

# Conveyorized Washing and Drying Machine

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**Abstract:-** The requirements were to produce a washing idea which is very simple in application with less resource to input and fit for the purpose. For the purpose to achieve we studied the available washing machines in market and the one present on the site. Present washing machines studied were Single Stage Machine (Cabinet Washing Machine), Multistage Machine, Tunnel Cleaning Machine, Basket Rotating Machine, Customized Cleaning Machine. Most of machine were comprising of pumps for high pressure pumping of water on the components, motors for automatic rotation of components, heaters and chemical caustic additives to enhance the water quality in order for effective and qualitative cleansing properties. Air compressor for dry cleaning and drying of the washed part. After studying these requirements, we had to use them in our design. So, we decided to make use of immersion type of washing machine which will save water as same water can be used for many numbers of cycles. To create turbulence in the washing area of the immersed part of the component we used air nozzles for blowing air of enough pressure to create the required turbulence enough to clean notches and critical areas. To enhance the washing water, we decide to use the heating coils which are placed at the bottom of the tank. These coils are also been used from the oil heaters which had been there in the scrap. The chemical is also to be added in the water. To provide the high-pressure water for surface cleaning a pump is provide for the purpose with flexible hose to direct the flow. The temperature and pressure sensors are installed for better indication. The whole assembly with tank, heaters, and pump is mounted on the stand which is placed on the wheels to make it portable.

**Keywords-** Washing machine; Compressor, Immersed, Coils, Chemical, Scrap, Pump

## I. INTRODUCTION

The Industrial Cleaning today is a complex undertaking. Each cleaning problem is unique from other because of many variables in a manufacturing process. Integrating the cleaning process with production and plant requirements through a proper equipment sizing and selection is very important. Here, at TRM Assembly shop the wash machine is used to clean the components for grease, wax, flux, scale, chips, fines, shop dirt, oil contaminants before carrying out the assembly. The machine was a need to overcome the limitations of current Cabinet type washing machine like high cycle time, higher operating cost, uneconomical for small surfaces and notches and high maintenance cost.

Special purpose machines (SPM) are those machines which are not available off the shelf. These are not covered in standard manufacturing programs. Therefore,

they have to be designed and tailor made as per the specific requirement. They are also called as Bespoke machines. The special purpose machine (SPM) and automatic are designed to operate continuously for 24 hours a day, with minimum supervision. The special purpose machine is generally product specific and they are required to be designed and developed for each specific requirement. Sometimes it may be possible to cater to the jobs having similar features but differing by using change tooling concept. These special purpose machine (SPM) are used hydraulic and pneumatic energy. This machine circuit which is totally automatic which avoids the accidents while a washing the components.

The productivity achieved after all the equipment is very high. Productivity of product is increase by 3 to 10 times than other washing. This industrial washing machine is a special purpose machine which is manufacturing for special purpose. This machine is designed according to the need as per the component to be washed for example, In various industries different jobs are manufacturing and as per the job the machine is designed. In this machine various sensors are provided which indicate and also reduce the chances of operations failure and assures the safety of operator. This machine helps in quick operations as well as good performance.

This machine highly cleans the job which is to be washed. This minimizes the time and this can be used in small as well as large scale industry. Purpose machine is a high productivity machine, with specially designed tooling and fixture, dedicated for mass producing the same component day in and day out. A judicious combination of limit switches, sensors, logic control, and automatic job clamping etc. the essence of a SPM. A well-conceived Special Purpose Machine finds ways and means to utilize the man and machine to the optimum. We offer low cost dedicated SPMs for mass production of small components of 2 & 4-wheeler, tractors, trucks, engines etc.

The Industrial Cleaning today is a complex undertaking. Each cleaning problem is unique from other because of many variables in a manufacturing process. Integrating the cleaning process with production and plant requirements through a proper equipment sizing and selection is very important. Here, at TRM Assembly shop the wash machine is used to clean the components for grease, wax, flux, scale, chips, fines, shop dirt, oil contaminants before carrying out the assembly of Gearbox.

The project was a need to overcome the limitations of current Cabinet type washing machine like high cycle time, higher operating cost, uneconomical for small surfaces and notches and high maintenance cost. The paper presents the design of washing principle to overcome the stated limitations and to take along the given constraints.

**A. Problem Statement:** -

In existing washing machine, there is a problem of washing and drying of casting components. Also, the machine is working manually, due to this machine consuming more time in operation. The efficiency of machine and quality of washing component is also not good; due to this we are modifying the existing machine with new one.



Figure No. 1. Existing Machine

**B. Objective:** -

- To optimize the washing machine by reducing the heavy components.
- To modify the existing machine with new design.
- To get better performance by existing machine.
- To modify the existing machine with new design.
- Poor performance of existing machine.
- To compare the existing machine with new machine.

**C. Methodology:** -

**Enquiry Standard:** -

In this standard, the customer inquiry of reputed company. They check the background of company which include the quality of material and standard.

**Customer Visit:** -

As the inquiry standard is done by the customer then the customer visits reputed company for machine to be manufacture in the company.

**Input Analysis:** -

In input analysis is required to input. This input is taken according to need of customer is supposed to fulfil by company and according to this.

**Input Sufficient:** -

When input analysis is done, the sufficient input is selected for the company other is nit be forwarded for the drawing.

**Proposal Drawing:** -

With the sufficient input the proposal drawing is done by designer of the company.

**Follow up/ Drawing:** -

The proposal drawing is verified by the experts and as well by the customer after doing correction.

**Drawing Approved:** -

When the proposal drawing converted in to the drawing the correction are done and this drawing is approved and this is final drawing.

**DAP Ok (Drawing Approving plan):** -

In the drawing approving process, the drawing is checked and if drawing is not ok then the correction is in this process and if it is ok so further process is done.

**Details Drawing:** -

When the drawing is approved the further process of details drawing is done in this detail drawing of each component is done.

**Manufacturing:** -

When the details design is done the manufacturing of component is start. This manufacturing is done according to dimension used in design.

**Assembly:** -

After the manufacturing of component, the assembly of component is done according to details design.

**Trial:** -

As the assembly is done and the circuit connection are connected. The trail of machine is taken in trail the quality of washing is check.

**Object Verification:** -

After of component its verification is done by company employee's this verification is done by doing varies of object test such as chemical test is conduct of the component.

**OK:** -

After the object verification the machine is ready to operation.

**D. Scope:** -

- It is used to wash the critical passage in components very easily & quickly.
- This machine is widely used in automobile industry.
- These can machine can be more efficient working in the any atmospheric condition.
- This machine improved the quality of washing.

## II. THEORY

This industrial washing machine is made for washing of specific components which are critical to wash or which cannot be washed by other method. Design of the machine is designed according to the use of machine, the environment in which the machine is used, in which type of industry it is being used. The main components of this are motor, pump, tank, filter, safety valve, washing cabin and drying cabin. The machine is provided with stator, sensors etc. the A.C current is supplied to the stator circuit, this circuit consists of start and stop switches and internal connections. The machine is start by the start button indicated by green color, by pressing this button the machine starts. Pump is pumping the water from the clean tank and to supply the nozzle. Then the distance between the nozzle and components are specified then wash the components on the both sides. Water from the washing components is flow to the dirty tank with the mixture of various lubricating fluid such as (grease, oils,

wax) the capacity of the dirty tank is more than the clean tank. Water level indicators are used in both tanks to indicate the water level in the tank. In the clean tank two water heaters are used to heat the clean water the temp of the water in the clean tank in between 95c0 to 65c0 the temp. Of the water below than 55c0 then water heater is start automatically. Using water heater in the tank to increase the temp. of the water then some amount of oil and other fluids are present in the water then increase the temp. of the oil then viscosity of the oil is reduced and easy to wash the crates with less time. Oil skimmer are used in the dirty tank to remove the oil in the tank when the operations is start then oil skimmer is stop. In the operations water wave are present in the tank then oil mixed with the water. Operations is stop then oil in the water float above the water and easy to remove with the help of chain type oil skimmer. One additional transfer pump is used to pump the water from the dirty tank to filter to clean tank. The duplex type filter is used to remove the water partials with filtrations capacity up to 300 microns. One standby mode because of cleaning of filter and choking of the filter then filter water id passed to the clean tank. Two parts are providing to both the tanks to remove the water and supply the press water with the specified period. For the drying of component blower with some arrangement are used. Blower is fitted to top of the drying cabin and on the frame. Oscillating mechanism is used to hold the nozzle tree in the cabin. During the operations movement of the Oscillating mechanism with the help of some arrangement on the cabin such as motor, reductions box, flange, chain, and sprocket and 'L' type link is used. During the washing of component nozzle strike water to the component and small water drops are mixed with the work environment and dangerous to the operator by eliminating this problem we use mist eliminator. Total cycle time of the operations is 2 min to washing of components is 1.2 min and drying 0.8 min.

### III. DESIGN OF MACHINE COMPONENTS

In this topic, some important points have been discussed which are useful in the washing machine.

#### E. CAD MODEL OF NOZZLE FRAME:

Nozzle tree is made up of SS304 this material has high strength and corrosive resistance. The Dimension 750\*550mm.

In the Nozzle tree there are three Frame provided for each stage of the Washing.

Every frame contains 15 nozzles according to design. There are pockets provided to easily inserting and removing of nozzles. As per the design and calculations 6 pockets on top side of frame for cleaning top face of component simultaneously 5 pockets on bottom side and 2 pockets on right and left side.

The distance between each pocket is 100mm for cover the surface area of conveyor.

The nozzle tree is designed as shown in above fig. we attach three frames in each nozzle tree for improves the washing.

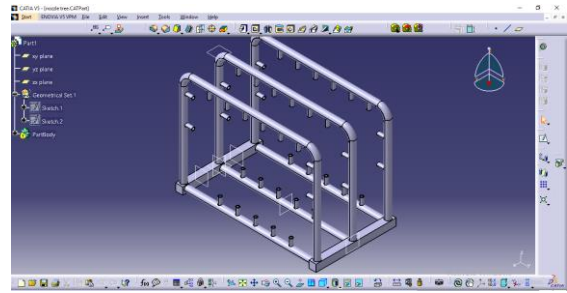


Figure no. 2. CAD Model of Nozzle Tree

#### F. CAD MODEL OF WASHING CABIN: -

The cabin is mounted on the upper side of the frame. Cabin is at the top of the machine. Cabin is made of SS 304 material in cabin three doors are provides for maintenance. There are one opening for inlet and another for exit.

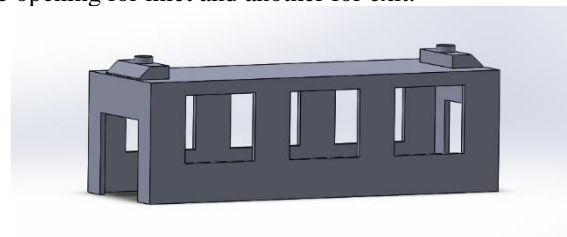


Figure no. 3. CAD Model of Washing cabin

#### G. CAD MODEL OF DRYING CABIN:

The cabin is mounted on the upper side of the frame. Cabin is at the top of the machine. Cabin is made of MS material. There are one opening for inlet and another for exit. The blowers are provided at the top of cabin, for heating air heaters are also used.

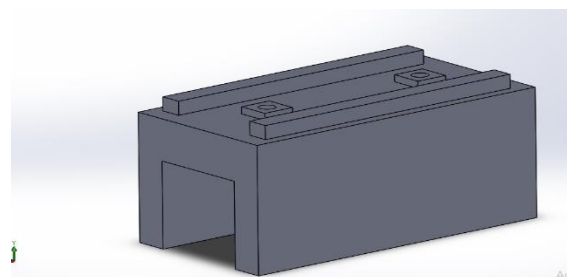


Figure no. 4. CAD Model of Drying cabin

#### H. CAD MODEL OF TANK:

The tank is mounted on frame, and on tank motor, pump, and filter are mounted. The tank is having four lids the tank used in industrial washing machine is made up of SS 304 (stainless steel) material. The sixteen-gauge SS sheet is used for tank. The storage capacity of the tank 600 liters.

Dirty tank is made for this machine is tapered at the base. This taper is provided for easy cleaning of tank for e.g. While washing components the impurities wash out are collected into tank along with water, because of the taper this impurity slides along the taper and comes towards the slope between the pump and washing chamber the cage is

provided. this cage prevents the impurities or any part of components fallen into the tank.

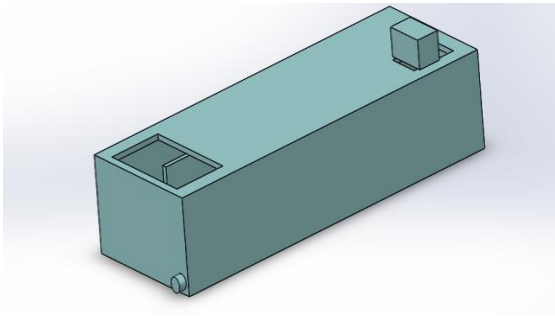


Figure no. 5. CAD Model of Tank

### I. CAD MODEL OF BASE AND SUPPORT:

The function of base frame is to support the part mounted on it. On the base frame overall assembly is mounted. At the side of the frame control panel is fitted to control the operations. Base frame supports the total component of machine.

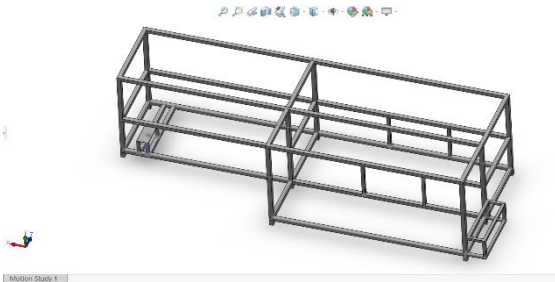


Figure no. 6. CAD Model of Base and Support

### III. FABRICATION OF MACHINE PART

#### J. Oscillating Mechanism: -

Oscillating mechanism is provided at the top of washing cabin. This mechanism is provided for TO and FRO motion of nozzle tree. This mechanism also helps in proper cleaning of components. This mechanism is operated with the help of separate geared motor to reduce the speed. To run the shaft chain and sprocket mechanism is used.



Figure no. 7. Oscillating Mechanism

#### K. Nozzle Frame: -

The nozzle frame is made up of SS304 this material are high strength and corrosive resistance with the dimensions are  $750 \times 550 \times 470mm$ . Each pipe makes fifteen holes using drilling machine; then by using tapping too internal threads in the pocket to fit the

nozzles, pockets are welded to holes. All pipes are pipe for obtain same pressure in the pipe diameter.



Figure no. 8. Fabrication of Nozzle Tree

#### L. Tank: -

While designing the tank it must be anticorrosive and it is slightly taper inside to flow the water used towards the pump. There are three tanks each tank has a partition of cleaning tank and other is Dirty tank on which pumps and filters are mounted.

The tank is fabricated in 1.6mm thick SS304 sheet and size is  $2240mm \times 500mm \times 810mm$ .

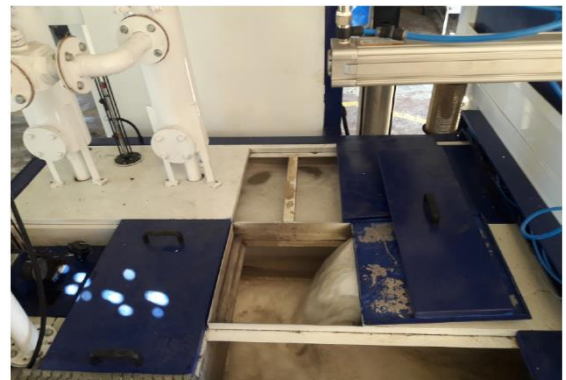


Figure no. 9. Fabrication of Tank

#### M. Washing Cabin: -

While designing the cabin, it must be anticorrosive. Cabin are fabricated they are made up of 1.6mm SS304 sheet. it has opening from front side to see the cleaning of object. In this cabin component is placed for washing on Conveyor arrangement. In the washing cabin nozzle are mounted to the tube which spray the water on the component with high pressure. The hose is placed at the bottom of washing chamber which is used to store the water in the tank.



Figure no. 10. Washing Cabin

**N. Drying Cabin: -**

While designing the cabin, it must be resisting the heat transfer from inside to surrounding. Therefore, Cabin are fabricated they are made up of 1.6mm outside and 1.2mm inside MS sheet which form the pocket which contain fire wool As insulation.

In this cabin component is placed on conveyor. In the drying cabin blowers are mounted on top of the cabin. Heaters are provided to heat the air.



Figure no. 11. Fabrication of Drying Cabin

**O. Base & Support: -**

While designing the frame we will considering all applied stress by the tank cabin, filter and pump based on that stresses we have to select the material for frame is M.S 70mm x 70mm square pipe.

The main purpose is to select of material to lift the overall load of whole assembly or vibrations, the designing of frame must be depending on it, it must be anticorrosive, harden and light in weight. The structure of frame is as shown in fig.



Figure no. 12. Fabrication of Base and Support

**P. Mounting of Conveyor: -**

Conveyor system is a common piece of mechanical handling equipment that moves material from one location to another. Therefore, we select Double wave wire mesh conveyor of SS 304 of length 11628mm.

We first calculate the stresses which are developed in the shaft during running, then for mounting the conveyor on machine, we select a shaft of Mild steel.



Figure no. 13. Fabrication of Conveyor

**IV. EXPERIMENTAL RESULT**

**Q. CONVEYORIZED WASHING AND DRYING MACHINE: -**

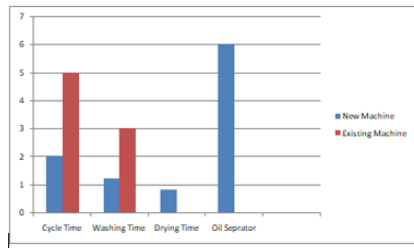


Figure no. 14. Conveyorized Washing and Drying Machine

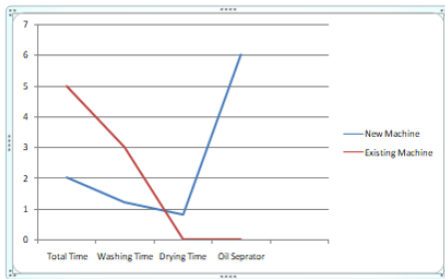
**R. RESULT COMPARISON: -**

Parameter	New Machine	Existing Machine
1. Cycle Time	2 min.	5-6 min
2. Washing Time	1.2 min	3 min
3. Drying Time	0.8 min or 48 sec	-
4. Oil Separator	60%	-
5. Sensor		
5.1 Proximity Sensor	Yes	No
5.2 Limit switches	Yes	No
6. Indicator	Yes	No

S. GRAPH: -



Graph No. 1 Result Comparison (Column)



Graph No. 2 Result Comparison (Line)

### CONCLUSION

Conclusion of this paper comprises of Cabinet Type Washing & Drying Machine improvement in the washing of Bin, reduction in the time of washing & Drying time of the Bin, improvement in the washing Quality, optimization and design modification is also included in the conclusion of this paper.

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