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APPROPRIATE TECHNOLOGY FOR DEVELOPING COUNTRIES FOR THE MANUFACTURE OF LINER BOARD AND CORRUGATING MEDIUM USING WASTE PAPER

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Introduction

Waste paper is a valuable raw material for the paper industry. A wide range of paper grades are now being made out of waste paper, such as liner board, corrugating medium, tissues, newspaper and even fine paper. On account of this trend, recycling is becoming popular even for countries which have an abundant supply of virgin fiber from wood. (See graph for USA Waste Paper Recovery for the period 1970–1988)

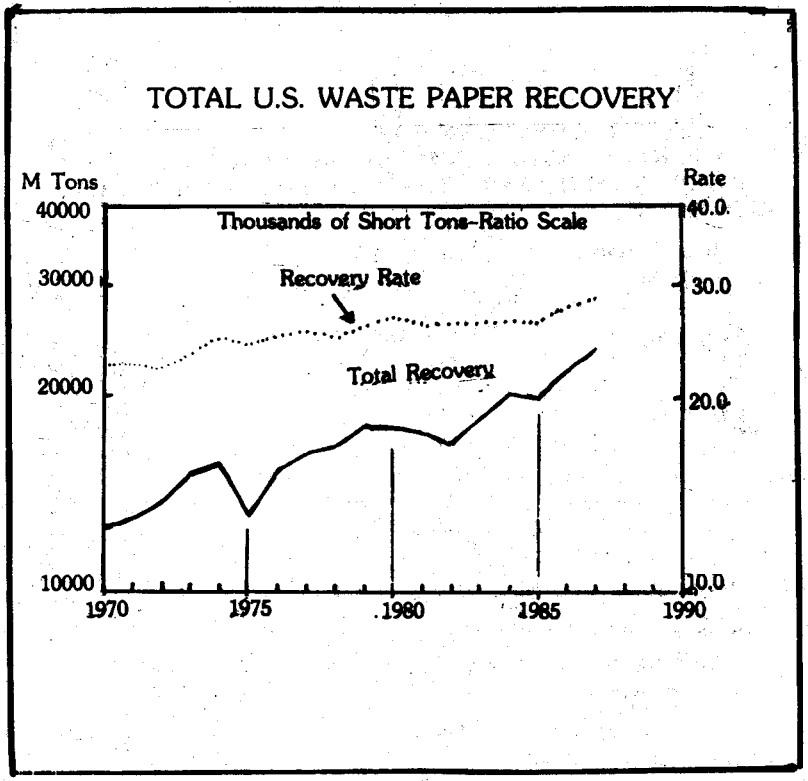
Recycling is an answer to several problems such as :-

— Diminishing of forestry resources thus preventing indiscriminate cutting of wood.

— Energy conservation since secondary fiber mills require less energy than virgin fiber mills.

— Reduced capital investment for paper manufacture compared with mills integrated to virgin fiber pulp production.

However, on the other hand, recycling poses a number of challenges to the papermaker. These challenges are on account of the new development of special types of adhesives, plastic materials, printing inks etc. used in the converting and printing of paper. Therefore the handling of waste paper to produce a quality grade of paper requires new approaches in the process technology for waste paper.


TOTAL U.S. WASTE PAPER RECOVERY
M Tons
Rate
40000
30000
20000
10000
40.0
30.0
20.0
10.0
Thousands of Short Tons-Ratio Scale
Recovery Rate
Total Recovery
1970
1975
1980
1985
1990

For the manufacture of liner board and corrugating medium, waste paper collected as OCC (old corrugated constasiners) is now widely used in North America and elsewhere. Generally OCC of about 50% fiber furnish is used mixed with 50% virgin fiber to produce liner board. For corrugating medium 85 to 90% OCC is used with 15 to 10% virgin fiber. As far as developing countries are concerned OCC is not readily available since the packaging and marketing technology is not well developed for the application of corrugated containers such as for example, in USA. The table on the next page illustrates this point as OCC is exported from USA to most countries all over the world.

In the case of most developing countries importing of OCC is not possible, due to the high price and import restrictions. The answer therefore is to use the locally available waste paper to produce liner board and corrugating medium for the manufacture of these grades.

This paper therefore is written in that context using a poor quality of waste paper which is normally available in developing countries and how to upgrade the quality of liner board and corrugating medium in these countries using such a poor quality of waste paper that is domestically available.

Preliminary Sorting of Waste Paper by Grades

This is an important step in the treatment of mixed grades of waste paper when it is either received at the mills or at the waste paper merchant's warehouse. In developing countries the collection and merchandising of waste paper is not well organized as in North America or West Europe. In USA and other developed countries, the waste paper could be bought by the mills from waste paper merchants specifying a particular grade. The PAPER STOCK INSTITUTE OF AMERICA specifies the standards and practices that have to be followed in the waste paper industry in USA. Unfortunately in developing countries there is no such self regulating body to conrol the quality of the waste paper supplied to the mills. The waste paper that arrives at the mills is all mixed up together and is then processed mostly as mixed waste paper.

This is the starting point for quality problems in the case of most developing countries. I have personally experienced this problem in countries of Europe, such as Yugoslavia and Turkey which are far more advanced in industrial development than most developing countries of Asia and Africa. It should be remembered the old saying holds good 'RUBBISH IN, RUBBISH OUT'. If we charge pulpers indiscriminately with no control on what goes into the pulper, the end result is rubbish at the end of the paper machine!

TABLE - I
U. S. EXPORTS OF WASTE PAPER TO MAJOR WORLD AREAS
TOTAL ALL GRADES

Thousands of Short Tons

YEAR	NORTH AMERICA			CENTRAL AMERICA & CARIBBEAN	SOUTH AMERICA	EUROPE	MIDDLE EAST & AFRICA	FAR EAST & OCEANIA	WORLD TOTAL
	CANADA	MEXICO	TOTAL						
1970	63.4	61.7	125.1	2.8	52.6	53.3	8.4	166.0	408.2
1971	134.2	33.2	167.4	3.3	62.2	38.1	0.3	147.7	419.0
1972	146.2	13.4	159.6	2.0	65.3	41.0	1.4	145.7	415.0
1973	152.2	46.9	199.1	3.5	55.3	53.8	1.3	370.4	683.4
1974	198.7	180.7	379.4	21.7	182.9	241.0	7.3	474.8	1,307.1
1975	124.3	52.5	176.8	10.4	161.9	118.7	3.2	390.4	861.4
1976	353.3	91.3	444.6	27.9	108.6	209.0	0.1	482.5	1,272.7
1977	350.2	151.3	501.5	20.5	132.1	203.1	1.4	653.8	1,512.4
1978	341.7	237.4	579.1	18.3	100.9	129.1	1.1	770.9	1,599.4
1979	478.5	381.2	859.7	34.6	128.4	238.5	1.5	970.5	2,233.2
1980	450.7	588.5	1,039.2	24.9	130.5	321.1	0.7	1,147.9	2,664.3
1981	356.5	346.0	702.5	24.1	170.8	179.3	11.5	1,124.3	2,212.5
1982	271.4	236.4	507.8	17.9	138.8	194.7	10.5	1,257.4	2,127.1
1983	346.8	427.4	774.2	31.0	104.8	143.3	.5	1,519.9	2,573.7
1984	325.7	455.4	781.1	33.8	127.4	229.5	11.7	2,051.9	3,235.4
1985	209.1	456.9	666.0	39.5	82.2	402.8	7.1	2,088.3	3,285.9
1986	226.3	580.3	806.6	29.4	58.3	351.2	10.8	2,492.4	3,748.7
1987	286.9	781.3	1,068.2	31.0	86.3	352.0	13.2	2,871.6	4,422.3

Source: U. S. Bureau of the Census

TABLE II
U.S. WASTE PAPER EXPORTS TO FAR EAST AND OCEANIA
CORRUGATED

Thousands of Short Tons

YEAR	China	India	Japan	Korea	phillipines	Taiwan	Thailand	All Other	Total
1970									
1971									
1972									
1973									
1974									
1975	—	—	56.6	53.9	7.1	34.2	15.0	8.1	174.8
1976	—	—	38.3	79.3	5.8	27.7	15.7	6.4	173.2
1977	—	—	59.6	158.2	13.0	35.4	11.7	10.4	288.3
1978	—	—	54.7	129.8	6.2	67.9	15.0	7.4	281.0
1979	—	—	79.7	263.6	7.5	99.9	21.1	3.5	475.3
1980	—	—	117.5	196.1	17.2	160.2	26.9	12.5	530.4
1981	5.9	0.1	41.6	169.4	16.5	149.3	32.5	6.9	422.2
1982	27.9	2.3	57.8	163.5	12.1	153.5	47.7	9.4	474.2
1983	26.3	3.1	81.0	153.4	5.9	170.4	29.7	11.4	481.2
1984	3.7	20.7	90.8	302.8	12.8	229.4	34.2	29.9	724.3
1985	9.8	42.0	91.4	220.2	10.4	257.6	32.0	44.4	707.8
1986	19.6	33.2	181.1	311.0	18.4	361.3	50.0	12.4	987.0
1987	26.3	21.3	346.9	289.6	25.1	413.0	60.0	29.2	1,211.4

Source: U.S. Bureau of the Census

The sorting of waste paper into major grades, even at the last stage at the mill ahead of the pulper, cannot be over emphasized. Although the PAPER STOCK INSTITUTE OF AMERICA has specified 47 different grades for the merchandising of waste paper, it is not necessary as far as developing countries are concerned to go into such specialized sorting.

What is essentially needed are the following grades:-

— Mechanical grades, like newsprint

— Coated grades, such as magazines

— Office waste, such as writings and typing paper

— Kraft grades and OCC

— Mixed grades which could go to manufacture filler grades for multiply board.

It is always advisable to do the segregating right at the source of supply. If proper incentives are given where school kids, organizations such as Boy Scouts and volunteer organizations for the handicapped could be enlisted for such a purpose, this would help a major headache at the mill as far as quality problems are concerned.

If the feeding to the pulper is well controlled and organized the fluctuation on strength properties and the maintaining of uniform quality and better runnability on the machine can be well achieved. I am stressing this point on the basis of what I have witnessed in some of the mills in developing countries where part of the operating shift on the pulper is charging bundles of kraft waste for a few hours and the next charges are made up of mechanical grades such as newspaper and magazines since all these grades are mixed up in one pile ahead of the pulper.

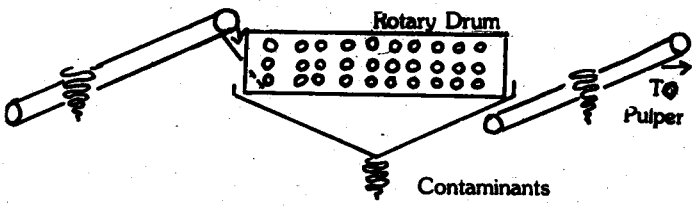
Pre Treatment Before Pulper

The waste paper that is received in most developing countries, as already mentioned before, is of poor quality containing various foreign materials, such as empty cans, rock, scrap iron, bottles etc. Sometimes these heavy materials are put there on purpose for monetary gain to increase the weight of the paper supplied to the mills! For this reason the writer is of opinion a preliminary separation of heavy contaminants is necessary before waste paper is fed into the pulper.

The writer has applied the principle of a rotary drum in a developing country as illustrated in Figure 1. The tumbling action provided in the drum helps to separate some of the heavy material that can fall through are holes provided in the rotation drum. This pre treatment reduces the quantity of junk that is delivered to the pulper.

Figure 1

Removal of Foreign Materials Using Rotary Drum



Separation of Foreign Materials At the Pulper

The conventional pulper normally used in the developed countries is fitted with a ragger and a junk trap. For the type of waste paper that is generated in developing countries these features are not at all adequate for the amount of contaminants present in the waste paper. Pulpers are generally bought with a ragger, and most of the time the ragger is unable to function because the waste paper that is received in these countries is not baled with wires, and there is not enough wire to spin on the rope to rag out the spinning impurities.

The junk trap normally provided is not large enough for the purpose and most of the time the pulper is stopped after 2 or 3 charges so that a man could get down into the pulper and clean out the rubbish. For this reason the writer is of opinion that a screen drum as illustrated in Figure 2. should be integrated to the pulper for handling poor quality of waste paper.

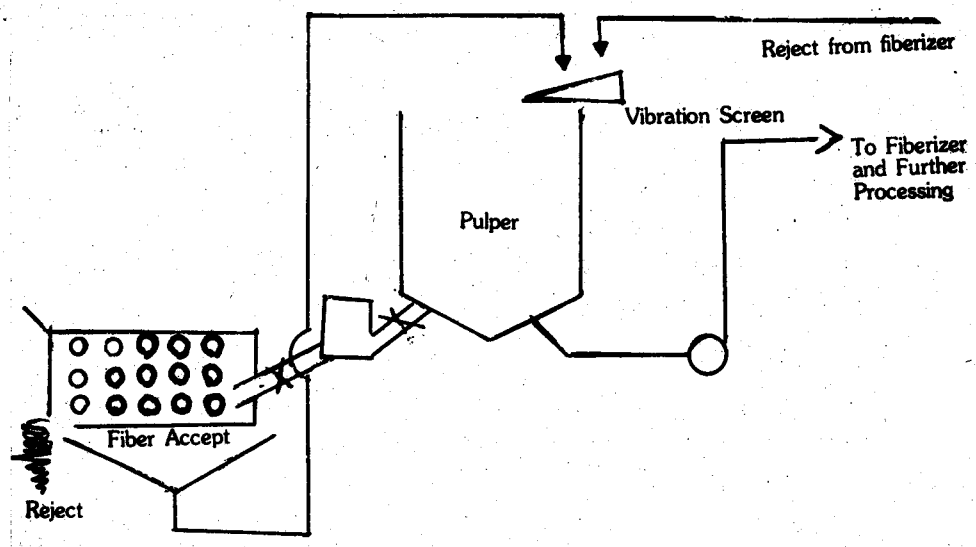
It will be also advisable where the quality of the waste paper is extremely poor to provide an orange peel type of bucket and hoist over the pulper to lift out the spinning material and debris that collects in the pulper bottom and blocks the pulper perforated plate. The use of such a hoist is recommended for developing countries in place of a ragger.

Further Processing Technologies That have to be Adopted to Handle Poor Quality Waste Paper

The Following are guidelines to be adopted as processing techniques for the handling of poor quality waste paper:-

- The major factor to be considered is the removal of the impurities and stickies as early as possible in the process before they are reduced in size and when screening for such smaller particles poses a problem.
- The removal of stickies should be conducted in such a way to avoid fiber damage by mechanical means.

Figure 2.



USE OE SCREEN DRIVE WITH PULPER

Pulper Operation Techniques

The waste paper pulper applied should not produce a cutting action. The pulper design should have factors that could produce a gentle slushing action. For easy removal of the contaminants, the higher the consistency applied in the pulper the better it is for the removal of the contaminants.

Unfortunately in developing countries, based on my experience, pulpers that are designed to work between 4 to 6% are generally worked around about 3% with no adequate control on pulper operation. As far as new technology is concerned, high consistency pulpers are now developed that can even be operated between 12 to 15%. For developing countries this may be a far reach at the moment, and the best thing that could be suggested is to work a conventional pulper at the highest consistency possible for reasons stated above.

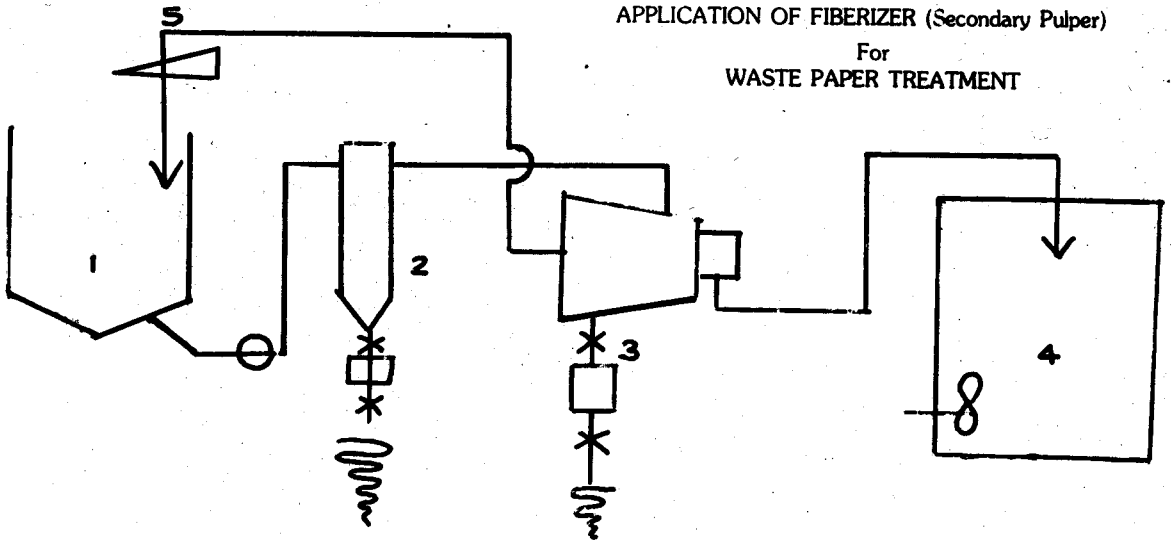
Use of The Fiberizer (Secondary Pulper)

This equipment has been available in the market for the last 15 to 20 years. In most mills in developing countries this technology has not been adopted, and in the opinion of the writer it is high time that such a technology is used, particularly when handling poor waste paper. By the name fiberizer, I am referring to equipment that is being marketed by most paper making equipment specialists, such as BELOTI, BLACK CLAWSON, ESHER WYSS, VOITH etc. under brand names such as Belcor, Turbo Separator, Fiberizer etc.

The operation of the fiberizer basically resembles that of a horizontal pulper and is sometimes known as Secondary Pulper. The advantage of this equipment is that heavy foreign material is thrown against the wall of the fiberizer by centrifugal action and is therefore easily removed from the unit. The light weight material is also concentrated by centrifugal action to the center of the fiberizer and could be bleeded off from the unit.

The writer, based on his experience in handling very poor quality waste paper for the manufacture of liner board and corrugating medium in a mill in Yugoslavia would recommend this unit. It was found at this mill the fiberizer was able to separate plastic material and light weight styroform, which were heavily mixed in the waste paper, very efficiently.

APPLICATION OF FIBERIZER (Secondary Pulper)
For
WASTE PAPER TREATMENT



1 — Pulper
2 — HO Cleaner
3 — Fiberizer
4 — Chest
5 — Vibration Screen

Figure 3.

The advantages of the fiberizer are as follows:

- The overall efficiency of pulping is improved by 30 to 50%
- Down time in the pulper is reduced
- Fiber characteristics are improved
- Fiber loss is reduced

Application of High Consistency Cleaners

The use of a high consistency cleaner in the consistency range of up to a maximum of 6% helps in the elimination of foreign material, such as stones, nuts and bolts, paper clips etc. before the stock is sent to further processing, without damage to pumps, screens and deflakers down the line. The dirt trap for such a cleaner has to be equipped with pneumatically or hydraulically controlled valves so that the removal of the contaminants can be done periodically while the unit is being operated continuously.

The use of Fractionating Equipment

The application of a fractionator is very essential to developing countries. This is on account of the shortage of long fiber pulp to most developing countries and the need to fractionate the short fiber from the long fiber present in the waste paper stock very early in the processing system ahead of the refiners so that the long fibers are not reduced in size by stock treatment.

Benefits of Fractionating

The following are the advantages that can result by fractionization :

- The replacement of virgin fiber by secondary fiber from waste paper. This is a major advantage for developing countries as they are mostly using imported long fiber pulp using up heavy foreign exchange.
- Possible to achieve the optimum fiber strength characteristics by selective stock treatment for long and short fiber
- Possible to achieve the optimum fiber strength characteristics by selective stock treatment for long and short fiber.
- Energy saving on account of separating the long fiber from the short fiber and treating them separately through stock preparation equipment.

Fractionization of fibers could be done by adopting the following equipment:-

- Deckers
- Curved Screens
- Vibration Screens
- Pressure screens, etc.

The most successfully applied fractionization units are those employing pressure screens, and this is the type the writer would like to recommend for handling poor quality waste paper stock in developing countries. (Refer to Figures 4 and 5 for the application of a fractionator to sort out the long fiber from the short fiber in waste paper treatment systems.

Size of Dump Chest

On account of the poor quality of waste paper, the size of dump chest should be large enough to allow for process interruptions as well as to obtain better homogenity. For these reasons it will be well advisable to have dump chest of relatively larger capacity, say to 3 to 3½ times the size of the pulper.

Conclusion

Developing countries which suffer from poor quality waste paper supply have to adopt new approaches to handling and treatment of waste paper to produce quality grade liner board and corrugating medium. The essential factors to obtain good quality would be pre sorting and pre treating paper ahead of the pulper and applying new process techniques such as the secondary pulper system and fractionation system as recommended in this paper.

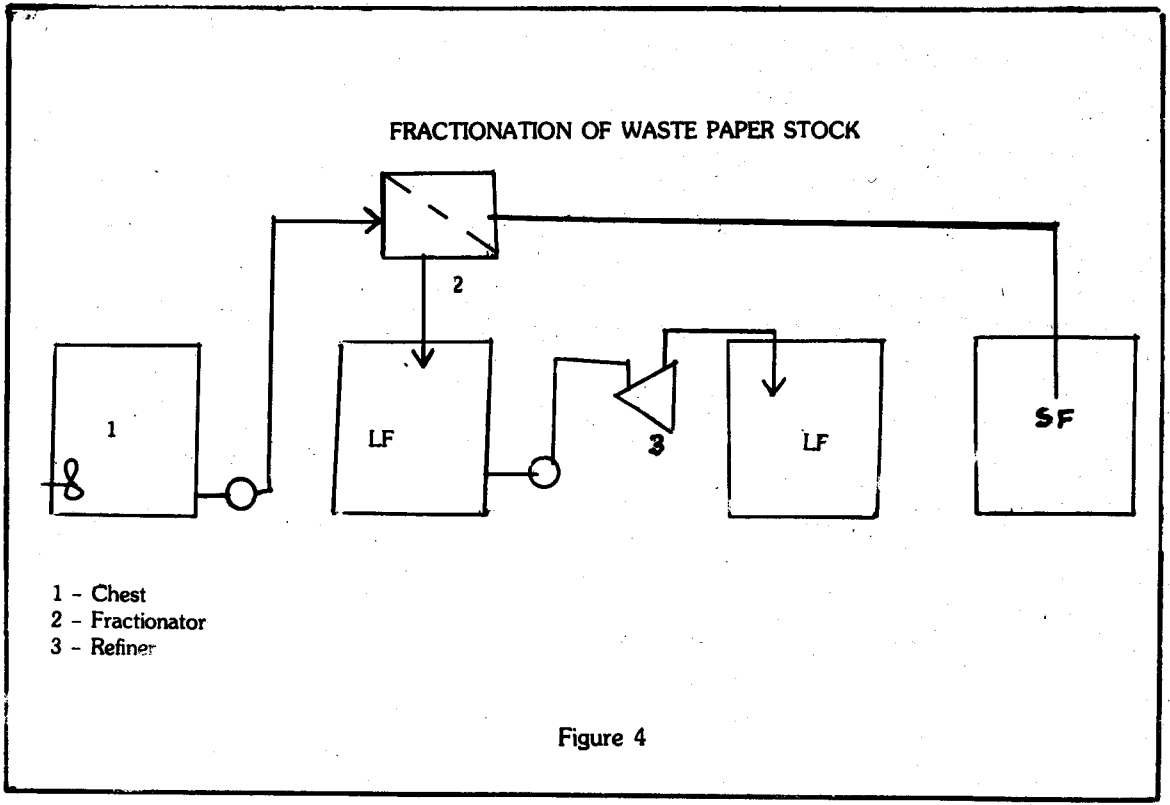
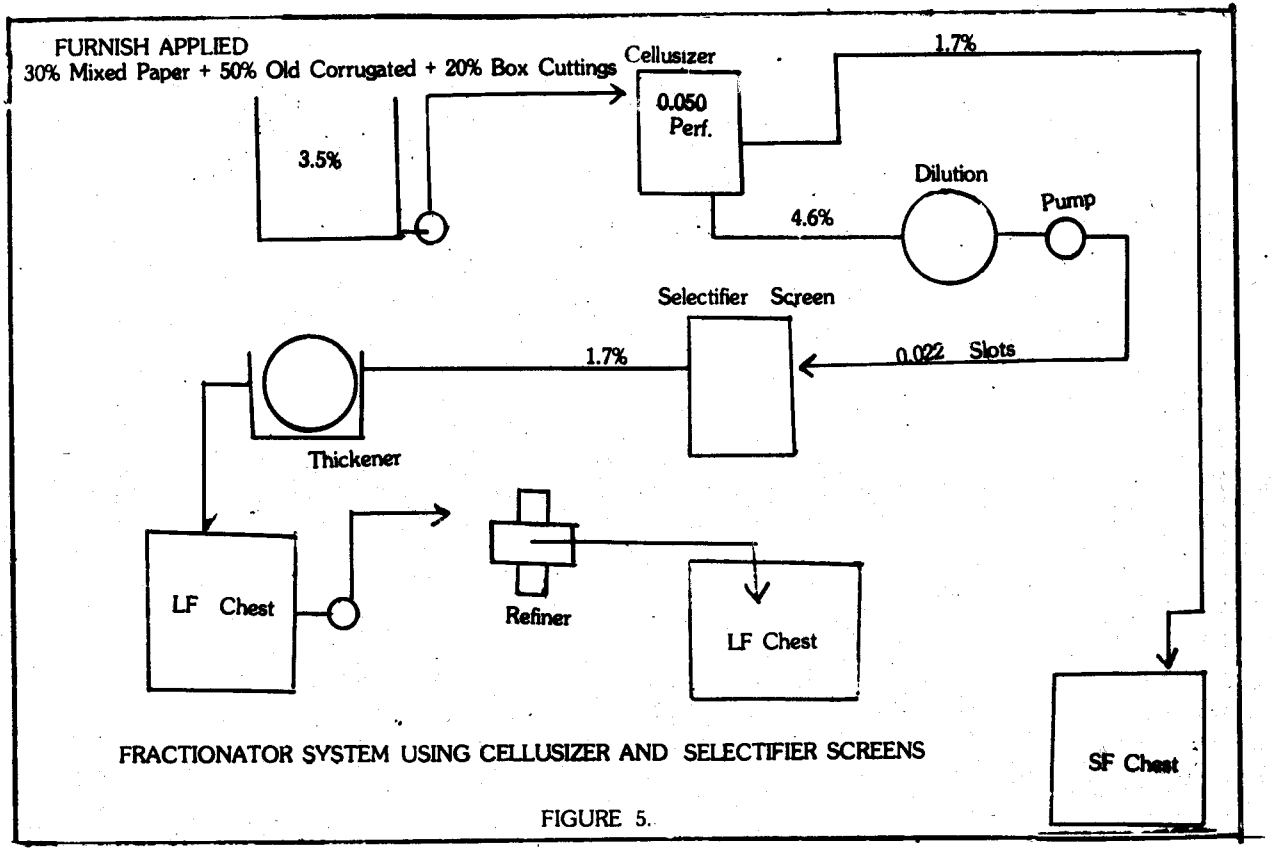

FRACTIONATION OF WASTE PAPER STOCK
2
1
LF
3
LF
SF
1 - Chest
2 - Fractionator
3 - Refiner

Figure 4



FRACTIONATOR SYSTEM USING CELLUSIZER AND SELECTIFIER SCREENS

FIGURE 5.

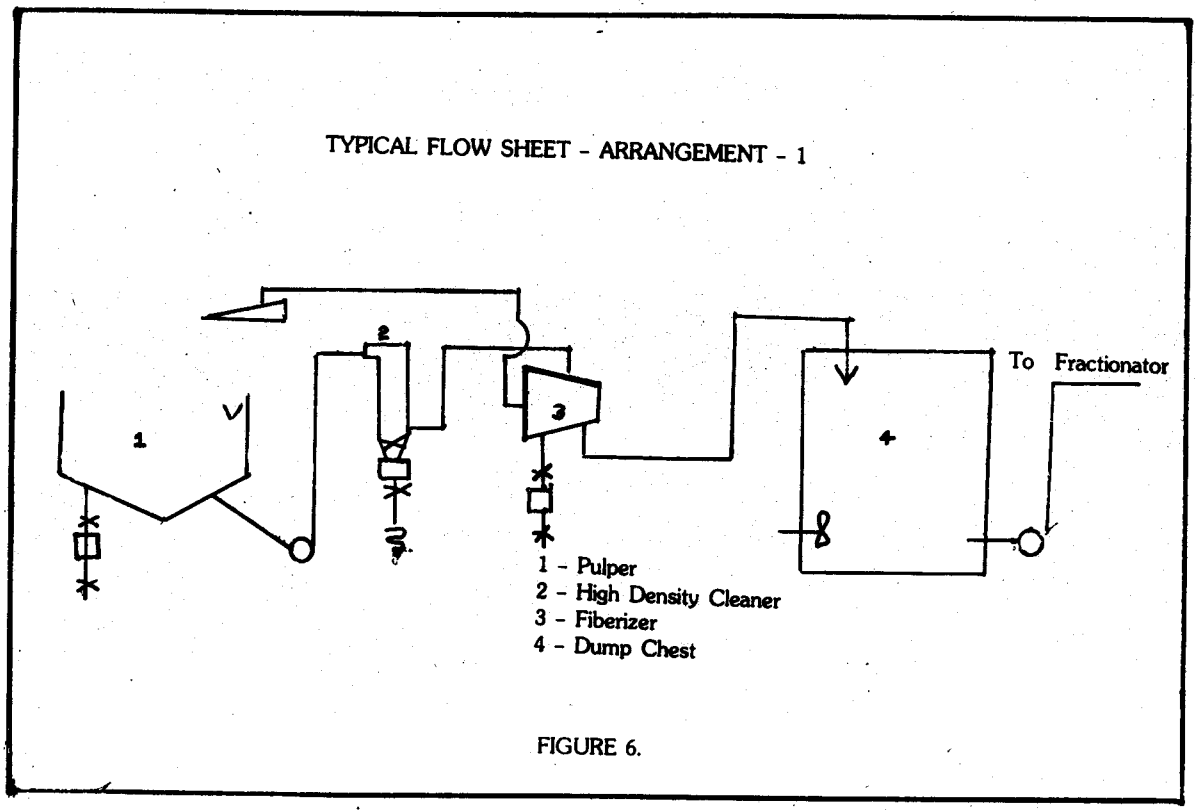
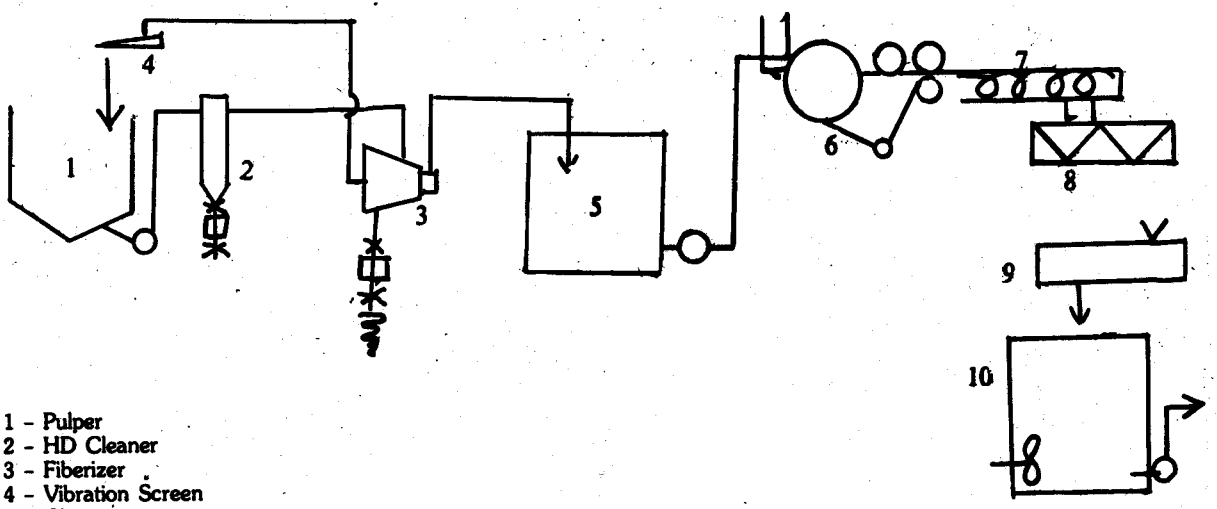

TYPICAL FLOW SHEET - ARRANGEMENT - 1
1
2
3
4
To Fractionator
1 - Pulper
2 - High Density Cleaner
3 - Fiberizer
4 - Dump Chest

FIGURE 6.

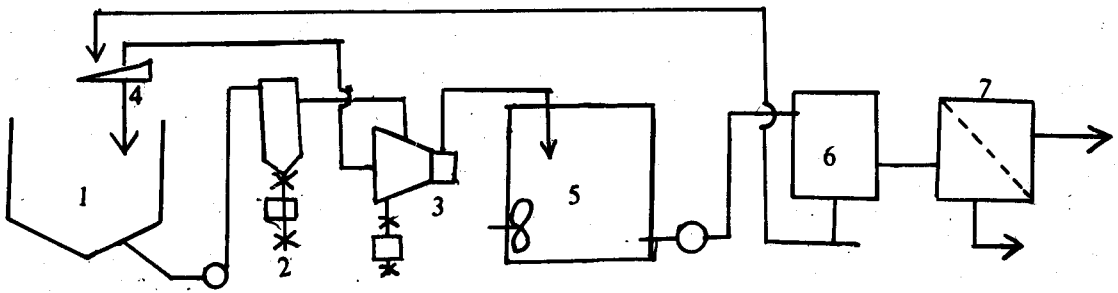
TYPICAL FLOW SHEET ARRANGEMENT - 2



1 - Pulper
2 - HD Cleaner
3 - Fiberizer
4 - Vibration Screen
5 - Chest
6 - Double Wire Thickner for 20 to 22% Consistency
7 - Screw Conveyer
8 - Kneader Type HD Pulper for 20 to 22%
9 - Mixer
10- Chest

FIGURE 7.

FLOWSHEET



1 - Pulper
2 - HD Cleaner
3 - Fiberizer
4 - Vibration Screen
5 - Chest
6 - Screen
7 - Fractionator

Figure 8

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