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A Study on Paper Industry Waste: Opportunities for Development of Low Cost Concrete in Indian Context

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ABSTRACT

Population scenario comes towards India by means of increasing industries. The fruitful efforts of industries lead to develop India. As the industries increases also the waste coming from them at the end of product. At the end of survey result coming that the amount of the approximately 250 to 300 million tonnes of industrial wastes are being produced every year by chemical and agricultural process in India. It is very essential to dispose these wastes safely without affecting health of human being, environment, fertile land, sources of water bodies, etc. These wastes have number of impurities which adversely affect the strength, durability, and other properties of building materials based on them. Paper producing industries produce a large amount of solid waste. For achieving high quality paper, the fibers which are used a limited number of times till they reach their weak stage. Many companies burn their sludge in incinerators which leads towards air pollution. So the paper presents the management of the wastes coming from paper industries.

INTRODUCTION

Paper production is a highly capital and labour intensive activity. Wood pulp is the fibrous material that results when wood is separated into its constituent fibers by chemical or mechanical means. Waste paper is composed of previously discarded paper or paperboard products. Both contain cellulose fiber that can be subsequently combined with other inputs to manufacture paper, paperboard, or other wood-fiber-based products. So, by using this paper waste we can solve the disposal problem. In urban cities, Solid waste management is one of the most challenging issues, which are facing a serious pollution problem due to the generation of huge quantities of solid waste. This paper presents an assessment of the existing situation of solid waste management in India .In this paper presents making hypo sludge from paper waste, which is use as a construction material.

PRESENT SCENARIO

The industry is fragmented with capacities ranging from 2 to 800 tonnes per day.

TABLE: 1
Information about Paper Production

Information about paper production	Amount
Total number of paper and pulp mills, Number of mills	666
Wood based ,Number of mills	34
Agro based , Number of mills	165
Recycled fibre based mills , Number of mills	467
Paper and pulp mills in operation , Number of mills	568
Paper and pulp mills closed , Number of mills	98
Installed capacity of mills, million tonnes	9.5
Per capita consumption, kg	7.0
Production, million tonnes	6.5
Production	newsprint
Exchequer, crore	2500
Employment, lakh	3
Turnover, crore	16000

Source: www.eriks.com/Paper-industry

TABLE: 2
FIBRE RESOURCES AND THEIR AVAILABILITY

Fibre resource	Wood	Agri residues	Waste paper
source	Eucalyptus, coniferous leaves	Bagasse , rice and wheat strew, cotton stalks	Domestic and imported waste
Production million tonnes	2.08	1.95	2.41
Proportion in production (%)	32	30	38
No.of mills	34	165	467
Proportion of mills (%)	5.1	24.7	70.2

Source: Federation of Paper Traders Association of India

PER CAPITA CONSUMPTION

While India accounts for nearly 15 per cent of the world population, it consumes only 1 per cent of the world paper production. India's per capita consumption of paper at about 7kgs is very low as compared to the world average of 50 kgs.

DEMAND & SUPPLY SCENARIO

Demand for paper industry is closely linked to the economic growth of a country. The paper industry has grown at a steady 6.0 per cent over the last few years and it is expected to grow by 6.6 per cent over the next 2-3 years. Capacities to the tune of 1.5 million tonnes (20 %of current capacity) will come onstream over the next 3 years. This will result in a decline in operating rates over the next 2-3 years till the additional supply is absorbed by the incremental demand. Although input costs are expected to increase over the next few years, the rise in price of paper will not be steep due to an improvement in plant efficiency due to the modernization being carried out by mills. The Indian paper industry uses wood, agricultural residues and waste paper as raw materials. In the early 70's, the share of waste paper used as raw material was only 7%, whereas now it constitutes the major raw material base for paper industry with 47% share in total production ion being carried out by mills.

TABLE: 3
AMOUNT OF WASTE PAPER FROM WOOD AND AGRO BASED MILLS

Year	Wood	% share agro residue	Waste paper
1970	84	9	7
2000	39	31	30
2011	31	22	47

Source: Paper Industry

WASTE PAPER COLLECTION IN INDIA

In India the collection of waste paper is mainly performed by the informal sector, i.e., by rag pickers and door to door collectors/ vendors. As much as 95% of the collection of waste paper in the country is carried out by the informal sector. The value chain comprises the direct collectors from various source points and small shops – where primary sorting of the waste into different

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categories takes place and zonal segregation centers owned by wholesalers where the waste material gets collected from small shops and baled for dispatch to the end users.

TABLE: 4
CURRENT WASTE PAPER COLLECTION MECHANISMS IN INDIA

Source	Items collected	Collected by	Quantity collected (in million tonnes / annum)
Collection from house holds	Old newspaper and magazines Notebooks and text books	Weekend hawkers	1.50 0.50
Annual scrap contracts of printers, publishers, convertors	Paper trimmings, print rejects, over print/misprint sheets and other waste	Contractor	0.25
Scrap contracts with industries, offices libraries	Old corrugated cartoons, examination answer sheets, library records, old offices etc.	Contractor	0.50
Total			2.75

Source: ITC-WOW, Aug. 2011

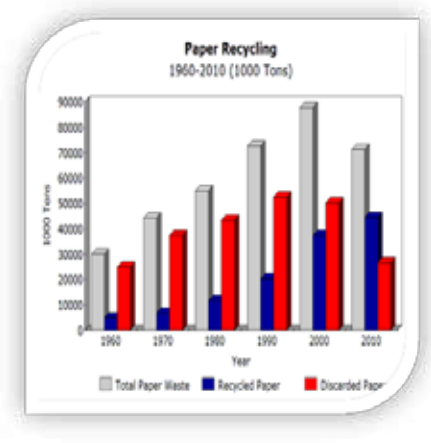

Figure: 1 Amount of Total Waste Paper, Recycled Paper, Discarded Paper in Tons

Source: paper industry in India

HYPO SLUDGE

Figure 2 Raw Hypo Sludge Disposal
Source:www.engineeringcivil.com

It is made up of paper waste coming from industrial waste. This hypo sludge contains, low calcium and maximum calcium chloride and minimum amount of silica.

TABLE: 5
PROPERTIES OF RAW HYPO SLUDGE

No	Constituent	Present In Hypo Sludge (%)
1	Moisture	56.8
2	Magnesium oxide(Mgo)	3.3
3	Calcium oxide(Cao)	46.2
4	Loss of ignescent	27
5	Acid insoluble	11.1
6	Silica(Sio2)	9

Source: Experimental Investigation in Developing Low Cost Concrete from Paper Industry Waste by R. Srinivasan, K. Sathiya and M. Palanisamy

ADVANTAGE AND DISADVANTAGE OF HYPO-SLUDGE
ADVANTAGES

1. It provides a most economical concrete.
2. It should be easily adopted in field.
3. Using the wastes in useful manner.
4. It reduces the cost of the construction.
5. It promotes the low cost housing to the E.W.S. group people.
6. It Minimize the maximum demand for cement.
7. Minimize the maximum degradation in environment due to cement and safeguard the ozone layer from greenhouse gases.

DISADVANTAGES

1. It contains high amount of chlorine so it is difficult to handle.
2. At this stage it is difficult to collect it in a bulk quantity.
3. It is generally found in slurry form hence in order to mix it with cement one has to remove water from it and make it dry.

PROBLEMS ARISE FROM PAPER WASTE

There are many problems arise from the paper waste industry. Some of the problems are given below.

1. **Deforestation:** Worldwide consumption of paper has risen by 400% in the past 40 years, with 35% of harvested trees being used for paper manufacture. Logging of old growth forests accounts for less than 10% of wood pulp, but is one of the most controversial issues. Plantation forest, from where the majority of wood for pulping is obtained, is generally a monoculture and this raises concerns over the ecological effects of the practice.
2. **Air pollution:** Nitrogen dioxide (NO2) sulfur dioxide (SO2) and carbon dioxide (CO2) are all emitted during paper manufacturing. Nitrogen dioxide and sulfur dioxide are major contributors of acid rain, whereas CO2 is a greenhouse gas responsible for climate change.
3. **Air emissions:** Air pollution mainly occurs from digester, blow tanks, steam boilers, and chemical recovery boilers.
4. **Water pollution:** Waste water discharges for a pulp and paper mill contains solids, nutrients and dissolved organic matter, and unless at low levels these are classed as pollutants. Nutrients such as nitrogen and phosphorus can cause or exacerbate eutrophication of fresh water bodies such as lakes and rivers. Organic matter dissolved in fresh water, measured by Biological Oxygen Demand (BOD), changes ecological characteristics, and in worse case scenarios leads to death of all higher living organisms. Waste water may also be polluted with organ chlorine compounds.
5. **Solid waste:** Solid waste is generated in the form of sludge, ash, wood waste, screening, and sand & grit. The major concerns with these wastes in their disposal.

CASE STUDY

In the present study, effect of hypo sludge as cement replace-

ment on the compressive strength of concrete having mix proportions of 1:0.83:2.29 was investigated. The percentages of replacements were 0%, 10 %, 20%, 30%, 40%, 50%, 60% and 70% by weight of cement. Tests were performed for compressive strength for all replacement levels of hypo sludge at different curing periods (7-days & 28-days).

TABLE: 6
PROPORTION OF M-25 GRADE CONCRETE

MIX	C Kg/m3	H Kg/m3	F.A. Kg/m3	C.A. Kg/m3	W Lt/m3
M1 (0%)	547.42	0	456.96	1255.47	191.6
M2 (10%)	492.67	54.74	456.96	1255.47	191.6
M3 (20%)	437.94	109.48	456.96	1255.47	191.6
M4 (30%)	383.20	164.22	456.96	1255.47	191.6
M5 (40%)	328..46	218.96	456.96	1255.47	191.6
M6 (50%)	273.71	273.71	456.96	1255.47	191.6
M7 (60%)	218.98	328.44	456.96	1255.47	191.6
M8 (70%)	164.24	383.18	456.96	1255.47	191.6

C=Cement, H= Hypo Sludge F.A. =Fine Aggregate, C.A. =Course Aggregate, W=Water.

Source: R. Srinivasan, K. Sathiya, and M. Palanisamy, Experimental investigation in developing low cost concrete from paper industry waste, The Bulletin of the Polytechnic Institute of Jassy, Construction. Architecture Section (Romania), 2010.

TABLE: 7
COMPRESSIVE STRENGTH (MPA) OF CONCRETE WITH FOUNDRY SAND

Mix	Hypo sludge Content (%)	Avg. Compressive Strength, (MPa)	
		7 Days	28 Days
M1	0	17.81	37.33
M2	10	25.67	40.37
M3	20	33.96	55.69
M4	30	35.50	56.11
M5	40	22.20	39.95
M6	50	15.50	18.33
M7	60	12.40	15.87
M8	70	8.60	12.94

Source: R. Srinivasan, K. Sathiya, and M. Palanisamy, Experimental investigation in developing low cost concrete from paper industry waste, The Bulletin of the Polytechnic Institute of Jassy, Construction. Architecture Section (Romania), 2010.

CONCLUSIONS

We can say that for 1m3 M25 grade of concrete consumption of cement is 547.42 kg. Here in specimen M-5 replacement of cement by 218.96 kg of hypo sludge for 1m3 M25 grades of concrete. So, we can say that up to 40% hypo sludge utilized for economical and sustainable development of concrete. Uses of hypo sludge in concrete can save the paper industry disposal costs and produce a 'greener' concrete for construction. An innovative supplementary Construction Material is formed through this study.

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