Waste Paper - Hope of Paper Industry

Koteswar Rao M., Fernandes J.D., & Bhargava S.C.

ABSTRACT:- The global situations are fast changing with respect to industrial growth. The environmental concerns all over the world are more dominant and are putting pressure on industries to adopt environmental friendly technologies. The demand for paper and paper board is increasing fast and naturally to meet the demand industries are increasing their capacities by either modifying the existing mills or putting new mills. This has created a situation where industries have no option than going for an alternate source of raw materials. In this situation waste paper resources is becoming more popular as the other alternatives like agricultural residues have limitations. The increased use of waste paper throughout the world shows the demand for waste paper. To use all types of waste papers the technologies are constantly being developed and the modern deinking plants is the result of these developments. In India also waste paper use is increasing fast. In an effort to use waste paper as an alternative raw material Hindustan Newsprint limited has conducted paper machine runnability trials using deinked pulp and the results are encouraging. In the changing global scenerio the future of waste paper resource is bright, and waste paper appears to be the only hope for the existance of paper mills.

INTRODUCTION

In the past our industry planning was based on the use of virgin fibre. Machine designs were also done to suite the virgin fibre. But the situation is totally changed now. The environmental concerns of our society have overtaken the industry all over the world. There is more concern about the social problems. This may be because of the factors like greenhouse effect, environmental episodes, nuclear waste disposal, air and water quality etc. The public became more demanding about the environmental aspects and are ready to sacrifice the quality of products for saving the environment, thus emerging the ecofriendly products. Naturally the statutory authorities have acted by implimenting on stringent standards for the industry. Under the present situation pulp and paper industry all over the world is looking for alternatives to exist. In this process though there are few alternatives available, waste paper recycling was found to be more suitable as the other alternatives like agricultural residues are having some limitations with respect to availability and usage. Recycling paper is an easy way to do something good for our environment as the benefits are two pronged. It results in the conservation of natural forests in addition to utilising the waste. To suitably recycle the waste paper the technology of deinking is developing fast. Many industries including big and small have already adopted the technology and it is a new trend now with deinking.

This paper reviews the global situation of pulp and paper industry, available alternative raw

Hindustan Newsprint Limited
Newsprint Nagar P.O.
Kottayam dist,
Kerala -686616

materials, waste paper as a resource, the technology of deinking in general, the new trends in deinking technology, runnability trial results in Hindustan Newsprint Limited and finally the factors influencing the deinking process.

GLOBAL SITUATION OF PULP & PAPER INDUSTRY

The world is passing through significant changes. The changes in the structure of Europe, Russian block, the reunification of Germany, changes in South Africa and also associated with these changes, the movement towards some form of world disarmament. The environmental issues like the green house effect, reduction of the ozone layer and pollution of air and water in general have become more important. now than in the past. The changes in the energy front added new dimensions to these. The natural energy resources became limited. All these are having significant effect on pulp and paper industry all over the world.

As regards paper industry even those in the red have changed colour. Only a year ago paper industry was struggling to keep its head above water. Now booming domestic demand and spiralling international and domestic prices have papered over all the creases in the industry. So much so that despite lower import duties many companies posted highest ever profits.

The rapid increases in the production capacities of existing mills and the new industries coming up fast are making the future more challanging than ever before.

There is a significant capacity growth observed all over the world-paper and paper board capacity was 204.7 million tonnes in the year 1981. Out of this 75% was in the developed countries. This has increased to 290 million tonnes in 1993 where the increase in developing countries is 19%. Global paper and paper board capacity is expected to reach 320 million tonnes by 1998 (Table-I). Worldwide capacity of printing and writing paper excluding newsprint in 1990 was 50.1 million tonnes. It is expected that there will be an increase of 47.4 million tonnes by 1998 which will be an increase of almost double the capacity in 10 years. During this period newsprint capacity is expected to reach 41.4 million tonnes with a capacity growth in Asia (8.8%), the Europian countries (4.8%) and Latin America (3.6%)

TABLE - I

WORLD PAPER AND BOARD CAPACITY

Countries	Capacity (000. Tonnes/Year) 1993	1998	Average annual Increase (%) 1988-93	1993-98
Developed				
North America	102597	108464	2.5	1.1
Eastern Europe	5308	6099	0.6	2.8
EU Countries	48065	53316	4.0	2.1
Nordic countries	23022	25449	3.2	2.0
Other W. Europe	6474	6819	2.9	1.0
U.S.S.R. (former)	11398	12470	0.4	1.8
Oceania	3499	3807	4.9	1.7
Others	35127	38047	3.8	1.6
Developing				
Africa	1361	1510	4.2	2.1
Latin America	15193	16703	3.4	1.9
Asia	38813	47280	9.6	4.0
World total	290857	319964	3.7	1.9

The demand for paper and board is expected to increase from 239 million tonnes in 1992 to 306 million tonnes by the year 2000 AD and to 345 million tonnes by the year 2005 AD (Fig.I). To meet this global growth in demand, more than 75 new

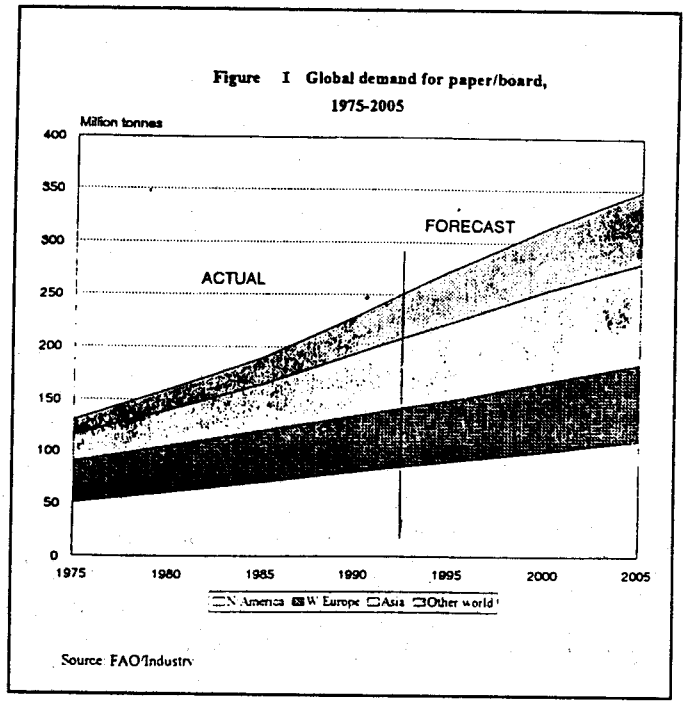

Figure I Global demand for paper/board, 1975-2005

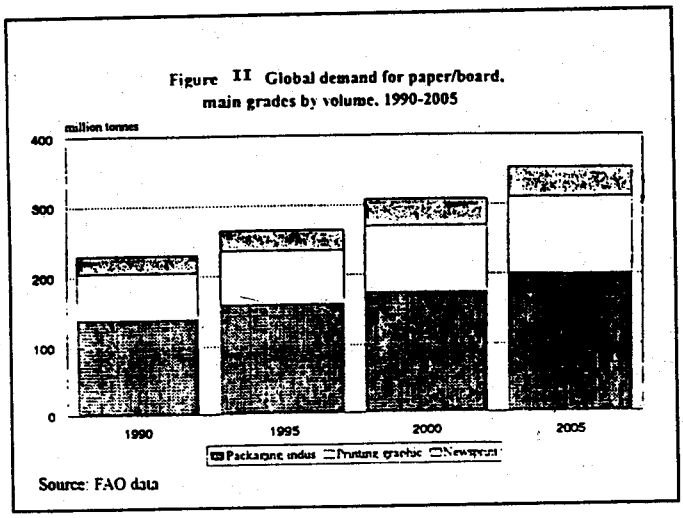

Figure II Global demand for paper/board, main grades by volume, 1990-2005

Source: FAO data

paper machines were started between 1980 and 1993. In addition to this more than 220 major paper machines were rebuilt in each year.

A global demand for newsprint, printing and packaging grade is shown in Fig.II for the period of 1990 to 2005. It can be seen that the printing and writing papers are universally expected to enjoy the highest demand growth rates. Certainly the industry has changed a lot with past 15 years. Many large capacity mills already working and many more are on projects all over the world. The historical dominance of U.S. companies has been declining. There is an increase in the capacity of mills in Japan. Interestingly companies from outside US. Japan and Europe had almost doubled their capacities. This is a new global development in the pulp and paper industry.

Comparatively in India pulp and paper industry is in the threshold of taking momentous decisions for enlarging the countries capabilities and technologies to enter the 21st century. India with its liberalised economy is seeking state of the art technology in pulp and paper making to meet the growing paper requirements of the country. India is also emerging as a strong and huge market for paper and paper board. To be globally competative in the medium term Indian paper industry will have to squarly address the energy and rawmaterial handicap it faces vis a vis the scarce fossile fuel and climatic disadvantages of being able to produce only short fibre woods. Indian pulp and paper industry was having a capacity of only 2000 T of annual output and only four paper manufacturing units in the beginning of the century. This has become 137,000 T by the year 1951 and 3,763,000 T (3,463,000 T of paper and paper board and 300,000 T of newsprint) in 1995. The number of units have sharply gone to 380 from a meger 25 mills in the year 1960-61. The growth of Indian paper industry from 1970 to 1994 is given in Table II.

TABLE -II

GROWTH OF INDIAN PAPER INDUSTRY

Year	No. of units	Installed capacity (million tonnes)	Production (million tonnes)	Capacity utilisation %
1950-51	17	1.37	1.16	85
1960-61	25	4.00	3.45	86
1970-71	57	7.68	7.58	99
1980-81	135	16.50	11.12	67
1989-90	317	32.31	18.75	58
1990-91	325	33.04	20.60	62
1991-92	326	33.64	21.11	63
1992-93	340	35.51	21.28	60
1993-94	380	37.90	22.71	60

The future of pulp and paper industry of the world is certainly bright. However, it is not free from challenges like rawmaterial problem, environmental compulsions and competitions from within. Industry all over the world in general and India in particular is already making itself ready to meet the challenges by adopting new technologies like deinking for using the waste paper resources.

ALTERNATIVE RAWMATERIALS

It is a well known fact that the raw material resources are becoming limited and are insufficient even for existing mill. The basic problem of the industry as well as the planners is how to meet the rawmaterial needs of the paper industry. The subject of availability of raw materials has been drawing the attention at all levels both globally as well as in India. Many of the developing countries of the world as well as some of the highly industrialized countries do not have adequate supplies of wood and also no land for increasing the wood supply. Though abundant forest area exist in developing countries to feed the raw material requirement of pulp and paper industry, in the effort of greening the world it is considered that forest conservation has a primary role to play. Under the

present senario it is but natural to find alternative sources to meet the demand.

In India industrial plantations by corporate sector on forest lands are not permitted. Equally farm Forestry by the corporate sector is not feasible due to ceiling regulations. Hence farm forestry programme in India by the paper mill have met with limited success.

AGRICULTURAL RESIDUES AS RAWMATERIALS

It is assessed over the years that agricultural residues like the straws, bagasse and other annual crops can be potential source of raw materials. Non-wood fibres are particularly important for the developing countries in the middle East, Asia, parts of Africa and in Latin America. In some of these areas the output of non-wood fibre pulp has actually been increasing further than the out put of wood pulp. The leading countries using the non-wood fibre pulp are Republic of China, Taiwan and in straw the leading users are China, Italy, Spain and Taiwan.

In India the potential of straw as a major raw material resource is likely to remain limited. This is because of the inherent problems like collection of straw from widely dispersed area, the problem of storage due to its seasonal nature, demand of cattle feed, non-availability of appropriate technology etc. Among all the non-wood plant fibres the technology advances are more in utilisation of bagasse. This has helped many industries to use bagasse in small and big mills. However the use of bagasse in a large scale have limitations, because of the fact that the availability is dependent upon the arrangement of alternative fuel to the sugar industry, the limitation of the use of bagasse in some grades of paper and the constrains due to its seasonal nature.

The raw material requirements are very large in view of increased production capacities and demand. It is felt that the agriculture residues like straw and bagasse though are usable for pulp and paper making, cannot meet the requirements in large quantities.

WASTE PAPER AS A RESOURCE

A combination of social, environmental, technical, economical and other compulsive factors are making the waste paper utilisation more important and suitable alternative. The waste paper utilisation as a source of fibre supply offers tremendous potential. Newspapers, office and communication papers and corrugated containers are all recyclable. Recycling may be a new concept in some communities but it has been a paper industry tradition for more than 300 years. Recycling started in 1690 at Rittenhouse mill near Philadelphia, Pennsylvania where paper was first made from rag. The waste paper collection and re-use is perhaps the most important subject all over the world particularly from the year 1990. For a global perspective the FAO noted that waste paper consumption rose from some 69 millions tonnes in 1985 to 89 million tonnes in 1991 and is likely to double by 2005.

The fastest growth of paper and paper board capacity additions are expected to be in Japan, Asia, Western Europe etc. when total demand is taken into consideration the waste paper section is growing excellently. The waste paper recovery rate and the utilisation rates are forecasted to be further growing to become 45% of available supply of total world paper and board industry (Table III).

TABLE -III

GLOBAL FIBRE BALANCE IN THE PAPER & BOARD INDUSTRY

	Million Tonnes			
	1985	1990	1995(e)	2000(e)
1. Paper and Board production	193.3	238.8	283.5	330.0
2. paper and Board consumption	192.6	237.1	285.6	329.0
3. Pulp consumption	140.6	160.6	175.2	186.9
4. Waste paper recovery	58.9	83.7	116.9	151.1
5. Waste paper consumption	59.5	83.5	114.8	151.1
6. Waste paper recovery rate (%)	30.6	35.2	40.9	45.9
7. Waste paper utilisation rate (%)	29.7	34.3	39.8	44.7
8. Pulp utilisation rate (%)	70.3	65.7	60.2	55.3

The current and forecast for continuing increase in the use of recycled fibre by the world paper and paper board industry is due to a number of factors which singly or together exert a strong

influence on demand in many consuming regions of the world.

The first or most important factor may be due to the availability of the waste paper at a cheaper rate. The second may be the less capital investment requirement for the installation of facilities for processing waste paper when compared to new pulp mills. This factor also relfects the greater flexibility offered by the addition of relatively small scale waste paper processing facilities. The third factor is the environmental issues which compell the industry to go for alternative fibre source and the recycling is regarded as most suitable alternative. Fourth factor is the marketing considerations, which gives an edge to industry by selling products with partly or wholly made by recycled fibres. The products like container boards or laminated boards are example of such products. The fifth factor is the customer acceptance of the recycled paper products. The sixth factor is the regulations with respect to collection, recycling and utilisation of waste paper agreed by the paper manufacturers in many countries. These regulations may come in other countries also where there are no compulsions at present.

The use of recycled fibre by Indian industries has risen appreciably in recent years with recovery also in the increasing trend. In the year 1990 consumption amounted to 1.25 million tonnes and recovery to 950,000 tonnes (Table IV). One fifth of demand for recycled fibre was met by imported waste paper. The waste paper collection systems within India is still to be developed. The recycled fibre use in the paper and paper board industry is around 29% of the total production in india. There are around 241 mills in the country using either completely or partly recycled fibre (Table V).

The rapid developments in the deinking technologies also indicate the interest of the industries and manufacturers in the use of waste paper all over the world.

TABLE -IV

INDIAN WASTE PAPER SECTOR
(000, Tonnes)

		1985	1986	1987	1988	1989	1990	1995
1.	Recovery	500	500	550	850	900	950	1755
2.	Imports	200	250	150	150	200	250	310
3.	Consumption	700	750	700	1000	1100	1250	2065
4.	Paper and board output	1590	1800	1886	2000	2185	2295	3445
5.	Paper and board consumption (estimated)	1590	1800	1886	2229	2240	2575	3865
6.	Utilisation rate (%)	-	-	-	42.6	46.4	54.3	60.3
7.	Recovery rate (%)	-	-	-	38.1	39.6	36.9	45.4

TABLE -V

INDIAN PAPER MILLS CLASSIFICATION

Type	No. of Mills	Number %	Production %
Agro based	111	29	30
Waste paper based	241	63	30
Wood based	28	8	40

WASTE PAPER PROCESSING TECHNOLOGY (DEINKING)

The advances made in various aspects of technology associated with fibre recycling have made industries to use more of waste paper. The initial attempts of using waste paper prior to the eighties were not encouraging as the technology was not fully developed not only from the point of view of

deinking but also the removal of contaminants. Most of the technical success have come to the major process area of waste paper decontamination and deinking technology. Other technical advances have occured in the areas of waste stock preparation process, pulping, bleaching and fractionation (for fibre separation). Deinking technology is perhaps the most important of all in determining whether or not waste paper can be recycled at all. Clean and unprinted waste paper can always be readily recycled but it is the printed grades which perhaps offer most potential for further advances in recycling. Deinking technology is used in a wide variety of paper sectors, with newsprint by far the most important and with tissue one of the fastest growing areas of application.

The deinking is basically a waste processing system with facility to add chemicals to help ink removal from the fibres, remove the ink particles from the fibre suspension and improve the brightness. There are in principle two different ways to remove ink from waste paper. One method is to disperse the ink particles to a particle size as small as possible or below 15 microns. The ink can then be washed out. This is known as washing process. The other method is to agglomerate the ink particles greater than 15 microns and then remove the ink by a flotation process. There are advantages with flotation process compared to the washing process, which are

- High fibre yield
- Low water consumption
- Low BOD discharge in the effluent

These advantages of the flotation process have made many Japanese and european countries to adopt the floatation technology. The use of more recycled fibre in paper products depends on, the cleanliness and brightness of the pulp. To improve the quality of the pulp in certain cases a combination of both flotation and washing techniques is applied. To meet these demands the deinking process is to be properly designed. To understand in its simplest form, the deinking process can be made into ten steps. They are,

- Pulping
- Prewashing (heat and chemical loop)
- Screening (course and fine screening)
- Forward cleaning
- Washing
- Dispersion
- Bleaching
- Water recirculation and make up

many combinations are usually made from these steps by either altering the positions or reducing some of the steps. These combinations depend upon the requirement of the particular system where the nature of the recycled fibres, the final product requirements are important.

The deinking process sequences are used in different ways in different industries. This is because of the local requirements and conditions. In western Europe the prime aim of deinking is to enable production of relatively bright sheet of paper using collector chemicals to maximise the removal of ink in floatation process. The typical deinking format used is a combination of washing and floatation technology. For specialist application which require a high level of washing (such as tissue production) displector chemicals are used.

In Japan deinking process typically also incorporate soak towers which facilitate the release and break down of ink particles, with disperger used to remove any residual specks of ink. Hence the requirement is a strong and uniformly coloured sheet for use in fast printing process. In north Americas, washing technology was used predominantly as there were no environmental considerations in the past. This was mainly due to economical reasons. Recently environmental regulations have made North American industries to go for Japanese and European technologies.

A system to manufacture fine papers need to be able to take care of all types contraries. The deinking process works more efficiently if more steps are given. The removal of contaminents should be done one after the other, preferably the biggest first. Gradual extraction should be done if the system is to remove too many contaminants in one step. The final design of a deinking plant is never possible as the technology growth is a continuous one. However, with the available technology a system should be selected for an optimal quality output.

TECHNOLOGICAL ADVANCES IN DEINKING

The success of being able to recycle waste

paper has helped the industry to find an alternative for overcoming the raw material problem. But the problems faced while recycling are many and the manufacturers and technologists felt that the need of improving the technology. In the initial stages all grades of waste paper could not be recycled. The waste paper especially old corrugated containers, newsprint are heavily printed. There were problems with contaminants. In addition to these technical problems, there were economical problems which requires the technologists to provide recycled fibres at a resonable investment. There were environmental reagulations which requires only environmental friendly technologies. All these factors have made the technologists and manufacturers to constantly improve the process to suit the requirement.

The advances made in waste paper processing technology are many. The use of continuous pulping in place of the more traditional batch pulping process is one such improvement, which facilitates in improving the ability to remove the contaminants at an early stage in the waste treatment cycle. Another advance has been that of high consistency pulping which is of further benefit in contaminant removal without damage to the fibres. The use of reverse flow cleaners during screening further reduces the quantity of (light weight) contaminents.

There has been considerable recent additional improvement in the treatment/removal of ink particles of variable size in non-homogenous waste furnishes. This has helped to use mixed wastes which could not be recycled in the past. The use of pressurised deinking modules is another development. Inherent brightness increase of the paper made from recycled pulp is a notable addition. The vertical floatation system, for instance, has been developed to improve the brightness and cleanliness in addition to other advantages. The system removes ash, specks, fines and also medium sized ink particles.

The development of enhanced waste paper processing system using a range of stages such as dispersing machines, bleaching during dispersing, post disperson floatation and combined washing and floatation will help the industry to improve the process to a large extent. This type of systems can give a final brightness of 80%. The split floatation technology is another addition to the deinking process which treats differently the two broad categories of inks found in waste paper (the soft greasy and brittle hard) and this gives greater flexibility in the use of furnish.

STUDIES ON DEINKED PULP USE IN HNL

In an effort to overcome the problem of raw material shortage, HNL is proposing to put up deinking plant to use recycled fibre. As part of this effort HNL had conducted paper machine runnability trials with deinked pulp in combination with chemical pulp and chemimechanical pulp to study the runnability and other quality aspects to manufacture newsprint.

DEINKED PULP COMPARED TO CMP AND CTMP

The CMP and CTMP pulps and deinked pulps are compared for the strength and optical properties. The results of the laboratory evaluation are given in Table VI. It can be seen from the table that the long fibre fraction of deinked pulp is almost comparable with that of CTMP. The breaking length, tear and burst are also comparable with that of CTMP. The deinked pulp opacity is high and brightness is low when compared to CTMP. The properties of CMP are low when compared to CTMP and deinked pulp. The ash of deinked pulp is high.

TABLE -VI

STRENGTH AND OPTICAL PROPERTIES OF PULPS

Sl.No.	Parameters	Units	CMP	CTMP	DIP
1.	Freeness	ml CSF	298	160	138
2.	Shive content	%	-	0.08	0.32
3.	Ash	%	1.0	1.0	5.0
4.	Bauer Mc Nett Fibre classification				
	+ 30	%	0.8	35.8	37.0
	-30+100	%	58.7	31.0	27.1
	-100+200	%	14.6	8.9	7.4
	-200	%	25.9	24.3	28.5
5.	Wet web strength	N.m/g	1.15	2.01	2.26
6.	Basis weight	g/m^2	49.7	49.7	48.2
7.	Bulk	cm^3/g	2.47	2.35	2.06
8.	Breaking Length	Metres	2810	3240	3580
9.	Tear factor	-	28.4	61.6	80.4
10.	Burst factor	-	13.9	20.2	21.6
11.	Folding Endurance	D.F.	2	11	18
12.	Porosity	ml/min	1804	362	207
13.	Brightness(Elrepho)	%	53.3	57.6	51.3
14.	Opacity(Printing)	%	92.2	94.3	96.2
15.	Yellowness	%	33.7	24.5	23.3

TRIAL RUN

Before using the deinked pulp, a blank run was taken alongwith normal furnish of 28% chemical pulp and 72% of CMP pulp. The chemical pulp was having a furnish of equal quantities of bamboo and reed. The chemimechanical pulp was having a furnish of equal quantities of Eucalyptus grandis and eucalyptus hybrid. The deinked pulp was used along with chemical and chemimechanical pulps. Based on the laboratory studies a combination of 8.8% chemical pulp, 48.5% of chemimechanical pulp and 42.7% deinked pulp was used. The trial was conducted for two days.

OBSERVATIONS

The machine runnability was good with 42.7% deinked pulp (Table VII). The machine speed of 680 m/min with blank run could be increased to 720 m/min. The chemical pulp consumption was reduced to 8.8% when compared to the normal consumption of 28% in the blank run, indicating a reduction of 19.2% of chemical pulp in the furnish. Comparatively the chemical pulp consumption was 20% when used with 18% CTMP and 62% of CMP. The ash content could be increased to 2.5% higher than the blank run (Table VII). The machine efficiency of 98.6% with deinked pulp was 7.4% higher than the efficiency of 91.2% with blank run. The running of the machine was smooth with reduced breaks and a marginal reduction of steam consumption is also observed with use of deinked pulp.

TABLE -VII

NEWSPRINT WITH DIFFERENT FURNISHES

Sl.No.	Particulars	Unit		CMP	CTMP	DIP
1.	Newsprint	g/m²		49	49	49
2.	Machine speed	m/min		680	720	720
3.	Furnish					
	Chemical Pulp	%		28.0	18.0	8.8
	Chemimechanical pulp	%		72.0	62.0	48.5
	CTMP	%		-	20.0	-
	Deinked pulp	%		-	-	42.7
4.	Machine production	MT/D		291	331	342
5.	Machine efficiency	%		91.2	98.3	98.6
6.	Number of breaks (process)	No.		12	3	2
7.	Downtime	Min.		105	15	10
8.	Steam consumption (on Fin.production)	MT/T		1.88	1.84	1.71
9.	Substance weight	g/sq.m		49.2	48.9	48.9
10.	Moisture	%		7.5	7.2	7.8
11.	Ash	%		3.4	5.4	5.9
12.	Thickness	Microns		73	74	75
13.	Bulk	cu.cm/g		1.5	1.5	1.5
14.	Breaking length	Metres	MD	4960	5330	4550
			CD	2020	1790	1420
15.	Tear factor	-	MD	38.4	36.1	34.0
			CD	51.4	53.6	52.6
16.	Burst factor	-		17.0	16.8	13.6
17.	Porosity	ml/min		1165	770	788
18.	Brightness(Elrepho)	%		52.0	53.6	51.7
19.	Opacity(Printing)	%		93.7	93.2	94.7
20.	Yellowness	%		17.1	16.8	16.4

In conclusion it is felt that the use of deinked pulp in combination with chemical and chemimechanical pulps can reduce the costly chemical pulp consumption. The runnability of machine can be improved and the speed of the machine can be increased. It also helps to increase the ash in the newsprint. Finally it can be seen that the use of recycled fibre not only helps as an alternative rawmaterial resource but also improves the economy.

CONCLUSION

It is clear that by 2000 AD the paper and board raw material supply pattern will have changed very substantially. Future availability of raw material will continue to be a main factor in deciding a new mill location. The increasing importance of recycle of paper will have strong influence on paper industry. A non-integrated paper mill close to the market may become more profitable than an integrated mill close to the forest. Paper makers will clearly rely havily in future on waste paper fibre and there will be considerable importance on deinking technology. When the demand for deinked pulp increases, there is a possibility that more waste paper of poor or unknown quality entering the rawmaterial. To over come this type of problems the technological improvements in deinking process are to be completely developed to help the changing requirements.

ACKNOWLEDGEMENT

The authors are thankful to the management of Hindustan Newsprint Limited for their permission to present this paper in IPPTA Seminar.

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