Disposal and recovery of waste paper in South Africa

G R de V Brooks

A report by the Committee for Solid Wastes
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PREFACE

In terms of mass, 80 per cent of the 900 000 ton of paper and paperboard consumed in South Africa during 1975 was locally produced. Coated paper and paperboard remains the most important category still imported. Development in local pulping and converting capacity should ensure 90 per cent self sufficiency for South Africa by 1981. Current trends indicate a possible shortage of fibre by the second half of the 1980's.

Waste paper comprises between 30 and 35 per cent of municipal solid waste and is therefore an important contributor to collection and disposal costs. The proportion of paper in municipal solid waste is relatively insensitive to changes in recycling activity. Paper waste provides no significant problems in collection or disposal.

Approximately 250 000 tons of waste paper are recovered yearly (representing about 28 per cent of total paper and paperboard consumption) of which (95 per cent) is used for the manufacture of paperboard for corrugated cases and other board products. Other applications include moulded products, packaging material and wrappings. Commercial dealers account for about 95 per cent of waste paper collected. Taking all costs into account, it remains generally much cheaper to use reclaimed fibre than virgin fibre. Foreign exchange savings, reduction of demands on local timber resources and probable reduction of solid waste disposal costs are factors further encouraging recovery and re-use of waste paper.

There appears to be a correlation between changes in the GDP, the consumption of paper and paperboard products, and the sales of waste paper to mills. Most organizations involved in the waste paper industry consider that the periodic changes in demand for waste paper are detrimental to the industry and that any measures which might be taken to alleviate the situation would be desirable. Measures which have been proposed include preferential rail tariffs, government subsidy of waste paper storage costs, closer ties between users and collectors of waste paper, cash operating subsidies and investment tax credits, among others.

Should it be considered necessary to take measures to increase the rate of recovery of waste paper in South Africa, more intensive investigation of possible courses of action will be required.

TABLE OF CONTENTS

LIST OF TABLES

INTRODUCTION

This survey of current practice relating to the disposal and recycling of waste paper was commissioned by the Committee for Solid Wastes, through the National Scientific Programmes Unit of the CSIR. It was undertaken by Louis Heyl and Associates, a firm of techno-economic consultants on behalf of the Group for Techno-Economic Studies (IRS, CSIR) which provided the financial support for this survey, as well as for the preceding survey on plastic wastes.

Objectives

The report is aimed at providing information on the following subjects :

- the nature and extent of waste paper generation in South Africa
- waste paper as a component of solid waste
- the recovery and re-use of waste paper
- the fluctuations in waste paper demand

Method of approach

Information was obtained by means of the following :

- Interviews. Personal and telephone interviews were conducted with most of the larger waste paper dealers, mills and moulders using waste paper.
- Literature search. Available literature was obtained from both local and overseas sources.

THE SUPPLY AND APPLICATIONS OF PAPER IN SOUTH AFRICA

In this chapter primary production of paper is traced through the stages of fibre growth, pulp and paper production and paper application. An indication of the degree of dependence on external supplies of paper and paperboard is given, as well as a resumé of expected expansion in the local paper industry. Finally, the application of waste paper as a fibre furnish is discussed in the light of the primary production volumes.

The relationship between paper consumption and waste paper generation

The cycle followed by paper products could be set out as follows :

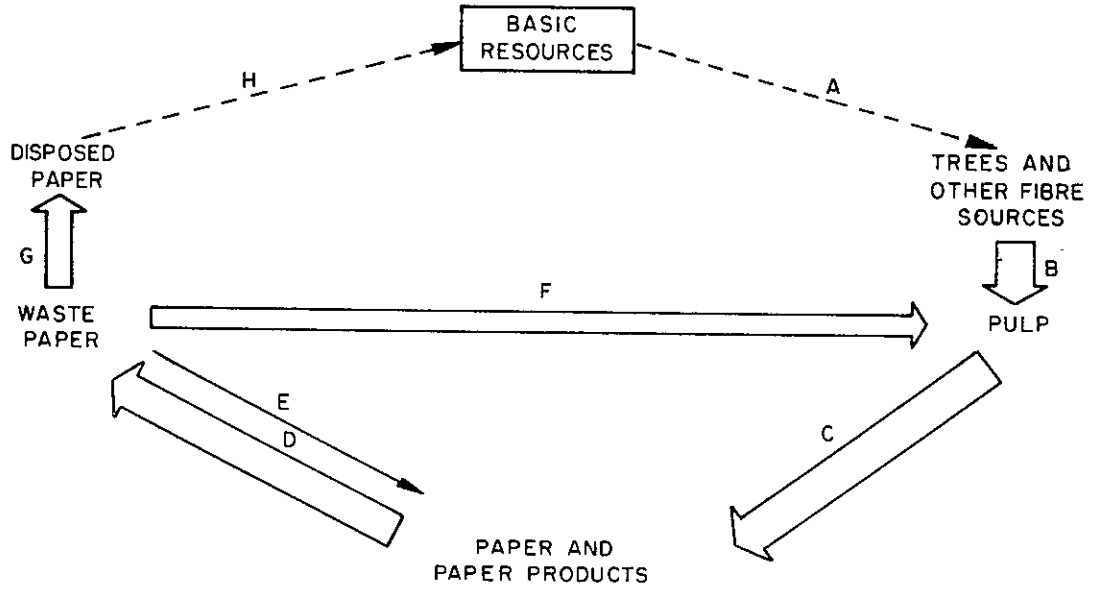


Figure 1. The paper production, use and disposal cycle

It is clear that each of the flows A to G is of importance when considering the generation, use and disposal of waste paper.

In this report, special attention is given to flows D and F. In order to gain an insight into waste paper generation, it is necessary to consider first flows A, B and C.

The development of South African timber production

An area of just over one million hectares was under timber in South Africa in 1976. Applications to cover an additional 200 000 hectares before 1980 were considered in July 1975 (representing an annual rate of afforestation of 40 000 hectares), but this growth rate was considered insufficient to provide for the estimated need for the year 2000 when three million hectares under timber will be necessary. Rapidly increasing labour costs, and the shortage of suitable timber land would seem to indicate that South Africa's dependence on imported roundwood and pulp will increase in the medium term. Marginal and sub-marginal land is already being exploited.

Of all local roundwood processed in the period from 1st July 1974 to 30th June 1975, 54 per cent was non-coniferous wood (mainly hardwood) and 46 per cent coniferous wood, or softwood. Approximately 12 per cent of non-coniferous wood, and 27 per cent of coniferous wood was used for the production of pulp for paper and paperboard (Department of Forestry 1976).

In Table 1, roundwood timber consumption projections are given. Note that these figures relate to total consumption and therefore include imports of roundwood timber.

Table 1. Projected annual consumption of roundwood timber

	1973/74			1974/75			1983			1998		
	('000m³)		%	('000m³)		%	('000m³)		%	('000m³)		%
Softwood-total		4 925	48		4 679	46		10 008	49		20 668	59
for paper pulp	1 572			1 267			5 499			13 940		
other	3 353			3 412			4 509			6 748		
Hardwood-total		5 392	52		5 488	54		10 448	51		14 676	41
for paper pulp	569			680			1 375			3 485		
other	4 823			4 808			9 073			11 191		
Total hard- and softwood		10 317	100		10 167	100		20 456	100		35 364	100

Sources : (i) Department of Forestry
(ii) Van Niekerk, D J T; An Analysis of timber supply and demand trends in South Africa. Timber Research Unit, CSIR. Pretoria, October 1973. Table 16.

Note : Figures for 1974/75 are abnormally low, due to a general depression in the use of wood and paper products.

It is estimated that the total South African demand for wood will exceed the total supply at some time between 1980 and 1985, depending on consumption developments and rates of afforestation. From Table 1, it is clear that the use of pulp for paper and paperboard is becoming an increasingly important component of the total wood demand (approximately 50 per cent by 2000 AD), and that the level of paper recycling activity will have a considerable effect on the timing and degree of South African dependence on imported wood and pulp in years. It is not only South Africa that will suffer from shortages. The Food and Agricultural Organization of the United Nations (FAO) has predicted that world consumption of paper and paperboard will jump to 300 million tons per annum by 1985, compared to 135 million tons in 1969 (Joseph E Atchison Consultants Inc., 1972). This explosion in demand is expected to bring about a continuing shortage (as opposed to the periodic shortages currently experienced) of pulp within the decade beginning in 1985 to 1995.

South African paper and paperboard consumption

Paper and paperboard consumed in South Africa may be placed into three broad categories, viz newsprint, printing and writing papers, and packaging and other papers. The relative shares of total paper consumption held by each are shown in Table 2.

Table 2. Broad analysis of South African paper consumption

Paper class	1973	
	('000 t)	% share
Newsprint	195	22
Printing and writing papers	182	21
Packaging papers	499	57
TOTAL	876	100

In the following sections, information is given on production and consumption of these papers. The volume of tissue paper produced in South Africa is considerable, but is not dealt with here. Glazed tissue used as fruit wrapping has been included as a packaging paper. Tissue paper for household use provides no disposal problems and is not readily available for reclamation, while that used in industry becomes, at best, a component of the "Common Mixed Waste" (CMW) waste paper category.

Newsprint

The long-expected detrimental effect of television on the consumption of newspapers has not materialised, and newsprint offtake has in fact shown some growth. The advent of advertising on television will reduce advertising revenue accruing to newspapers and consequently affect newsprint consumption. The smoothed growth rate for the first half of this decade was about seven per cent per annum. Consumption is expected to remain constant until about 1979 after which a growth of about four per cent per annum is projected. Recently increased papermaking capacity should increase exports, and the 8 000 tons exported in 1975 is expected to rise to a level of 20 000 tons by 1980.

Printing and writing papers

Consumption of other printing and writing papers has shown a low average growth rate of four per cent per annum since 1973, due largely to recessive conditions experienced in 1975 and 1976. Growth to 1980 is expected to improve, and to reach an average level of just over six per cent per annum. It is especially the expected reduced consumption of mechanical papers for consumer magazines (as opposed to the number of issues sold, which should rise slightly) which will inhibit growth. Paper for use in offices, computers and trade and technical magazines will be in particular demand.

Packaging paper and paperboard

Packaging paper and paperboard constitutes the major component of paper consumption. Corrugated cases constitute the most important pack type, and are likely to become even more important in years to come. Considerable competition from plastic packaging is being experienced, and the growth in paper packaging consumption, although reasonably healthy (estimated at over six per cent per annum for 1976-1980), will be less than the growth in total packaging consumption (estimated at 8 per cent to 8,5 per cent per annum). Coated and lined papers as well as laminated papers appear to have an excellent future, but due to plastic and metal contamination, greater available volumes of some of these papers will probably be of little use to the waste paper industry.

Analysis of paper consumption figures

In Table 3, levels of South African paper consumption are given. Primary paper consumption has been related to paper waste generated in terms of paper grades.

The paper industry has recently experienced large fluctuations in apparent consumption (purchases), due to excessive stocking and de-stocking by paper users and converters as a result of expected shortages following the "oil crisis" of 1973 and 1974. For this reason, 1973 is considered to have been the last "normal" year in which apparent consumption approximated to actual consumption (paper utilized).

In view of the nature of the applications of paper and paperboard it is estimated that at least 85 per cent of paper consumed becomes waste within

Table 3. Analysis of South African paper consumption

Paper type	Main applications	Consumption						Related waste paper grades
		1973			1976 (Estimate)			
		('000t)	% Per type	% Total	('000t)	% Per type	% Total	
Newsprint	Newspapers	195	22	22	202	22	22	Flat News (FN) Common mixed Waste (CMW)
Printing & Writing papers		182		21	205		22	
Bonds, banks	Printing, envelopes, office papers and books	26	3		29	3		White woodfree (W1) White slightly printed paper (W2) Coloured shavings (Col2)
Mechanical printing	Consumer magazines, general printing	37	4		45	5		Mechanical papers (Mech1, Mech2), Books and magazines (SB & M)
Woodfree offsets, MF & SC Printing, Laids & Woves	Printing, books office papers, exercise and account books	34	4		34	4		Heavy letters (HL1, HL2), White woodfrees (W1, W2) Coloured shavings
System Index & Ivory boards	Printing, computer stationery	10	1		10	1		W1, W2, Hollerith cards
Business forms, duplicator paper, cheque paper, other woodfree papers, Kraft/Manilla	Office papers, computer and continuous stationery, envelopes	27	3		33	4		HL1, H12, W2, Buff Manilla envelope cutting (Man)

(Continued)

Coated mechanical and woodfree papers, carbonless copying paper	Printing, consumer and trade and technical magazines, labels, business forms	48	5		54	6		SB & M, Industrial mixed waste (IMW)
Packaging paper and paperboard		499		57	526		56	
Sackkraft, bleached & unbleached bag kraft (Mf & MG), Bleached & unbleached wrapping kraft	Paper sacks (multi-wall) paper bags, paper wrappings	95	11		96	10		Pure unbleached kraft paper (K1) Used kraft bags (K2) Kraft wrapping (K5)
Linerboard, fluting	Corrugated cases	274	31		290	31		New uncontaminated corrugated container offcuts (K3) Used corrugated containers (K4)
Cartonboards, lined chipboards, lined greyback boards, solid bleached board	Folding cartons, rigid boxes	130	15		140	15		W1, IMW
Total newsprint, printing and writing, packaging, papers		876	100	100	933	100	100	

Source : Consumption figures from

(i) The year ahead in South Africa for printing and writing papers and their users; BIS MRL, Louis Heyl and Associates, Pretoria, April 1976 (pp 2,4).
(ii) The year ahead in South Africa for paper and paperboard packaging. BIS MRL, and Louis Heyl and Associates. Pretoria, June 1976 (pp 2,3).
(iii) Personal communication, Mr J H van Wyk, SAPPI Ltd.

a year of consumption, and that virtually all paper becomes waste within five years. Figures published in the USA confirm this estimate. In a report to Congress, the Environmental Protection Agency estimates that the equivalent of 94 per cent of the 34,2 million tons of paper consumed in the USA in 1970 was discarded into the solid waste stream during that year (US Environmental Protection Agency 1974).

Except in "abnormal" years, paper stocks do not exceed an average of 2,5 months at each level (mill, converter/merchant, user). Since apparent consumption figures are derived from sales, ex-mills and imports, by converters and merchants, apparent consumption precedes actual consumption by users by not more than six months. Times between actual consumption and waste generation are generally very short.

The volume of waste paper generated in any one year is therefore considered to be very similar to the pattern of primary paper consumption in the previous year. At an average growth rate since 1973 of just over two per cent, the consumption of all paper and board in 1975 is estimated at about 935 000 tons. Considering that, due to depressed demand in 1976, paper consumption in 1975 was very similar to that forecast for 1976, this figure constitutes a fair estimation of 1976 waste paper generation.

Sources of supply

In this section, the degree of South African self-sufficiency in paper supply is discussed, followed by a look at developments in fibre supply. The information presented here is of importance when considering the present and future role of the waste paper recycling industry (see "The role of waste paper in solid waste", page 13).

The origin of paper supplied to the South African market

Taking newsprint, printing and writing papers and packaging papers together, approximately 80 per cent (by mass) of South Africa's total paper consumption in 1975 was supplied by local sources. The ratio of the value of paper supplied locally to the value of that imported is probably somewhat lower, and it is safe to say that at least one quarter of the value of paper and paperboard sales in South Africa during 1975 was due to overseas suppliers. As was noted in the section on printing and writing papers (page 5), South Africa is at present entirely self-sufficient in newsprint supply. At present the newsprint papermaking capacities should ensure (at a newsprint demand growth rate of five per cent per annum) that this situation will continue until 1980. It is in the field of printing and writing papers that there is much room for improvement in increasing local supply of printing and writing papers. In Table 4, an indication is given of the changing relationship between imported and local supply for the years 1973, 1974 and 1975.

The lack of local capacity for paper coating is evident in Table 4. The drop in the proportion of locally supplied uncoated papers reflects large imports made during 1974. Table 5 presents information on the major countries of origin of imported papers.

Table 4. Broad analysis of printing and writing paper supply sources

Paper type	% of total consumption by origin					
	1973		1974		1975	
	Local	Imported	Local	Imported	Local	Imported
Uncoated papers	65	35	59	41	67	33
Coated papers	0	100	0	100	0	100

Although Finland is clearly the largest supplier of imported papers, the range of paper types supplied by that country is small. Between 80 and 90 per cent of the paper supplied by Finland was uncoated mechanical paper which is used chiefly for consumer magazines. Possible replacement of this large quantity of paper will be discussed in the next section. Italy, Canada and Sweden, all countries which are supply sources of

Table 5. Major countries or origin of imported printing and writing paper

Country	Imported quantity					
	1973		1974		1975	
	('000t)	%	('000t)	%	('000t)	%
Finland	39,6	42	61,6	44	38,7	48
USA	7,3	8	15,2	11	8,6	11
UK	10,2	11	10,9	8	8,5	11
W Germany	6,2	6	9,0	6	5,7	7
Italy	7,8	8	9,5	7	4,7	6
Japan	5,3	6	8,9	6	3,1	4
Sweden	4,0	4	5,6	4	2,4	3
Canada	3,9	4	5,9	4	2,3	3
Other	10,2	11	13,6	10	5,8	7
TOTAL	94,5	100	140,2	100	79,8	100

uncertain reliability, together supplied 12 per cent of all imported paper during 1975, or five per cent of total paper consumption. The paper from these countries was used mainly for general and government printing and for magazines.

In Table 6, the level of imported paper and paperboard for packaging is shown. Coated board for folding cartons and rigid boxes constitutes the major item on the import bill. As yet, South African coating capacity is very limited. As was the case with printing and writing papers, imports shot up in 1974 despite the face that the level of local supply increased by more than enough to real cover natural growth in real consumption as well as a measure of stock increase.

Table 6. Broad analysis of supply sources of paper and paperboard packaging

Packaging type	% by mass of apparent consumption supplied by source					
	1973		1974		1975	
	Local	Imported	Local	Imported	Local	Imported
Corrugated case board and fluting	95	5	90	10	93	7
Board for folding cartons and rigid boxes	68	32	61	39	62	38
Other packaging papers	92	8	88	12	92	8

In Table 7, countries of origin of imported paper and paperboard for packaging are given.

Table 7. Major countries of origin of imported paper and paperboard for packaging

1975 Rank	Country	Imported Quantity					
		1973		1974		1975	
		'000t	%	'000t	%	'000t	%
1	USA	44,6	56	69,1	55	46,8	56
2	Sweden	12,8	16	16,4	13	11,4	14
3	Finland	4,1	5	12,0	10	6,5	8
4	UK	3,0	4	5,1	4	2,9	4
5	Norway	2,5	3	1,5	1	1,0	1
6	W Germany	0,8	1	2,2	2	0,4	-
	Others	11.6	15	18,6	15	14,5	17
	TOTAL	79,4	100	124,9	100	83,5	100

Source : Department of Customs and Excise

Developments in pulping and converting capacity and in fibre supply

The pattern of paper supplies in South Africa will change considerably over the next five years, and at the end of this period, it is possible that South Africa will be able to supply a much greater proportion of her paper and paperboard needs from local sources than is at present the case. It is estimated that 90 per cent self-sufficiency in printing and writing papers and paper and paperboard for packaging will be achieved before 1981.

A new pulp and paper mill, owned by the Reed Corporation, commenced production at Stanger in Natal during May 1976. This mill is the first in South Africa to bleach sugar-cane bagasse for fine paper and has a capacity of 34 000 tons per annum. It is intended to concentrate on the production of coated papers, all of which are presently imported.

The new No 3 paper machine recently installed by Mondi Paper Company has a capacity of 90 000 tons per annum. Besides newsprint, it will be possible to manufacture an uncoated mechanical paper suitable for use in consumer magazines as well as woodfree printing and writing papers. The 33 300 tons of uncoated mechanical paper imported during 1975 constituted 42 percent of all imported printing and writing paper during that year.

Although no South African company has yet announced plans to manufacture plastic coated board for use in the packaging of food and beverages, it is known that this very promising market is being carefully watched by all major paper and paperboard manufacturers. Imports of plastic coated board for food and beverages amounted to 40 000 tons or 53 per cent of total packaging imports during 1975.

Woodpulp is not the only fibre source which can be used for paper manufacture. The use of sugar cane bagasse has already been initiated in South Africa at the Reed Stanger mill. A firm of USA consultants has estimated that throughout the world, about 22 million tons of bagasse pulp could have been made from sugar cane in 1972 (Joseph E Atchison Consultants 1972). Applying the method used to derive this figure to South African sugar cane production in the 1975-1976 season, approximately 720 000 tons of bagasse pulp could be manufactured if all sugar cane were used. While it is recognized that total utilization of sugar cane is not feasible, it is clear that this is obviously a vast source of fibre which awaits only economic justification to be exploited for papermaking on a large scale.

Other possible fibre supply sources are straw from wheat and maize, bamboo, reeds, cotton linters and sorghum stalks. Although the fibre sources mentioned above are not used extensively at present it is the opinion of Atchison Consultants that for many, "... (their) greater use awaits only the economic necessity".

Developments relating to fluctuations in the apparent consumption for paper and paperboard

The apparent consumption for paper and paperboard is the demand as measured by volumes bought by merchants and converters from local and overseas mills. It is therefore the demand as it appears to the mills. Real consumption is the demand measured by the actual use of paper and paperboard by final buyers of these products. The difference between actual, or real consumption and apparent consumption is therefore equivalent to the change in the level of stock held by merchants, converters and end users together. In Figure 3 (page 28) the apparent consumption of paper and board is plotted from 1970 to 1976.

It is clear that stockbuilding was rife during 1974, as was de-stocking during 1975. The reason generally given for the stockbuilding was uncertainty as to the continuity of supply resulting from the "oil crisis" and the expectations of a world-wide recession. At the beginning of 1974, the depth of the expected depression was unknown, and many predictions of conditions, similar to those experienced in 1931 and 1932, were made. The "oil crisis" led to anticipation of large rises in the price of feedstock for plastics manufacture, and a consequent swing from plastic to paper packaging. All indications were that a shortage, perhaps serious and extended, of paper and paperboard would occur by the beginning of 1975. Paper and paperboard users, converters and merchants imported as much as possible as soon as possible in order to protect themselves from the threatened shortages.

As it turned out, the relative mildness and brief duration of the recession, the natural lag of the South African economy, the strong market for gold and the latterly responsible attitude of OPEC, among other factors,

proved the fears of paper shortages to have been largely unfounded. The already high, (and rising) cost of stockholding became more important than the now unlikely shortages and the same people who caused the boom in apparent consumption during 1974 caused the slump of 1975 by cutting back stocks to levels even lower than in 1973.

Reclaimed waste paper is used mainly as a fibre furnish for the manufacture of fluting and test linerboard for corrugated cases, and for fibreboard and chipboard for packaging, cores for toilet and other rolls, stationery etc. Considerable destocking by converters and users of corrugated cases and folding cartons took place during 1975. When this occurred, apparent consumption, and therefore mill offtake decreased to the extent that stocks, held by converters and users, were diminished. The mill demand for all fibre dropped accordingly, and caused the present slump in demand for and prices of waste paper. The relationship between movements in the business cycle, primary paper and paperboard production and waste paper demand will be investigated in more detail in section 5.

It has been suggested that part of the problem of widely fluctuating waste paper demand can be ascribed to a lack of adequate market and economic information at the disposal of concerns at all levels of the paper production process. It is noteworthy that some changes have been made in this respect in recent years. There has been a gradual movement towards vertical integration of printing and writing paper marketing, this movement following more marked overseas trends. The South African mills, SAPPI, Mondi and Stanger, all have financial connections with one or more paper merchants. While independent merchants have at present no reason to complain of unfair treatment by local mills, importing sprees such as that that took place in 1974, which led to disruption of mill production in 1975, can only damage relationships and encourage further vertical integration. Other considerations aside, this could only be beneficial to the waste paper industry.

Efforts on the part of paper and paperboard mills, merchants and converters to obtain market information have recently been streamlined and intensified, but it is still too early to judge the effect of this on the stability of buying patterns. Should, as is expected, the effect be beneficial, the waste paper industry will definitely benefit from the damping of waste fibre demand oscillations. It is apparent that merchants of printing and writing papers are not well adapted to supplying or using marketing information. The Association of Paper Distributors (APD) is seen by a number of its own members as an ineffective organization which is not in a position to provide assistance of any value to its members. Some merchants still only keep records in terms of values and are uncertain as to the tonnages that they handle. Until problems such as these are resolved, the lack of information and communication will continue to inhibit movement towards stability in the paper and paperboard industry.

THE ROLE OF WASTE PAPER IN SOLID WASTE

Paper, by mass and by volume is the most important material type occurring in municipal solid waste. In this section, the nature and extent of its presence as well as its behaviour in various solid waste disposal systems will be described.

The nature of municipal solid waste

Although no reliable South African figures are available, it is evident that the nature of solid waste has been undergoing a continual change. The occurrence of dust, ash and char, once major components of waste, has diminished considerably, and metal, glass and plastic have become significant components. Perhaps the most dramatic change has occurred in the presence of paper and board, which today comprises between 30 per cent and 35 per cent by mass of municpal refuse. An analysis of solid waste composition is given in Table 8.

Table 8. Composition of solid waste from a South African municipality

Components	Percentage by mass of total
Paper, board and rags	33
Ash and cinders	22
Organic matter	15
Glass	8
Ferrous metal	8
Non-ferrous metal	0,2
Mixed plastics	5
Others	8,8
TOTAL	100,0

Source : Bolitho V. Possibilities of Recycling in South Africa. Choices and Conflicts. Paper delivered at Symposium on Recycling of Waste Materials, Sandton, October 1975.

It should be noted that refuse characteristics vary from location to location and that the analysis in Table 8 is only an indication of South African refuse composition.

In Great Britain, paper comprises over 40 per cent of refuse on average, while figures for different areas of the United States vary between 32 per cent and 44 per cent. It is generally recognised that increasing industrialisation and affluence in a society leads to a greater paper component in refuse. It is expected that the standard of living of the South African population will rise and that the proportion of paper in solid waste will increase in the long term. In the shorter term, improving

waste collection facilities in Black areas will cause the average paper component to remain static and perhaps even decrease, due to the low average paper component in waste from these areas.

The nature of paper waste

Quantities of waste paper re-used by mills are shown in Table 9.

Table 9. Quantity of waste paper used by paper mills in 1974

Grade of waste paper	Quantity used (t at 10% moisture)	%
Special grades	9 425	4
} K1	11 651	4
} K2	1 594	1
Kraft grades } K3	26 760	10
} K4	89 641	35
} K5	1 357	1
Manilla	1 056	-
White 1	3 277	1
White 2	596	-
Colour 2	492	-
Mechanical 1	4 263	2
Mechanical 2	4 553	2
Heavy letter 1	2 041	1
Heavy letter 2	5 556	2
Flat news	19 107	7
Industrial and common mixed waste	69 107	27
Other	8 531	3
TOTAL	258 917	100

Source : White M D and Riekert H. Waste Paper Recovery II. Timber Research Unit, CSIR, Pretoria, January 1975, Table 1.

The applications of paper products are such that most paper and board becomes waste within a short period of having been produced. Current paper production, as described in "The supply and applications of paper in South Africa" (page 1) is therefore a good indication of current waste generation. By subtracting known recycled quantities, as given in Table 9 it is possible to arrive at an estimate of the composition of the paper component of solid waste, in terms of paper types. Such an estimate is given in Table 10. Included in this table is a similar breakdown for the United States, as released by the US Office of Solid Waste Management Programs.

Table 10. The composition of paper in municipal solid waste

Paper type	Contribution to paper waste (%) by mass	
	RSA 1975 (estimated)	USA 1971
Newspaper	23	19
Printing and writing papers	22	21
Corrugated board	26	25
Other packaging	29	28
Other paper and board	-	7
TOTAL	100	100

Note : Because the figures for South Africa in this table are not empirically derived, there is no estimate for the "Other" category.

It is apparent that South African municipal waste paper composition is very similar to that in the United States.

It is expected that the packaging component will increase in the long term.

Current recycling activity removes about 24,5 per cent waste paper (White and Riekert 1975). If no waste paper were recovered at all, then the waste paper component of municipal solid waste would rise from about 33 per cent to about 40 per cent. If the recovery rate were increased to 30 per cent (considered to be the maximum attainable with present collection systems and price ranges) then the occurrence of paper in municipal waste would drop by only two per cent to about 31 per cent. It is clear that the size of the paper component in solid waste is relatively insensitive to changes in recovered quantities, the difference between no recovery and

maximum recovery being only a nine per cent change in the paper component of municipal solid waste. Of course, the absolute quantities involved are considerable - approximately 250 000 tons of paper per annum is currently recovered.

Fluctuations in waste paper collection activity have no significant effect on solid waste composition, and therefore do not cause any noticeable problems in any of the disposal systems currently used in South Africa.

Paper composition

Virtually all paper used in South Africa is made from wood pulp. Before pulping, wood is composed chiefly of cellulose and lignines. Cellulose is a carbon-oxygen-hydrogen compound, and is a relatively simple and stable molecule. Lignines serve to bind the cellulose in wood and are comprised of more active and more complicated molecules. Cellulose is not toxic in its natural state and is totally insoluble in water, while lignines, also non-toxic, are fractionally soluble. Lignines are, however, intense colouring agents, and will discolour water even when only present in very small concentrations.

Woodpulping is carried out either mechanically, chemically or semi-chemically. Chemical pulping leads to removal of 96-97 per cent of lignines, and the bleaching process, used to make white papers, removes virtually all remaining lignin content, so that bleached, chemically pulped papers are lignin free. Kraft papers are unbleached and chemically pulped and contain less than four per cent of original lignin content. Semi-chemically pulped paper and board has a certain lignin content, but it is generally low. Newsprint is made from mechanical pulp, and as such contains all of its original lignin content (about 38 per cent from SA softwood) before bleaching. Only partial bleaching is applied and the lignin content is not significantly reduced. Consequently, newspaper in landfill and in dumps can cause discoloration of any water that might pass through the waste. Clay and other fillers used in paper making do not cause significent pollution problems.

Paper in refuse collection

In the larger centres of South Africa, household and commercial refuse is collected by trucks served by teams of labourers. In many centres, compaction trucks are used. Where the compaction process is not employed, the low density of the waste (caused to a large extent by paper) results in under-employment of truck carrying capacity, and hence in a degree of inefficiency in equipment utilization. The main culprit here is corrugated cases, since their density is especially low in erected form.

Where compaction trucks are used, waste density is still low, but is somewhat better than in the previously mentioned case. Compaction of up to a third of the original volume is achieved. According to some municipal cleansing officials, the overall density of their waste and therefore truck utilisation is satisfactory. Indeed, the presence of paper is advantageous, in that it acts as an absorbant for any water or liquids that would otherwise remain in the truck or leak onto roads.

The low density of paper waste can lead to inefficiency in equipment utilization, but employment of compaction trucks solves the problem to a large extent. Paper does not otherwise provide any special problems for waste collectors.

Paper in landfill

Paper is certainly an important part of the decomposable portion of waste. In refuse landfill, where an effort is made to compact waste, two distinct bacteriological breakdown processes are observed. Near the surface aerobic digestion takes place in the same way as in the composting process. Deeper down, anaerobic digestion (ie where oxygen presence is insufficient for aerobic digestion) occurs. The chief end-products of this slow process, which amounts to decomposition of carbonaceous matter, are carbon dioxide, methane and ammonia. Any leachate from the landfill area would be contaminated by these products.

As noted by Bolitho (1973) leachates can occur only where the rate of rainfall exceeds that of the evapo-transpiration of water from the landfill area. Experience in the Transvaal has shown that no leachate normally flows from well-chosen and well-managed landfill sites. It is only in the Western Cape that special precautions have to be taken to prevent any possible leachate from reaching the subterranean water.

Uncompacted dumps of waste generally undergo aerobic digestion only, and cause no pollution besides their smell and unsightliness.

Although paper in landfills can contribute to leachate pollution either through its decomposition products, or through discolouration resulting from the lignin content of newsprint (see "Paper composition" page 17), well-managed landfills do not have significant leachate outflows.

Paper in compost

Composting of refuse is practiced by some municipalities in the Western Cape. In the composting process, the relationship between the carbon and nitrogen contents of the waste is of great importance. Ideally, the average carbon to nitrogen ratio should be between 30:1 and 40:1. A lower ratio (eg 15:1) leads to a loss of nitrogen - a valuable component of compost used for agricultural purposes - to the air, and a higher ratio leads to a slowing down of the breakdown process. The slower the process, the more costly it becomes, due to the need for increased maturation area and higher labour costs. Paper, which has a high carbon to nitrogen ratio, normally balances other nitrogen-rich components of waste which have ratios lower than the desired average of between 30:1 and 40:1. Where the paper content of waste is excessive, nitrogen loss is high, and other waste, such as dried sewage sludge, must be added to improve the carbon to nitrogen ratio.

It appears that although the role of paper in compost is not yet well documented, no technical research is urgently necessary.

Paper in incineration

Due mainly to the cost of the process, no large scale incineration of solid waste is carried out in South Africa.

Figures from the USA demonstrate the value of paper as a component of incinerated waste (Snyder 1974).

	Higher heating value (Btu/lb)
Paper	8 000
Plastics	16 000 - 18 000
Wet waste	3 000 - 5 000 (40%-15% moisture)
Dry waste	5 600

Where the energy from waste incineration is used for steam generation, a high paper content in waste is desirable.

Most incinerators provide for complete combustion of waste. Where combustion is complete, the combustion products of paper are carbon dioxide, water and a small quantity of ash, none of which are serious pollutants. Where combustion is incomplete, destructive distillation takes place, and the main paper-derived products from this process are acid, methyl alcohol and char, which can cause pollution. Destructive distillation takes place in a smouldering or slow burning fire, such as occurs when waste dumps burn.

South African waste disposal practice (chiefly landfills) is such that no significant air pollution results from the presence of paper in refuse.

Paper in pyrolysis

The US Environmental Protection Agency is currently supporting a number of solid waste processing demonstration projects. Among the processes under scrutiny is pyrolysis. At Baltimore, USA (Environmental Protection Agency 1975), waste with a 38 per cent component of paper left a residue containing carbon char, glass, metals and rock. A major part of the carbon char comes from the original paper component of the waste. Research is being conducted into uses for the carbon char residue, and the following possibilities are being investigated :

- carbon char, as a substitute for activated carbon for use in waste-water treatment plants
- in combination with dried and digested sewage sludge, carbon char might be a good soil conditioner
- carbon char might be suitable as a filler for plastic products.

Char, with a heat value of 9 000 BTU/lb would be a good fuel were it not for the high proportion of ash (32 per cent at Baltimore). Until such

time as a beneficial use is found for carbon char, it is being disposed of at a landfill site.

Gases resulting from the pyrolysis process itself are burnt, and the energy used to create steam. Although air pollution testing has not yet been completed, the gases released into the atmosphere are expected to comply with US Federal standards.

It appears that paper in pyrolysis does not provide any special problems, and research is needed rather into possible applications for char residue, than into the behaviour of paper in pyrolysis.

Conclusion

Although paper is a major component of municipal solid waste, and therefore contributes significantly to disposal costs, it does not pose serious technical problems to any of the disposal systems presently in use in South Africa. What problems there are, concern the logistics of collecting and disposing of the ever-increasing volumes of solid wastes.

RECYCLING OF WASTE PAPER

In this chapter, a brief resumé of the paper recycling industry is given. The aim is to indicate what groups are involved in the process, approximate quantities handled, which paper types are used and what products are made from recycled fibre. Quantification of waste paper flows is not attempted, but use is made of figures contained in two CSIR reports on waste paper recovery (White and Riekert 1974). The White and Riekert reports provide great detail on quantities of waste paper recycled in South Africa, and should be studied in conjunction with this report if an accurate picture of paper recycling is to be obtained. The reports referred to are to be followed up by a series of statistical releases by the National Timber Research Institute designed to provide accurate information on current paper recycling practice.

Waste paper collection

There are three distinct groups involved in the collection and sale of waste paper. They are as follows :

(a) Informal collection groups

(b) Moulders

(c) Commercial collectors.

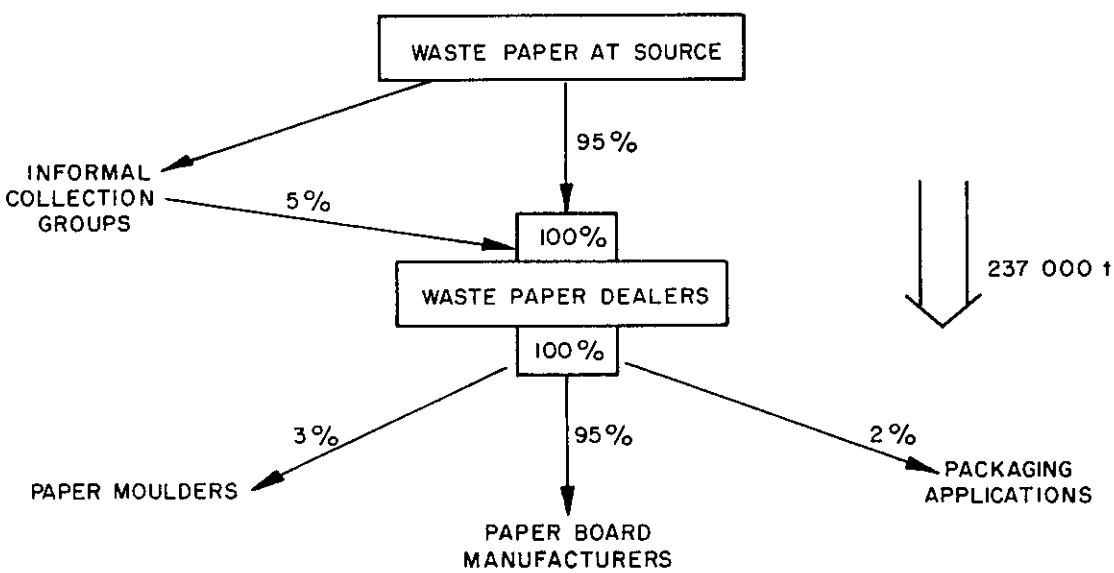
Informal collection groups and commercial collectors are discussed in the sections dealing with informal collection groups (see over page) and commercial collectors (page 21), while moulders, regarded rather as users of waste paper, are considered in the section on "Moulders" (page 24).

Informal collection groups

Informal collection groups are groups such as schools, scouts, charity organizations, municipalities and individuals, amongst others, whose primary aim as a group is not waste paper collection. Normally collection is done at no apparent cost, and paper is sold to provide funds for the group. Virtually all informal groups restrict their activities to collection of newspaper, due to the fact that it is uniform in nature, easily recognisable and easily stored. Small quantities of kraft boxes are also collected, often from municipal refuse disposal sites. Households constitute the major source of paper. Paper is sold to commercial collectors and moulders. It is not clear how much of recovered paper is collected by informal groups, but it is probably not more than five per cent.

Commercial collectors

Commercial waste paper dealers form by far the most important group involved in waste paper collection. Approximately 95 per cent of all recovered paper is handled at some stage by a waste paper dealer. Figure 2 gives an indication of the sources of and markets for waste paper handled by dealers.



Source of figures : White M D and H Riekert; Waste Paper Recovery - An introductory survey *op cit* (pp 37, 38, 56).

Figure 2. Waste paper dealers - sources and markets (1973)

There is a clear distinction between large dealers and small dealers. Large dealers are generally tied, either financially, or by contract, to a paper or board mill, and are situated in the larger centres. Smaller dealers, also known as satellite dealers, sell most of their paper to the

larger dealers, and together with informal collection groups, provide about one third of the paper collected by larger dealers. Satellite dealers operate in country areas, where waste paper sources are too small to interest larger dealers, or in city areas, where they are responsible for collection of marginal quantities. "Marginal quantities" refers to paper collected from small, dispersed sources. Large dealers, geared for collection of large quantitites, generally find collection of marginal quantities unprofitable. Nearly all waste paper is therefore handed on to paper and board mills by the larger, affiliated dealers.

Waste paper dealers fulfil four distinct functions. They are as follows :

- Collection
- Storage
- Sorting
- Distribution

They do in fact, play a role exactly opposite to that of the wholesaler, and, to a certain extent, the retailer, in the normal system of marketing products from manufacturer to consumer. Where the prime function of the wholesaler is to break bulk and distribute in variety, the waste paper dealer must collect in variety, and create and distribute bulk.

Table 11. Contributions of sources supplying waste paper to large dealers (1972)

Source	Quantity (t)	%
Converters	35 110	17,4
Printers	32 710	16,2
Retailers	61 590	30,2
Offices	17 200	8,5
Consumers	54 700	27,2
TOTAL	201 310	100

Source : White M D and H Riekert; Waste Paper Recovery - An introductory survey

The function of collection has already been discussed. Table 11 gives an analysis of the sources of supply of waste paper to large dealers.
Storage of large quantities of waste paper is essential, firstly to allow for efficient sorting and distribution, and secondly to provide a reservoir with which any excess in either the supply or demand of waste paper may be

controlled. It is clear that the reservoir as a buffer is not a sufficient measure to ward off the effects of the larger fluctuations in demand for waste paper which take place from time to time. This will be discussed more fully in the section dealing with the fluctuating demand for waste paper (page 26).

Although the bigger sources of waste paper provide large quantities of a uniform paper grade, much of the waste paper collected has to be sorted if specific grades are to be sold to mills. Unsorted paper can be sold as industrial mixed waste (IMW) or common mixed waste (CMW) but prices obtained for these grades are considerably lower than those obtained for the "pure" waste paper grades. Sorting is done by hand, and the degree of sorting carried out by dealers is therefore determined by the relationship between labour costs and waste paper price levels. The relative sizes of the markets to which waste paper is distributed are shown in Figure 2. The "other markets for waste paper" cited are firms using shredded paper and unprinted newsprint for packaging and other waste paper dealers. On average, large dealers supply waste paper to between four and five pulp mills. In Table 12, an analysis of waste paper used by mills is presented in terms of waste paper grades. Because mills take over 95 per cent of paper sold by dealers, this analysis is a very close approximation of that of paper sold by dealers.

An interesting development is that some larger dealers are making an effort to collect paper from marginal sources. Promotional campaigns are being used to sustain the interest of householders and small retailers. Paper collected from these sources is mainly flat news and kraft. Experience has shown that a response of about one in six households may be expected.

The recovery rate

The term "recovery rate" refers to the ratio of waste paper collected to the total consumption of paper and paperboard. In South Africa, this rate was approximately 23 per cent in 1973, compared to the world average of 22 per cent in 1970. Recovery rates in 1968 for the USA, the UK, Western Germany and Greece were 20 per cent, 26 per cent, 29 per cent and 17 per cent respectively (Food and Agriculture Organisation 1969). It is considered that, without significantly increasing the cost of waste paper collection, and without changing the collection system drastically, the recovery rate in 1973 could have been as high as 29 per cent, although subsequent experience has shown that the cost of extra collection might be considerably higher than was thought at the time of publication of the White and Riekert report. Any further increase would require a complete re-thinking of the collection problem (White and Riekert 1974).

Applications of waste paper

As indicated in Figure 2, there are three main types of waste paper users. They are paper and board mills, moulders and users of waste paper for packaging.

Paper and board mills

The types and quantities of waste paper used by mills are shown in Table 12. Virtually all of this is supplied by waste paper dealers, but a

Table 12. Quantities of waste paper used by paper mills 1973

Waste paper grade	Quantity used (tons)	per cent
Special grades	8 097	4,1
} K1	5 183	2,6
} K2	2 603	1,3
Kraft grades } K3	23 211	11,8
} K4	59 373	30,1
} K5	1 789	0,9
Manilla	1 338	0,7
White 1	5 383	2,7
White 2	163	0,1
Colour 2	2 990	1,5
Mechanical 1	5 445	2,8
Mechanical 2	3 895	2,0
Heavy letter 1	1 065	0,5
Heavy letter 2	5 818	2,9
Flat news	12 586	6,4
Industrial and common mixed waste	46 434	23,5
Other	12 019	6,1
TOTAL	197 392	100

Source : White M D and H Riekert; Waste Paper Recovery - An introductory survey.

small quantity is bought by mills directly from printers and converters. Products manufactured include lined and unlined chipboards, lined greyback and manilla boards and fluting and test linerboard for corrugated cases. While some manufacturers use an exclusively waste based fibre furnish, others manipulate the proportions of waste and virgin fibre in order to derive the cheapest material still complying with strength and colour

requirements. Very limited quantities of waste paper are used to supplement the fibre furnish for paper manufacture, and only in-plant waste and de-inked waste computer cards are used for this purpose. From the approximately 400 000 ton of paperboard consumed in South Africa during 1973, the last year in which apparent consumption was approximately equal to real consumption, about 50 per cent was made from waste fibre. This quantity, approximately 198 000 tons, was considerably less than the 237 000 tons of waste paper recovered during 1973. The reasons for this are as follows :

- withdrawals from waste paper stocks are not necessarily equal to volumes collected
- some waste paper was diverted to other uses, such as moulding, packaging and fibre furnish for non-paperboard products
- re-pulping and re-processing of waste paper entails a certain mass loss.

Moulders

Paper moulders are organisations which use recovered paper as the feedstock for a pulp from which a number of moulded products are made. These include egg boxes and trays, fruit trays, wine bottle sleeves, bitumen pipes, tamping plugs for mines, textile roll covers, acoustic cones and artificial pigeon nests. Egg boxes and trays, fruit trays and bitumen pipes are made of newsprint, while the other products mentioned are moulded from a mixture of Common Mixed Waste and Kraft board (K4).

Markets for the newsprint-based products are showing healthy growth - especially bitumen pipes. The demand for wine bottle sleeves is declining due to a preference which is currently being shown for corrugated kraft board partitions for separation of bottles packed into boxes. The reduced demand for sleeves will not reduce the total volume of waste paper re-used, since the partitions now being used are generally made from a waste based linerboard. A new market is being developed for disposable hospital containers.

Moulders obtain paper from informal collection groups, commercial collectors and through their own collection activities. It is estimated that 43 per cent of newsprint, and three per cent of kraft and mixed waste grades, is re-used by moulders. In total, 5,3 per cent of all waste paper was used by moulders in 1972.

Users of waste paper for packaging

Approximately two per cent of waste paper (or 5 000 tons) sold by larger dealers is used as a packaging material. Mixed waste paper is shredded and used as a protective filler for the packaging of fragile items, corrugated cases still in good condition are re-used as corrugated cases, and unprinted waste newsprint and other clean, unprinted papers are used as wrapping paper by small food retailers. A certain quantity of once-read newspapers is used as a wrapping by greengrocers.

Costs associated with waste paper recovery

There are three broad areas in which the overall cost of recovered paper to mills is determined. They are the sources of supply, the waste paper dealers and the mills themselves.

The price at which waste paper is bought by dealers from sources of supply is determined by a number of factors, amongst which are the following :

- the cost of disposal which would have been incurred had the waste paper not been recovered
- the benefits resulting from alternative use of the waste paper (eg use as packaging or fuel)
- competition between buyers of waste paper.

In the absence of effects from the latter two factors, it is theoretically possible to have a negative price for waste paper, ie dealers are paid for the service that they perform in removing waste paper.

Although dealers are seldom paid to remove waste paper, the situation where no payment of money by either source or dealer is made, frequently occurs in times of slack demand from paper and board mills. During 1973, when there was a healthy demand for waste paper, prices paid by dealers ranged from R3,00 per ton to R52,00 per ton, depending on the grade, and when and where the paper was bought. Kraft grades fetched between R9,00 per ton and R30,00 per ton. Flat news was bought for between R8,00 per ton and R13,00 per ton (White and Riekert 1975).

Besides the price paid to sources of waste paper, waste paper dealers incur "processing" costs resulting from the handling necessary to supply mills with the qualities and quantities desired. The processing costs include costs associated with collection of waste paper from sources of supply, sorting waste paper into grades, holding stocks of sorted and unsorted paper, and where applicable, transporting paper from the premises of the dealer to the mill. Enquiries amongst dealers revealed that the average "processing" cost (excluding long distance transport to mills) could vary from R10,00 per ton to R25,00 per ton, the actual cost being determined by the degree of dispersion of the sources of paper, the degree of sorting necessary, and length of time between collection and dispatch to mills. The cost of sorting Kraft paper for instance (about R4,00 per ton) is considerably less than for computer cards (about R10,00 per ton) due to the need for greater homogeneity in the computer card grade, and to the comparative ease with which Kraft paper is recognised and sorted. The average undercover storage cost appears to be about R10,00 per ton per year. Long distance transport of waste paper is avoided where possible, due to the high costs involved. Railage between Cape Town and Johannesburg costs between R30,00 and R34,00 per ton. Costs incurred by paper mills are comprised of collection costs (where applicable) and handling and storage costs, and are similar to those of dealers for collection and storage.

Gross margins between the average purchase and selling prices of different grades of waste paper, as achieved by waste paper dealers in 1973, ranged between R34,00 and R3,50. The average gross margin was R6,00 per ton, and was considered to be too low to allow for any significant level of

competition between dealers (White 1975). Although the figure was probably considerably higher in 1975, it was still not much higher than the estimated average operating costs of R10,00 to R11,00 per ton.

Taking all costs into account, it remains generally much cheaper to use reclaimed fibre than virgin fibre. As an example, waste paper pulp for corrugated cases cost a mill about R60,00 per ton in April 1976 as against the R200 per ton for virgin pulp. Manufacturers of tissue papers find that reclaimed fibre costs up to R100 per ton less than virgin fibre.

Motivation for paper recovery

The main products made from recovered fibre in South Africa are chipboard, greyback board and linerboard and fluting for corrugated cases. The manufacture of chipboard and greyback board is especially dependent on waste fibre, (about 90% of total production is waste based) and it is considered that if waste fibre were to become unavailable, the fibre furnish would have to consist of imported virgin pulp, which would effectively price most board products out of the market. If for some reason, use of virgin fibre for corrugated case making materials were to be made compulsory, it would be necessary to import at least some pulp, thereby increasing the average price of corrugated cases, and probably decrease the demand for them. Approximately 21 per cent of all linerboard and fluting for corrugated cases is based on waste paper. It is clear that the recovery and re-use of waste paper contributes to a saving of foreign exhange, and effectively reduces the demands placed on local timber resources. For this reason alone, recovery and re-use of waste paper is most desirable.

As was pointed out in the section on the role of waste paper in solid wastes (page 13), the presence of paper in the solid waste stream presents, technically speaking, no real problems, although the fact that paper is the major component of urban solid waste makes paper a significant contributor to disposal costs. Therefore, waste paper recovery activity probably reduces disposal costs. Small increases or decreases (under 10 per cent) in the recovery rate of paper would not meaningfully affect disposal costs.

THE FLUCTUATING DEMAND FOR WASTE PAPER

Wherever waste paper is recovered and re-used, problems are experienced with fluctuating demand. This section is devoted to a discussion of the problem, its causes and possible solutions.

The problem

According to a number of South African mills using waste paper, and to waste paper dealers, a condition of depressed demand for waste paper has occurred at regular intervals during the past 15 years. The years 1963, 1967, 1971 and 1975/76 are cited as years during which the depressed demand situation was experienced. On each occasion, the situation has been characterised by the following phenomena :

- Falling apparent demand for the products manufactured by mills using waste paper. This is caused by overstocking and consequent reduced purchases by converters and users of the products; by a general economic slowdown and therefore slowing in the rate of growth of the real demand for the products; and by efforts on the part of converters and users to reduce costs by cutting stocks and improving material utilisation efficiency. The causes described above may occur singly, or together, and may be accompanied by other factors which reduce the apparent demand for waste paper derived products.

- Increasing stock levels of waste paper at mills and at waste paper dealers. This is largely a result of the fact that a reduction in end-product demand mentioned above preceeds a reduction in volumes of paper collected by waste paper dealers, by a certain length of time. Another factor contributing to increased stock levels at mills is the fact that mills and dealers continue to buy waste paper in times of reduced demand in order not to cut off supply channels which would be difficult to re-establish in times of increasing needs for waste paper.

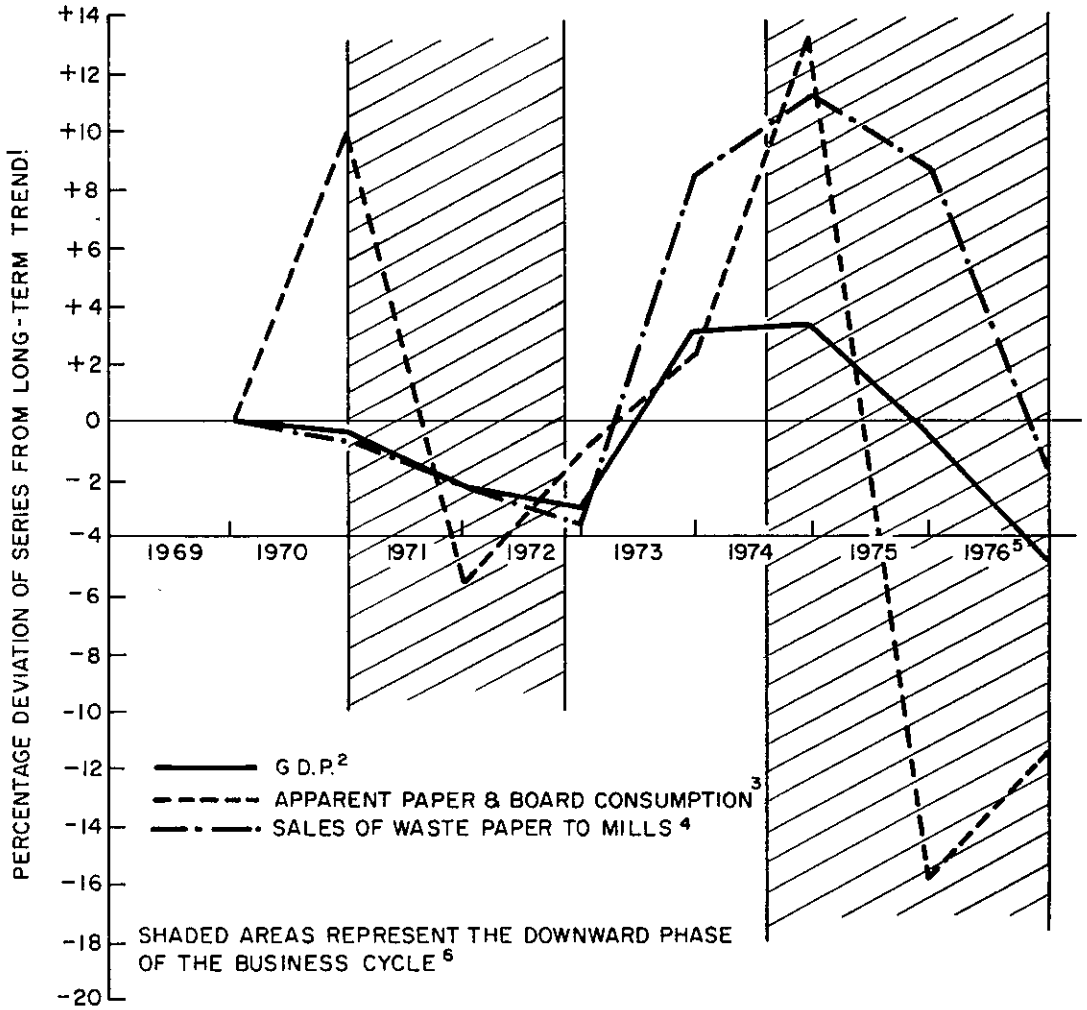
- Falling waste paper prices. As a result of the need to reduce supplies to a minimum, and in an effort to cover increased stock-holding costs and therefore effective waste paper prices, prices paid by mills to waste paper dealers, and in turn by waste paper dealers to sources of supply, are cut.

It should be noted that, owing to differences in application of different waste paper grades, conditions of underdemand do not necessarily apply to all grades simultaneously. For example, flat news, much of which is sold to moulders, is currently not in a state of underdemand, whereas certain kraft grades are. White woodfree papers (W1), unprinted mechanical papers (Mech 1) and Hollerith cards are used as pulp substitutes and are other examples of grades which do not normally follow general trends in the waste paper industry. Generally, though, most grades tend to move in unison, and dealers definitely do experience times of generally low prices and demand.

It is interesting to take note of the following comment on the basic nature of the problem made in the UK. "The waste paper industry knows very well that the demand for waste paper closely follows the demand for finished paper and board, which is in turn dictated by a country's economic activity. Currently the UK is facing its worst economic recession since the early 1930's and consequently the demand for waste paper is similarly in the doldrums" (Hughes 1976).

The applicability of the above comment to the South African situation is illustrated in Figure 3, in which trends in the Gross Domestic Product (GDP), the apparent consumption of paper and paperboard products, and the sales of waste paper to paper mills are compared (see over page).

From Figure 3, it is apparent that there exists a measure of correlation between changes in the GDP, the consumption of paper and paperboard products, and the sales of waste paper to mills. The data are insufficient for formal analysis, but from Figure 3, it would appear to be reasonable to assume the following :



Notes : (1) Long term trends from 1969-1976 are assumed to be as follows :

GDP	: 6,5% per annum
Apparent paper and board consumption	: 7,5% per annum
Sales of waste paper to mills	: 8,7% per annum

(2) GDP excluding agriculture, forestry and fishing, at factor cost and deflated using consumer price index at constant 1970 prices.
(3) Sales by mills and imports - exports (t).
(4) Sales by dealers to mills excluding sales to moulders (t).
(5) Forecast levels.
(6) As shown in annual economic report 1975, South African Reserve Bank, Pretoria 1975, p 15. The present downward trend has been extended to end 1976.

Source : Data used in Figure 3 are derived from the following sources : GDP - a statistical presentation of South Africa's quarterly national accounts for the period 1960 to 1974. SA Reserve Bank, Pretoria, March 1976. Paper consumption - Surveys of printing and writing papers and packaging papers op cit; Surveys of pulp, paper and board industry in SA; APPBM Durban, 1972, 1974. Waste paper sales - White M D, H Riekert; Waste Paper Recovery.

Figure 3. Trends in GDP, apparent paper consumption and waste paper sales

- When it becomes apparent that the business cycle has embarked upon its downward phase, the apparent consumption of paper and paperboard products increases strongly, to be followed by a large drop in consumption soon afterwards. Recovery of paper and paperboard apparent consumption begins before the bottom of the business cycle is reached, and from there continues more or less normally until the next downward turn is experienced.

- Changes in the growth of sales of waste paper to paper mills follow the changes in GDP and the business cycle fairly closely, and are generally smaller than the changes in apparent consumption of paper and paperboard products. It should be noted that the inclusion of sales of waste paper to moulders would have decreased the periodic deviations of the sales of waste paper from the long term growth rate, due to the relative stability of the demand for moulded paper products.

It is clear from Figure 3 that the volume of waste paper sold does not vary drastically, and that, as far as volumes handled are concerned, the "slumps" in the waste paper industry are mild, and not very different from those experienced by industry in general during unfavourable economic conditions. Slumps in the industry are however particularly detrimental to waste paper dealers because of the fact that considerable price decreases accompany volume decreases.

Attitudes of the industry

All waste paper dealers and waste paper users approached during the course of the survey indicated that they are regularly affected by changes in the price of and demand for waste paper. Most consider the fluctuations to be detrimental to their companies, although some smaller dealers expressed the opinion that even wider price fluctuations than are at present experienced would be desirable since they would then, in times of undersupply, be better able to make provision for lean periods than is at present the case. The continually growing demand for moulded products has insulated moulders from the problems of changing price levels to a certain extent, but with mills taking up to 50 per cent of flat news sold, the insulation is not complete. Some of the smaller, unaffiliated dealers are known to be experiencing difficulty in continuing to function in the present situation. In general, those concerned consider that any measures which might be taken to alleviate the situation would be desirable.

The roots of the problem

A great amount of comment has been made in overseas publications on the problems experienced by the waste paper industry. In this section, selections from this comment will be presented, and related to the South African situation.

A general appraisal of the supply and demand interaction in the secondary materials field follows : "All who have studied the demand/supply relationships in the secondary materials field are well aware of the critical dependancy of the supply variable on the demand side of the equation. The record is clearly established that when demand levels and market values

permit, the supply of secondary materials will increase to fulfil the demand levels. When demand levels drop and market values do not justify the economic recovery of these materials, they, along with the other wastes, end up in disposal sites" (Wingerter 1975). That this is the case in South Africa is borne out by the following comment made by a South African waste paper dealer : "There is never a shortage of waste paper - only a shortage at a price." Research by White and Riekert shows that the above appraisals are only valid within certain limits and restraints. They estimate that there is potentially another 505 000 tons of waste paper available for collection in South Africa (as against about 270 000 tons presently collected), but that "of this 505 000 tons it is estimated that 59 000 tons of waste paper could be collected by practical means without drastic cost increases. Any additional increase in quantity will be dependent on price increases and improved collection systems." Subsequent experience by waste paper dealers in collection of marginal quantities suggests that the cost of collection of extra quantities is considerably higher than was thought at the time of publication of the White and Riekert report.

In a report to Congress, prepared by the Office of Solid Waste Management Programs of the US Environmental Protection Agency (EPA) barriers to waste paper recycling are discussed as follows : "Increased wastepaper recycling is inhibited by a number of factors including consumer preference, paper manufacturing economics, technology and raw material availability. Supply of waste paper may be an important constraint in the short term, but as was indicated previously, there are sufficient quantities of waste paper available in the waste stream to increase consumption significantly. The most important barrier in the long run is the uncertain demand for waste paper, which is related to the economics of paper and paperboard production" (Environmental Protection Agency 1974). The report proceeds to propose a number of reasons why waste paper demand has consistently fallen short of available paper in waste. Extracts from the report are printed in italics below. Comment on the South African situation has been added.

- *Although the situation appears to be changing, consumers still show a marked preference for virgin fibres.* There is no 100 per cent waste based printing and writing paper produced in South Africa, as is the case in the USA and some European countries. Consumer preference here is therefore largely untested.

- *The paper industry is vertically integrated into timber production in order to provide long term stability of raw material supply.* This is also true of South Africa, and it remains easier to ensure supplies of virgin fibre than of waste based fibre. Vertical integration into waste paper supply sources has taken place in this country.

- *Existing paper mills are large, and are situated near to sources of timber, and problems of logistics and smaller scale make increased use of waste paper unattractive.* This is only partly true in South Africa, due to a number of reasons, the most important of which are the differential rail tariffs in force, and the reliance on imported pulp during the early days of the paper industry.

A number of reasons for the difficulty in collecting and using waste paper, and for the fluctuating demand for waste paper are cited in an article by

Whiting (1975). They are listed below.

" - The material availability : this relates more to national paper and board consumption and movements in the national GDP rather than to national production of paper and board.

- New demand occurs in large lumps, on machines commissioned or converted.

- There is a long lead time required to develop waste paper collections from scratch.

- (It is difficult) ... to turn off, or turn down, the supply tap.

- (There is the problem of) ... how and where to carry buffer stocks, and who should carry and finance them."

With regard to the second reason mentioned by Whiting, one South African paper dealer went so far as to say that mill capacity changes in the product mix manufactured are the major causes of demand fluctuations, and are more important than paper consumption or economic changes.

During the course of interviews with mills and dealers, a number of other possible causes of demand fluctuations were mentioned. They are discussed below.

- Changing demand for the products of an industry using paper and paperboard (especially packaging) leads to an ajustment of stock levels, amplifying the change in apparent demand as experienced by converters and mills and their demand for waste paper. This is actually a more specific statement of the interaction between changes in GDP, paper consumption and waste paper sales.

- When the consumption of paper and paperboard is stimulated, and the demand for waste paper increased, the supply of waste paper must come from waste originating from the lower consumption levels experienced six to twelve months previously. The organization of collection activities must then be improved, and marginal quantities exploited. When waste from the increased consumption becomes available, the supply of waste paper is in excess of the needs, which by this time will often have dropped again. Collectors are then faced with increased supplies from normal channels for another six to twelve months as well as with the supplies from marginal sources previously established. The lag of waste paper sales behind paper and board apparent consumption is evident in Figure 3.

- When the demand, and therefore prices offered for waste paper is increased, collection becomes a more attractive proposition, and new collectors enter the field. This effectively increases the cost per ton of collection all round, without increasing the total quantities collected significantly. This leads to the elimination of some regular collectors and dealers, and to the breaking down of collection channels, and accentuates the shortage being experienced.

COURSES OF ACTION

It has been made clear in previous chapters that an increase in the quantity of waste paper recovered and re-used would be beneficial to the paper recycling industry, to paper makers and converters, and to the country as a whole. In this section, a number of courses of action which would lead to an increase in the recovery rate for waste paper are briefly discussed. The measures mentioned are either those proposed or adopted in other countries, notably the USA, or those proposed by people interviewed during this survey. In both cases, the measures are untested as to desirability and practicability in the South African situation. Such testing will require specific and intensive attention which is not within the scope of this report. Consequently, courses of action are described without comment.

Local comments

Persons interviewed during the course of this survey were unanimous that an increase in the volume of paper recycled is desirable, and that stabilization of the demand for waste paper would contribute favourably to the increase. The following list summarizes some of the proposals made.

- *Preferential rail tariffs.* Forty per cent of respondents suggested an effective reduction in the tariffs applicable to waste paper transport. At present, the SAR has a dual tariff, whereby the cost of transport is determined according to mass of paper loaded. The present mass required per truck in order to qualify for the lower tariff (16 tons and 8 tons, according to the truck used), is considered to be too high, and only rarely attainable by waste paper shippers. According to respondents, a 20 per cent reduction in the mass requirement would result in a considerable saving in long distance transport costs, and make the operation of wider collection networks more attractive.

- *Government subsidy of waste paper storage costs.* Such a measure would, according to the 60 per cent of respondents proposing it, enable collectors and users of waste paper to absorb excess supply in times of slack demand, and alleviate the pressure on collectors to break down collection channels.

- *Extension of waste paper applications.* All agreed that an extension of applications for waste paper would increase the volume of paper re-used, and would improve the stability of demand. Extension into fields not susceptible to dramatic changes in apparent demand, such as the moulded products and pipes currently made, is especially desirable.

- *Closer ties between users and collectors of waste paper.* Closer ties were proposed, with some reservations, by 20 per cent of respondents. Ties could be either through agreement or financial arrangements.

Other proposals are :

- more price co-operation

- provision for better information and forecasting
- reduction of specifications applicable to government tenders
- use of better ink by newspaper printers (to facilitate easier de-inking)
- deals between the waste paper recovery industry and major sources of waste paper who are also potential users of recycled fibre.

Overseas proposals

Well supported proposals made overseas are generally confined to monetary incentives. They are summarized in an EPA report to Congress (Environmental Protection Agency 1974) as follows :

- a 30 per cent cash operating subsidy (repayment of 30 per cent of the cost of acquisition of waste paper)
- a 75 per cent loan interest payment (payment of 75 per cent of the interest on loans for construction of new secondary paper mills)
- a 25 per cent investment tax credit
- a five year rapid depreciation provision for new secondary mills.

It should be noted that subsidy payments are treated as income for tax purposes and that a portion of the funds (equivalent to the company tax rate) is returned to government.

The above measures are listed in order of their beneficial effect on volume of waste paper recovered. When considering the cost to the community (government) of increased recovery in terms of expenditure per extra ton of waste paper recovery, the order given above is reversed. Seen from the viewpoint of existing or prospective secondary paper millers, proposal 4 is the most attractive since the effective windfall to the miller (or equivalent rate of interest, if future income is discounted at the company's cost of capital) is greatest. Second most attractive in these terms is proposal 1, followed by proposals 2 and 3.

Conclusion

Should it be considered necessary to take measures to increase the rate of recovery of waste paper in South Africa, more intensive investigation of the impact of possible courses of action will be required.

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