International Journal of Advance Research in Science and Engineering
Volume No. 11, Issue No. 11, November 2022
www.ijarse.com
IJARSE
ISSN 2319 - 8354

# Development of a Manual Sweeping Machine

**Sudip Bhowmik, Arup Datta, Johnson Debbarma,**

**Bijoy Kumar Deb, Sukanta Das**

*Department of Mechanical Engineering, Tripura Institute of Technology, Narsingarh, India, 799015*

## ABSTRACT

Directly and indirectly, good cleaning and sanitising promote and safeguard human health. Additionally, by removing residues that can attract and nourish bees, bugs, and other insects, cleaning and sanitising helps reduce pest infestations. Due to routine cleaning and care, the floor, walls, etc. have a longer shelf life. A machine that must be manually operated in order to replace the standard electric cleaning machine. A set of wheels that are fixed to the dust-cleaning machine system and connected by a shaft. The shaft connects the wheels to each other. With the use of manual force that can manage it, the wheels are shifted to the proper position. Three adjustment holes are provided for the handle so that it can be adjusted to the desired height. At either side, a chain drive connects the wheels and gear. The wheel and gear determine how the chain is moved.

***Keywords: Dust-cleaning machine, Design, Development, Manual, Sweeping Machine***

## I. INTRODUCTION

In recent years, conventional floor cleaning machines are most widely used in airports , railway stations, malls, hospitals and in many commercial places, as cleaning is one of the important parameter for the sanitation and government regulations . For maintaining such places, cleaning the [1]floor is the major task which is necessary. There are conventional floor cleaning machines available to perform floor cleaning operations in above said places. Generally a conventional floor cleaning machines requires electrical energy for its operation. Effective cleaning and sanitizing help and protect the health of human beings directly and indirectly. Generally, in the era of modern technology, different devices such as electric motors, diesel engines, and robots are being used to clean the floor, road. A machine which should be operated manually so that it can be as an alternative for conventional electric cleaning machine. The brush moving the alternative direction of the wheels move and the brush brooms the waste present on the road also it dumps the waste into the waste-collecting box. Ravi Tandel et al. [1] developed sweeping equipment that remove dust on streets, government places, industries and private places etc. They used two big wheels and two small wheels with one brush only for this hand drive sweeper machine. Hand drive back side dustbin is also used. They have shown that comparing with the conventional sweeping equipment this equipment requires less effort for sweeping. M. Ranjit Kumar et al. [2] developed a low cost user friendly manually operated floor cleaning machine using suitable commercially available software. They used conventional materials for the equipment. From the finite element analysis they also observed that stress level in the machine is within the safe limit. Dhiraj M. Bankar et al. [3] reviewed various manually operated floor cleaning machine used in recent years. They observed that the equipment purposely

[1] Corresponding Author: Sudip Bhowmik, Mobile:+91 9774346093, Email: sudip.tit@gmail.com

design for cleaning floors, but can only be use in outdoors with large ground like hospitals, bus stands etc. They also preferred simple chain drive mechanism which can be easily operated by any person and any fault in machine can be easily identified and can be corrected on the spot. Praveen H et al. [4] made a user friendly as well as eco-friendly multipurpose cleaning machine with easily available materials with low cost. It can be easily fabricated, easy to use and control. It can work very efficiently with respect to covering area, time and cost of road cleaning process compared with the existing machines. They observed that it is less effective where the road seems to be very rough and damaged. Mukesh et al. [5] developed the equipment which can be used for cleaning the long distances and wide width reducing human effort, so that the cleaning can be done in a single drive. The system has been used to clean roads and could clean various forms of papers, covers, food beverages, smooth dust and unwanted waste noticed on the roads. The equipment is suitable for Indian conditions because of its reliability expandability. Nighot et al. [6] found that the existing street cleaning machines uses petrol and diesel. It can cause pollution and also the vibration produced in the machine causes noise pollution. While manual cleaning may cause health problem as the person directly comes in contact with dust. Also the shoulder problem due to continuously sweeping occurs. So they developed a tricycle operated street cleaning machine seems an alternative concept for avoiding such problems. Jagtap et al. [7] designed and developed the process for cleaning the dry as well as wet floors. They used moisture cotton mop, swiping brushes wiper and vacuum cleaner for simple construction and easy to operate. It is used for dry and wet cleaning simultaneously. They reduced the human efforts to a great extent. Meng et al. [8] designed a lawn garbage sweeper. The motor drives the cleaning roller and the travelling mechanism to realize the automatic cleaning and recycling of garbage. They designed a filter compartment and a compacting mechanism in the recycling bin to complete the preliminary screening of the garbage. By ANSYS software they showed that the axle can meet its stiffness requirements. The equipment meets the functional requirements and has a simple structure.

A manually operating floor sweeper machine is developed with a major list of objectives

- To achieve simultaneously dry and wet cleaning in a single run.
- To make it in low cost and efficient.
- To reduce the maintenance costs as far as possible.
- Requires no training to operate/ fast.
- No external power requires.
- Lower Maintenance Cost and Time.
- Required less cleaning time.
- High Cleaning Capability.
- Clean more space in less time.
- To reduce the maintenance cost of the manually operated floor cleaning machine as far as possible.

## II. METHODOLOGY

**Problem Identification:**

During literature survey we got that on many large places it hard to clean floor properly. Like in collages, companies, hospital etc. in this places the cleaning of floor takes much time and men power this cleaning is done

on large scale because the area to be covered to clean is so large and this place doesn't clean properly by manual cleaning.

**Literature Survey:**

After studying the various research papers of floor cleaning machines we have concluded that there are certain limitations in floor cleaning machines which can be worked upon. For example cleaning machines are made with an aim to clean only dry surface of the floor. This means that they are only sufficient in the summer and winter season but not in rainy season this is the major issue for cleaning the floor surface but during the rainy season floor cleaning machines are required which can perform the tasks when the surface contain moisture or little amount of water on the surface of floor. So we are developing the machine which can work in both dry and wet conditions. This machine called as dry and wet floor cleaning machine. This machine can remove the dust in summer season and also it can remove and clean the dirt, water from floor in rainy season.

**Market Survey:**

During the market survey we got that in the market there are several types of floor cleaning machines are available for large scale cleaning but the cost of these machines are very high.

**Design:**

In the design of the floor cleaning machine is very compact as compare to other cleaning machine are available in the market but has the attractive design and high durability.

**Development:**

The machine consist of several parts that is vacuum cleaner, DC motor, wiper, mope and brushes these parts are fitted on the welded chassis made up of mild steel square bar of one inch and these parts are connected electric system. For DC motor the supply is provided through SMPS which converts AC supply into 12v DC supply.

**Testing:**

After the completion of this project we tested and concluded that the cleaning performance of these machines is satisfactory.

## III. CONSTRUCTION AND WORKING PROCESS

Here the construction design or structural design given in steps –

Step 1 - At first we need to arrange steel which is wieldable like stainless steel so that we can make our structure of the project.

Step 2 - Then we have to join the front wheels and back wheels shafts, may be little welding is required. A shaft for the brush needed to join but all shafts must be movable.

Step 3 - Then we have to join our gears the big one in back wheels shaft and small gear in brush shaft in one particular side.

Step 4 - The brush and wheels and gear chain need to fix in their places.

The brush must slightly touch the ground while rotating.

Step 5 - There must be enough space for fixing the dust collector, between the brush and back wheels.

Step 6 - A T or U shape handle must be welded so that it can be push forward.

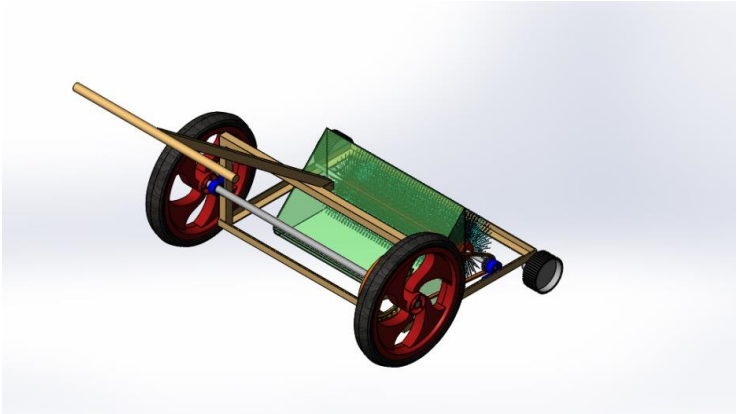

Figure: 3D view of manual sweeper machine

## IV. PARAMETERS FOR THE CONSTRUCTION OF THE MANUAL SWEEPER MACHINE

**Shaft (axel) -** we use mild steel for Axle material. It contains very low carbon (0.05-0.3) % making it malleable and ductile. It has relatively low tensile strength but it is cheap and easy to form surface hardness can be increased through carburizing.

**Dust collector**- It is made and used according to the design of the frame. We use dust collector made of Tin (sn). Which atomic number 50.melting point 231.9°C. Easy to cut and we can make it in any desired shape with little bit of welding

**Sprocket chain** - we use two sprockets or wheel chain and one chain. It is profiled wheel with teeth, cogs that mesh with chain, the name sprocket applies generally to any wheel upon which radial protections engage a chain passing over it. It is made of steel. Steel is alloy of iron and carbon contains less than 2%carbon and 1%manganese, small amount of silicon, phosphorus, sculpture and 02.

Table 1. Technical specification of sweeping machine:

| ***PARAMETERS*** | ***SPECIFICATIONS*** |
|---|---|
| Sprocket material | Stainless steel |
| Axle material | Mild steel |
| Sweeper material | Polypropylene, dust |
| Frame material | Steel |
| Shaft | 20 mm |

Table 2. Projected cost economics:

| **Sl. No.** | **Components** | **Unit cost** | **Quantity** | **Total cost** |
|---|---|---|---|---|
| 1. | Wheels | Recycling Product | 4 | 00/- |
| 2. | Frame | 200/- | 1 | 200/- |
| 3. | Collector Bin | Recycling product | 1 | 00/- |
| 4. | Sprockets | Recycling product | 1 | 00/- |
| 5. | Chain | Recycling product | 1 | 00/- |

| | | | | |
|---|---|---|---|---|
| 6. | Shaft | 150/- | 2 | 300/- |
| 7. | Handle | 100/- | 1 | 100/- |
| 8. | Base Frame | 250 | 1 | 250/- |
| 9. | Supporting Frame | 50/- | 1 | 50/- |
| 10. | Brush | 400/- | 1 | 400/- |
| 11. | Screws and Bolts | 15/- | 8 | 120/- |
| **Total cost** | | | | **1420/-** |

**Brush-** We are using a cylindrical type brush. It is made up with Nylon which is strong, stiff, engineering plastic without standing bearing and wears properties. It is a generic designation for a family of synthetic polymers composed of polyamides (repeating units by amide links).Nylon is silk like thermoplastic, generally made from petroleum that can melt processed into fibbers, films or shapes. It is a plastic with super long, heavy molecules built up of short endless repeating section of atoms. Just like a heavy metal is made of ever repeating links. Nylon is not actually one single substance but the name given to a whole family of very similar materials called polyamides. So, whenever we say "Nylon is" it generally more correct to say Nylons are. Ex=Nylon6, 6 and Nylon6, Nylon6, 12and Nylon5, 10.

## V. IMPORTANCE OF MANUAL SWEEPING MACHINE

A manual push sweeper is a professional cleaning machine that every company should consider making available.

Ideal in different contexts, with minimum overall dimensions and maintenance requirements. A floor cleaning machine that “lasts forever” and has no limit in the range of applications in which it can be used. Furthermore, it can be easily operated by anyone.

For companies with a logistics department a manual sweeper is the perfect ally, for example to clean the loading zone after each delivery. Or if made readily available to employees near manufacturing assembly lines, it becomes a flexible tool to resolve most daily cleaning requirements around individual work stations.

For sweeping the floor at the end of a shift, or for ad hoc cleaning. A manual sweeper is always ready and quick to use.

A mechanical push sweeper can be used any moment as it doesn’t have batteries that require charging: it’s therefore the ideal partner to sweep work station areas at the end of a shift, for quick clean ups after minor incidents, and for ad hoc cleaning of accumulated dirt, shavings, and dust.

In the furthest corner of the warehouse, a bag of floury material has broken. If quick action isn’t taken this material could quickly become dispersed, resulting in a slippery floor. Most companies have a cleaning machine, but it could be stored in an inconvenient position, or if cleaning is carried out by a contract cleaner the equipment might not even be available. A manual sweeper, placed in the key areas of a company, is a small investment that could resolve this case and many others. Ensuring that work zones are always clean without the unnecessary loss of time.

Also suitable for outdoor use, it’s the ideal machine to sweep car parks, driveways and courtyards.

A storm covers the company parking lot with leaves, branches and other debris brought by the wind. A manual sweeper can resolve this situation in just a few minutes, however armed with only a broom and dust pan it could take hours to clean up.

How Manual Floor Sweepers Could Benefit Your Business and Working space

A large commercial space, in general, can be very challenging to keep clean due to the volume of people going in and out daily. The floor receives the most amount of battering and is likely to wear more easily than the walls or the ceiling. That being said, commercial floor care is one of the most important tasks at hand when trying to maintain a place of work or business.

Floor sweeping and scrubbing both seem to be easy cleaning tasks to do. However, sweeping and scrubbing a large floor area, such as in malls or warehouses, can be very difficult, especially if your cleaners only use manual cleaning tools (e.g. brooms, mops). Not only will doing so exhaust them, it may also not be as effective as using industrial floor cleaning machines.

**Efficient Cleaning**

With multiple brooms doing the job of one, it would be easier to clean a large surface area in just a single pass. Thus, an industrial floor sweeper can significantly reduce your cleaning time and increase efficiency by almost 100 percent compared to manual techniques.

Additionally, an industrial floor sweeper does a far more effective job of collecting dust and debris than hand sweeping, making it the better cleaning option between the two.

**Employee Satisfaction**

With an industrial floor sweeper in tow, floor cleaners are bound to be less fatigued and more productive because they do not have to exert too much effort when cleaning.

In fact, they may even have extra time in their hands to do other things in the office that can help boost your business's productivity.

**Cost-Effective Maintenance**

An industrial floor sweeper is cost-effective in many ways: First, it saves time by efficiently cleaning where a regular broom can only do so much. Second, it saves you the cost of hiring more cleaners to do the job as only one person is needed to operate such machines. And last but not the least; industrial floor sweepers are generally made to be durable for long-term commercial use. Whereas brooms and mops can only last a few months, these mechanical sweepers can last for years.

## VI. ADVANTAGES OF MANUAL FLOOR SWEEPER MACHINE

With the introduction of innovative cleaning techniques, a remarkable boom in the demand of professional cleaning services has been observed. But, what good is a cleaning service that isn't backed by technological advancements prevailing in the present era? Therefore, many leading commercial cleaning services have adopted technologically sound cleaning equipment that simplifies cleaning in commercial premises to a great extent.

Hand-Push sweeper is a pure mechanical transmission maintenance-free cleaning tool. No power cords and batteries and any power source can be recycled into the trash as long as it is pushed on foot. The sweep and collection are completed at the same time.

Very practical sweeping machine, cheap, efficiency can replace 6 cleaning workers.

Proficient: The commercial cleaning equipment in question are designed in such a way that they clean a large area in one go and that too effectively. Cleaning equipment, like Warehouse Sweeper, will clean few square feet of area in just one go which increases the efficiency by almost 100 percent when compared to manual cleaning techniques. Moreover, it will save the hassle and physical labor as well.

Eco-friendly: Since the leading manufacturers of commercial cleaning appliances/equipment have always been considerate of the environment, they develop cleaning machineries that consume lesser power and inflict no harm the crucial environmental entities, such as air. Therefore, it clearly makes sense to have these eco-friendly cleaning equipment at your disposal.

Low maintenance and easy to operate: Since these cleaning appliances are designed for cleaning and nothing else, there's no rocket science involved in their operation. They are designed with a user-friendly console that accommodates essential switches and LED indicators for ease of operation. Also, these appliances incur low maintenance cost, because cleaning regimes are not rigorous enough to cause early wearing of the equipment. If handled carefully, such appliances are sure to deliver upmost performance without breaking down, over years to come.

Eliminates the hassle of 'cleaning staff management': No one would want to take the onus of staff management when there are other important things to do. If you have in-house cleaning staff, you'll have to manage their pay checks, which seems an overwhelming burden to heave. However, with cleaning equipment at your disposal, you will only need one operator and few watts of electricity to make the ends meet. Plus these cleaning appliances serve the purpose of several individuals; thereby, saving you on money and time.

Availability: The availability of these cleaning appliances is not an issue – not at all. There are several manufacturers of commercial and industrial cleaning equipment, like industrial pressure washer, floor sweepers and more. You can get in touch with them to receive a quote for your requirements. You can either buy or rent cleaning equipment according to your convenience and preference. If you have a vast commercial or industrial premise that seek regular cleaning, then renting would cost more than one-time purchase. And, on the other hand, if your cleaning requirement is monthly based, then renting would a better alternative.

It is merely a one-time investment whereas its fruits are perpetual. You can only imagine how much time and money can be saved with these cleaning utilities, along with increased efficiency. All you need is an operator with basic skills to ride such vehicle-like cleaning equipment over the floors, across large areas to be cleaned. If you are looking forward to buying or renting these utilitarian cleaning appliances, don't forget to conduct a little research before plunging into purchases; it'd do you a bit of good.

High efficiency: Every hour can be cleaned about 8000 square meters, the same work area time greatly shortened

Low cost: Electric sweeper can replace 12-15 manual cleaning, save a lot of labor wages, welfare benefits and pay rise to deal with the problem

High Security performance: Let the cleaners people in a safe environment (horse road fast traffic too much, manual cleaning is not safe).

The economic return High: spend only more than 10 Yuan per day (charging, consumables, wear), if it is more than 10 people, wages and benefits, such as at least thousand Yuan, but also to invest in basic cleaning tools and operating costs

One-pass cleaning on all hard floor types bringing increased productivity with the best results.

Saves lots of time and manual labor with its every efficient sweep.

The perfect solution for heavy duty cleaning and sweeping.

Combination sweeper scrubbers are ideal for deep cleans of large floor areas.

Low cost maintenance, durable construction & reliable.

Ride-on floor cleaners are an effective machine that efficiently sweeps, scrubs and vacuums debris at the same time.

The manual effort of sweeping and mopping now becomes a lot less labor intensive.

Leaves the floor exceptionally clean.

Ideal for cleaning of industrial warehouses, distribution centre's and construction sites.

## VII. CALCULATION

Surface area clean in one rotation of brush-

Wheel radius- 8 cm

Brush height between the wheels- 15 cm

So, Surface area clean in 1 rotation- 2× (22/7) ×8×15 = 753.6 〖cm〗^2

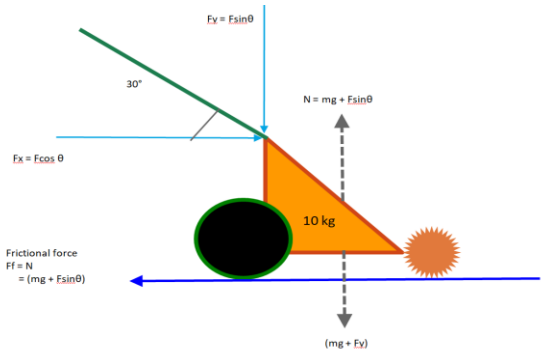


Figure 2: Application of Forces

Force need to move the cleaner

So, $Fx \leq Ff$

Or, $F\cos\theta \leq (mg + F\sin\theta)\,\mu$

Or, $F(\cos\theta - \sin\theta\mu) < mg\,\mu$

Or, $F \leq (mg\mu) / (\cos\theta - \sin\theta\mu)$

Or, $F \leq (10\times9.8\times0.3)/\cos(30°) - \sin(30°)(0.3)$

Or, $F \leq 29.4 / (0.866-0.15)$

Or, $F \leq 41.06$

[It'll move at F>41.06N]

## VIII. CONCLUSION

The use of innovative technology not only reduces cost significantly but also reduces the human effort while increasing the effectiveness of floor cleaning. Reduced human effort means more frequent floor cleaning which results in increase in overall cleanliness and supports healthy well-being. Small steps in technological advancement like this will have higher impact in long run in future, making India a better country. The manually operated eco-friendly road and floor cleaner is successfully designed, and fabricated. This project works implements the manually operated eco friendly road cleaner for road cleaning that reducing the cost, human efforts as well as time. It is the best alternative for automated road cleaning machine during power crisis. It is found that the existing road cleaning machines works with a human simple effort. Manual cleaning may causes shoulder problem due to continuous sweeping. The manually operated road cleaning machine is alternative concept for avoiding such problems. It works very efficiently with respect to covering area. It is very economical to use. The manually operated eco-friendly road and floor cleaner can work very efficiently with respect to covering area, time and cost of road cleaning process compared with the existing machineries. Also it is economical. It was seen while testing of machine, that the cleaning is less effective where the road seems to be very rough and damaged. It can provide job to the uneducated person who is in need for such jobs as human energy is needed to drive the machine. Maintenance of machine is less and it is easy to control and clean it having health benefits and it mainly protects environment pollution. Manually operated floor cleaning machine is an alternative for an automated floor cleaning machine during power crisis. The equipment purposely design for cleaning floors, but can only be use in outdoors with large ground like the hospitals, bus stands, railway stations etc. The equipment will result more beneficial when it is compared to other existing floor cleaning machines. Our project is based on very simple chain drive mechanisms which can be easily operated by any person. Any fault in machine can be easily identified and can be corrected on the spot. Thus, by using manually operated floor cleaning machine a clean surface i.e. free from dirt and dust is achieved. As the desired effect is for dry and wet cleaning is done simultaneously .The human efforts is also reduced to a great extent. The work of sweeping and wiping is also saved .as it runs on clean energy, it I also environment friendly product.

Floor washing machine ideal for small & medium size Super- markets. Floor washing machine ideal for hospitals because of the low noise level. Essential tool for maintaining high level of hygiene for College and universities. No tools required to change brushes.

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