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Manually Operated Eco-Friendly Road and Floor Dust Cleaning Machine

[1]N. Somachaitanya, [2]I. Vamsi Krishna, [3]T. Sai Ganesh, [4]P. Himasagar, [5]B. Sunil Raj, [6]K. Mohan Kumar

[1,2,3,4,5]U. G Scholars, Dept. of Mechanical Engineering, Raghu Engineering College (A), Dakamarri, Bheemunipatnam Mandal, Visakhapatnam, AP, India

[6]Assisant Professor, Dept. of Mechanical Engineering, Raghu Engineering College (A), Dakamarri, Bheemunipatnam Mandal, Visakhapatnam, AP, India

ABSTRACT:

The quality of the air has considerably decreased as a result of unchecked industrialization and poorly managed building and development projects in developing nations like INDIA. People are forced to breathe in a lot of filthy air and dust particles. It has become a major problem since air quality has sufficiently deteriorated below the World Health Organization (WHO) level. One of the main causes is that automobiles travelling on roads that have been dug up for building purposes only to leave them unfinished due to the political, financial, and personal interests of the elite groups and owners of construction companies. Serious health risks like severe allergies, lung cancer, and other breathing issues can result from this.We have created a mechanically operated road sweeper prototype that is economically feasible and socioeconomically advantageous in order to address this issue. This device uses materials that are readily available, operates on the straightforward principal of a cylindrical brush spinning centrifugally to discharge road surface dust particles into a container, and is inexpensive compared to other devices while still being effective. This can be applied to the side of roads where the most dust has accumulated. We have computed mathematically in great detail. After that, we tested its performance after successfully fabricating it with normal fabrication techniques.

1. INTRODUCTION:

Cleaning is a necessary factor of daily routine process. Directly and indirectly, good cleaning and sanitizing promote and safeguard human health. To maintain the area around us clean, we utilize the road cleaner. so that we can roam the streets feeling revitalized.Robots, diesel engines, electric motors, and other technologies are frequently employed to clean the ground and roads in the age of contemporary technology. But these procedures are difficult to carry out, produce a lot of pollution, and require a lot of upkeep. Therefore, user-friendly road and floor cleaning equipment must be developed in order to conserve energy and protect the environment.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. At either side, a chain drive connects the wheels and gear. The wheel and gear determine how the chain is moved. The brush sweeps up any debris on the road and deposits it in the waste-collection box while travelling in the opposite direction of the wheels. To dispose of the waste where you want it to go, remove the waste collection box.We used such type of materials for manufacturing of road cleaning machine finally. We have observed that all the components are with in safe limit in the manually operated road cleaning machine.

2. METHODOLOGY:

a) PROBLEM FORMULATION:

The effects of air pollution are now felt by everyone. They are still far from accomplishing their goal of cleaning the streets of the dust. Even though cleaning is done every day, the practise has shown to be inefficient and expensive in terms of time, money, and energy. As a result, a mechanical push-on sweeper is developed to effectively clean the streets while saving resources like time, money, and electricity.

b) LITERATURE REVIEW:

The manual study, expert interactions, and web-based research methods used for the literature review were all used. The machine-related literature was looked up online. The mechanisms in the prototype push-on sweeper were examined.

c) DESIGN ANALYSIS:

A variety of machine design experiments will be conducted as part of the project. Using Solid Works 2013 for 2D sketching, dimensioning, and 3D modelling, various designs will be derived, examined, and modified as appropriate.

d) FORCE ANALYSIS AND CALCULATION:

Force analysis and load calculations of different components of the machine will be done. The results will be used during the fabrication process and will help in maintaining structural balance and integrity of the machine after construction.

e) FABRICATION:

With the application of appropriate processes, resources and tools, a prototype of the mechanical push on sweeper will be fabricated with the selection of suitable material.

f) ANALYSIS,CONCLUSION AND RECOMMENDSTIONS:

The prototype will then be analyzed from mechanical, economic and environmental perspective and necessary conclusions will be drawn out. Based on those conclusions recommendations will be given.

3. SELECTION OF COMPONENTS:

a) CHASSIS:

The chassis is one of the major components on which the various components such as shafts, bearings, brushes, container and other components are mounted. It carries the load exerted on it due to various components and load of the dust particles collected during operation

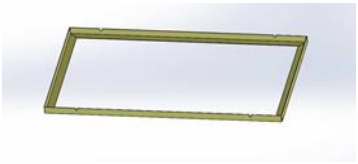

Figure : Chassis

b) WHEEL:

Due to friction between the ground and the tire's friction material when the machine is being pushed ahead, the wheel is utilized to transmit rotational motion and torque to the machine. The cycle's tyre is decided upon. It disperses the weight on the chassis into the soil, absorbs vibrations, and also supplies the machine's balance loads.

Figure : Wheel

c) HANDLE:

The handle serves as the component that transfers manual power from the operator's hand to the chassis so that the machine can be pushed. It is made up of hollow shafts attached together to form a U-shaped construction, as seen below. Its U-shaped structure limits motion in the horizontal plane, and the structure's attachment to the vertical support restricts motion in the handle's vertical axis. The handle's ergonomic design, including its height above the ground, has also been taken into account.

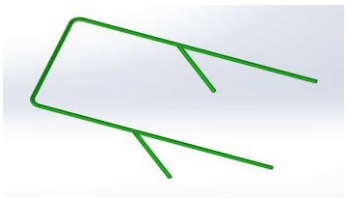

Figure : Handle

d) BRUSH:

The brush consists of the brush tool, ring and brush support. The brush support supports the brush in a groove holding it tightly. The brush support is welded to the ring fixing it. The ring is a circular structure made using flat bar which has central bar having bore to fix to the shaft which rotates to brush.

Figure : Brush

e) SPROCKETS:

The sprockets of different diameter have been used to transmit the power acting as a spur gear varying speeds and torque to transmit to further shafts with the help of chain drives... Sprocket of the rickshaw was selected. The smaller sprocket was selected from the cycle shop.

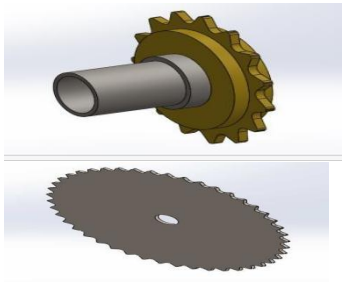

Figure : Sprockets

f) CHAIN:

The chain drive is used to transmit the power from one shaft to another due to larger center distances between shafts. The chain drive acts as simple gear train and open belt drive as it transfers the rotation in the same direction as that of driven shaft. It consists of various chain components such as internal and external components. It is meshed with the sprockets into the groove between successive teeth.

Figure : Chain

g) SPUR GEAR:

The main function of the gear was to transmit power from the back tire shaft to further shaft changing the direction of rotation as required rotation for the brush providing anticlockwise rotation form clockwise rotation.

Figure : Spur Gear drive

Number of teeth on spur gear = 33

Number of teeth on pinion gear = 20

h) SHAFT:

This shaft has composite structure having different diameters. The outer section is for providing space for the wheels and second diameters are for bearings. The larger sprocket is mounted on it.

Shaft of carbon steel of diameter 18 mm was selected.

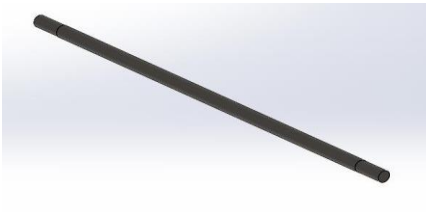

Figure : Shaft

i) CONTAINER:

Container is used to collect the dust particles thrown by the cylindrical brush. This also provides a guide steel plate for guidance for the dust particles to go into the containers. Holding rod is also provided to make it stable in horizontal plane placing it into the groove. Vertical L- shaped supports are provided on each side to make it stable in vertical plane. The two handles are provided to provide the easy handling of container and dumping of the collected dusts. It also has a vertical plate in front of the container which restricts the dusts coming out along with the end of the brush to fly out side of the container.

Figure: Container

j) BEARINGS:

A machine's bearings reduce friction between moving parts by limiting relative motion to only that motion that is intended. For instance, the bearing's design might allow the moving part to move freely in a linear direction or to freely rotate around a fixed axis. By controlling the vectors of the normal forces acting on the moving elements, it may also be used to prevent motion.

Figure : Bearing

4. DESIGN CONSIDERATION

Length of Shaft = 1.75 ft = 525 mm

Length of Roller = 450 mm

Approximate Load P = 200N

FOS = 3

Max Bending Moment = 625 N-mm

Dia. Of shaft

$$= \sqrt[3]{\frac{625}{\pi/32}}$$ = 18.53 mm

Spur Gear

I. Outer diameter (OD) =170mm

II. Inner dia (ID) = 19mm

III. No. of teeth (N) =33

Pinion Gear

I. Outer dia of pinion gear = 100mm

II. Inner dia of pinion gear = 19mm

III. No. of teeth on pinion gear =20

SPEED INCREMENT

INCREMENT = No. of teeth on Sprocket

No. of teeth on Freewheel

$$= \frac{44}{18}$$

= 2.44

5. FABRICATION TECHNIQUES USED:

a) WELDING:

By utilizing intense heat to melt the components together and then allowing them to cool, which results in fusion, welding is a fabrication method that unites materials, typically metals or thermoplastics. Welding is separate from lower temperature processes that don't melt the base metal.

Figure : welding

b) GRINDING:

A grinding wheel or grinder is used as the cutting tool in this abrasive machining technique. Given that grinding is a genuine metal-cutting operation, grinding is a subset of cutting.Grinding is used to finish work-pieces that must show high surface quality and high accuracy of shape and dimension. It has some roughing applications in which grinding removes high volumes of metal very rapidly.

Figure: Grinding

c) DRILLING:

A drill bit is spun to create a circular cross-sectional hole in solid materials during the drilling process. The drill bit is often a multi-pointed, rotating cutting instrument. While rotating at speeds ranging from hundreds to thousands of revolutions per minute, the bit is forced against the work piece.

Figure : Drilling

6. WORKING:

Eco friendly road cleaning machine is an advanced type of machine used for the roads or streets.We manufacture environmentally friendly road cleaning equipment without the need of motors, fuels, or power sources. The machine is powered or operated by human labour. A pair of wheels that are joined by a shaft hold the system in place. The shaft connects the wheels to each other. With the use of a manual force that can manage it, the wheels are shifted to the proper position. On one side of the wheel, there is a chain drive.The wheel and gear determine how the chain is moved. The brush sweeps the trash on the road and puts it into the trash cans while travelling in the opposite direction of the wheels.

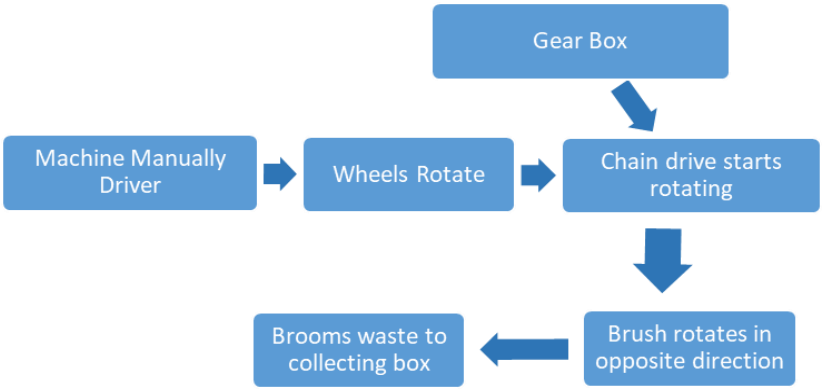

Figure : Working

Figure: Final fabricated model

7. ADVANTAGES:

1. The process takes less time.
2. There are less staff needed.
3. This road cleaning machine was created primarily to clean plane, smooth surfaces like cemented, tile, and mosaic surfaces.
4. The machine is easy to operate.
5. Machines can also be used by unskilled workers.

8. DIS-ADVANTAGES:

1. Human labour is necessary
2. Slower than an electric road sweeper equipment in terms of operation.
3. It only functions on flat surfaces.

9. APPLICATIONS:

1. Cements Factories
2. Steel Factories
3. Food Industries
4. Engineering Industries
5. Highways
6. Electronic Industries
7. Municipal Corporations
8. Ports
9. Airports

10. FUTURE SCOPE:

The resulting product performs the required motion and is completely functional. In the testing environment, it passes the test. The concept has a lot of potential, and mechanical part growth is enormous.Up until the best outcome is obtained, the optimization process will continue. Overall, the project was successful in meeting its objectives and is undoubtedly changing how floors are cleaned. Floors are cleaned more successfully as a result of this product's capacity to move in the direction of dust. This is a well-made object that might be used in contemporary Indian homes.

11. TESTING CALCULATIONS:

Quantitative testing						
			For man		For machine	
S.N	Area taken(sq cm)	Mass of dust spread (kg)	Time taken(s)	Mass collected(kg)	Time taken(s)	Mass collected(kg)
1	20600	1.2	43	0.638	09	0.6559
2	51000	1.5	104	0.99	24	1.2
3	90000	2.1	178	1.29	44	1.33

A machine-cleaned area produced more clean and dust-free surface than a human-cleaned area using a simple broom, according to examination and observation of the area we made an effort to clean. The machine, however, is likely to blow some dusts more forcefully than a regular broom because of the fast brush speed.

12. CONCLUSION:

Road cleaner that is manually operated and eco-friendly has been successfully designed, analysed, and constructed. This project uses a manually operated, environmentally friendly road cleaner to clean the roads, saving money, time, and labour. During a power outage, it is the ideal replacement for an automatic road cleaning machine. It is discovered that the current road cleaning equipment runs on fuel and diesel. It may pollute, and the machine's vibrations may also produce noise pollution. Manual cleaning, however, might be unhealthy because it puts the individual in direct contact with the dust. Additionally, the shoulder issue brought on by constant sweeping occurs.An alternative idea for preventing such issues is a manually operated environmentally friendly road cleaner. When compared to existing machinery, the manually operated eco-friendly road cleaner may perform very effectively in terms of covering area, time, and cost of road cleaning procedure. Also, it is cost-effective. When the machine was being tested, it was discovered that the cleaning was less successful when the road appeared to be particularly broken and bumpy. Because driving a machine requires human power, it is giving the uneducated person who needs such jobs a job.

Future Project Modifications

The project was unable to operate at 100% efficiency due to a number of limitations, including technical, financial, environmental, material availability, etc. To enhance the functionality of the machine, someone can continue to work on our project.

The following are potential future changes that could be made to our project:

a) Proper value analysis can be performed to choose the right materials. lowering costs and weight while boosting effectiveness.

b) Vertical brushes can be used to stop dust from spreading, and vacuums can be used to collect micro dusts.

c) Manual drives can be replaced with motor drives to increase efficiency in areas with abundant electricity, and advanced mechanisms can be added to collect both organic and inorganic waste.

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