

# DESIGN AND DEVELOPMENT OF SEMI-AUTOMATIC DISHWASHER

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**Abstract**— This paper discusses how to reduce human efforts in dishwasher. The dishwasher has made cleaning and drying dishes much easier and more efficient. This paper also discusses the problems faced in usage of Automatic Dishwasher and solutions on those problems. Automatic dishwasher uses large amount of energy, time and is costly. And being costly, the usage of automatic dishwasher in our country is very less. By using semi-automatic dishwasher, we can reduce time as well as human efforts significantly. Also by using plastic material for casing part, the overall weight of the assembly is also reduced. By separating assembly in 3 parts for washing of dishes, rinsing of dishes and washing of glasses, large amount of work can be done in considerably lesser time. 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 Semi-Automatic dish washer is developed. Also we can use this in places where there is vast use of dishes for example, marriage ceremony. This dishwasher is useful for household use, which can save time and cost rather than spending in washing dishes by hand and wasting large amount of energy.

**Keywords**— carbi , motor, gears, steel basin, rotary brush, rotary sponge, drain pipe

## INTRODUCTION:-

Washing dishes is most commonly done activity in the world, in most of families people wash dishes by hand which is straining to muscles and detergent is chemically harmful. As far as manual process is concerned in houses of India, washing is done by hand scrubbing which is straining to the muscles through its energy and postural requirements. It may also lead to clinical, anatomical disorders and back pain which may affect the operator's health. Many of their household chores are performed by the women and some can be very physically challenging and time-consuming. So in several ways in which we can improve their lifestyle, and one aspect that we can improve on is the way they wash their dishes. Currently the chore of washing dishes is performed by the women, and can be very labor intensive as it is done for up to several hours each week. The same can be experienced in marriage ceremony with caterers. In today's world of Automation Era it is barely possible to find any field that implemented atomization which reduces Human effort, improves Production rate and also increases Efficiency. Then it could be the biggest manufacturing industry, Pharmaceutical industry, Hospitality field and even Household or Kitchen automation. But still our country is not getting enough benefits from automation and the reason behind this limitation is less Knowledge about automatic products, High device cost, kind of nascence feeling about atomized devices. However this fear is not seen in the product which does not involves much Sensors, Complex Electronic Circuits, and simple easy User Friendly devices. The very familiar example of Automatic dishwasher. This automatic dishwasher is used on mass scale in foreign countries, however the same is rarely seen in our country.

## MATERIALS AND METHOD

### NEED :-

Washing dishes is not the most rewarding task. Cooking can be creative, but cleaning up afterward seems like a waste of time and leaves the person washing complaining about "dishpan hands." Most conventional dishwashers installed in U.S. households today use 7-14 gallons per load and account for less than 2 percent of the water used in an average American home. Despite the small portion of overall water consumption by dishwashers, newer machines are substantially more water-efficient than older models. Today the most efficient (full-size) machines use a maximum of 7 gallons per load - and some as little as 4.5 gallons. Energy savings also result from upgrading to an efficient dishwasher because fewer gallons of water need to be heated per cycle. Many new dishwashers feature microprocessor-controlled, sensor-assisted wash cycles that adjust the wash duration to the quantity of dirty dishes or the amount of dirt in the rinse water. This can save water and energy if the user runs a partial load.

MATERIALS:- Plastic carbi, steel basin, Brush, Sponge etc.

### LITRATURE REVIEW:-

#### Limitations of automatic dishwasher

- **Lower spray arm:-** The spray arm is blocked by small items or food remains, due to that it faces difficulty. So, periodic inspection is necessary.
- **Remnants of detergent stuck inside dispenser:-** Most of the time compartment of automatic dishwasher is damp when it was filled with detergent, but in actual practice it must be dry before detergent is added.
- **Water remains inside appliance:-** If blockage or similar types of problems occurs in automatic dishwasher then water gets stagnated in drum of dishwasher. If pump is jammed or filters are blocked due to some items then also water remains inside the drum.
- **It can't be open until the cycle is complete:-** One of the limitations of this dishwasher is, it cannot be open until its full cycle is completed, and to complete one cycle it takes large time. If the water supply has been interrupted then automatic dishwasher stops suddenly.
- **White stains:-** If the detergents which are used to wash the dishes is used in excess quantity then white stains are appeared on crockery. Due to excessive use glasses give milky appearance.

**Energy and Time consumption:-** During the citation of literature, we found that according to the study at the University of Bonn, in Germany, the dishwasher uses only half the energy, 1/6th of water and less soap, to execute. That sounds easy enough but there is lot more to it than just a comparison. The results vary with model of dishwasher according to what hand washing habits are people using? How do you heat water in your home? And how often do you do the dishes? These are all factors that can change the impact.

- Siemens dishwashers take a mere 125 minutes to complete the regular cycle. This makes them, by some distance, the fastest in the world.
- Most of our dishwashers can consume as little as 10 liters of water, compared to up to 60 liters if you wash up the same load by hand.

### DESIGN CALCULATIONS :-

**Design calculations:** The design calculations of three (3) basic machine components; (i) motor power (ii) spur gear and (iii) bevel gear are presented below.

#### Motor Power:

Motor power is  $\frac{1}{2}$  hp.

So, power =  $0.5 \times 746 \text{ kW} = 0.373 \text{ kW}$

**Design of spur gear:**

speed of pinion ( $N_1$ ) = 1440rpm, power =  $0.5 \times 746 \text{ kW} = 0.373 \text{ kW}$

1st Stage :- 1st stage = 3 Teeth on pinion,  $Z_1 = 40$ , Teeth on wheel,  $Z_2 = 120$

Module,  $m = \text{P.C.D. of pinion} / Z_1 = 40 / 40 = 1$

2nd Stage :- 2nd stage = 3  $N_2 = N_3 = 480 \text{ RPM}$

Teeth on pinion,  $Z_1 = 40$ , Teeth on wheel,  $Z_2 = 120$

**Design of bevel gear:**

Pressure angle =  $\phi = 20^\circ$ , i/p to the bevel gear = 41.44 watt

Speed = 160 rpm, Teeth on pinion and wheel = 54

$m_t = 2 \text{ mm}$ ,

**WORKING PRINCIPLE:-**

The title semi-automatic is because it involves both the machine work with very less human effort. The design will consist of one rectangular plastic casing and will be divided into 3 compartments.

- The very first compartment will contain the dish, cutlery or crockery utensil's cleaning. This compartment will be filled with detergent water upto 50% height to avoid splashing. There will be two rotating brushes with negligible clearance between them. A stand will be fixed at the bottom so that the dishes can rest on it and there will be no need to hold the dishes while they are being washed.
- The second compartment which is middle one will function same as that of first one. The only difference is that this compartment will be filled with clean water for rinsing the detergent, and instead of rotating brushes, rotating sponges will be fixed at both the sides of the dishes. So that there won't be any possibility of food stains or detergent remnants on the dishes.
- The third and last compartment will comprise again detergent water, but now for the glass cleaning. This compartment will contain inner rotating brush and outer fixed brush.
- And to rotate all this brushes there will be single motor shaft which will be mounted with 4 pulley for belt drive. 2 pulleys to drive 2 rotating brushes in first compartment, 2 pulleys to drive 2 rotary brushes in second compartment and at the end of a bevel gear to drive the vertical rotary brush in third compartment.

**RESULTS AND DISCUSSIONS :-**

Series of test were carried out in order to determine the performance and efficiency of the machine. This was done by comparing the rate of washing with the designed dish washer to the hand-washing (manually). In carrying out these test, six (6) parameters were taken into consideration, they are: no of plate washed; quantity of water used in washing (litres); quantity of detergent used (ml); time of washing (sec); quantity of water used in rinsing (litres); time of rinsing (sec). These are shown in tables 1 and 2 below. Table 1 shows how the designed machine performed under loads.

**Table 1: Performance evaluation of the Machine**

S/N	No of Plate	Quantity of water used in washing (litres)	Quantity of Detergent used (ml)	Time used in Washing (sec)	Time used in Rinsing (sec)	Quantity of Water used in Rinsing (litres)
1	1	0.2	1	5	3	0.5
2	4	0.5	1.5	10	4	1
3	10	1	4	30	15	3
4	30	2	8	90	45	5
5	60	3	10	180	100	10
6	90	4	15	240	120	12
7	100	4	15	260	160	12

**Table 2: Performance parameters using manual dishwashing**

S/N	No of Plates	Quantity of water used in washing (litres)	Quantity of Detergent used (ml)	Time used in Washing(sec)	Time used in Rinsing (sec)	Quantity of Water used in Rinsing (litres)
1	1	0.5	1	15	5	1
2	4	1	1.5	40	10	2
3	10	2	4	60	20	4
4	30	3	10	150	60	6
5	60	3	15	240	120	12
6	90	5	20	400	240	15
7	100	5	20	400	240	15

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#### CONCLUSION :-

The design, construction and evaluation of a dish washing machine were successfully carried out. The capacity of the machine was 20 plates per minutes (i.e 1880 plates per hour). The designed dishwashing machine is very efficient and easy to operate.

In order for this comparison to be competent, the result must be statistically significant. This means that a large enough number of participants with different dishwashing skills has to be included and appropriate statistical analysis performed. Dishwashing machines have other negative aspects that have not been considered. One of them is that they use heavy detergents in order to consume less water. On the other hand the detergent used by the Dish master is quite diluted and is biodegradable, with no phosphates, enzymes, or citrus additives. Also, end-of-life of dishwashers is not considered, i.e. problems with their disposing, recycling, permanent waste. One should perform more detailed analysis to determine does

savings in energy and water overweight, negative ecological aspects. It is possible that dishwashing machines might leave a greater “ecological footprint” than other methods of dishwashing.

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