Manually Operated Paper Recycling Machine

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Abstract- *Paper is one of the most important products ever invented by man. Widespread use of a written language would not have been possible without some cheap and practical material to write on. The invention of paper means that more people would be educated because more books would be printed and distributed. Industry would grow because all the plans, blueprints, records and formulae it uses would be written down and saved, together with the printing press, paper provided an extremely important way to communicate knowledge. The primary source of raw material for production of paper is vegetable fibers, obtained mainly from plants. To ensure that the forest is not depleted of these woods, there is need to provide alternative source of raw materials, this therefore leads to the invention of the process of recycling. Recycling, which is the extraction and recovery of valuable materials from scrap or other discarded materials, is employed to supplement the production of paper.*

Keywords- hydro pulper, container, screw type pneumatic press, sheet formation.

I. INTRODUCTION

paper is one of the most important products ever invented by man. The primary raw material for the paper production is pulps fibers obtaining by a complicated chemical process from natural materials, mainly from wood. This fibers production is very energy demanding and at the manufacturing process there are used many of the chemical matters which are very problematic from view point of the environment protection. The paper recycling, means the repeated defibering, grinding and drying, when there are altered the mechanical properties of the secondary stock, the chemical properties of fibers, the polymerization degree of pulp polysaccharidic components, mainly of cellulose, their supra molecular structure, the morphological structure of fibers, range and level of inter fibers bonds. Paper recycling saves the natural wood raw stock, decreases the operation and capital costs to paper unit, decrease water consumption and last but not least this paper processing gives rise to the environment preservation. A key issue in paper recycling is the impact of energy use in manufacturing. Paper recycling is the process of recovering waste paper and remaking it into new paper products. There are three categories of paper that can be used as feedstock for making recycled paper:- mill broke, pre-consumer waste, and post-consumer waste.

Designing a manually operated paper recycling plant ensures that a cheap and noncomplex method of production of paper product is guaranteed. Recycling, which is the extraction and recovery of valuable materials from scrap or other discarded materials, is employed to supplement the production of paper. The fabricated plant consists of six major component units that include the disc refiner, the hydrapulper, the head box, the felt conveyor, the driers and the rollers. The invention of paper means that more people would be educated because more books would be printed and distributed. The primary source of raw material for production of paper is vegetable fibers, obtained mainly from plants. To ensure that the forest is not depleted of these woods, there is need to provide alternative source of raw materials, this therefore leads to the invention of the process of recycling.

II. LITERATURE REVIEW

[01] **Carlson W. E. C**. grinding and drying, when there are altered the mechanical properties of the secondary stock, the chemical properties of fibers, the polymerization degree of pulp polysaccharidic components, mainly of cellulose, their supramolecular structure, the morphological structure of fiber, range and level of inter fibers bonds. A cheap and noncomplex method of production of paper product is guaranteed. Recycling, which is the extraction and recovery of valuable materials from scrap or other discarded materials, is employed to supplement the production of paper.

[02] **Kenneth W.B.** Today, recycling of construction and demolition waste (C&DW) by plants is a reasonable alternative to the existing unsustainable disposal methods such as landfilling and fly tipping. Therefore this study aims to report current management issues of these plants in the literature. As a result, it was seen that these management issues investigated in past researches can be classified under four main groups such as economics, environment, location, and administration. Their pros and cons were also revealed in a covering manner. As these issues have not been addressed together up to date and each one of them has been investigated separately, the present study is the first attempt to give a full picture of management issues of the recycling plants. Thus, it

can fill the gap in the literature. As a research implication, this study may help researchers who will investigate C&DW recycling plants from different perspectives.

[03] **Ivana Bolanca Mirkovic** A manually operated paper-recycling machine was designed and fabricated. This was done to enable waste paper conversion into useful product. The fabricated plant consists of six major component units that include the disc refiner, the hydrapulper, the head box, the felt conveyor, the driers and the rollers. From the results of experimental analysis carried out on the study, it was discovered that for every 0.1kg of used paper fed into the refiner, about 7000ml of water is required to defiber it, and about 0.2 kg of starch adhesive is required. The calculated volume of the refiner, Hydrapulper and head box is 11795.62cm3, 62930.47cm3 and 60979.096cm3 respectively. The fabricated machine is capable of producing 7.6 kg of recycled paper from 10 kg of used paper.

III. PROCESS OF PAPER RECYCLING

Pulping and Bleaching

Paper contains wood cellulose fibers. First, the wood material/used paper is crushed and dissolved in to pulp which results in a mass of individual fibers. Then the pulp is washed and filtered to remove foreign residues. The remaining water in the pulp is removed by pressing the pulp, which is then directly used or bleached for imparting whiteness and brightness. For recycling, the paper collected from various places is categorized and sorted using conveyor belts. Deinking is necessary for waste paper recycling since it contains written ink, graph marks, etc. deinking is done by two methods – washing and flotation. Washing process- a hydro-pulper is used for separating the fibers from the paper web by agitating with water and making slurry. Any undesirable material can be removed by centrifugal screening, through which most of the ink is drained of through ink screens. Sickies (unwanted adhesive particles) are then removed by fine screening process.

Flotation process – the used paper is dissolved and made into slurry and chemical surfactants are added to produce froth floating on the pulp. This froth which carries ink and unwanted foreign particles, is then blown away from the slurry before the bubbles break. The pulp cleaned in this way is then subjected to bleaching to make high quality paper. Bleaching process imparts absorption capacity to the paper. ECF (elemental chlorine-free) pulping using chlorine dioxide is now the dominant technology worldwide.

Papermaking

On the paper machine, more water is added to produce a fiber suspension of as little as 1-to-10 parts fiber to 1000 parts water and the resulting mixture is passed into a head-box which squirts it through a thin, horizontal slit across the full machine width (typically 2 - 6 m) on to a moving, endless wire mesh. The water is then removed on this wire section by a mixture of gravity and suction in a process known as sheet formation where the fibers start to spread and consolidate into a thin mat, which is almost recognizable as a layer of paper on top of the wire mesh. This web of wet paper is then lifted from the wire mesh and squeezed between a series of presses where its water content is lowered to about 50%.

IV. DESIGN OF PAPER RECYCLING EQUIPMENT

Hydrapulper

Paper pulper is used, for crushing virgin pulp (slabs or sheets), waste paper processing, machine broke, deinking and pulp purification. It disintegrates the fiber by the action of mechanical operation. Among, the raw materials waste paper processing is significant. hydrapulper can be designed, to operate at high (20%-40%), medium or low consistency (3%-5%). They can have bottom entry, side entry or top entry rotors.

Fig1: Isometric Front View of Hydro Pulper

Design Calculations and Modelling

Mass of waste paper (m) = 70kg

Density of the pulp (ℓ) = 1.732 g/cm^3

Volume of the pulp (V_p) =m/ℓ

$V_p = 70*10^3/1.732 = 40416$ cm^3

Volume of the Hydrapulper $V_H = V_p + 0.3\ V_p = (1.3)\ V_p = 52540$ cm^3

the shape of Hydrapulper is cylinder, VH = π/4 D2h
Let, h = 50 cm
D=37 cm

Design of Blade

Diameter of blade (Db) = 0.5+D =18.5 cm

Height of the blade from base of the cylinder =5cm.

Univat

Univat plays a crucial role in paper recycling process. After completion of pulp preparation the pulp is placed on Univat box. The Univat is submerged ¾ Univat tank. It is connected to lifting bars with the help of chains. Here, the pulp is poured into the Univat box and mixed thoroughly. After completion of mixing, the Univat box is lifted with help of lever mechanism by applying force on it. The flat wire screen is having uniform thickness sheet of paper pulp on the screen, water starts to drain from the pulp and the recycled fibers begin to bond together to form a watery sheet. The paper pulp is separated with help of cotton cloths and placed one by one in order. The number of paper sheets are moved to screw-press to squeeze cut more water by applying the human effort. The Univat tank is made of 18" MS guage sheet material. The long sheet is made into five pieces with the following dimensions:

Base – 42"×30 Side – 42"×18"Width – 30"×18"

Fig2: Fabricated UNIVAT Tank

Screw-Press

Screw press is used to separate liquids from solids. A screw press is a type of machine press in which the ram is driven up and down by a screw. The screw shaft can be driven by a handle or wheel. It works by using a coarse screw to convert the rotation of handle or drive-wheel into a small downward movement of great force.

Fig3: Screw Press Design and Fabricated Model

V. COLLECTION OF WASTE PAPER

The waste paper generated in various departments, office, library, stationary, examination cell is identified and collected for the recycling of waste paper and their by utilizing waste generated in the campus effectively. The collected waste paper is made into small pieces and made to rest in water for the entire day for making pulp. The Hydro pulper, which is used to make pulp fibers in the recycling process, is replaced with the blender. After pulping process, the pulp is deinked. The deinking of pulp is carried out in a container which consists of H2O2, Boric Powder and Gaur Gum. One liter of pulp that is taken for the deinking utilizes 10ml of H2O2, 5 gm of Boric Powder and 10 ml of Gaur Gum. The above figure 5.4 shows pulping of paper waste collected and adding adhesives to the pulp collected in the container for strengthening of fibers.

Paper Extraction

The pulp made is placed on Univat box. The Univat box is submerged ¾ Univat tank. It is connected to l ifting bars with the help of chains. Here, the pulp is poured in to the Univat box and mixed thoroughly. After completion of mixing the Univat box is lifted with help of lever mechanism, by applying force on it. The flat wire screen which is having uniform thickness sheet of paper pulp on the screen, water starts to drain from the pulp and the recycled fibers begin to bond together to form a watery sheet.

The paper pulp is separated with help of cotton cloth and placed one by one. The screw press squeezes the material against a screen or filter, and the liquid is collected through the screen. After the water is squeezed, the outcome is dried and made into pieces or sheet of paper of different sizes.

Design and Fabrication of Low Cost Paper Recycling Equipment

Fig 6: Making Sheet of Pulp

This is he univet which is use to making pulp. Here net type sheet is used which purify the pulp and obtain the paper in wet condition which are after dry within the few hours

VI. ADVANTAGES

- Low cost of operation
- Low cost for development
- Easy to transport
- Suitable for small industries
- Simple operation
- Easy maintenance
- Recycling saves the Earth.
- Recycling conserves energy.
- Recycling minimizes waste products placed in landfills.
- Recycling can help you save money.
- Recycling of waste paper is beneficial not only from economic point of view but also for the protection of environment.

VII. CONCLUSION

Recycling of waste paper is beneficial not only from economic point of view, but also for the Protection of Environment. It promotes conservation of one of our very important natural resource trees. Considering this, a small scale manually operated recycling machine has been designed and fabricated, which can recycle waste paper for various productive purposes. here we produce a4 size paper without any damage to our environment. This is very economical and very cheap process.

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