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STUDENT PROJECT PROPOSAL FOR THE

46th SERIES OF STUDENT PROJECT PROGRAMME

DESIGN AND FABRICATION OF COFFEE PRE CLASSIFIER

Submitted in the fulfillment of the student project programme of

BACHELOR OF ENGINEERING
IN
MECHANICAL ENGINEERING

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ABSTRACT

Harvested coffee cherries arrive in a variety of conditions. With them come stones, sand, leaves, and other impurities. As it has been for ages, incoming fruit is initially sorted by hand.Workers examine coffee cherry for ripeness, pulling over- and under-ripe cherry from each lot.They also pick out the unwanted debris.

The Coffee pre-classifier is used to distribute, destone, and float cherry coffee. Additionally, it allows the coffee to be lifted up to the pulping unit. It prevents damage to the pulping equipment andincreasing the life of machine and also installed within small area and the water consumption is low. Sorting and classifying coffee cherries by density can give coffee producers another steam of income.

Keywords: Pre classifier, distribute, destone, float

CHAPTER 1

INTRODUCTION

Coffee is a cash crop comes under plantation farming. Coffee is a genus of flowering plants, whose seeds are called as coffee beans are used to make coffee. They are shrubs or small tree native to tropical and Southern Africa and Tropical Asia. Coffee ranks as one of the world's most valuable and widely traded commodity crops and it is an important export of several countries, including those in central and South America, the Caribbean and Africa.

Coffee is the indigenous crop of Abysinia Plateau from Ethiopia, it was taken to Yemen in the 11^{th} century from Arabia, the seeds were brought by Baba Budan in the 17^{th} century and were raised in Baba Budan hills of Karnataka. British planter who took keen interest and large coffee estates established in the hills of Western Ghats.

Arabica and Robusta are the two main varieties of coffee grown in India. Arabica is mild coffee, but the beans being more aromatic, it has higher market value compared to Robusta beans. On the other hand, Robusta has more strength and is, therefore, used in making various blends.

Harvested coffee cherries arrive in a variety of conditions. With them come stones, sand, leaves, and other impurities. As it has been for ages, incoming fruit is initially sorted by hand.Workers examine coffee cherry for ripeness, pulling over- and under-ripe cherry from each lot.They also pick out the unwanted debris, if this is not done the stones and other impurities mightharm the pulping unit. The existing methods used to do it are either manually which is time consuming and a lot of labours are required. It can also be done using machines which are bulky and take up a lot of space they are also expensive.

Producers sell the coffee without separating them based on their density which can decrease the outturn. In most countries, coffee cherries are usually sorted in floating tanks. All are pouredinto a water tank, where ripe fruit sinks and defective fruit floats. After that, the floating fruitsare picked out separately. Sorting and classifying coffee cherries by density can give coffee producers another stream ofincome. Rather than selling all the coffee blended, sorting coffee can give producers access toboth specialty markets overseas and the internal market within the country, thus giving them ability to earn more every harvest. This small added step within the supply chain can help a producer achieve a higher cupping score and a more consistent and developed coffee.

CHAPTER 2

OBJECTIVES

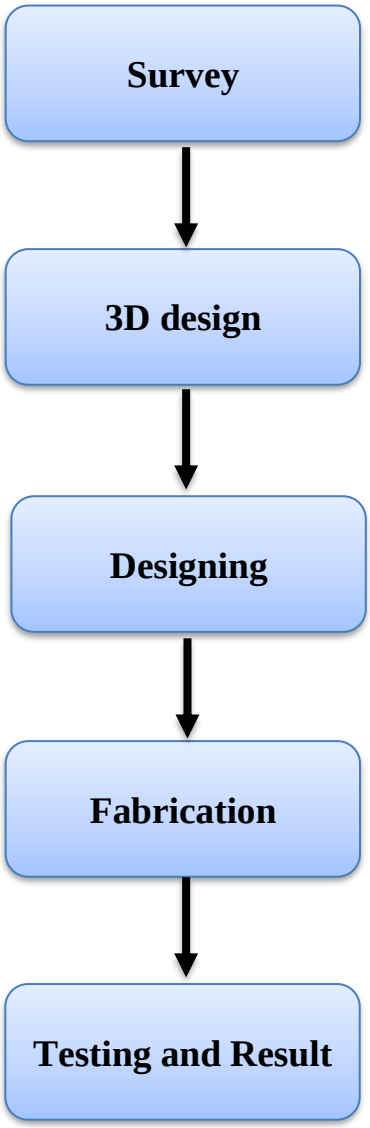
The objectives of developing Coffee Pre-Classifier machine are:

- To overcome scarcity of labor.
- Reduce time required for cleaning.
- Maintaining the density, which leads to constant outturn.
- Achieve a higher cupping score and a more consistent and developed coffee.
- To enhance the overall productivity and production without scarifying the quality.
- Developing compact machine to reduce large installation area.
- Water used for this process is recycled hence, huge quantity of water is not wasted.

CHAPTER 3

METHODOLOGY

The various steps involved are:



SURVEY

In order to figure out the current problems in the existing machineries, we visited an estate in Chettali, Kodagu where they were using coffee sorting machine which was bulky and it was not affordable by the local farmers. We approached Mr. Darwin, the owner of Begur trading company, who provided us insights about the coffee processing methods and drawbacks of the existing machines. Considering all the points and ideas, the coffee pre-classifier is designed and fabricated. The coffee pre-classifier is used to distribute, destone, and float cherry

coffee. Additionally, it allows the coffee to be lifted up to the pulping unit. It prevents damage to the pulping equipment andincreasing the life of machine and also installed within small area and the water consumption is low. Sorting and classifying coffee cherries by density can give coffee producers another steam of income.

DESIGN AND FABRICATION

The design of the system to is be made such that the space required for the system is less and the cost required to fabricate is not too expensive. All the designs were done using 'Fusion 360' design software.

Design and Fabrication of collection tank

The collection tank where the cherry coffee is initially kept is designed with required dimensions. The tank is fabricated using GI metal sheets of 16 gauge. Initially the sheets were cut for the required dimension and later it was bent using bending machine. Later it was welded.

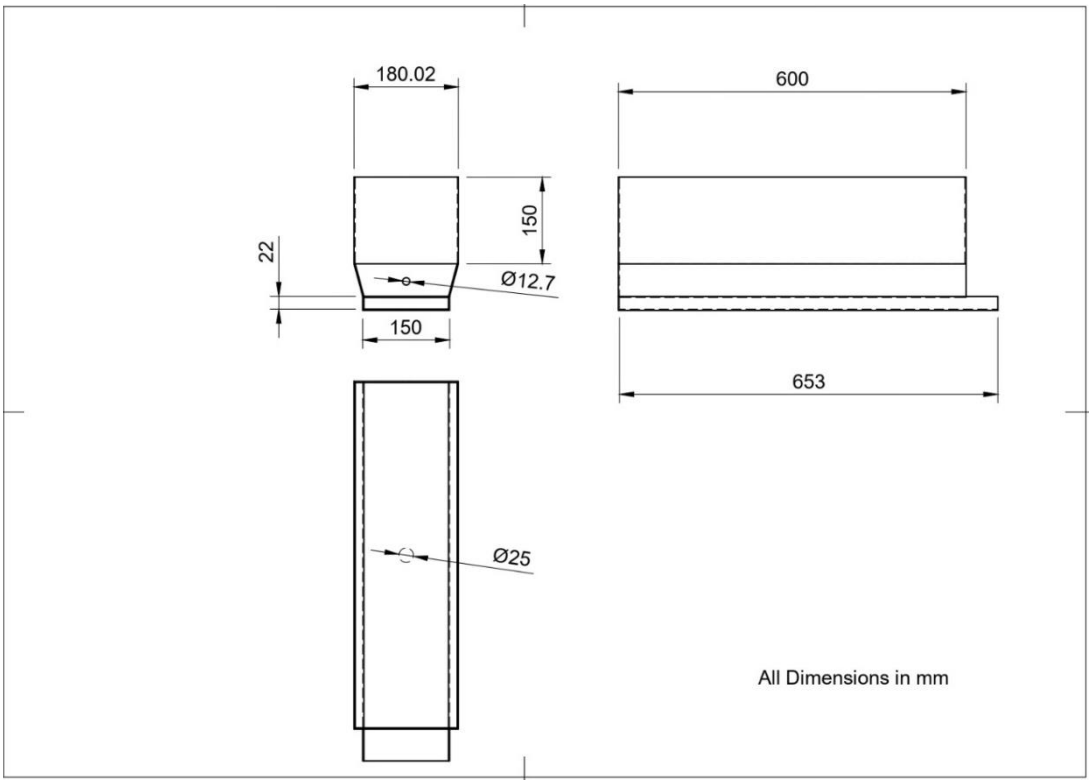


Fig. Design of Collection Tank

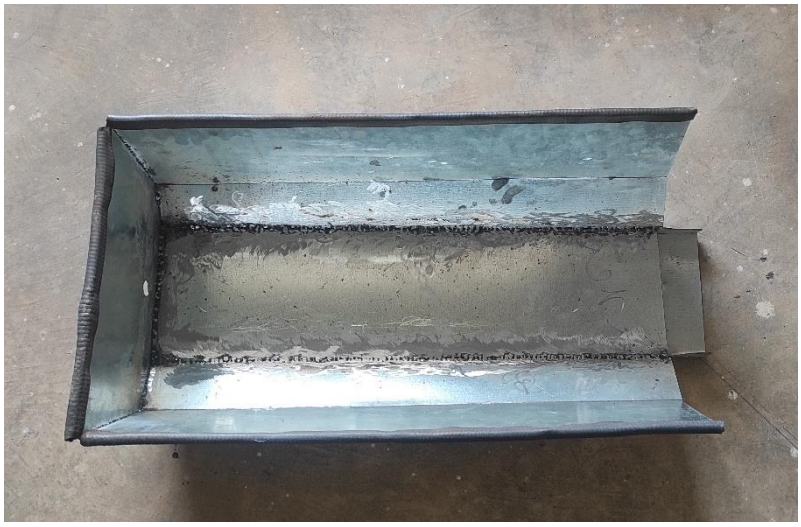


Fig. Fabrication of collection tank

Design and Fabrication of Destoner Tank

The destoner tank is used to remove the stones present in the coffee and lead the coffee to the storage tank is designed with required dimensions. This tank is fabricated using GI metal sheets of 16 gauge. Initially the sheets were cut for the required dimension and later it was bent using bending machine. Later it was welded.

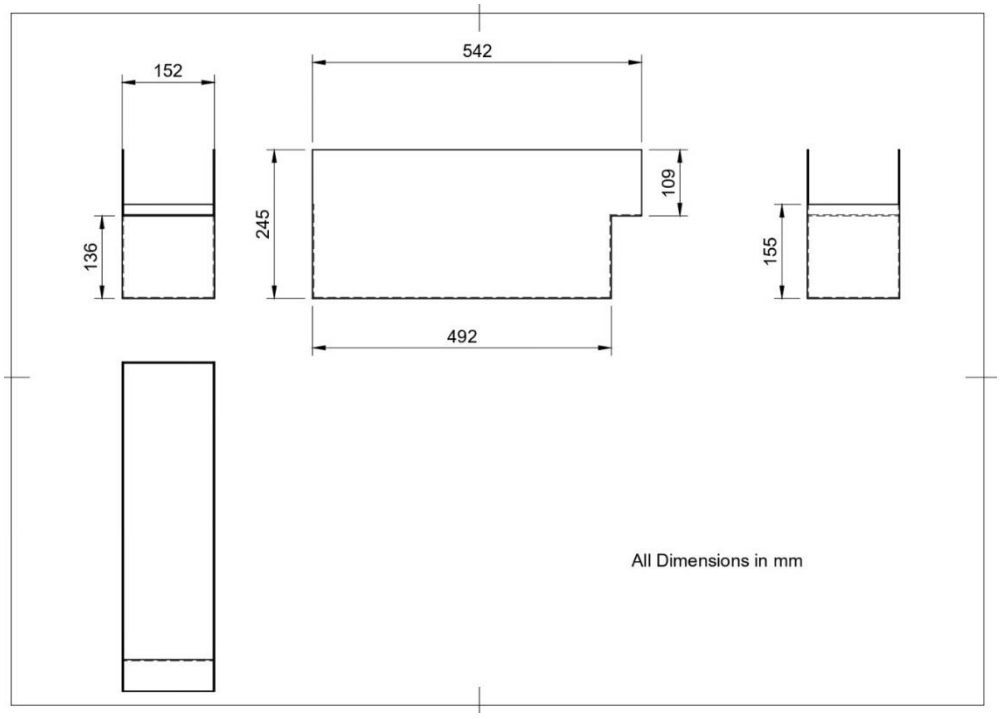


Fig. Design of destoner tank

Fig. Fabrication of destoner tank

Design and fabrication of Water Storage Tank

The aim of the storage tank is to store the water for continuous supply and circulation throughout the system is designed using the proper dimension. This tank is fabricated using GI metal sheets of 16 gauge. Initially the sheets were cut for the required dimension and later it was bent using bending machine. Later it was welded.

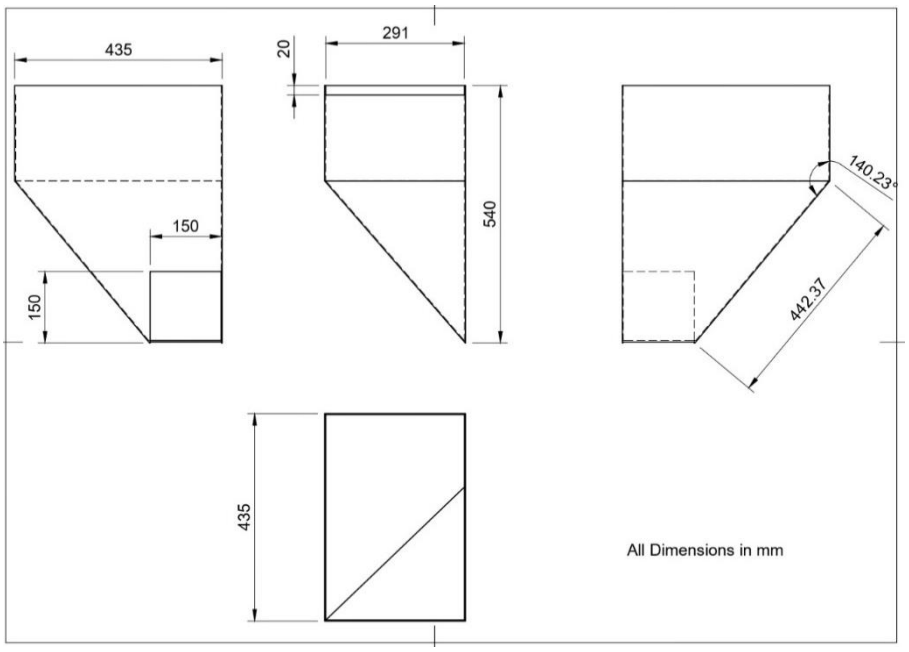


Fig. Design of water storage tank

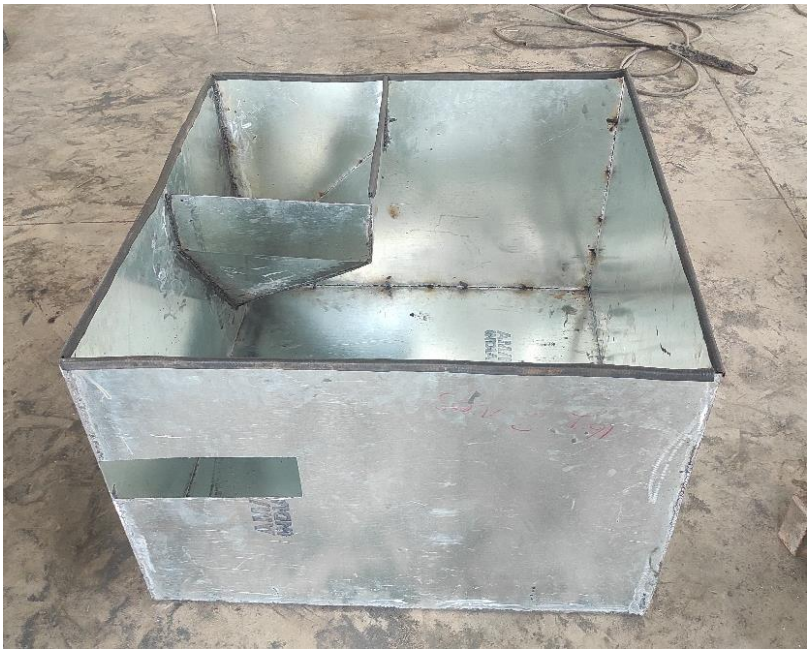


Fig. Fabrication of water storage tank

Design and fabrication of Coffee Distribution Tank

The purpose of the distribution tank is to separate the float coffee out of cherry coffee which has higher density. It is designed with required dimension. It also feeds the higher density cherry coffee into the screw conveyor. Initially the sheets were cut for the required dimension and later it was bent using bending machine. Later it was welded.

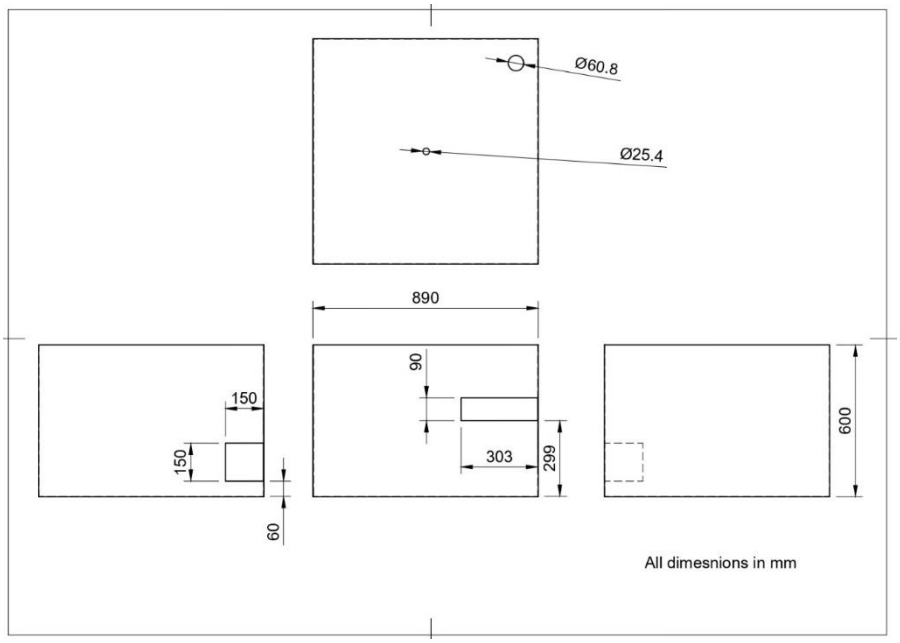


Fig. Design of Coffee Distribution Tank

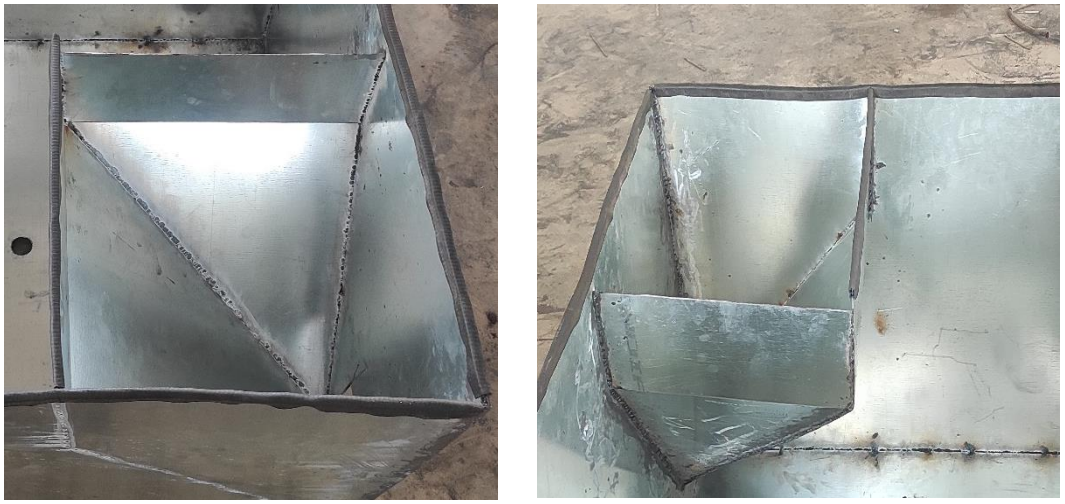


Fig. Fabrication of Coffee Distribution Tank

Design and Fabrication of Screw Conveyor

1. Belt speed (v) = (Screw diameter (D)*3.14*RPM)/60

= (0.152*3.14*251)/60

= 1.99 m/sec

2. Capacity (Q) = 60* (π/4) *D^2*S*n*Ψ*ρ*C

Where, D - Screw diameter in m

S – Pitch in m

n – Speed in rpm

Ψ – Loading efficiency of the screw (0.25-0.3 for mildly abrasive material)

ρ – Density of the material (430 Kg/m^3)

C – Inclination factor (for angle of the screw with the horizontal being 40^o)

The value of C is 0.4)

= 60* (π/4) *0.152^2 *0.114*151*0.28*430*0.40

=1500 Kg/hr.

=1.5 T/hr.

The coffees that settle at the bottom are elevated to the pulping unit using a screw conveyor.The dimensions of the screw conveyor flights are shown below

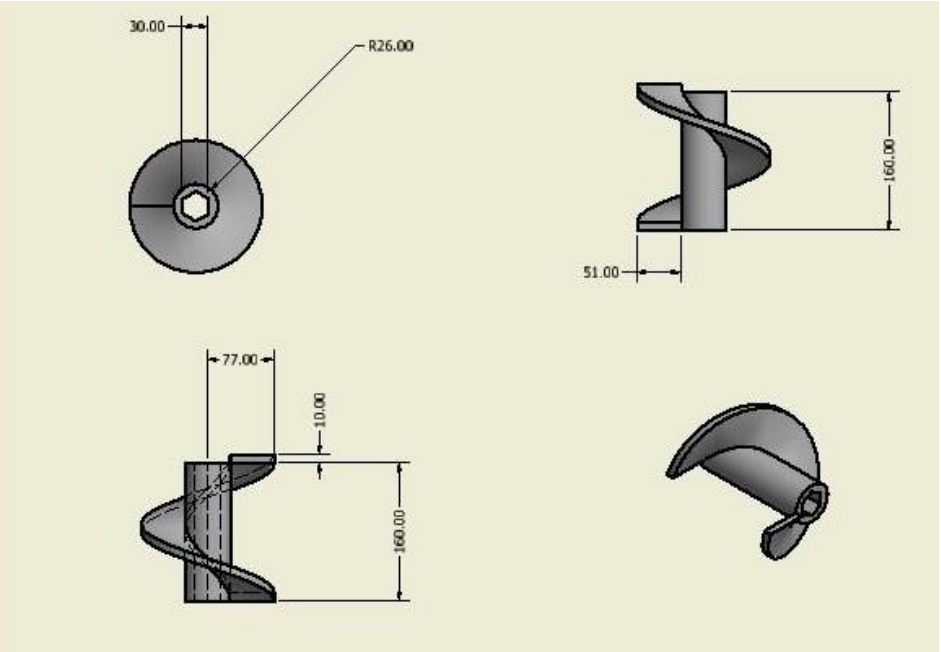


Fig. Design of Screw Conveyor

Fig. Fabrication of Screw Conveyor

Assembly:

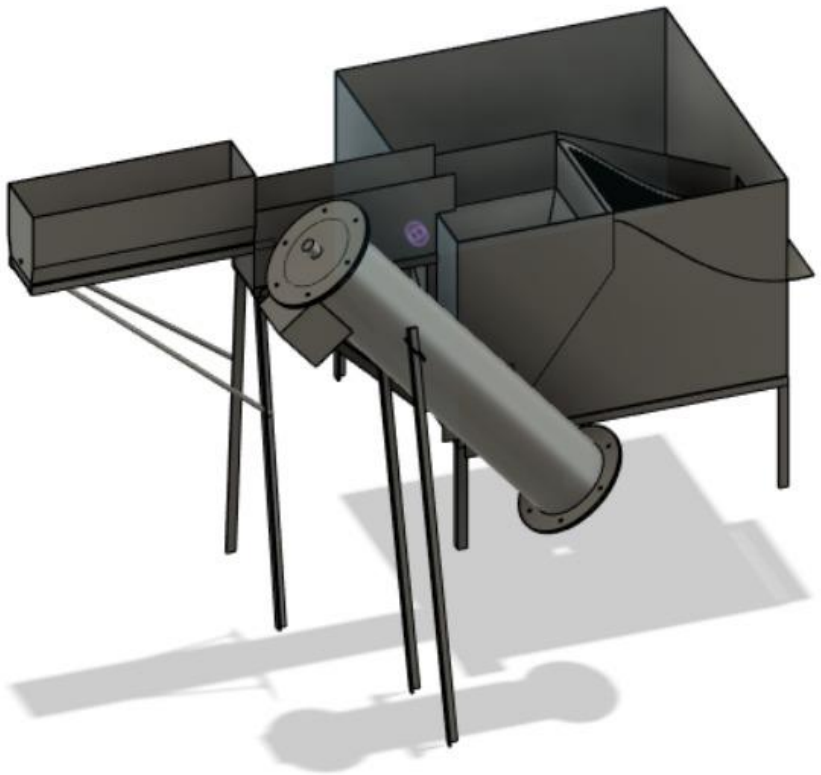


Fig. Assembly design of coffee pre-classifier

WORKING

- The coffee cherries which are harvested from the plantation is then fed into the coffee pre-classifier for destoning and removing the debris and also to separate the density and float coffee.
- Initially the coffee is fed into the collection tank and water is supplied, so that the coffee is distributed to the destoning tank with the help of the continuous water flow.
- Once the coffee is fed from the collection tank to the destoning tank, the stones get collected in the destoner tank and later the coffee cherries are moved to the coffee distribution tank.

- In the coffee distribution tank, the separation of the float and density cherries occurs. The cherries with higher density sink to the bottom of the distribution tank and the floats along with the debris will be separated.
- The higher density coffee cherries which sink will be elevated using a screw conveyor.
- The water will be stored in the water storage tank and it circulates the water for the whole system using pump and water pipes.

CHAPTER 4

RESULTS AND CONCLUSION

RESULT:

The testing of the coffee pre classifier was conducted for up to 30 mins and was concluded with the following results:

Capacity of the machine to classify cherry coffee in 30 mins	= 500-600 kilos
Water requirement	= 400 litres
Maximum machine height	= 3.8 feet
Maximum machine width	= 6.6 feet
Collection tank width	= 60cm
Pump power	= 1hp
Conveyor speed	= 175rpm
Conveyor Power	= 1 hp
No of labor required	= 1

CONCLUSION:

The development of design and fabrication of coffee pre-classifier improved the efficiency of the labor and thereby lessen the labor constraint and also increase the productivity without sacrificing the quality. Achieved a higher cupping score and a more consistent and developed coffee.

This method is viable to maintain the density and constant outturn is achieved. It also helps in implementation of farm operations in a timely manner and ultimately reducing the cost of cultivation substantially. Small installation area and recycling of water has made this mechanism viable.

This project work has provided us an excellent opportunity and experience, to use our knowledge. While working on this project, we gained a lot of practical knowledge regarding planning, designing, purchasing, assembling, machining and team building.

CHAPTER 5

SCOPE OF FUTURE WORK

- The existing system can be enhanced by incorporating a blower to facilitate the removal of dust particles effectively.
- The blower installation will enable the system to efficiently clean and eliminate dust particles, improving overall air quality.
- Another valuable addition to the system is a strainer, which serves the purpose of eliminating larger, undesirable suspended particles from water.
- By installing a strainer, the system can effectively filter out unwanted particles, resulting in cleaner and purer water.
- The strained water, free from larger suspended particles, can then be recirculated within the system for various purposes.
- This recirculation of strained water ensures a more sustainable and efficient utilization of water resources.
- With the inclusion of a blower, the system becomes capable of maintaining a dust-free environment, promoting better health and cleanliness.