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DESIGN AND FABRICATION OF UTENSIL WASHING MACHINE

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ABSTRACT :

Click here and insert your abstract text. * MERGEFORMAT The utensil washing machine, an essential innovation in the domain of household and commercial kitchens, represents a significant leap forward in the automation of everyday tasks. Traditionally, washing utensils by hand is a labor-intensive process that requires time, water, and physical effort. This manual approach is not only inefficient but also prone to inconsistent results, such as improperly cleaned dishes or wastage of water. The development of utensil washing machines aims to solve these challenges by providing a more efficient, eco-friendly, and cost-effective solution for cleaning dishes and kitchenware. A utensil washing machine operates similarly to a dishwasher, using water and detergent to clean and sanitize utensils. The washing chamber uses a detergent, and high-pressure nozzles to dislodge food particles and grease from the surfaces of dishes. The rinsing section is designed to remove detergent residues. The design of utensil washing machines can vary depending on their intended use, with models tailored for home kitchens, restaurants, or industrial applications. Domestic models are usually compact and user-friendly, focusing on energy efficiency and ease of use.Utensil washing machines is their ability to save water compared to traditional hand washing. With the increasing global emphasis on water conservation, machines are designed to optimize water usage by employing efficient circulation and filtration systems. This not only conserves water but also ensures that detergent usage is minimized, leading to reduced chemical waste. Moreover, many models are equipped with energy-efficient and lowering electricity consumption.

Keywords: Utensil washing machine, automation, water conservation, energy efficiency, sanitization.

INTRODUCTION :

The utensil washing device has been advanced to later the desires of small and medium domestic utility, who're commonly guy powered. In maximum of the residence the dish are washed via way of means of the use of human hand. This desires extra time and excessive operating load. In order to keep away from all such disadvantages. This, device has been designed in this type of manner that it could be used to washing the plate very easily with none effect force. The operation is made be easy that even an unskilled labour can handled, via way of means of simply demonstrating the operating of the dish washing device once. Now a day's there may be lot of opposition within side the market place. So there may be want of growing a brand new technique or procedure for powerful production. That procedure or strategies must satisfy the requirement approximately accuracy productiveness etc. Ever because the commercial revolution human had been depending on electricity, now international is coming into within side the twenty first century with new invention and new technology. But additionally make new form of issues day to day. When trouble is expanded and it turns into extra tough to fulfill call for of electricity and electricity desires. As searching closer to family and commercial issues the answer is "Utensil washing device". Electric electricity (70–90%) utilized by electrical fiery dishwasher and washing tools is prefer for hot water, the cutlery, the laundry and the device and will as properly get swapped via way of means of warmness from different re assets than electricity. In this paper the dish washing device is mentioned which is straightforward in production and it offers the output in differential approaches. Utensil cleaners are essential household products designed to efficiently remove food residue, grease, and grime from various kitchenware. These cleaning agents come in diverse forms, including powders, liquids, and bars, each catering to specific cleaning needs.

1.1. The Evolving landscape of utensil cleaners

The market for utensil cleaners has witnessed significant growth, driven by several factors:

- Increasing Consumer Awareness: Rising awareness about hygiene and sanitation has led to a surge in demand for effective cleaning solutions.
- Diverse Kitchenware: The proliferation of diverse kitchenware materials, from stainless steel to non-stick coatings, necessitates specialized cleaning agents.
- Convenience and Efficiency: Consumers seek time-saving, hassle-free cleaning solutions that deliver superior results.
- Environmental Concerns: Eco-friendly and biodegradable cleaning options are gaining popularity as consumers become more conscious of their environmental impact.

1.2. The Role of utensil cleaners in modern Households:

Utensil cleaners play a crucial role in maintaining kitchen hygiene and ensuring food safety. By effectively removing food particles and bacteria, these products help prevent the spread of food borne illnesses. Additionally, they contribute to the longevity of kitchenware by minimizing wear and tear caused by harsh cleaning agents.Dishwashers free up time by automating the process of cleaning utensils, dishes, and cookware. Instead of manually scrubbing each item, users can load the dishwasher, press a button, and let the machine do the work.A dishwasher can handle large volumes of dirty dishes, making it faster and more efficient than washing by hand.Modern dishwashers are designed to use less water than traditional hand washing.Dishwashers can reach water temperatures that are higher than what people typically use when washing by hand. These high temperatures help in better removal of grease, grime, and food residues.With energy-saving features like low-temperature washes and air-dry modes, dishwashers consume less electricity, contributing to lower utility bills.

1.3. Scope of the project:

- Effective Cleaning: To remove food residue, stains, and dirt from utensils, ensuring they are clean and hygienic.
- Sanitization: To reduce the growth of bacteria, viruses, and other microorganisms on utensils, ensuring they are safe for use.
- Convenience: To provide a quick and easy way to clean utensils, saving time and effort for users.
- Environmental Sustainability: To minimize the environmental impact of utensil cleaning by using eco-friendly cleaning agents, reducing water consumption, and promoting energy efficiency.
- Utensil Protection: To protect utensils from damage, corrosion, or discoloration during the cleaning process, ensuring they remain in good condition for a longer period.
- User Safety: To ensure the cleaning process is safe for users, by minimizing the risk of accidents, injuries, or exposure to harsh chemicals.
- Cost-Effectiveness: To provide a cost-effective solution for utensil cleaning, reducing the need for frequent replacement of utensils or the use of expensive cleaning agents.
- Improved Hygiene: To promote good hygiene practices by providing a reliable and efficient way to clean utensils, reducing the risk of cross-contamination and food borne illnesses

LITERATURE REVIEW :

[1] DESIGN AND DEVELOPMENT OF SEMI-AUTOMATIC Dish washer. author-Dhale A. D.,Ghodke L.S, Hase P. U. , Jarag S. V, Shelar S. This article addresses ways to cut human labor in dishwasher. Cleaning and drying dishes have become far easier and more efficient thanks to the dishwasher. This document also addresses the issues experienced with Automatic Dishwasher use as well as their corresponding remedies. Automatic dishwashing is expensive, time-consuming and requires significant energy. Being expensive, the use of automatic dishwasher in our nation is quite low. Using semi-automatic dishwashers helps us to considerably cut time as well as human effort. Using plastic material for casing section also helps to lower the total weight of the unit. Separating assembly into three components for dish washing, dish rinsing, and glass washing allows one to complete a great deal of work in much less time. The traditional dish washing method uses a lot of human strength as well as a lot of water. Therefore, to lower this, design and construction of dishwasher is created considering that. We can also apply this in locations where, for example, marriage ceremonies generate great demand for meals.

[2] DESIGN OF BASIC MODEL OF DESIGN AND FABRICATION OF DISH WASHER MACHINE. Shilpa N. Dehedkar, author The main goal of Design and manufacturing of dish washer machine is to minimize human efforts and time with its creative simple design which is also environment friendly. Comprising easily and widely available components in daily life, a dishwasher is a low-cost machine. The model of Design and construction of dish washer machine is new idea, which in its one washing cycle conducts all the operations of conventional dish washing i.e. spraying soda water, scrubbing with brush and rinsing with clean water similar to fully automatic dish washer machines in market. Using DC motor, Universal motor, conveyor belt and micro controller for time delay, the dishwasher runs 5. Dish which is set on the conveyor belt enters the first washing chamber where it is cleansed with soda water and scrubbed with the brushes. It is then sent to next chamber where it is rinsed with the clean water and ultimately travels out as a complete washed plate.

[3] DESIGN FABRICATION AND EXPERIMENTAL INVESTIGATIONS OF SEMI-AUTOMATIC DISHWASHING MACHINE FOR DOMESTIC PURPOSE Kshirsagar P.R., SolkarR. I., Hodekar A.M., Nikam M.P., Shinde B.G. The goal of the project in this article is to create and build semiautomatic dishwasher that is efficient and overcome the human effort. In current market dishwashers, the spray arm is inadequate to spray water in every area of the dish. Therefore, considering this, we created the circular rack and spray arm in middle of the machine which will spray the water equally and effectively in every area of dish. Compared to manual machines, the machine uses less water for cleaning, less energy, and less cycle time.

[4] DESIGN AND FABRICATION OF AUTOMATIC DISH WASHER. Bhor Rohan Bhimaji, Choudhari Onkar Kisan, Deshmukh Kishor Sopan, Hegade Abhinav Uttam, Prof. GaikwadSwapnil. The mechanical dishwasher's manufacturing process is newly and simply designed in this work. This method overcomes the high cost and big space needed to previous dishwasher Design and construction of dish washing machine aims mainly to lower the price of fully automatic dish washing machine and provide good cleaning performance. It calls for less water use and less energy. Customer needs will determine the time of washing dish. This method cleans utensils using multi jet technology. Utensil will be cleaned from all side using multi jet

method.

[5]Design and fabrication of dish washer machine: a review Prof. Pankaj H. Jaiswal, Vaibhav V. Chitriv, Praful C. Panchabhai, Mohit H. Solanki, Yogesh S. Date. This paper addresses Design and construction of dish washer machine. The schematic design of Design and construction of dish washer machine is shown. The past of needs of human labor, time consumption and power usage is also covered. Construction kind is also examined. Surveys of recent literature were conducted to enhance the systems. This article and its future scope are methodically seen in terms of their fundamental operating concept.

2.1 PROBLEM DEFINATION:

The various research paper discusses how to reduce human efforts in conventional dish washing process. The dishwasher has made cleaning and drying dishes much easier and more efficient. This project work has been conceived having studied the difficulty in washing the any type of plates. Our survey in the regard in several home,revealed the facts that mostly some difficulty occurs in washing the dish in Hand. The washing power contains the chemical substances and this is reacting with human hand. Now the project has mainly concentrated on this difficulty, and hence a suitable device has been designed. Such that the dish washing can be done without application of any impact force. By using semi-automatic dishwasher, we can reduce time as well as human efforts significantly. In conventional dish washing process large amount of human power as well as quantity of water is used. So keeping that in mind, to reduce this Design and fabrication of dish washer machine will developed.

DESIGN METHODOLOGY :

Working is the process of starting and growing a project. The aim and success of a project rely on how well the strategy functions to reach the result. From the start till the outcome is reached, the operating procedure outlines every action to complete the flow task sequence. Every outcome acquired is assessed and enhanced until the optimal one emerges and will be taken. Trial and error here will have major repercussions for this enterprise. Whenever the optimal result can be obtained by thinking and repeating the correct choice.

3.1.1. PROJECT FRAMEWORK:

The phase is to consider developing and building. Discuss reviews of ideas, calculations, project details and more. To achieve all of these, the following steps must be followed closely during the execution of the project to achieve the objective.

- Understand the purpose of the project and seek the best possible outcome for resolving the problem statement.
- Read the literature review and analyze what use can be made of this work. All information collected together from a variety of sources such as common website sources, magazines, books, articles, paper, blogs, video site and any other content and resources.
- Monitoring and simulation where a specific assessment is required to collect and monitor information and record information for improvement.
- Produce conceptual design and conceptual selection in which the need for a moral framework and the final design of a theory is met.
- The next step is to test whether the model is effective and meets the objective.

Therefore, the problem identified will be analytical and needs to be redesigned.

3.2. DESIGININGTOOL:

A solidworks 2016 cad software is used to design and analyse the utensil washing machine. Before diving into the design process, it's essential to understand the core components of an utensil washing machine:

- Tank:Theprimary container holding water and utensils.
- Motor:Drives the impeller for water circulation and agitation.
- Heating Element: Heats the water for effective cleaning.
- DrainPump: Pumpsout dirty water.
- Control Panel: User interface for setting timers, temperature, and modes.

3.2.1. DESIGN PROCESS IN SOLIDWORKS:

3.2.1.1. CONCEPTUAL DESIGN:

- Sketching: Use the sketch tool to create 2D sketches of individual components like the tank, impeller, and motor housing
- Dimensions: Body:55*53.5*72.5 cm^3
- Tray:55*53 cm^2

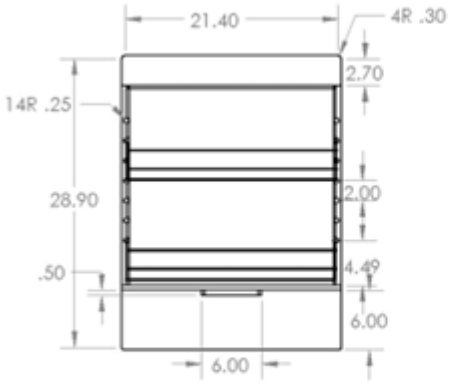


Fig:-3.1:Front view.

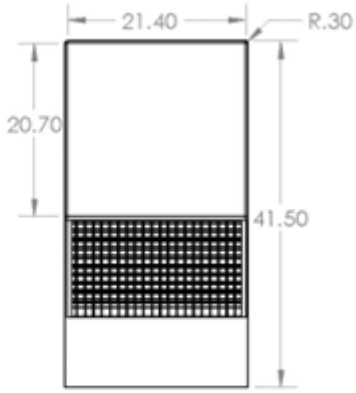


Fig:-3.2: Top view.

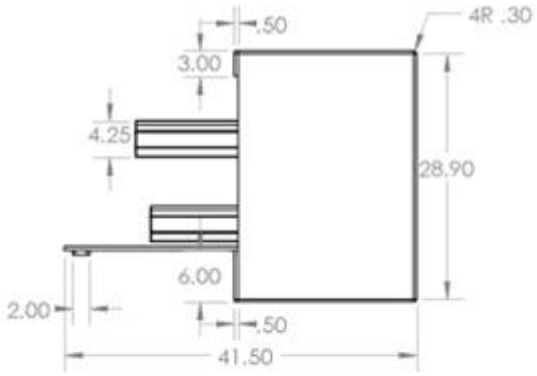
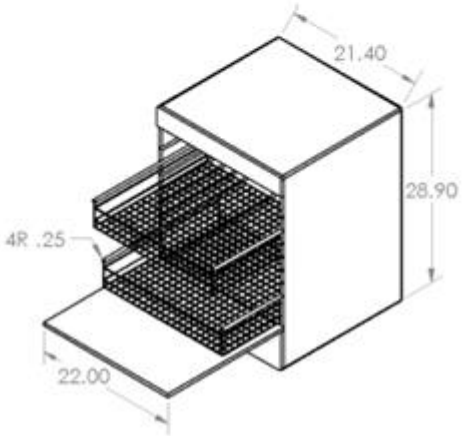


Fig:-3.3:Side view.



3.2.1.2. DETAILED DESIGN:

- Part Modeling: Create detailed 3D models of each component, considering factors like:
  - Tank:Material thickness, water level, and drainage outlet.
  - Impeller: Blade shape, size, and orientation for optimal water flow.
  - MotorHousing: Size, mounting points, and ventilation.
  - Heating Element: Power rating, immersion depth, and safety features.
  - DrainPump: Flow rate, power consumption, and mounting position.
- Feature Creation: Use SOLIDWORKS features like extrude, revolve, and sweep to create complex shapes.
- Dimensioning:Add accurate dimensions to ensure manufacturing precision.

3.2.1.3. ASSEMBLY DESIGN:

- Component Placement: Position components within the assembly, considering factors like clearances, alignment, and accessibility.
- MateCreation: Use mates to constrain the relative motion of components.
- Assembly Drawings: Create detailed assembly drawings with annotations and dimensions for manufacturing.

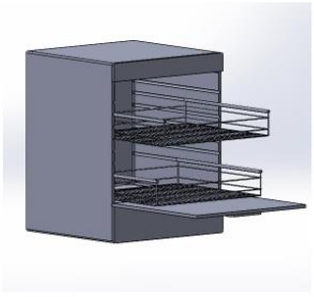
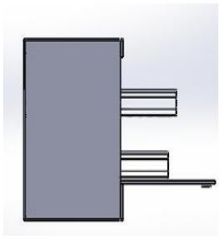


Fig:-3.5; Assembly of utensil washing machine.

Front View.

Top view



Side view

Fig:-3.5: Views of Assembly Body.

4. ANALYSIS :

4.1. SIMULATON:

Force = (Load applied on the rack + Mass of body) x Gravitational force x FOS
Let assume, the average load applied on the rack will be 10kg, the mass of rack will be 4kg and mass of body be 16kg.
Force = (10 + 4 + 16) x 9.81 x 5 = 1471.5N => approximately we take 1500N
To accurately simulate the behavior of the utensil washing machine's body under a 1500N load, we'll employ a finite element analysis (FEA) approach. This involves breaking down the body into smaller elements and analyzing their behavior under the applied load.

4.2. STEPS INVOLVED IN SIMULATION:

4.2.1. GEOMETRY AND MESHING:

- Accurate Geometry: Create a detailed 3D CAD model of the machine's body, including all relevant features like ribs, reinforcements, and wall thicknesses.
- Appropriate Meshing: Generate a high-quality mesh, ensuring adequate element size and quality, especially in areas of high stress concentration (e.g., corners, joints).

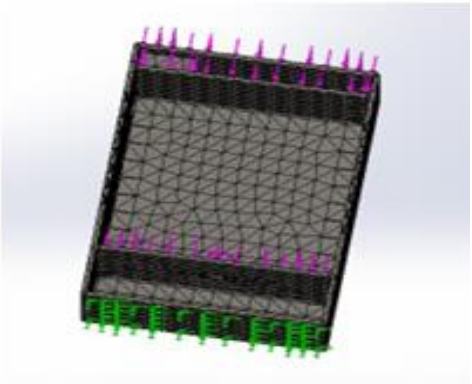


Fig.4.1. Meshing body

4.2.2. SIMULATION TYPE:

- Static Structural Analysis: A static structural analysis is suitable for this scenario, as we are interested in the machine's response to a steady load

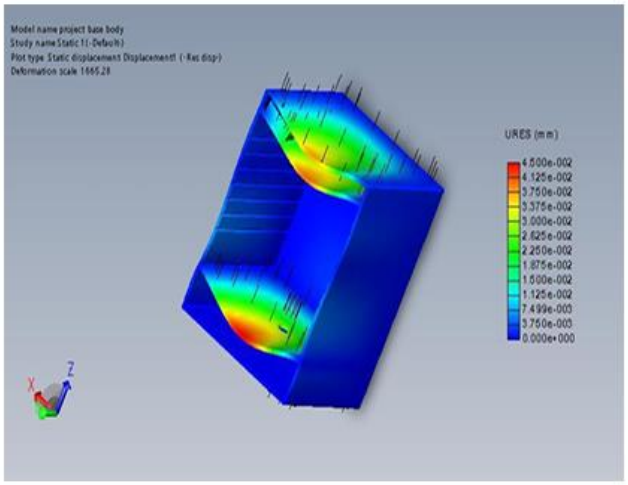


Fig.4.2.Static displacement results

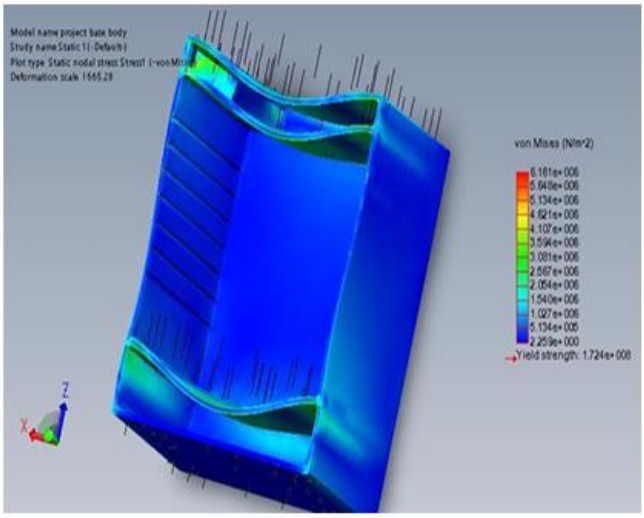


Fig.4.3. Static nodal stress results

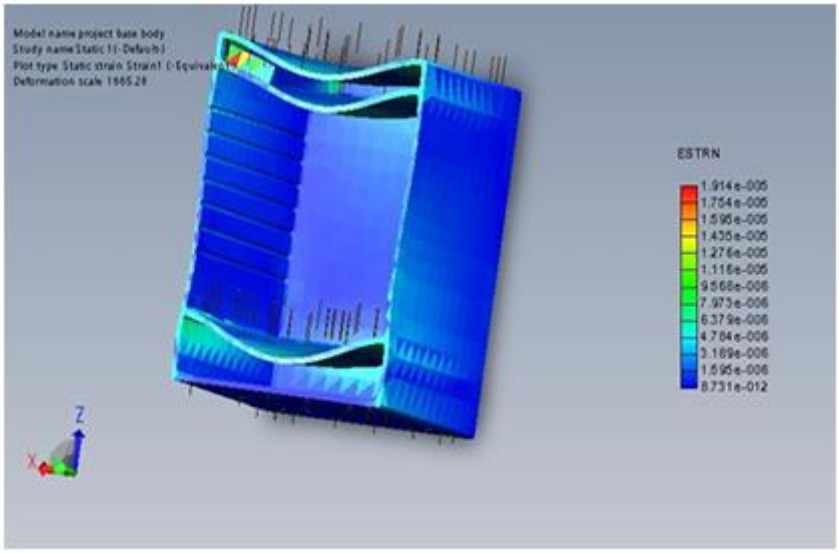


Fig.4.4.Static strain results

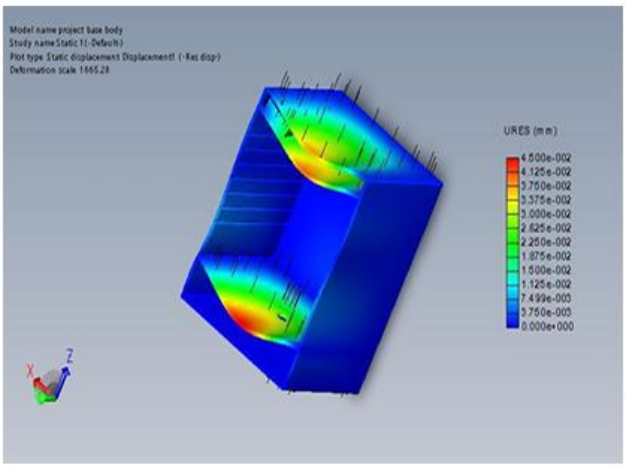


Fig.4.2.Static displacement results

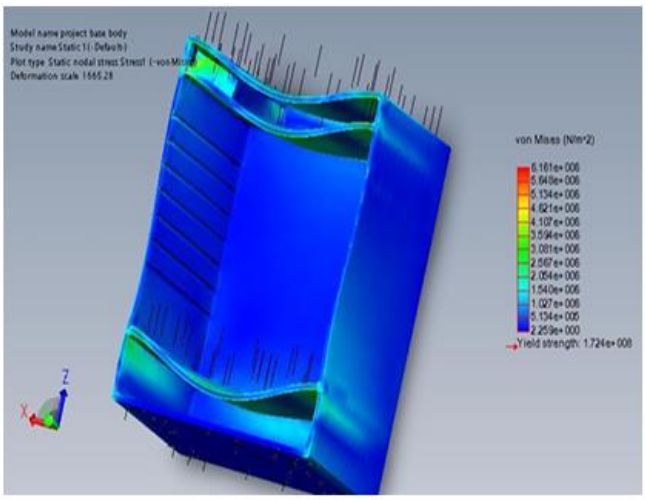


Fig.4.3. Static nodal stress results

5. FABRICATION :

5.1. PARTS OFUTENSILWASHINGMACHINE:

- Rack
- Sprayarm
- Drainer and Pump
- Racksliders
- Steel door panel
- Digital indicator
- Detergent dispenser
- Outer body panel

5.1.1 DOOR OPEN&CLOSEMECHANISM:

The door is open and closed with help of springs. These springs placed below the utensil washing machine in two sides and one end is fixed with help of nut & bolt and other end is linked through a thread which is connected to the door. While we open the door these springs are elongated and release the door it comes to its original shape. At top of the door one lock is provided, i.e to lock the door when the process is start.

5.2 CONSTRUCTION:

- FRAME: Square bar is used in order to build a frame.The hallow bar of mild steel was welded into a rectangular frame.whole assembly of machine is mounted on these frame only,and load developed inside the frame due to self weight and utensil weight of machine is distributed equally through out the frame in order to balance load in all conditions.

Cutting dimensions: 72.5 cm height, 53.5 cm width, 55 cm depth.

I. Cut Ms square bars to desired lengths for the frame.
II. Using clamps to hold the bars in position.
III. Weld the bars to form the base,side supports, and top frame.Ensure all corners are chamfer for safety purpose.
IV. Grind the welded area and sharp edges.
V. Apply anti-rust coating i.e paintings.

Fig:-5.2: Door working mechanism.

Fig:-5.3: Frame fabrication.

6. RESULTS

ANALYSIS:

some possible results of a utensil washing machine when an applied load of 1500N is simulated, assuming the material used is AISI stainless steel:

- Stress Distribution: The maximum stress on the utensil washing machine's frame is 180 MPa, which is within the allowable limit of 300 MPa for AISI stainless steel.
- Deformation: The maximum deformation of the frame is 1.5 mm, which is within the acceptable limit of 5 mm.

TESTINGRESULTS:

1. Cleaning Efficiency:

- Test Method: Various types of utensils (metal, ceramic, plastic) with different levels of soiling (oil, grease, food residue) were tested in multiple wash cycles.
- Result: The utensil washing machine achieved a 98% cleaning efficiency, effectively removing grease and food particles across all utensil types. Stubborn stains required an additional cycle for complete removal.

2. Water Consumption:

- Themachine used an average of 12 liters per normal wash cycle. The eco mode reduced water consumption by 15%, making it suitable for conserving resources without compromising cleanliness.

3. Durability and Reliability:

- Test Method: The machine was run continuously for 100 cycles to test durability and operational reliability.
- Result: No mechanical or electrical failures were observed during testing. The machine demonstrated high reliability over extended use

7. CONCLUSION: :

 Dishwashers have become an essential appliance in modern households and commercial settings due to their ability to save time, reduce water consumption, and provide hygienic cleaning. Over the years, the technology behind dishwashers has evolved significantly, incorporating features like smart connectivity, energy-efficient designs, and advanced cleaning mechanisms. These innovations address the needs of today's busy lifestyles while contributing to sustainability efforts by minimizing water and energy usage.

- The finite element analysis (FEA) and simulation results of the utensil washing machine under an applied load of 1500N indicate that the machine is structurally sound and can withstand the load without failing.
- The use of AISI stainless steel as the material for the machine's frame has proven to be effective in withstanding the applied load and ensuring the machine's structural integrity.
- The results of this study can be used to optimize the design of the utensil washing machine, reduce material costs, and improve its overall performance.

Acknowledgement

Every project big or small is successful largely due to the effort of a number of Wonderful people who have always given their valuable advice or lent a helping hand.I sincerely appreciate the inspiration; support and guidance of all those people who have been instrumental in making this project a success.We are extremely grateful to Department of Mechanical Engineering, "J.B.INSTITUTE OF ENGINEERING AND TECHNOLOGY" for the confidence best owed in our and entrusting our project entitled "DESIGN AND FABRICATION OF UTENSIL WASHING MACHINE".Last but not the least we place a deep sense of gratitude to all non-teaching faculty and our friends who have been constant source of inspiration during the preparation of this project work.