

Design and Fabrication of Paper Recycling Machine

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ABSTRACT

In Many big educational institutions like schools / colleges or offices, generation of large quantity of waste papers is quite apparent and effective use of recycled paper is also possible (craft papers, registers etc.). So, instead of disposing off the waste papers into trash, recycling them makes sense. This is not only helping the institute or office to save the paper cost but also ensure its contribution towards the protection of the environment. The schools, colleges or offices has going to establish automatically operated small-scaled paper recycling plant inside, so that the papers required for daily use can produce very cheap by using non-complex method of production of paper. In this project design and fabricate a paper recycling machine has been made with all necessary design specifications of the customer.

1. INTRODUCTION

Papermaking and producing paper from recycled materials came to the United States simultaneously in 1690, when William Rittenhouse, who had learned to make paper in Germany, founded America's first paper mill on Monoshone Creek near Germantown, which is now Philadelphia. Rittenhouse made his paper from discarded rags of cotton and linen [1]. On April 28, 1800, an English papermaker named Matthias Koops was granted the first patent for paper recycling-English patent no. 2392, titled Extracting Ink from Paper and converting such Paper into Pulp. In his patent application, Koops described his process as, "An invention made by me of extracting printing and writing ink from printed and written paper, and converting the paper from which the ink is extracted into pulp, and making there of paper fit for writing, printing, and other purposes.

Modern civilization cannot be imagined without the use of paper. Large amount of papers are being used in everyday life; among most of them are treated as useless and they are thrown here and there after using. Sometimes it causes environmental pollution. Today, 90% of paper pulp is made of wood. Paper production accounts for about 35% of felled trees, and represents 1.2% of the world's total economic output. Recycling one ton of newsprint saves about 1 ton of wood while recycling 1 ton of printing or copier paper saves more than 2 tons of wood. So, it is the necessity of paper waste management to save the environment from its annihilation and pollution. Newsprint papers, Printing paper and tissue can be made by this recycling process that can be repeated at least 5 to seven times. The ratio of waste paper and water is a vital factor in the paper recycling process.

Counsell T.A.M et al [1] studied that Recycle is an essential method to minimize waste accumulation and reduce pollution. It is possible to reuse several different types of paper including white office paper, newspaper, colored office paper, cardboard, white computer paper, magazines, catalogs, and telephone books, but carbon paper and stickers cannot be recycled. DibakarBhattacharjee and MdKamrulIslam et al [2]Developed a manually operated paper-recycling machine is much cheaper than the automated recycling machines of low capacity, which is widely used in industries. The fabricated machine can serve dual purposes, it can be manned permanently at a stationary position or it could be shifted from one place to another. The simplicity of operation of this machine ensures that no skilled worker is needed to operate it. When the machine is well maintained, its durability is guaranteed. AmanSoni et al [3].Designed a manually operated paper recycling machine which is very cheap and noncomplex method of production of paper. This machine recycles used papers and form new papers which have correct thickness and size. The cost of manufacturing of this machine is very low and processing cost for paper recycling is also very cheap. Ajay Thakur et al [4]designed an automatically operated compact recycling machine which can be used to simply the process and reduce the production cost of paper. They observed that the paper recycling machine reduces the time required for paper recycling. This machine can be used in offices, schools, colleges and even small-scale industries. Only one operator is sufficient to carry out the entire process. We can increase the quality of paper obtained by adding some easily available chemicals like bleaching powder, talcum powder, sodium hydroxide, etc. SaheelKapse et al [5]designed manually operated recycling machine.They suggest that when the recycling process is manual the quality of paper is less, so it can be operated in automatic then recycled paper will more practical and turnover ratio will increase with a large amount. At that moment the recycle paper would be perfect for writing. As sun beams is needed for heating purpose, in rainy season it will be challenging task to heat. So, a serving dish heater can be used for heating purpose. Sundaramahalingamet al [6] designed manually operated recycling machine. It is fully mechanical operated, so there is no need of electricity, low cost, maximum usage of waste paper as in the form of recycled paper. Recycling presents an opportunity for extracting economic and environmental benefits from waste.

2. WORKING PRINCIPLE

The raw material for the paper recycling plant is paper pulp slurry and the waste papers. It is a mixture of approximately 50% pulp and 50% water. Generally, for big paper recycling plants, the source of raw material is the waste paper pulp from paper industry. But, as the machine unit fabricated under this project is of small scale and is meant for reusing and recycling the waste papers generated in a school or college, pulp slurry can be prepared locally. Additives can also be added to slurry to obtain certain desired properties of the paper.

Once the crushing operation is over, the granules are transferred to a container for adding some additives which helps to reduce the recycling time. Then finally a stirrer is used to stir the granules thereby adding required amount of water slowly. Thus, the water addition and the stirring operation are performed side by side.Then, finally the stirred granules are poured in a bed and a punching machine is used to flat and any excess water is squeezed out. The material which is obtained in squeezing should be dried at room temperature only. This drying operation cannot be done in an oven or a heater since this temperature will be very

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high for the paper material and there is a chance of product getting spoiled and hence the room temperature is preferable.



Fig: 1 Hopper with sieve drum



Fig: 2 Assembled figure of paper recycling machine



Fig: 3 Produced paper

3. FABRICATION PROCESS

The paper recycling process basically involves the generic recycling process of collecting the recyclables, sorting them by their types, processing them into raw materials and manufacturing new products using these recycled raw materials. Nevertheless, there are some variations from the process of recycling other materials. Three categories of paper can be used as feed stocks for making recycled paper – mill broke pre-consumer waste, and post-consumer waste. Mill broke is paper trimmings and other paper scrap from the manufacture of paper, and is recycled internally in a paper mill. Pre-consumer waste is material which left the paper mill but was discarded before it was ready for consumer use. Post-consumer waste is material discarded after consumer use, such as old corrugated containers (OCC), old magazines, and newspapers. Paper suitable for recycling is called "scrap paper", often used to produce molded pulp packaging. The industrial process of removing printing ink from paper fibers of recycled paper to make deinked pulp is called deinking. The conventional method of the paper recycling involves the following processes:

To start the paper recycling process, the waste paper needs to be sorted, such as by newsprint, computer paper, magazine paper etc., as different types of paper are treated differently during the paper recycling process to make different types of recycled paper products. For example, finer paper with multi-colored ink would require additional processing. Effort is taken to ensure that the waste paper is free of any pins, clips, staples etc. The last stage of the recycling process is cleaned-up pulp made ready to produce into recycled paper. The recycled fiber can be used alone, or blended with new wood fibers (i.e. virgin fibers) to give it extra strength or smoothness. The pulp is mixed with water and chemicals, such that the pulp is 99.5% water. This watery pulp mixture then enters the head box of a paper making machine, and is sprayed in a continuous jet onto a huge wire mesh-like screen moving very quickly through the paper machine. On the screen, water starts to drain from the pulp, and the recycled fibers begin to bond together to form a waterless sheet. Then the sheet moves rapidly through a series of felt-covered press rollers which squeeze out more water from the pulp. The major components involved in the fabrication of the automatic paper recycling machine are as follows. Frame, Stirrer, Pulper, Heating element, D.C Motor,

Bearing with bearing Cap, Pneumatic cylinder, 5/2 Direction control valve, Flow control valve, Connectors and hoses, Air Dryer, Micro controller along with GSM facility, ThermocoupleFrame is made up of mild steel material. All the necessary parts are fixed in to this frame with a suitable arrangement.



Fig: 4. Frame



Fig: 5 pulper

In agriculture, a pulper is a machine is used to remove pulp (i.e. the soft flesh is produced from agricultural). For example, in coffee growing the ripe red cherries are picked from the coffee bushes and prior to fermentation and later drying the soft pulp needs to be removed (otherwise a potentially uncontrollable fermentation/rot will occur).

4. PRINCIPLE OPERATION OF DC MOTOR

The Fig 6 shows a uniform magnetic field in which a straight conductor is placed to carry no current. The conductor is perpendicular to the direction of the magnetic field. The conductor is as carrying a current away from the viewer, but the field due to the N and S poles has been removed. There is no movement of the conductor during the above two conditions. The current carrying conductor is placed in the magnetic field. The field due to the current in the conductor supports the main field above the conductor, but opposes the main field below the conductor. The result is to increase the flux density in to the region directly above the conductor and to reduce the flux density in the region directly below the conductor. It is found that a force acts on the conductor, trying to push the conductor downwards as shown by the arrow. If the current in the conductor is reversed, the strengthening of flux lines occurs below the conductor, and the conductor will be pushed upwards.

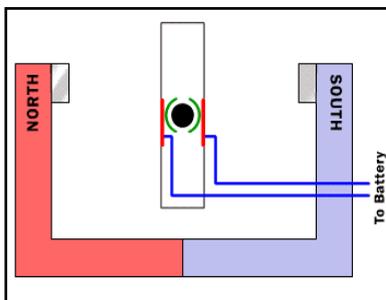


Fig: 6. Rotation of magnet

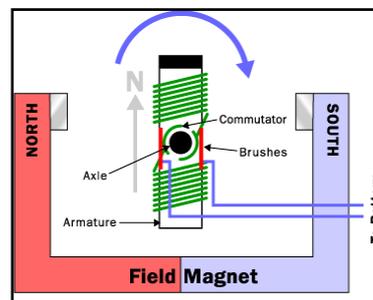


Fig: 7. DC motor arrangement

An electric motor is all about magnets and magnetism: a motor uses magnets to create motion. In general the opposite poles of magnets are attracted and like poles are repel. So, if the two bar magnets with their ends marked north and south, then the North end of one

magnet will attract the South end of the other. On the other hand, the North end of one magnet will repel the North end of the other (and similarly south will repel south). Inside an electric motor these attracting and repelling forces create rotational motion. In the diagram above and below two magnets are arranged in the motor, the armature (or rotor) is an electromagnet, while the field magnet is a permanent magnet (the field magnet could be an electromagnet as well, but in most small motors it is not to save power).

DOUBLE ACTING PNEUMATIC CYLINDER

Mechanization is broadly defined as the replacement of manual effort by mechanical power. Pneumatics is an attractive medium for low cost mechanization particularly for sequential or repetitive operations. Many factories and plants already have a compressed air system, which is capable of providing both the power or energy requirements and the control system (although equally pneumatic control systems may be economic and can be advantageously applied to other forms of power). The main advantages of an all-pneumatic system are usually economy and simplicity, the latter reducing maintenance to a low level. It can also have outstanding advantages in terms of safety.

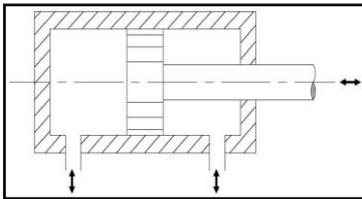


Fig: 8. Double acting Pneumatic Cylinder



Fig: 9. Directional control valve



Fig: 10. Connectors and Hoses

The cylinder is a double acting cylinder one, which means that the air pressure operates alternatively (forward and backward). The air from the compressor is passed through the regulator which controls the pressure to required amount by adjusting its knob. A pressure gauge is attached to the regulator for showing the line pressure. An air cylinder is an operative device in which the input energy of compressed air i.e. pneumatic power is converted in to mechanical output power, by reducing the pressure of the air to that of the atmosphere. A double acting cylinder is employed in control systems with the full pneumatic cushioning and it is essential when the cylinder itself is required to retard heavy masses. This can only be done at the end positions of the piston stock. In all intermediate position a separate externally mounted cushioning derives most be provided with the damping feature. The normal escape of air is out off by a cushioning piston before the end of the stock is required. As a result, the slit in the cushioning chamber is again compressed since it cannot escape but slowly according to the setting made on reverses. The air freely enters the cylinder and the piston strokes in the other direction at full force and velocity. This valve is used to speed up the piston movement and also it acts as a one-way restriction valve which means that the air can pass through only one way and it can't return back. By using this valve, the time consumption is reduced because of the faster movement of the piston.

In pneumatic system there are two types of connectors used; one is the hose connector and the other is the reducer. Hose connectors normally comprise an adapter (connector) hose nipple and cap nut. These types of connectors are made up of brass or Aluminum or hardened steel. Reducers are used to provide inter connection between two pipes or hoses of different sizes. They may be fitted straight, tee, “V” or other configurations. These reducers are made up of gunmetal or other materials like hardened steel etc.

MICROCONTROLLER ALONGWITH GSM AND RELAY CONTROL USING KEIL PROGRAMING:

A Micro controller is a computer present in a single integrated circuit which is dedicated to perform one task and execute one specific application. It also contains memory, programmable input / output peripherals as well a processor. Microcontrollers are mostly designed for embedded applications and heavily used in automatically controlled electronic devices such as cell phones etc.

Far more economical to control electronic devices and process as the cost involved is comparatively less than other methods. Operating at a low clock rate frequency, usually use four-bit words and are designed for low power consumption.

Architecture varies greatly with respect to purpose from general to specific and with respect to microprocessor, ROM, RAM or I/O functions. Has a dedicated input device and often has a display for out-put. Usually embedded in other equipment and are used to control features or actions of the equipment. Used in situations where limited computing functions are needed. The AT89C52 is a low power, high performance CMOS 8-bit microcomputer with 8 k bytes flash programmable and erasable read only memory. The device is manufactured using high density nonvolatile memory technology and is compatible with industry standard 80C51 and 80C52 instruction set and pin out. The on-chip flash allows the program memory to be re programmed in system or by a conventional nonvolatile memory programmer like KEIL and C software.

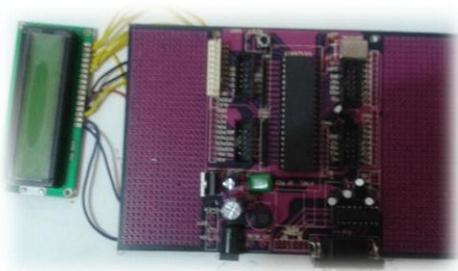


Fig: 11. 89C52 Micro controller along with LCD screen



Fig: 12. GSM module

GSM Module:

GSM (Global system for Mobile communications) is basically a modem which accepts a sim card and works in the GSM network provided by the operator just like a mobile phone. The GSM module can be controlled by a computer or a micro controller to do different task in the network such as calling, sending messages, accepting messages etc. The GSM module usually communicate with the parent hard ware is a personal computer the communication is

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done by the serial port and if the parent system is microcontroller based, the communication is done through the TTL pins Rx and Tx. Advanced GSM may even have WIFI and Bluetooth connectivity. Common applications of GSM are message sending and delivery of the message. There are many variants in GSM module like SIM 900, SIM 300, SIM 800.

Manufacturing processes are the steps through which raw materials are transformed into a final product. The manufacturing process begins with the creation of the materials from which the design is made. These materials are then modified through manufacturing processes to become the required part. Manufacturing processes can include treating (such as heat treating or coating), machining, or reshaping the material. The manufacturing process also includes tests and checks for quality assurance during or after the manufacturing, and planning the production process prior to manufacturing.

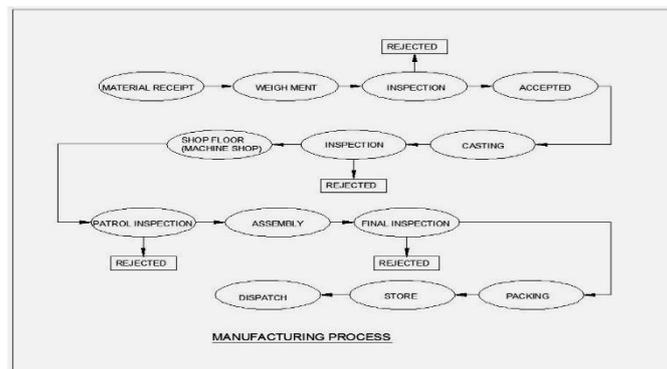


Fig: 13. Flow chart of manufacturing process

METAL CUTTING

Metal cutting or machining is the process of by removing unwanted material from a block of metal in the form of chips with the help of cutting tool. The chips may be continuous or continuous. Cutting processes work by causing fracture of the material that is processed. Usually, the portion that is fractured away is in small sized pieces, called chips. Common cutting processes include sawing, shaping (or planning), broaching, drilling, grinding, turning and milling. Although the actual machines, tools and processes for cutting look very different from each other, the basic mechanism for causing the fracture can be understood by just a simple model called for orthogonal cutting.

Cold saws are saws that make use of a circular saw blade to cut through various types of metal, including sheet metal. The name of the saw has to do with the action that takes place during the cutting process, which manages to keep both the metal and the blade from becoming too hot. A cold saw is powered with electricity and is usually a stationary type of saw machine rather than a portable type of saw. The circular saw blades used with a cold saw are often constructed of high speed steel. Steel blades of this type are resistant to wear even under daily usage. The end result is that it is possible to complete a number of cutting projects before there is a need to replace the blade. High speed steel blades are especially useful when the saws are used for cutting through thicker sections of metal. Along with the high-speed steel blades, a cold saw may also be equipped with a blade that is tipped with tungsten carbide. This type of blade construction also helps to resist wear and tear. One major

difference is that tungsten tipped blades can be re-sharpened from time to time, extending the life of the blade. This type of blade is a good fit for use with sheet metal and other metallic components that are relatively thin in design.

WELDING

Welding is a process for joining two similar or dissimilar metals by the application of heat with or without application pressure and with or without application of filler metal. Welding joins metals by melting and fusing the base metals by applying the filler metal. Welding employs pinpointed, localized heat input. Most welding involves ferrous-based metals such as steel and stainless steel. Weld joints are usually stronger than or as strong as those of the base metals being joined.

Welding is used for making permanent joints. It is used in the manufacture of automobile bodies, aircraft frames, railway wagons, machine frames, structural works, tanks, furniture, boilers, general repair work and ship building. An assembly line is a manufacturing process (most of the time called a progressive assembly) in which parts (usually interchangeable parts) are added as the semi-finished assembly moves from work station to work station where the parts are added in sequence until the final assembly is produced. By mechanically moving the parts to the assembly work and moving the semi-finished assembly from work station to work station, a finished product can be assembled much faster and with much less labor than by having workers carry parts to a stationary piece for assembly.

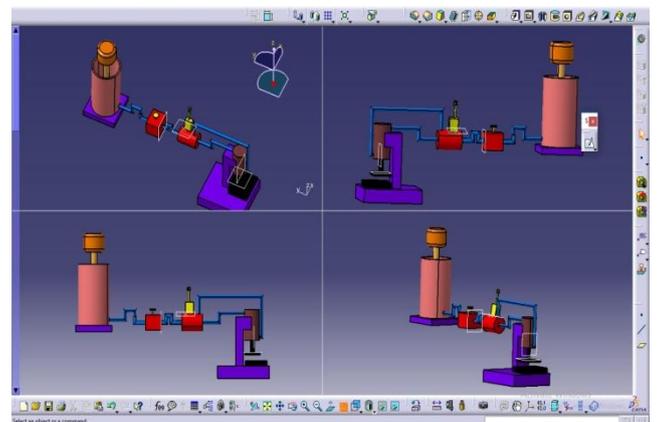
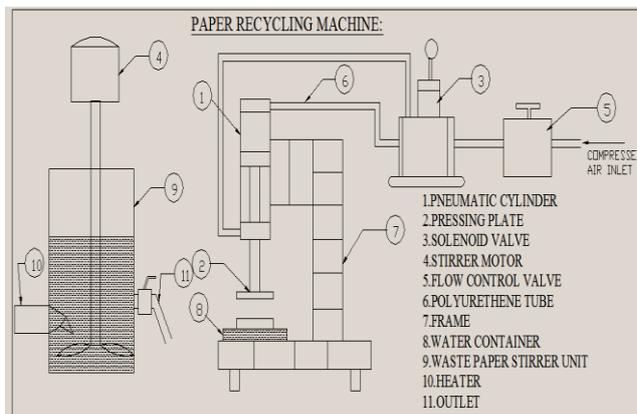


Fig: 14. 2D- Drawing of Paper Recycling Machine Fig: 15. Isometric Drawing with Front, Top & Side views

The capital cost of the machine is low. Increases production. Small in size and hence it is portable. The wastes that are produced from this machine are environmentally friendly and don't produce any harm to the environment, No need of skilled persons to operate the machine. Regular maintenance is a must. Cleaning of the machine must be done periodically.

5.CONCLUSION

The design and fabrication of paper recycling machine project completed in limited time and the machine is working with satisfactory conditions. Recycle is an essential method to minimize waste accumulation and reduce pollution. Recycling of waste paper is beneficial not only from the economic point of view but also for the protection of the environment. It promotes conservation of one of our very important natural resources like trees. In this project a manually operated paper recycling machine designed and fabricated, which can recycle waste paper for various productive purposes. The fabricated machine can serve dual purposes, it can be manned permanently at a stationary position or it could be shifted from one place to another as the case may be. The fabrication cost and running cost of the machine is very low which is quite economical.

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