

**AN INTEGRATED APPROACH FOR
UTILIZATION OF RICE STRAW
FOR PRODUCTION OF VARIOUS
GRADES OF PAPER.**

BY

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Air Pollution caused by incineration of Rice straw in open field

- India is the among world's largest producer of paddy. India produces 98 million tonnes of paddy with roughly 130 million tonnes of straw.
- About half is used as animal fodder. The rest is mostly burned in the fields, t
- Every year about 12 million tonnes of rice straw is burned in Punjab
- Plumes of smoke arising from the fields is a common sight in Punjab during rice harvesting season. In the months of October-November

AIR POLLUTION CAUSED BY INCINERATION OF RICE STRAW IN OPEN FIELD

- Burning of rice straw remains emits trace gases like carbon dioxide, methane, carbon monoxide, nitrogen oxide, sulphur oxide and large amount of particulate matters, which adversely affect human health as well as the environment.
- Last year, the magnitude of stubble burning was so high that it received international attention.
- The National Aeronautics and Space Administration (NASA) released a satellite image showing large number of fires across millions of hectares of agriculture fields in Punjab

AIR POLLUTION CAUSED BY INCINERATION OF RICE STRAW IN OPEN FIELD



UTILIZATION OF RICE STRAW

Different Ways of Utilization

Production of fuel

Cattle feed

Briquette making

Composting

In Paper Industry for making various grades of Paper

In Biorefinery for production of liquid fuel



COMPOSITION OF VARIOUS AGROBASED RAW MATERIALS

Type of fibers	α -cellulose	Lignin	% Pentosa n %	Fiber length mm	Fiber diamete r μ	Ash %
Rice straw	28-36	12-16	23-28	1.4	15	15-20
Wheat straw	29-35	16-21	26-32	1.4	13	4.5-9
Bamboo	26-43	21-31	15-16	2.7	14	1.7-5
Bagasse	32-44	19-24	27-32	1.7	20	1.5-5
Esparto grass	33-38	17-19	27-32	1.2	13	6-8
Jute fiber	45-63	12-16	18-22	2.5	20	0.5-2
Cotton stalks	36.15	16.7	27.1	1.3	20-30	3.1
Corn stalks	45.5	30.87	19.86	1.0-1.5	18	6-6.9
Cotton	85-90	0.7-1.6	-	25	20	-
Kash	52	16.82	24	1.52	16	3.89
(<i>Saccharum spontaneum</i>)	40-45	26-34	7-14	2.7-4.6	32.-43	<1

CHEMICAL COMPOSITION OF RICE STRAW COLLECTED FROM DIFFERENT SOURCES

Parameters, %	Chhatti -sgarh	Punjab	West Bengal	Uttar Pradesh
Ash	17.28	16.17	14.47	14.20
Silica	10.29	8.92	7.15	6.95
Acid insoluble lignin	16.51	15.02	13.96	13.55
Holocellulose	53.11	56.42	58.62	55.96

RESULTS OF SODA PULPING OF RICE STRAW WITH AND WITHOUT PRETREATMENT

Pre-treatment Stage	Blank	Run 1	Run 2
Chemical app.,% (Alkali as NaOH /Methanol)	--	2/2	2/4
Pulping			
Alkali applied as NaOH,%	10	8	8
AQ dosage,%	0.05	0.05	0.05
Bath Ratio	1:5	1:5	1:5
Pulp Yield, %	51.73	54.51	61.20
Screened Yield, %	51.04	52.50	59.31
Screen Rejects, %	0.70	2.01	1.89
Kappa Number	16.0	12.45	11.50
Viscosity, cm ³ /g	663.19	775.5	750.4

RESULTS OF RICE STRAW AND BAGASSE MIXED PULPING (SODA PROCESS)

Parameters	1	2
Rice straw :Bagasse Ratio	50:50	70:30
Alkali charge% (as NaOH)	16	14
Bath ratio	1:5	1:5
Unscreened pulp yield, %	51.2	53.4
Rejects, %	0.48	0.54
Screened pulp yield, %	50.7	52.8
Kappa number	18.2	14.5
Pulp brightness, % (ISO)	29.1	27.7
Pulp viscosity, cc/gm	793	769
Burst index(k Pa m²/g)	3.15	3.40
Tensile index (N m/g)	57.91	49.76
Tear index (mN.m²/g)	4.20	3.94

Results of Rice Straw and Bagasse Mixed Pulping (Kraft Process)

Parameters	1	2
Rice straw :Bagasse Ratio	50:50	70:30
Alkali charge% (as NaOH)	12	12
Bath ratio	1:5	1:5
Unscreened pulp yield, %	52.95	49.91
Rejects, %	1.63	0.88
Screened pulp yield, %	52.54	45.46
Kappa number	14.36	10.16
Pulp brightness, % (ISO)	30.63	33.27
Pulp viscosity, cc/gm	1042.1	918.0
Burst index(k Pa m²/g)	4.15	3.80
Tensile index (N m/g)	62.91	55.76
Tear index (mN.m²/g)	5.20	4.80

RESULTS OF RICE STRAW AND WHEAT STRAW MIXED PULPING

Parameters	1	2	3
Rice straw: wheat straw	100:0	50:50	70:30
Alkali charge % (as NaOH)	10	12	12
Bath ratio	1:5	1:5	1:5
Unscreened pulp yield, %	49.0	55.2	55.3
Rejects, %	0.25	2.41	1.33
Screened pulp yield, %	48.8	52.8	53.9
Kappa number	12.1	20.0	13.5
Pulp brightness, % (ISO)	35.4	29.5	33.9
Pulp viscosity, cc/gm	681	855	770
Burst index(k Pa m²/g)	3.50	3.56	3.73
Tensile index (N m/g)	57.3	66.5	61.6
Tear index (mN.m²/g)	3.80	4.0	4.3
Black liquor properties			
pH	10.17	10.93	10.83
Total solids, %(w/w)	9.60	10.8	9.95
RAA as Na ₂ O, gpl	0.28	1.17	0.62
Silica content, %	4.5	4.7	4.6

Results Of Physical Strength Properties Of Rice Straw and OCC Blended Pulp

Parameters	Freeness in (ml CSF)	Burst index (k Pa m ² /g)	Tensile index (N m/g)	Fold Kohler Molin (log)	Tear index (mN.m ² /g)
100% rice straw	230	1.98	34.47	17	4.23
100 % OCC	290	1.96	38.86	8	6.02
40:60 (OCC: rice straw)	270	1.26	23.11	6	3.98
50:50 (OCC: rice straw)	290	1.28	25.69	6	4.37
60:40 ((OCC: rice straw)	290	1.00	22.50	5	4.07
70:30 (OCC: rice straw)	375	0.995	20.77	4	4.08
80:20 (OCC: rice straw)	430	0.903	19.40	4	4.06

Conclusion :

1. Rice straw is undoubtedly a potential raw material for production of paper and paper board. The main drawback associated with use of rice straw as principal source of fiber is the presence of silica.
2. In order to stop the incineration of rice straw an integrated approach is required to make this fiber suitable for various grade of paper and board.
3. The problem can be eradicated through pretreatment of rice straw, mixed pulping and production of semi-chemical or mechanical grade of paper.
4. The results of two stage solvent pulping of rice straw are very encouraging in terms of unbleached pulp yield gain and reduction of kappa number.

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5. Mixed pulping of rice straw along with bagasse and wheat straw is a good substitute of agro-based raw materials alternate, while controlling the silica content in raw material furnish.

6. A very good alternate option of utilization of rice starw for value added product is production of semi chemical/mechanical grade pulp and its utilization for manufacturing paper and paper board. The Indian recycled fiber either OCC or ONP can be blended for production of various packaging grade paper and board.