

Wall Cleaning Machine

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Abstract : Due to the rapid growth of advanced technology automation in the various aspects of life, industry, medical, domestic machine etc. we know that there are corners and wall surfaces in buildings, offices, railway station or bus stop which are full of dust and dirt. Cleaning is the standard of our life. The traditional floor or surface cleaning machines can't be able to clean vertical surfaces. Hence we have need of the automatic wall cleaning machine with less weight and low cost. Some building corners have large height, so to clean that surfaces which is at a particular height is so risky. It can be possible by our machine. It consists of conveyer with brushes which are rotated by motor. It also consists of nozzle by which we can provide water and detergent for cleaning purpose. The main purpose of this machine is to clean the dirty wall surfaces.

Keywords: Wall cleaning, DC motor, Stain, Electrostatic attraction, Hydrogen bonding, Vander Waal's forces, Ethylene diaminetetraacetic acid, Semiautomation.

1. INTRODUCTION

1.1 Problem Statement

Now days there are many more problems related to room corners and walls, society staircase corners are not clean, then you risk exposing you and your family to allergy-inducing dust mites, pet dander, mold, and other free-floating debris. These problems can also trigger asthma attacks in people who are prone to them. You don't have time to clean these areas. This is the most obvious problem; this can cause some serious health risks. These have some of the highest incidences of illness in the world. Wall surfaces and floors are particularly susceptible to bacteria and other parasites that can enter into the human intestines, such as worms. Cleaning them (walls) regularly is to keep your house clean and hygienic. How to clean painted walls without damaging them? The walls can get dirty because of dust, dirt and grime. Cleaning your walls can be a daunting task. The dirt on the walls can affect health hazards especially folks affected with asthma as reported by the Consumer Product Safety Commission(CPSC). According to their statistics, the number of people who have asthma has greatly increased

to over 59 percent since 1970 reaching a whopping 9.6 million afflicted with this deadly disease. The General Services Administration reports on dirt being deposited on walls through contact with people, objects, and furniture. This becomes cleaning interior walls really necessary. And yes, it's important to keep the walls in your home clean and not just for appearance sake but for health reasons as well.

1.2 Objectives

- Best cleaning method for the wall cleaning.
- To develop a simple machine with economically cost effective.
- To provide valuable and supportive services to the Society.

1.3 Scope

- Design the structure and framework.
- Design the tools and equipments related to surface cleaning.
- Design of the various mechanisms.
- Study of the various surfaces.
- Study of various chemicals related to surface cleaning.
- Analysis of the structure, links, framework and mechanisms.

1.4 Methodology

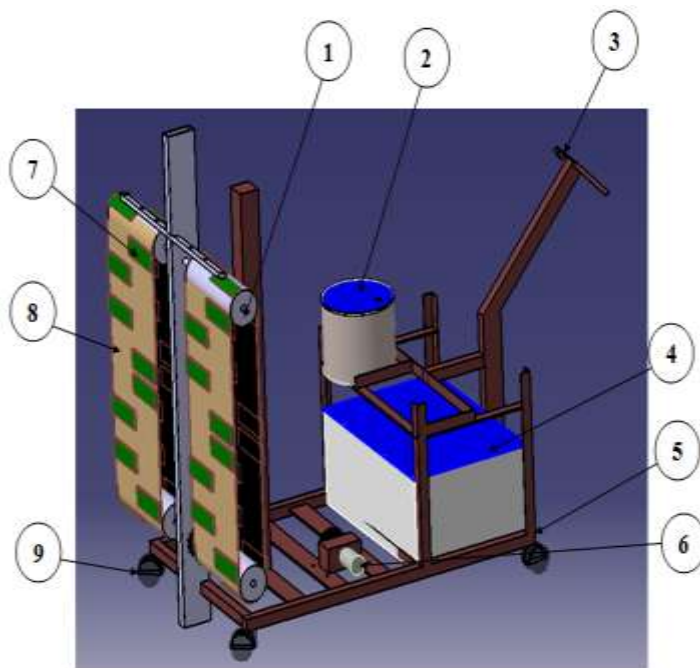
To achieve our objectives we are going to design and fabricate automatic machine which mainly consist of parts like brush or scrubber, pump, motor, sponge, nozzles and frame etc. First of all we give the power through motor to the conveyer with the help of sprocket and chain arrangement. The brushes and sponges are mounted on conveyor with the help of screwed arrangement. When the power is supplied to the motor then it will start and then it will provide the power to conveyor with the help of sprocket and chain arrangement. As the conveyor rotates the brush and sponges which are mounted on the conveyer also rotates. Conveyer rotates vertically, so the brushes are

comes in the contact with wall. At the same time water and detergent or chemical mixture is supplied to the contact between brushes and wall through nozzles. When the water and chemical mixture fall on the rotating conveyor, foam will create, due to the chemical reaction. Then brushes remove the dust as well as the dirt from the wall surface. There is a container is provided which is used to collect the dirty water comes from the wall. There is a water pump and detergent pump provided to supply the water and detergent from respective tanks to nozzle through pipes. To mount all these system, there is a frame is provided with the wheels. Due to that it becomes portable and easily travelled to the required space and completes the work properly with less time and less cost.

2. CONSTRUCTION AND WORKING

2.1 Construction

Wall cleaning machine is used to clean the walls surfaces and corners. It is having following components:



- | | | |
|---------------|-------------------|-----------|
| 1. Roller | 2. Detergent Tank | 3. Handle |
| 4. Water Tank | 5. Frame | 6. Motor |
| 7. Scrubber | 8. Conveyor Belt | 9. Wheel |

Fig -1: Actual wall cleaning machine

1. Frame

Frame is main part of machine in which supports all parts or components of machine which are assembled and mounted or welded to it. Frame is made from number of square bars of mild steel.

2. Conveyer.

Conveyer consists of two shafts and four rollers. It gets support from center and rollers are mounted on both sides of each shaft. Rollers are made from PUC material and have ability to sustain the belt which transfers the rotation to belt. Shaft is supported by bearing which gives minimum friction resistance. Conveyer belt is mounted on rollers by means of tension. It is made from rubber and numbers of brushes are mounted on rubber conveyer.

3. Reservoir

Machine consists of two reservoirs one of consist water while other consist of detergent for cleaning purpose. Reservoir is used for storing purpose.

4. Submersible pump.

The main function of pump is to suck the liquid from tanks or reservoir which gives pressurized water or detergent to the nozzle. Submersible pump is having or consuming 18W power.

5. Pipes and nozzles

Pipes are used to provide liquid to the nozzle from the reservoir. It is made from polyurethane material and it carried liquid. Nozzles are used to sprinkle liquid which increase the velocity with decreasing the pressure of liquid.

6. Chain drive.

Chain drive is consisting of two sprockets; one sprocket is mounted on motor shaft while other is mounted on conveyer shaft..

7. Motor

DC Motor is used to provide the rotary motion to the conveyer. It is having 45kgcm torque and 12V supply.

8. Switch board

Switch board is used to allow the power supply as per requirement. It can be handled manually.

2.2 Working

1. Power supply is given to the motors by means of switch board hence after receiving power, motor start rotating and gives drive to live shaft of conveyer.

2. Live shaft and dead shaft are connecting through conveyor mounting. Hence, power is transmitted to the dead shaft; it results into rotation of conveyer.
3. When conveyer rotates, brushes are also rotate and when it comes in contact with the wall or any obstacle, then due to friction it gets cleaned.
4. Switch board also allows the rotation of pumps of water as well as detergent. Switch board is operated manually hence as per requirement we can provide liquid and detergent at required time in order to clean the wall.
5. Handle is used for carrying purpose of machine. Hence we can transport the machine at anywhere we want.

3. EXPERIMENTAL VALIDATION

Physical and chemical aspects of removing dirt, stains and corrosion.

- Dirt can be considered to be simply “stuff in the wrong place” “Dirt” may be classified into three broad categories – soiling; staining and corrosion.
- The Oxford English Dictionary defines the verb to clean as “to free from dirt, filth, or impurity”. And dirt as “unclean matter, such as (something that) soils any object by adhering to it”.
- Wikipedia describes dirt as follows “unclean matter, especially when in contact with a person’s clothes, skin or possessions when they are said to become dirty”

3.1 Categories of dirt:

- Soiling, that may be considered as solid particulate matter sitting on the surface of an object. Soiling includes dust accumulated over time in storage or use. Soiling may be bonded to the surface either mechanically or via electrostatic attraction, hydrogen bonding or Vander Waal’s forces.
- Staining occurs when liquid matter is carried into a porous substrate by capillary action, darkening or discoloring the surface. Again, staining is distinguished from intentional dyeing by being an accidental event. Staining differs from soiling in that any particulate matter must generally be very small in order to penetrate the pores of the substrate. Staining an also be caused by liquids, either because the liquids are themselves colored – e.g. ink or coffee – or because the liquid changes color because of a chemical reaction with the substrate or due to subsequent degradation of the liquid – e.g. oxidation and yellowing of an oil or fat.
- Corrosion is a general term that can describe alteration and degradation of the original composition

of the surface, either by external or internal chemical processes.

3.2 Cleaning methods:

Mechanical cleaning is the term used when foreign matter or corrosion is physically removed from the surface of an object using an external force. There is no requirement that a machine is used and most mechanical cleaning is done by hand using small tools with no moving parts. The simplest act of mechanical cleaning is the removal of superficial dust or particulate matter using a soft, dry cloth. No chemical interaction takes place between the cloth and the object’s surface, nor between the cloth and the particulate matter. Table 1 shows that there are many different ways of applying an external force to remove unwanted surface contamination and some are more gentle or aggressive than others.

Method	Tools
Air movement	Rubber bulb Breath, Vacuum cleaner , Compressed air jet
Brushing	Natural bristle (water color brush), Nylon bristle, Glass bristle brush, Brass wire brush, Steel wire brush
Peeling/Pulling	Adhesive tapes, Latex poultice
Rubbing/Polishing	Cotton swabs, Cotton swabs with a polishing compound, Soft pencil, eraser Hard pencil eraser
Scraping/Scratching	Bamboo sticks, Needle Probe, Scalpel
Cutting	Scalpel
Abrading/Grinding	Polishing compounds, Sandpaper, Rotary grindstone
Impact	Air-abrasion, Solid CO2 blasting, Sandblasting Hammer & chisel

Table -1: Methods of mechanical cleaning ranked by increasing energy input.

- Wet cleaning, which involves the use of a liquid “wetting agent” to dislodge soiling from a porous or non-porous substrate. Wet cleaning of a surface is usually done in combination with an absorbent swab into which the “dirty” liquid is drawn by capillary attraction. Alternatively it can be “washed” in an excess of water, as in the wet cleaning of textiles. Wet cleaning is often undertaken using a soap or detergent to increase the attractive forces between the particulate matter and the liquid and hold the dirt in

suspension (Hofenk-de Graaff 1968). At other times the liquid may simply act as a solvent for the dirt or contaminant and therefore the properties of the wetting agent – e.g. polar solvent, non-polar solvent – are selected according to the nature of the material to be dissolved (Rice 1964). In wet cleaning there is no chemical interaction between the solvent and either the dirt or the substrate.

- Chemical cleaning is obviously related to wet cleaning but in this case implies a chemical reaction between the applied liquid (usually water-based) and the dirt to be removed. This reaction may be obtained quite simply by adjusting the pH of the water or the reaction may be more sophisticated. A chelating agent such as oxalic acid or ethylene diaminetetraacetic acid (EDTA) may be used to surround and solubilise (sequester) specific cations, thus removing them from a compact or porous surface. Both EDTA and oxalic acid will sequester Fe³⁺ ions and are used in removing rust or iron staining from paper, ceramics, wood and leather, and wrought iron (Selwyn & Argyropoulos 2005). Watson (1985) also used EDTA in the cleaning and conservation of archaeological lead objects. Alternatively, a dissolved species that forms a soluble complex with an otherwise insoluble contaminant may be used to remove stubborn stains or corrosion crusts. Sometimes a water-soluble oxidising or reducing agent may be used to change the oxidation state of a metal corrosion product, thus rendering it more soluble. The chemical or electrochemical modification of the altered (corroded) surface is sometimes used in the cleaning and consolidation of severely corroded metals. Here the corrosion products on a metal object are transformed chemically, either by exposure to a reducing aqueous solution, a reducing gas or plasma, or under the influence of an external electrical current.

3.3 Products we are mostly focused to clean:

Orally used products are chewed and placed in the space between the lower lip and gums or in the space between the gums and the cheek.

Khaini prepared from sun-dried tobacco and slaked lime is commonly used in the states of Gujarat and Maharashtra.

Zarda, a mixture of tobacco, lime, spices, and occasionally, silver flakes is also added to pan and chewed.

Mawa, a mixture of thin shavings of areca nut, tobacco, and slaked lime is widely preferred in Gujarat state.

Gutka or pan masala with tobacco is a ready-to-eat tobacco product has become extremely popular in all parts of India due to its user friendly packaging. It contains areca nut, slaked lime, catechu, and tobacco as well as flavoring agents and sweeteners that are added to improve taste.

3.4 Methods for cleaning wallpapered walls :

Following observations are taken to get best detergent water or chemical quantity and speed of brush which have the most desirable properties to clean the stains on the wall:

Table-2: Detergent type

No, Of Trails	Detergents	Water Quantity	Remark
I.	Soapy Water	1Ltr	Good Clean
II.	Ariel	1Ltr	Remove Colour
III.	Tide	1Ltr	Stains

Table- 3: Quality of soapy water

No. of Trials	Soapy Solution	Water	Remark
S	30	200	Medium
2	50	200	Base
3	40	180	Weak

No. of Trials	Detergent	Stoke of Speed	Remark
1	Soapy Water	0.6	Not well Clean
2	Soapy Water	0.8	Good Clean
3	Soapy Water	1.0	Stains are Remain

Table-4: Speed stroke of brush.

Conclusion: Soapy water solution with 1.5 Liter water is selected.

3.5 Time Required For Conventional Process:

- First worker require time to make the water and detergent solution.
- Worker generally uses one brush to clean wall. Hence they required more time.
- More strokes are require to clean wall like 4 to 5 strokes.
- If stains are so sticky then at that condition worker required extra time to clean that stains.
- Hence finally from considering all time which is discussed above, we say that a common worker

required 1hr to clean the 50 sq ft wall i.e. 0.833 sq ft/min.

3.6 Cost of Conventional Process:

- In conventional process most of the cost is require for worker.
- From the standard, we should pay Rs 500/- for 8 hrs of working.
- In 1 hour, worker can clean 50 sq ft area.
- It means he will clean 400 sq ft are in 8 hrs.
- According to this we have to pay Rs 500 for 400 sq ft.
- Also we pay to Rs 200 for detergent and Rs 50 for bush.

Here,

$$\begin{aligned} \text{Total Cost for 400 sq ft} &= \text{worker cost} + \\ &\text{detergent cost} + \text{brush cost} \\ &= 500 + 200 + 50 \\ &= \text{RS } 750 \end{aligned}$$

$$\text{Total Cost Required For 1 sq ft} = \text{Total Cost for 400 sq ft.}$$

$$\begin{aligned} \text{Total work by worker} &= 750/480 \\ &= 1.875 \text{ Rs/sq ft} \end{aligned}$$

3.7 Time Required For Machine:

- Mixture of detergent and water is already loaded on machine.
- On machine numbers of brushes are mounted and they work simultaneously. Hence time required to clean the wall is very less as compared to conventional method.
- By machine there are only one stroke is essential to clean the sticky stains also.
- Hence it reduces the time to clean the sticky stains.
- Hence finally we can conclude that time required to clean the wall by machine is 90 sq ft in 1 hr i.e. 1.5 Sq Ft /min.

3.8 Cost Required To Machine:

- Motor and pump consume 0.5 units of electricity per hr.
- Hence motor and pump required =unit of electricity × cost per unit

$$\begin{aligned} &= 0.5 \times \text{RS } 8 \\ &= \text{RS } 4 \text{ per hr} \end{aligned}$$
- We have to pay Rs 500 to the operator for 8 hrs i.e. Rs 62.5 per hr.
- Machine cleans the 720 Sq Ft in 8 hrs i.e. 90 sq ft per hr.
- Detergent cost RS 350.

Here,

$$\begin{aligned} \text{Total cost for 90 Sq Ft per hr} &= \text{motor and} \\ &\text{pump cost} + \text{detergent cost} + \text{operator cost} \\ &= 32 + 350 + 500 \\ &= \text{RS } 882 \end{aligned}$$

$$\text{Total cost for 1 Sq Ft} = \text{Total cost for 90 sq ft per hr}$$

$$\begin{aligned} \text{Total work by machine} &= 882/720 \\ &= \text{RS } 1.225/\text{sq ft} \end{aligned}$$

4. FUTURE WORK

Considering the present position and working setup, some changes in present state would be done in future. The future scope of this project is as follows:

- For effective cleaning search effective solutions.
- Instead of switch operation give programming for operation of solutions, water and chemical.
- Install blower to clean surface.
- Install proper drainage system to it and have to focus on recycling.
- Convert semi automation into total automated.

5. CONCLUSION

Manual Cleaning might not be that effective as it will not be cleaning up everything in as it is not in sight but using this cleaning machine it can be done easily. The components are needs to design in order to enable easy operation and to reduce the effort of human beings. Cleaning time depends on the speeds of the motors and the degree of dirtiness of the wall. Finally, this system should be further developed so that it will have more features. In general the system works adequately as anticipated in the design process. Our machine is cheaper, compact, portable and easy for the operation as compare others heavy and costly machines of it made.

6. REFERENCES ANNEXURE

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