved that traditional method is not optimized. The efficiency of actual processing plant is very less that is 13.19%. The loss from every part of plant is the reason for less efficiency. It is very hard to control the losses in minimum cost. So the objective of the study was to reduce cooking time, recycle condensate, reduce labour effort, and cost, reduce fuel consumption and reduce heat losses.
3. K. A. Athmaselvi and N. Varadharaju determine and compared the heat utilization factor for boiled turmeric rhizomes. In open steam boiling rhizome showed highest utilization factor which was carried out for 15 min. highest percentage of curcumin oleoresin and essential oil contents showed by the rhizomes boiled at 0.5 kg/cm2 and 5 min.
4. Patil P. M., Chhapkhane N.K. says in large scale turmeric boiling the conventional plants is used with multiple cooker and boiler assembly placed on trolley. The plant is provided with furnace, condensate extraction mechanism, packed pressure vessels and mobile plant. Here in boiling, the turmeric rhizomes are placed in the cooker and the steam is supplied from the boiler to the pressure cooker and the turmeric is boiled. In traditional plants the boiling is done without maintaining the pressure in the vessel, so the boiling is inefficient. Along with that the leakage problems related with pressure vessel gives rise to heat loss. Overall the losses are much more and the process is not optimized. The efficiency of the actual processing plant is 13.19% which is very less. This is due to the lot of losses from every part of plant. The losses are very hard to control in minimum cost. So the objectives of this project are Reduce cooking time, Recycle condensate, reduce labour effort and cost, Reduce fuel consumption and Reduce heat losses.

EXPERIMENTAL PROCEDURE

1. Pressurized cooking

The lab study using pressure cooker indicates reduction in cooking time of turmeric; this can lead to high production rate and reduced fuel consumption. The present turmeric boiler produces steam at 3-4 bar (g) pressure and turmeric cooker operates at less than 0.5 bar (g) pressure (as this is Open to atmosphere). Based on design of cooker (thickness 5 mm) raw turmeric rhizomes is cooked at 2 bar pressure without affecting on cur cumin percentage and safety of cooking vessel. A pressure relief valve is installed on present cooker to operate the same at 3 bar (g) safely.

2. Pre-heating

The pre-heater arrangement is fixed at the top of the boiler by using two columns. The heat from the furnace, heats the water inside the pre-heater arrangement. So the water is heated initially before usage. This helps reducing time for steam generation in the boiler.

3. Steam Distributing

In previous the steam is distributed at the particular area. By creating holes on the distributing pipe line in a row helps equal steam distribution inside the pressure vessel. By reducing the diameter of the holes in the distributing pipe from the bottom to its top, the quality of the cur cumin is maintained.

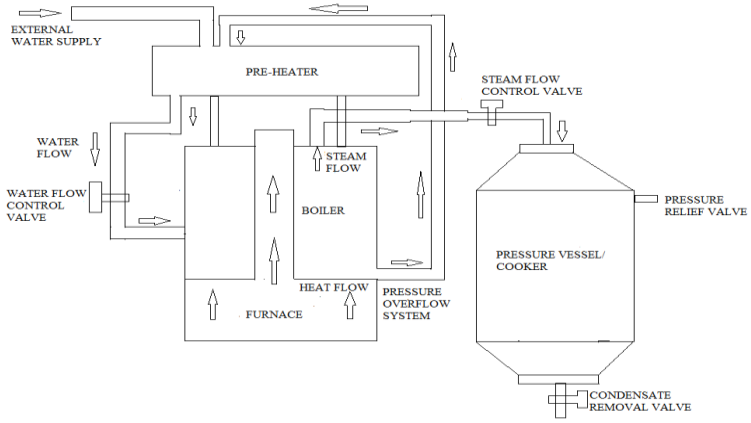

Fig.1 Experimental Setup for Turmeric Processing Unit.

PRESSURE VESSEL DESIGN AND ANALYSIS

Tensile Stress = Tensile Strength/Factor of Safety.

Tensile Stress = (PD)/(2t)

t = 3.5 mm

Corrosion Allowance is 1.5mm.

Hence, the thickness of the vessel is 5mm.

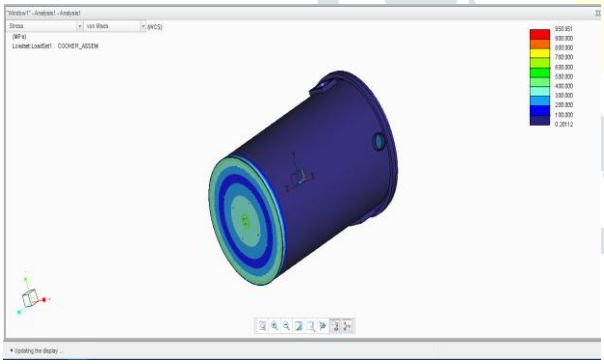

Fig.2 Stress

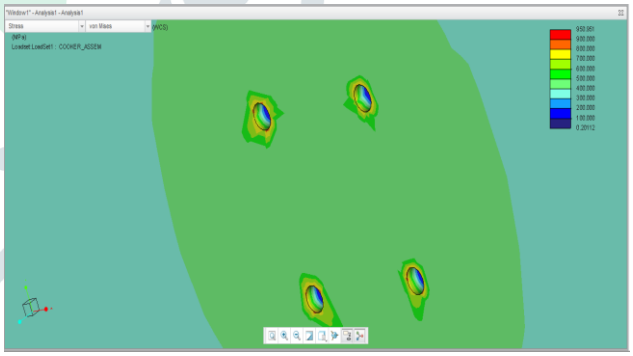

Fig.3 stress at condensate extraction holes.

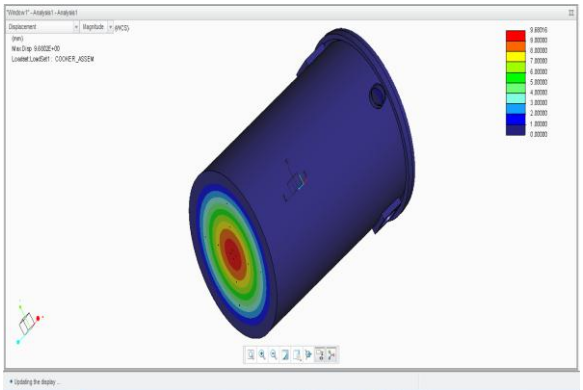

Fig.4 Displacement

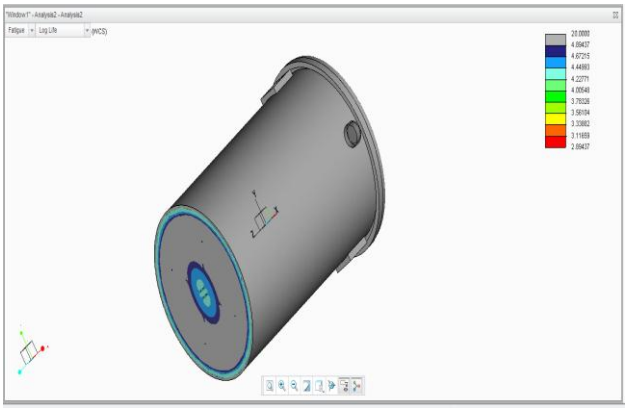

Fig.5 Factor of Safety

CONCLUSION

The connection of furnace outer shell and pre-heater the heat is exchanged, so time required for steam generation is reduced. Wood required to create steam is reduced. By increasing wall thickness of components, stress concentration is reduced and insulation used to increase the steaming efficiency and also increases the Factor of Safety 11 to 20.By improving design of steam distribution line (inside the pressure vessel/ cooker), steam is equally distributed all over the vessel and cur cumin percentage is maintained. By decreasing steam generation time, reduce the fuel consumption and labour effort.

REFERENCES

[1] **PATIL P. M., CHHAPKHANE N. K**., IMPROVING DESIGN AND OPERATION OF STEAM BASED TURMERIC COOKING PROCESS, VOL-3, ISSUE-4.

[2] **APURVA R. PENDBHAJE, MAHESH GAIKWAD, NITIN DESHMUKH, RAJKUMAR PATIL,** DESIGN AND ANALYSIS OF PRESSURE VESSEL.

[3] **GOPAL U.SHINDE, KAILAS J.KAMBLE, MAHESH G.HARKARI, DR.G.R.MORE,** PROCESS OPTIMIZATION IN TURMERIC HEAT TREATMENT BY DESIGN AND FABRICATION OF BLANCHER, VOL-15.

[4] **PRATIK B. YADAO, SHRIKANT R. JACHAK,** A REVIEW ON OPTIMIZATION OF TURMERIC CURING PROCESS.

[5] **GOPAL U. SHINDE**, PROCESS OPTIMIZATION IN TURMERIC HEAT TREATMENT BY DESIGN AND FABRICATION OF BLANCHER VOL-15.

[6] **K. A. ATHMASELVI, N. VARADHARAJU**, HEAT UTILIZATION IN DIFFERENT METHODS OF TURMERIC BOILING.

[7] **SPICES BOARD INDIA**, TURMERIC (EXTENSION PAMPHLET) 2016.

[8] **R.K.RAJPUT**, THERMAL ENGINEERING, LAKSHMI PUBLICATIONS PVT. LTD.; SEVENTH EDITION.