Technological Advancement in Cup Stock Collection and Recycling Process

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ABSTRACT

Recycled fibre today plays very crucial role in pulp & papermaking sector due to deficiency of forest based resources and urge to move for agro residues, particularly, for mills not having chemical recovery. At present 30 % to 35% of waste paper requirement are met through indigenous collection as mixed form .Therefore, processing poses a difficult challenge for the paper industry for efficient use. Proper segregation & sorting and subsequent use of appropriate technology is the key to derive best possible results from this raw material. The introduction of various additives and polyethylene coatings in paper composite has brought new challenges in recycling process. Cup stock is widely used for drinking purpose both hot and cold drinks. It is manufactured by blending with hardwood pulp and 5 -30 % of the softwood pulp to improve stiffness and evade cracking during manufacturing .Many of the Indian paper industries has left out the cup stock from recycling due to the presence of polyethylene .The experimental results indicated that cup stock can be recycled after appropriate removal of polyethylene coating.

Keywords: *Cup stock, collection methods, consistency, agitator rpm, agitator angle, vibrating screen*

Introduction

During the last 50 years , the effect of recycling on pulp properties has been investigated and continues till date (1).Recycling process reduce the processing cost and also helps to environment act . Most of the Paper industries utilize its broke at stock preparation with or without the specific ratio addition. Paper cups used as coffee cups or for cold drinks are accumulating as wastes on the earth surface at a rapid rate. Most paper cups are designed for a single use and then disposed or recycled.

A comparison between paper and plastic cups show environmental effects of both with no clear winner. One paper cup represents 4.1g equivalent petrol with a production cost 2.5 times higher than plastic cups (2) . Paper cups are not specifically recycled. They come under regular waste and burnt or put on landfills. Recycling paper cups is difficult because of its composition as a complex of paper and paraffin. Hence they need about 150 years (same as plastics) to degrade because of their plastic foil (3). The paper cups are produced from wood pulp (cellulose) and polyethylene plastic film, made out of petrol or paraffin, to improve its water resistivity and resistance to heat. Cellulosic resources are in general very widespread and plenty available. Unlike newspaper and cardboard boxes, disposable paper cups are not recyclable. The thin lining that makes a paper cup waterproof also keeps it from being recycled. Materials may decompose very slowly in landfills, which is another incentive for recycling instead of land filling. Table: 1 shows the decomposition rates of some common items that are frequently landfilled.

Table: 1 Decomposing time for various fibrous materials

Item	Amount of Time Required to Decompose
Paper Bag	1 month
Banana peel	3-4 weeks
Cotton Rags	5 months
Wool Sock	1 year
Wood	10-15 years

Some Possible Collection Methods

One of the major issue in recycling is the collection and sorting of recycled paper. The mill authorities / concerned departments are to be implementing some collection methods depending on their views. There are four methods generally considered for the waste paper collection. They are discussed below.

1. Drop-off Center

This is the easiest to set up from a programming point of view. Arrange for a central site where recyclables can be deposited.

2. Building Pickups

For greater participation, a weekly pickup at each building or group of buildings is preferable. Containers for each type of recyclable

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material should be provided to allow for recyclables to be separated accordingly. The pickup process can be made easier by assigning to one person in each building the responsibility of putting the containers outside the evening before pickup will occur. Building pickups simplify materials tracking procedures while presenting opportunities for campus recycling competitions.

3. In-House Pickup

Depending on how the broker/contractor runs the collection system, it may be possible for him/her to collect the containers themselves from each building. Find out if the campus will still receive the proceeds from recyclables if the broker picks materials up directly from sites (as opposed to a campus centralized location). Examine the possibility of involving the custodial staff in the collection. When trash is converted to recycling, the amount of materials handled still remains the same, so the program would not be detracting from current disposal processes.

4. Outside Contractor

There are some companies that will completely run a program,

Fig: 1 Drop-off Center method

Fig: 2 Drop-off Center method

Fig: 3 Drop-off Center method

including supplying containers, collection, and maintenance. Sometimes the campus can share in the recycled materials revenue while saving money on labor and disposal costs. Be sure to research creative waste hauling contracts. For instance, many schools have built in contract language that rewards increased recycling by a hauler. The followings are the collection methods used for these studies.

Commonly the easy approach for dropping the used cup stock material at specific place in a party or in a town will make the collection very easy. To measure the effectiveness of the above four collection methods, field study conducted in and around Kalyan Mahals at Erode during various parties.

Collection data indicates that the use and demand for cup stock and good future for eco friendly paper products. Among the four methods, Drop-off Center gives a better result of collection.

Sorting and Cleaning

After collection, the primary process is the sorting and cleaning. Used cupstock should be sorted out to get free from contamination. Due to polyethylene coating there is no absorption and adsorption of liquids inside the cup stock. How ever a little cleaning on the spot or in the mill area avoid the agitator contamination.Examples of the cup stock materials after sorting and cleaning are presented below

This result shows the proximate and ultimate analysis of cup stock

Rheological properties of fiber suspensions

The rheological properties of fiber suspensions are discussed by Gullichsen. Fiber suspension initially behaves as a non-Newtonian fluid with a shear stress “t”. When the shear stress exceeds a certain “y” value the fiber network structure is disrupted and the suspension behaves nearly as a turbulent Newtonian fluid. As a result of this rheological behavior fiber suspensions are extremely difficult to agitate. To provide motion through the whole tank the shear stress has to exceed the yield stress every where in the fluid. Since gradients in shear stresses can be expected, there will be regions in the fluid where the fiber network structure is disrupted and the flow will be turbulent. At the same time the flow may be laminar or even be stagnant in other parts of the chest.

Material and Methods

Disintegration experiments were carried out after sorting and cleaning of cup stock. 20 grams the cup stock was soaked in 2000 litre deionized water at 20 ± 2°C of the water for 10 min. After the pulp suspension it was diluted to get 1.0 to 4.0 % consistency. Disintegration was performed after the modification blade angle at 400 rpm until all fiber bundles are separated but not more than 800 rpm revolutions. At the end of disintegration all the fiber suspension were transferred to Sommerville Type equipment to measure the flakes, plastic content of the pulp suspension .Slushing Water flow rate controlled through calibrated flushing nozzles located in the centre of the screen with a flow rate of 8.6 litre/min. at 1.23 Kg/cm^2 and 0.0150 mm Screen plate size were used to measure the contaminants. All other processes were made as per T:275

Table: 2 Cup stock collection by Drop-off Center method

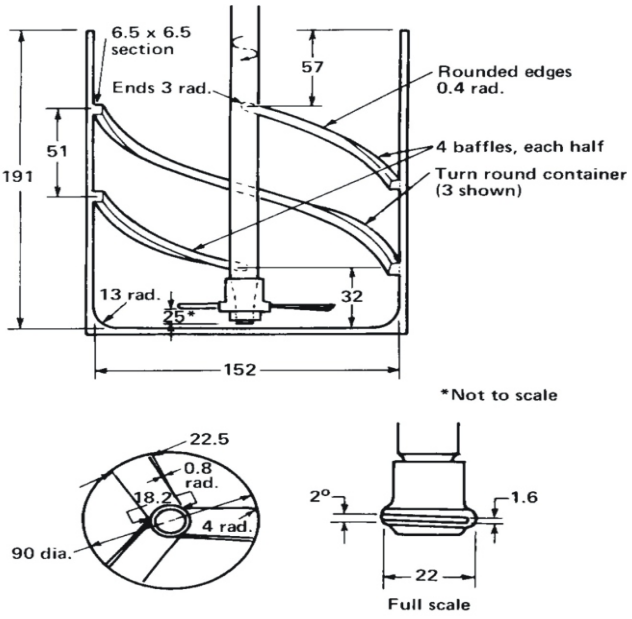
Date	Area1 kg	Area2 kg	Area3 kg	Area4 kg	Area5 kg	Area6 kg	Area7 kg	Area8 kg	Area9 kg
15.04.12	120	80	42	75	35	69	95	24	19
16.04.12	65	58	32	65	42	61	95	10	98
19.04.12	32	21	54	6	71	17	18	19	21
25.04.12	24	51	65	85	32	28	49	56	63
07.05.12	65	52	28	29	61	49	35	29	96
11.05.12	65	51	42	92	26	28	73	31	65
16.05.12	36	51	42	56	26	20	50	46	30
17.05.12	20	40	51	20	60	70	85	93	31
18.05.12	30	50	42	26	82	29	22	44	31
23.05.12	32	25	26	24	24	30	50	40	63
25.05.12	29	82	28	27	19	64	25	56	26
31.05.12	71	18	45	43	83	69	52	45	49
01.06.12	29	56	58	46	19	12	21	25	46
07.06.12	18	45	42	28	26	27	37	38	29
14.06.12	25	29	28	27	37	29	36	49	56
18.06.12	52	42	46	43	39	46	05	25	26
21.06.12	26	45	43	26	38	26	96	85	25
29.06.12	25	45	51	26	28	46	56	62	62

Fig: 4 Cup stock after sorting and cleaning

Table: 3 Analysis of cup stock (2)

Proximate Analysis wt %	**Paper cup waste**
Moisture	0.0
Volatile matter	52.0
Ash content	2.0
Fixed Carbon	46.0
Ultimate Analysis %	
C	46.7
H	6.7
N	2.12
S	0.0
O	44.4
Emprical Formula	C1.4H2.41N0.05O
Gross Calorific Value (MJ / Kg)	20.102

Model for Proposed alternative approach



Cup stock disintegrating photo: 1

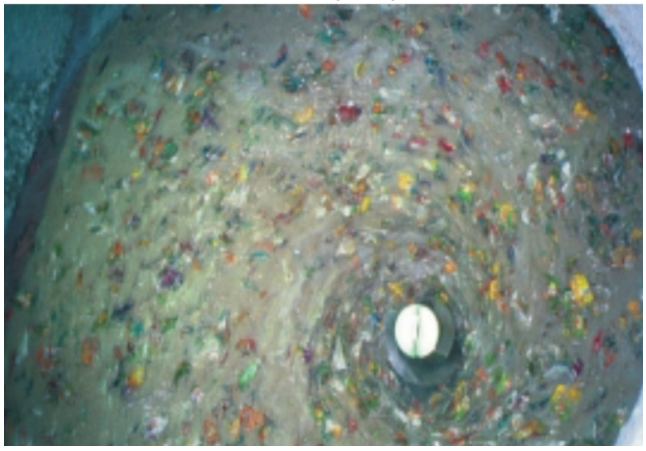


Table: 4 Laboratory model angle 1° disintegration conditions

Sl No	Laboratory disintegrator angle	% consistency	Flake and contaminations (Wt %)
1	1°	1.0	75.6
2	1°	2.0	64.0
3	1°	3.0	58.0
4	1°	4.0	44.0

Table: 5 Laboratory model angle 2° disintegration conditions

Sl No	Laboratory disintegrator angle	% consistency	Flake and contaminations (Wt %)
1	2°	1.0	88.4
2	2°	2.0	79.9
3	2°	3.0	52.0
4	2°	4.0	41.0

Table: 6 Laboratory model angle 3° disintegration conditions

Sl No	Laboratory disintegrator angle	% consistency	Flake and contaminations (Wt %)
1	3°	1.0	69.2
2	3°	2.0	57.0
3	3°	3.0	49.9
4	3°	4.0	40.9

Table: 7 Laboratory model angle 4° disintegration conditions

Sl No	Laboratory disintegrator angle	% consistency	Flake and contaminations (Wt %)
1	4°	1.0	54.0
2	4°	2.0	47.0
3	4°	3.0	39.9
4	4°	4.0	29.9

"Screening of pulp" (4)

Results and Discussion

Cup stock from various areas were collected and sorted out. Table: 2 shows the usage of cup at various points.

As seen from the table 4 disintegration yield a result for Flake and contaminations removal for 1° angle at various consistencies , maximum flakes and contaminations removal were got at 1.0 % consistency and minimum at 4.0% consistency . Table 5 clearly indicates that the maximum flakes and contaminations removal were got at 2.0 % consistency as 88.4%.From table 6 , 7 at an angle of 3° 4° poor flakes and contaminations removal as may be seen from table as maximum flakes and contaminations removal for

3ºangle was 69.2 % and at an angle of 4º was 54.0 %

Conclusions

From the above laboratory experiments, the recycling of cup stock can be effectively implemented in plant scale. For that some modifications could be done on pulper design. It is clearly understood that the application of drum pulper and hydra pulper is not suitable for the removal of plastic coating in cup stock because of the high speed which produce high damage to polyethylene layer and unavailabity of the equally spaced spiral baffles. To make the rubbing action of crushing action between the solid cup stock materials and the agitator blade by which the polyethylene coating can get effectively deboned from the fiber mass. The time requirement for efficient slushing may vary from ½ hr to ¾ hr depending up on the input. From the above laboratory model 2 º angle and the operating consistency 2% produces the better result which may be considered for the designing of Vertical top entering pulper model for cup stock recycling. It was observed the cutting of plastic is more at angle increased at more than 3 degree. The angle more than 2 degree and the consistency more than 2% will not yield a fruitful result.

All scales are in mm. Blade angle should be designed at 2º and operating consistency may vary from 1.5 to 2.0 % depending up on process conditions. Other mechanical design aspects such as volume, height, material of construction is to studied and also disposal of contaminants can disposed as per local municipal solid waste management or incineration method .

Acknowledgement

The author sincerely thank to Research guide, guidance of Co-author and support of the principal , Management of Nandha College of Technology , Perundurai , Erode for their valuable guidance on submission of this article in IPPTA seminar -2013 August .

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