

Design and Fabrication of Washing Machine from Waste Materials

**Dommeti.Varaha.Venkata.Yashwanth Kumar, Batchu Charan Reddy, Adari Pavan
Kumar, G Satyanarayana Reddy, K.S.Raghuram**

Department of Mechanical Engineering

Vignan's Institute of Information Technology, Visakhapatnam, India

dvvyashwanthkumar@gmail.com, charanreddy657@gmail.com, adaripavan900@gmail.com,
reddyprasad478@gmail.com, hodmechanicals@gmail.com.

Abstract

The objective is to design and fabricate a washing machine. The Pedal washing machine is a product that can wash clothes without using electrical energy. The aim is to produce device to washcloths that can be run without using of electrical power. The various parts used for making a power-operated washing machine can quickly available in the market at a cheap cost and it requires less maintenance. It consists of various components i.e, outer drum (fabricated using MS sheet), internal drum (SS sheet), stainless steel shaft, frame(MS angular bar), bearings, chain sprocket, seat, and pedal arrangement. Initially, individual various components need to be drawn in CATIA and need to assemble the components for obtaining the final product design. Once the design is done each individual component can be fabricated based on the required dimensions. The outer drum and inner drum, the frame is fabricated by doing mechanical activities rolling, welding, cutting, shearing, riveting, and grinding activities. Rolling is performed for obtaining a cylindrical shape drum. welding is done to assemble components together. Shearing is performed to remove excess material. Drilling is performed for producing holes. Grinding is performed for good surface finishing at sharp covers and at the welded area and also for cutting of material to obtain the required dimensions. Finally, all the individual fabricated components are assembled together for obtaining the final product. When a person starts pedaling the cycle by applying load on the pedal transmission of energy takes place from the pedal to the inner drum shaft. as we placed the clothes in the inner drum when it rotates the washing of clothes can be done. By employing pedal washing machines in rural and tribal areas, peoples can wash their clothes easily without having a burden, by applying less effort to the pedal.

Keywords

Design, Fabrication, Scrap Materials, Washing Machine, Pedaling

1. Introduction

The main objective of this research is to reduce strenuous work of people who are living in rural area and tribal areas where there is lack of electricity. By employing pedal operated washing machine, energy used for washing cloths can be reduced, therefore people need to apply less effort for washing cloths instead of manual washing. In some countries people who are migrated to various places, people use to give their cloths for laundry for washing, with the help of pedal operated washing machine both washing cloths and fitness is done. The main mechanism is when the load is applied on the pedal by human is converted in rotary motion. The pedal operated washing machine is cost effective and can be used without electricity, maintenance cost is also less

Main objectives are:

- RINSING, WASHING, SPINNING can be done.
- Low cost of maintainence & Can wash various clothes effectively & Fitness can be maintained.
- Low operating cost & Less human effort is required to wash clothes & cloths can washed without electricity.

2. Methodology

The method are as follows (Figure 1 and 2).

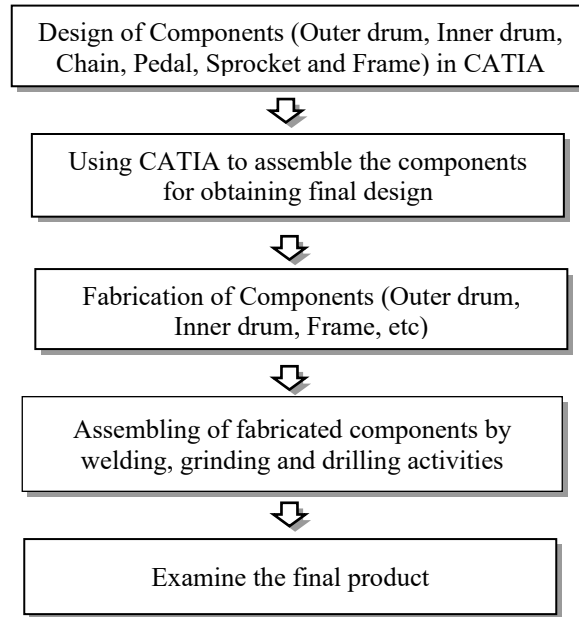


Figure 1: Flow diagram of the methodology

3. Hardware Components

- a. Pedal
- b. Chain
- c. Sprocket
- d. Plummer Block
- e. Rotating Shaft
- f. Inner Drum (i.e Washing)

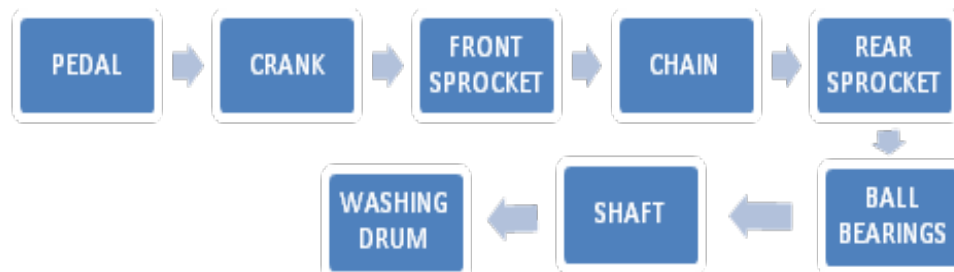


Figure 2: Showing arrangement of components

4. Modelling

The modelling results are as follows (Figure 3, 4, 5, 6, 7, 8, and 9).

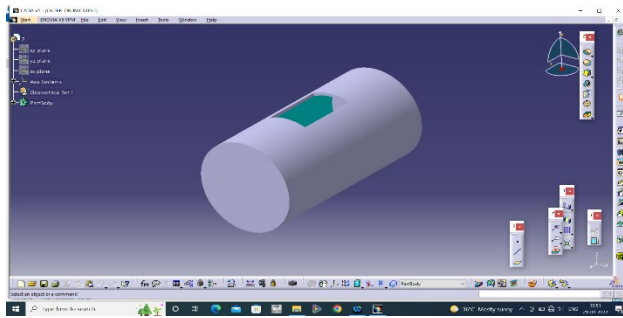


Figure 3: Outer Drum Design

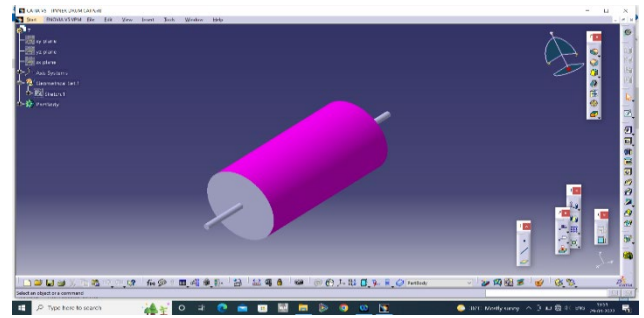


Figure 4: Shaft in Inner Drum

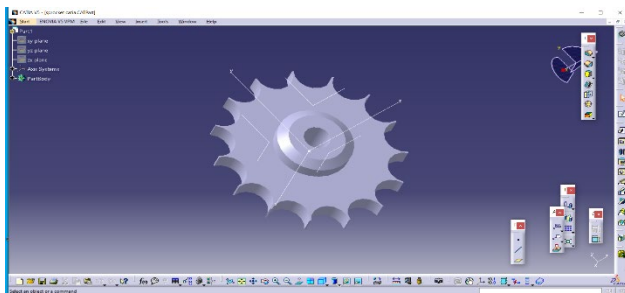


Figure 5: Sprocket Design

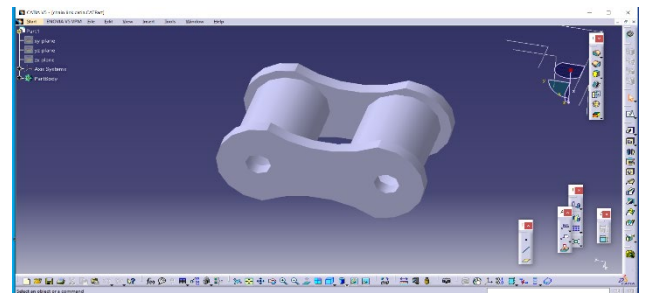


Figure 6: Chain Link Design

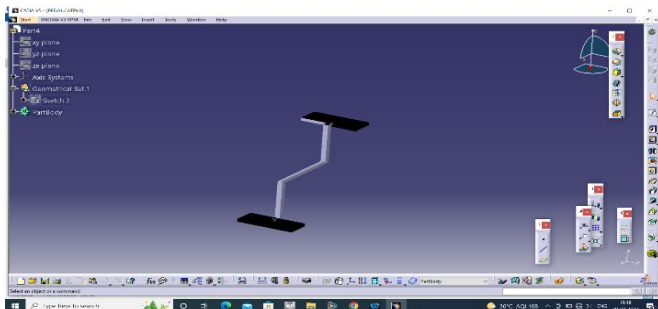


Figure 7: Pedal Design

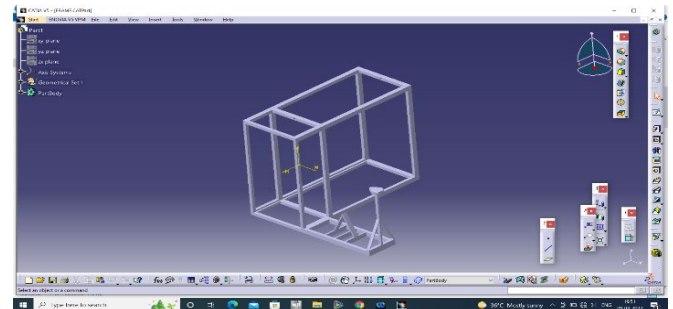


Figure 8: Frame Design

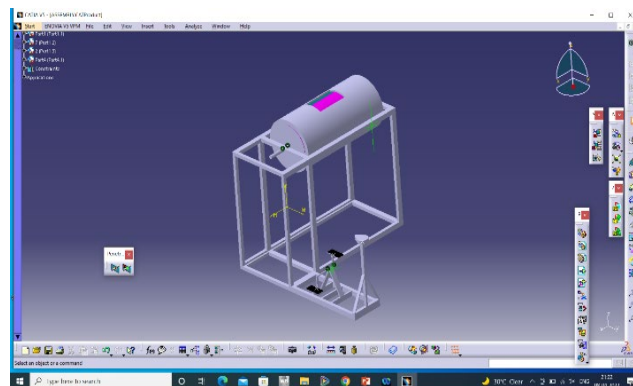


Figure 9: Pedal Operated Washing Machine Design

5. Components Fabrication

OUTSIDE DRUM:

Refer with Figure 10, Outside drum is done using MS sheet. The MS sheet used for making outside drum with dimensions of 700mm x 500mm x 1.5mm. Outside drum dia is 500mm and length is 700mm and thickness of the MS sheet is 1.5mm.



Figure 10: Outside Drum

FRAME:

Refer with Figure 11, Product's frame is made using MS angular bar. The size of MS bar 6mm thickness and width 40mm. By doing mechanical processes shearing, rolling, welding etc, frame of the device is done.



Figure 11: Equipment Frame

INNER DRUM:

Refer with Figure 12, Inner drum measurements are 500mm x 300mm x 1mm and it is made of stainless steel sheet with small pores across the surface. The inner drum has a diameter of 300mm, a length of 500mm, and a stainless-steel thickness of 1mm. The inner drum was created by mechanical operations such as cutting, rolling, welding and grinding.



Figure 12: Internal Drum

SHAFT:

A SS shaft having a rad. of 10mm and length of 1000mm is taken to rotate the internal drum. The SS shaft is placed at middle of internal drum and outside drum by bearings.

BEARINGS:

Inner drum rotation must be smooth and steady. So, on each side of the drum, two ball bearings are installed. The bearings will provide support to the SS shaft that is fitted in the middle of internal drum.

PEDAL ARRANGEMENT:

The pedal's arrangement transmits motion to the shaft. When the cyclist applies pressure to the foot lever, the pedal rotates, and the rotation of pedal will transferred to the internal drum's shaft, that rotates the inner drum.

CHAIN:

The inner drum is connected to the pedal by a chain, which transmits rotational movement from the pedal to the inner drum.

6. Working Principle

Refer with Figure 13, When the operator puts a load on the pedals the front sprocket and chain experience rotational movement it is usually connected between the front and rear sprockets transferring mechanical force from the front sprocket to the rear sprocket the shaft attached to the rear sprocket tends to rotate with the help of ball bearings if pedaling is clockwise then shaft rotate clockwise direction, if pedaling is anticlockwise direction ,the shaft will rotate anticlockwise direction , the internal drum attached to shaft will rotate with shaft that is useful for cleaning clothes first open the doors for the both outer and internal drums keep clothes in the internal drum then pour certain amount of washing powder and water, close doors of both outer and internal drum, then lay on seat then pedal the device after pedaling upto certain time stop pedaling and take of the washed clothes from internal drum, use drain passage to slowly drain the dirt water use to wash the clothes.



Figure 13: Washing Machine Operated by Pedal

7. Experimentation and Tabulation

We need to tabulate results and plot graph to find the result of the conducted experiment. These are the steps that need to be followed while performing the experiment,

1. The outside drum can be filled with water till the half
2. Detergent should be added only in required amounts
3. The clothes which are to be washed, should be added in the internal drum
4. The load applied on pedal makes it to rotates and transmit the load to shaft of drum that help in working of washing machine
5. We must note results at the various loads with respect to time

For Washing Activity values are (Figure 14, and 15):

| Serial Numbers | Speed of Shaft [rpm] | Weight [kg] | Time Taken [min] |
|----------------|----------------------|-------------|------------------|
| 1 | 50 | 1 | 16 |
| 2 | 50 | 1.5 | 23 |

| | | | |
|---|----|-----|----|
| 3 | 50 | 2.5 | 30 |
| 4 | 50 | 3 | 38 |

Table.1: Washing values table

Graphs:

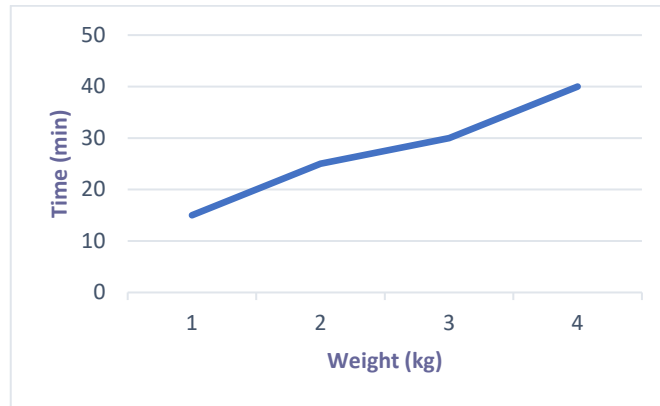


Figure 14: washing activity graph

For Spinning Activity values are:

| Serial Numbers | Speed of Shaft [rpm] | Weight [kg] | Time Taken [min] |
|----------------|----------------------|-------------|------------------|
| 1 | 85 | 1 | 4 |
| 2 | 85 | 1.5 | 7 |
| 3 | 85 | 2.5 | 10 |
| 4 | 85 | 3 | 15 |

Table 2: Spinning values table

Graphs:

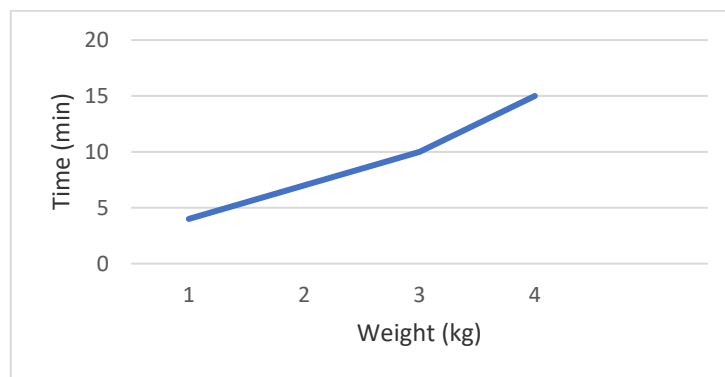


Figure 15: spinning activity graph

8. Result and Discussion

Here we can conclude that, the spinning and washing operations of the machine can be adjusted by maintaining constant speed and changing the load and time parameters. Refer with Table 1 Washing is a constant speed operation and requires less speed, in which the time varies with respect to the load in it i.e., if the load in the machine increases the time of washing increases, and if the load decreases the time of washing decreases gradually. Refer with Table 1

and 2. Same principle applies with the spinning operation as well. Time of operation is directly proportional to the load present in the machine, but it requires more speed when compared to washing operation.

9. Scope for Future work

1. Energy conservation:

Flywheel is installed in the model stores the energy that is produced in surplus than required. It is advantageous for the cyclist, as it reuses the energy during the further operation.

2. Expansion of machine capacity:

Increasing the machine capacity may be advantageous in reducing the time of washing operation. But, it doesn't work well in case of spinning operation. Damage of drum may occur if the spinning is done with higher loads. It should be done in turns to prevent damage to the machine.

3. Multi purpose design:

Charging of batteries, powering of pedal operated equipment like wood cutting machine, circular saw, winnowing can be done with the generated excessive energy instead of sending it to fly wheel.

10. Conclusion

In the view of rural areas and the places where there is scarcity of electrical energy, a pedal powered washing machine is designed. The apparatus and equipment used for the design and assembly are economical and easily available. It satisfies the cost effective design as pedal operated washing machine wholly fabricated at a cost of around Rs. 5000/- INR, that is cheaper than a low end electrical washing machine available. It also has the advantages of less maintenance and operating cost, easy operation, environment friendly, moreover it helps in maintaining the physical fitness of the user.

References

- Hakizimana E, Masengesho P, Cyusa O, Niyigena M: Design and Analysis of a Pedal Operated Washing and Drying Machine, 2020.
- R. S. Khurmi "Design of Machine Elements", Eurasia publishing house 3 Pvt Ltd, 14th revised edition, 2020.
- Anand Prakash Singh, Ashish Kumar Singh, Arman Gupta, Deepak, Rahul Shrivastava: Design and Fabrication of Pedal Operated Washing Machine , 2021.
- Bicilavadora: The Pedal-Powered Washing Machine - IDEAS 2005 Proposal, 2005.
- Tawanda M, Tererai JM, Charles M. Design and fabrication of a pedal-powered washing machine, in Proceeding of the international conference on industrial engineering and operations Management, Bogota, Colombia. 2017.
- Teresa B, Stephanie D, Harrison K, Jessica V, Alexander Y. Pedal-powered washing machine, IDEAS 2009 Proposal, Chimaltango. 2009.
- Dharwad CK, Tandle P, Shiypuje S, Ladkat S, Simran K. Design of washing machine for cleaning of small components. IJEERT;30-36, 2015
- Bhavani, G., Harish Kumar, K., Raghuram, K.S., Bendu, H.S. Analysis on Inverse Kinematics of Redundant Robots, Lecture Notes in Mechanical Engineering, pp. 943-950, 2016. DOI: 10.1007/978-981-15-2696-1_91
- Raghuram, K.S., Arji, N.K., Kadregula, M., Kavya, P.S. Minimizing the ship exhaust radiations, JP Journal of Heat and Mass Transfer, 17 (1), pp. 215-225, 2019. DOI: 10.17654/HM017010215
- Padhi, S.N., Bhavani, G, Naga Sudha, V. Raghuram, K.S., Rout, T. "Effect of hub radius on rotational stability of functionally graded Timoshenko beams", International Journal of Innovative Technology and Exploring Engineering, 9 (1), pp. 4246-4251, 2019.
- Naga Sudha, V., Raghuram, K.S., Savitri, V., Shanthi Swaroopini, A. Design Optimization of Slag Pot Transfer Car, Lecture Notes in Mechanical Engineering, pp. 269-281, 2020.
- Vasanthraj A, Rani P.S. et.al. "Automated Brain Imaging Diagnosis and Classification Model using Rat Swarn Optimization with Deep Learning-based Capsule Network." International Journal of Image and Graphicsart. No. 2240001, 2016.

Biographies

K.S.Raghuram working as Associate Professor in the Department of Mechanical Engineering in Vignan's Institute of Information Technology.

D.V.V. Yashwanth Kumar, Batchu Charan Reddy, Adari Pavan Kumar, G Satyanarayana Reddy are the students who are Completed Under-graduation in B.Tech, Mechanical Engineering from Vignan's Institute of Information Technology, Duvvada, Visakhapatnam from 2018 to 2022.