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APPLICATION OF DOUBLE WIRE BELT WASHER CONCEPT FOR EFFICIENT WASHING OF AGRICULTURE RESIDUE PULP

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Abstract

Due to shortage of forest based raw materials the Indian paper Industry is increasingly depending upon raw materials, which are residues, byproducts or left overs of agro-based industries or agricultural produce. Bagasse, rice straw, wheat straw, Jute sticks, cotton stalks would replace the conventional raw materials like bamboo and hardwoods and may probably dominate in the raw material scenario.

Agricultural residues differ widely from the forest based raw materials in the morphological and physicochemical characters. Processing of these agro-based fibrous raw materials in the pulp and paper have to be dependent on the nature of fibers, raw material preparation, fibre processing, beleaching, refining and sheet forming of agro based fibres are carried out in equipment normally used for conventional raw materials.

In the fiber line, washing of pulp is an important step. Efficient washing of pulp results in lower soda loss, less carryover with pulps, reduced volume of spent liquor resulting lower energy demand for concentrating the spent liquor for soda recovery of reduced cost of effluent treatment.

Most of these agricultural raw material have short and fragile fibers, which get damaged during processing the raw material into pulp and a considerable amount of fines are generated. In pulp washing both the dewatering as well as the displacement phenomena are influenced by the fines content of pulp fibers. The Usual equipment and system for pulp washing is the counter current multi-stage vacuum drum filters. Disadvantages of conventional system of washing such as high dilution factor, larger filter surface area, higher consumption of energy, lower consistency of filter cake, frequency of cleaning the filter surface, frequency of breaks in continuous mat pick-up are more predominant with rice and wheat straw and bagasse pulps.

Considerable success has been achieved in eliminating or minimising the disadvantages by washing the pulp on a moving wire or belt. The paper deals with the actual avantages of this system when dealing with agro-residues. It gives results of experiments recently conducted at CPPRI on a Andritz washer with pulp from rice and wheat straw and bagasse.

Introduction

In Indian paper Industry 40% of paper production is made by small paper mills using agriculture residue as major raw material. The conventional equipment used in paper industry for washing e.g.Rotary drums vaccum washer have been designed on the basis of data available with conventional raw material like bamboo and hardwood. It is observed that agricultural residue differs widely from the forest based raw material in the morphological and physical character. Refering to Table No. 1 particularly to the freeness value and fiber classification, it is evident that the agriculture residue; straw pulp is a difficult material to wash in the conventional Rotary drum vac washer. Of the total fibre, 50% represent bast and scleranshyma, 30% Paranchyma, 15% eqidermal cells and 5% vessels, as reported by Reydohlm. The fiber classification results of straw pulp is in the following order : Long fiber– 30.9%, short fiber 46.5% & fines 22.6%.

Approximate dimensions of straw pulp fibers range between 0.7–3 mm length and the diameter of fiber ranges between 7–27 microns. Although fiber length to diameter ratio is excellent from paper making consideration, its wide variance in lengths and diameters creats a very closely woven mat on th brown stock washers, and the washing efficiency is greatly retarded due to poor filtrability.

Aside from the physical properties of straw pulp, its chemical properties are also contributing factors in creating difficulties in washing such as high pentosan content, swelling of cell walls and tendency for easy hydration. These specific properties of straw pulp are major differences compared to hardwood pulp, and therefore demanded special attention in washing operation. Bagasse, which forms about 70% of the sugarcane, consists of 50% moisture and 50% fibre alongwith pith cells. The fiber content of this bagasse is around 65% and pith around 30% and solubles around 5%. The bagasse has a higher degree of hydration as compared to bamboo or wood.

The disadvantages faced during processing the agriculture resude pulp in a Rotary vacuum washer can be summarised as follows :

a) Specific loading of agriculture residue pulp is less.

b) Frequency of break and pick up over the washer surface is more due to less vaccum created in a drop leg system.

c) Difficult to wash due to low drainage characteristic of low porosity of the pulp mat.

d) High dilution factor, low cons. of black liquor to soda recovery resulting increased energy demand.

e) Frequenty cleaning of the filtering surface, due to presence of some non-fibrous cells, fines and mineral matters (silicate), resulting decrease in productivity.

f) Low outlet consistency and low washing efficiency.

Drainage Characteristic

The drainage characteristic of pulp made from rice straw, wheat straw and bagasse were studied using PIRA drainage drainage Tester in Table-1.

It can be seen that drainability rate of Rice straw pulp is quite less in comparison to wheat straw and bagsse. The permeability/sp. surface area was calculated for various pulp made from agricultural residue. Specific surface area of straw pulp is maximum and for bagasse it is minimum. Therefore permeability of rice straw is minimum. Considering the disadvantages of washing of agriculture residue pulp in a rotary drum washer and with the emphasis on chemical recovery, it is essential to generate the black liquor at maximum concentration. With the stringent pollution laws, it has become most imperative for efficient washing of this agriculture residue pulps. The common ways of reaching a better washing are either applying an increased wash water dilution or installation of one additional washing stage. Increasing the wash water dilution is normally an expensive way due to the rapidly increasing evaporation cost. The concept of double wire can thus be adopted by small and big mills using agricultural raw materials and offers maximum advantages.

Development of Brown Stock Washing Equipments

Considerable success has been achieved for washing of different kinds of pulp in advanced countries by suitable designing and sizing the equipment to achieve improved washing.

A. Displacement Press :- The displacement press, now in operation in a number of brown stock washing application. It combines high washing efficiency with limited building requirements and greatly reduced liquor tank volumes Fig. 1.

B. Ultrawasher :- The latest development for brown stock washing is the ultra washer. The ultrawasher, which is utilizing the so called fourdinier principles makes it possible to do the complete brown stock washing on one single machine. Fig. 2.

As can be seen the so called fourdinier principles is used to dewater and wash the pulp. The pulp suspension of about 3% Cy is dewatered to a pulp mat (8 to 9% Cy) on a wire and is transported on the same wire through the machine where wash liquor is added counter-currently in a number of stage. In this way the liquor flow in the machine is strictly counter-current from wash stage to wash stage all the way up to the main liquor tank. Fig. 3

C. Pressure-washer (Rauma-Ropola) : A preassure washer depicted in Figure 4 is similar to a rotary vacuum washer in many ways. A pulp mat is made on the surface of the cylinder and dewatered with the aid of pressure applied inside the washer hood (out-side the cylinder). On the upper part of the cylinder, where the pulp mat is not immersed in the vat, wash water is applied with showers. The washer can be operated with two or three displacement stages by subdividing the effluent draining in to the rotating cylinder. The cleanest effluent, collected under the last set of showers, is led back to the previous set of showers on the same washer. Thus in addition to the dilution/extraction washing, as many as three distinct displacement washing stages can be employed.

D. Twin-Roll washing Press (Ingersoll-Rand). : A wash press Fig. 5. is dilution/extraction washer and is used frequently for pulp that is difficult to permeate. The high efficiency of these devices is derived from the high consistency of the discharged pulp, which is typlically 30-40%, depending on the design of the washer. Some wash presses also have a displacement stage, but these are not effective for pulp that is difficult to permeate.

E. Fiber Fuge Washer. : An interesting new development which is also particularly useful for washing pulps that are difficult to dewater is the fiberfuge continuous pulp centrifugs. Fig. 6. A pulp shurry at 3-4% consistency is fed in to a rotating basket fitted with a dewatering screen. Helical flights rotate in the same direction as the basket but at a slower speed, sweeping the dewatered pulp from the screen. A subsequent scalping screen further clarifies the large portion of the concentrate. The product consistency is typically 20-30%.

ANDRITZ Double wire washer.: See Fig. 7. The ANDRITZ double wire belt washer has three main functions : dewatering, displacement and pressing. Due to high efficiency of double wire washer, it is notable that washing efficiency is high even at low wash water dilution.

The belt washer consists of two convering wires, forming a wedge section, which results in purely mechanical dewatering due to gravity as well as due to the wire tension applied at the S-Roll. In the Wedge zone, the wires containing the pulp deflected at the S-Roll, before entering into wash shoe, this increases the dryness to about 15 to 17% O.D.

The washing module is mounted after the wedge-shaped dewatering zone; the wash water is fed to the washing module at difinite pressure at the No 3 compartment and there is a counter current washing at compartment no. 2 and 1. This design permits proper displacement washing in counter current. In order to remove the remaining chemicals the water runs through holes in the face of the washing modules and is pressed through the press cake between the wires.

Immediately after the washing module the stock cake is pressed approximately 25-40% OD in 3 press nips.

The ascending wire arrangement allows the water drainage channels to be mounted in front of the individual pressing points and the water pressed through the top wire can be carried off before it can be reabsorbed by the stock web. This method countributes considerably towards eleminating reabsorption

Take off removes web and scraps off any remaining stock from the wires.

Result and Discussion

Productivity- There are various washers, where pulp washing were applied to meet the required production. There are drum washer (vacuum or pressure), cylinder thickner horizontal belt washer and double wire washer. Every type of washer has a special property, which satisfy to some kind of pulps. The productivity of rotary vacuum washer can vary in a wide range for different kinds of Pulps which are listed on table 3.

The productivity is influenced by the characteristic and the operating condition of the pulp washer. In the double wire washer the mechanical dewatering takes place due to the tension of two wire at the wedge zone. Therefore different type of pulp can very easily be processed without much difficulties to a consistency of 15 to 16% and it is further washed at the wash shoe without any disturbaces of the pulp sheet and finally pressed to 31 to 32% Cy (Approximately). Table 5.

The total active filtration area of the pilot machine was 2.3m^2. The basis wt. of rice and wheat straw and bagasse was found to be 650 gsm, 750 gsm and 900 gsm respectively.

Therefore output in double wire belt washer for agriculture residue is considerably more in respect to a drum washer and is continuous as shown in Table No. 3.

Washing Efficiency.- The washing efficiency of double wire belt washer is superior to any conventional three stage washing system for rice and wheat straw and bagasse. Results shown in table 4 clearly indicate that washing efficiency of more than 93%, 94% and 95% are obtained respectively at a dilution factor of 2 to 2.5 (Fig. 8).

The percentage reduction of solids at different zones is shown in table 5. About 85% of the total disolved solids is removed from the pulp at the wedge zone and the remaining 8–10% is washed out at the washing zone and press zone.

From the above, it is interesting to note that washing efficiency upto 90% can be achieved even without addition of wash water which occurs because of dewatering as well as pressing action at wedge and press zone respectively (Table 4).

It is, therefore, concluded that the final dry content of the washed out pulp is mainly responsible for achieving higher washing efficiency and the later increases if former rises. It is further added that the machine speed has considerable influence on washing efficiency as lower machine speed results in higher washing efficiency.

Displacement washing.- Table 4 fig. shows that the wash water quantity used hardly influenced the displacement ratio. Though D. R. increases with the increase of dilution factors (Fig. 9) and are in the range of 0.2 to 0.5 with all the three raw materials. On careful examination of the results shown in Table 4, Fig. 9. It is found that bagasse pulp showed highest D.R. whereas D.R. is lowest in case of rice straw. This behaviour may be explained because morphological characterstics of these pulps. From the fig. 10. it is also observed that the D.R. is affected by the denisty of the formed pulp mat and that the nominal basis weight 650 gm/m^2 gives a better DR than a density weight of 850 gm/m^2 in case of rice straw. The same seems to apply in wheat straw and bagasse also.

Pressing.- Pressing do, however, have a place in the washing picture as it removes the loose liquor which is close to the fibre and contains most of the remained solids after washing. The results on the effect of pressing in D.W. belt washer is shown in table 5 fig. ll showing TDS reduction in wheat straw/rice straw bagasse pulp which are to the tune of 6.99/6.35/4.78 with a stock processed at inlet consitences of 15–16% (approx) and was squeezed out upto 34% consistencies. Though there is a tendency of higher reduction of TDS at higher consistencies but beyond a consistency of 34% (wheat straw) the TDS reduction is not proportionate to increase in consistency as explained by Stone, J. E. et al[5] that the fibre wall contain submicropores, which are smaller than the biggest dissolved carbohydrates or lignin molecules but significantly large to contain water. Thus this water sometimes called "Non solvent water" is inaccessible for diluting the macromolecule. Upon intense compaction the "non solvent water" is partially squeezed out of the pulp and is then able to dilute the surrounding liquor.

Chemical Carryover- Soda losses of Rice straw, wheat straw and bagasse are found to be 37.5, 31.6 and 26.1 Kg/MT of pulp when no wash water is added to the system i.e. because of dewatering and pressing only which decrease as DF increases. For each particular DF, there is substantial decrease of chemical carryover with all the three types of pulps upto a dilution factor of 2 (2.5 in case of wheat straw) beyond which the trend became an asymptotic (Fig. 12) indicating the use of the said DFs to be economical while considering other important factors such as evaporator capacity and the cost of evaporation etc.

From fig. 12 it is however observed that soda caryover in case of rice straw is highest and lowest for bagasse (23Kg/MT pulp) which attributes the morphological behaviour of the different fibres and are in accordance with the studies of carri, et. al.[6]

Experimental

Pilot Plant Trials.- The pilot plant trials were conducted at Saharanpur pilot plant unit of CPPRI. The flow sheet of pilot plant pulping and washing unit is shown in Fig. 13. The raw material was charged to a stainless steel tumbling digester of 11m³ capacity. Cooking liquor from liquor preparation tank was sprayed from the top of digester. After cooking the pulp alongwith liquor was blown into 30m³ blow tank.

Then the pulp was diluted to about 3% consistency and taken to pulp chest for finding its yield, freeness and total dissolved solids. Pulp was processed to ANDRITZ belt washer at a uniform rate to the head box, to wedge section, washing section and press section. The speed of the belt washer was regulated to achieve the required basis weight and wash water added at the washing shoe to maintain dilution factor. Black liquor samples at wedge section, washing section and press section were collected to determine the 'total dissolved solids' at different stages. Pulp sample was collected from the outlet of the washer to find out the TDS in pulp, rate of production, dryness % and washing efficiency.

Spent liquor analysis.- The analysis was carried out as according to procedure described in Tappi standard method T-625-t s-64.

Pulp analysis- The kappa number of the pulp was determined according to Tappi method T-236-05-76. Basis wt of the sheet and freness of pulp was determined according to Tappi method T 220 05-71 and (T 227 05-58) and sodium content of wet pulp according to SCAN-C30:73.

Physical Layout of Pilot Plant

D. W. Washer

1. Physical layout-

Length	- 8100 mm, 319 inches.
Width	- 1700 mm, 67 inches.
Height	- 3300 mm, 130 inches.
Types fabric	- Synthetic
Filtering	- 0.25 meters width
area	- 2.3 square meter.

2. Application-

Inlet cons	- 0.5-6% (Depending upon the types of raw material)
Discharge consistency	- 15-35% -do-
Specific production	- 25-40 ODTPD per one meter working width. (Depending on kind of pulp)

3. Electrical

Power	- 440V, 5OHZ, 3 phase,
supply	- 60 Amps.
Motor	- 20 HPDC TEFC 1760 RPM std Theramosrate.
Reducer	- Sew Eurodrive Right angle (Helical-Beval) Reducer.

4. Air (Filtered Mill air)

85 PSI - 6 CFM

5. Press.

3 NIP Presses.

Line pressure of 300 N/cm of roll width (max.)

6. Wire tension.-

Maximum 80 N/cm wire width (max.) using a pneumatic-mechanical device.

7. Wire guide.-

Pneumatic- Mechanical

Advantages with Double Wire Washer

Compared to conventional brown stock washing system based on vaccum filters, the double wire washer features many obvious advantages :

a) **A Single machine for the whole brown stock washing.-** The washing efficiency of a single D.W. washer is superior to any conventional four stage filter drum wash system.

b) **Low dilution factor.-** At comparable washing efficiency the DW washer requires only a dilution factor of 2m^3 ptp while the conventional 3 stage drum washer requires about 3.5 to 4m^3 ptp. This reduces considerably the energy requirement for evaporation as each m^3 of additional liquor to evaporation consumes about 200 kg of steam.

c) **Low electrical energy consumption.-** The dropleg type wash filters require some 8 to 10 meters drop height and because of the pulp is being rediluted in each stage, the electrical energy required to primarily lift all that liquor is about 45 kwh ptp. compared to a double wire washer is 12 Kwh.

d) **Small building volume.-** Building costs to house a DW washer system will be substantially less than that required for a drum washer system (no drop leg required less floor space).

e) **Small wash liquor tanks.-** The volume required is about 1/10 than that of a conventional washing system.

f) High concentration of black liquor to evaporator due to high washing efficiency.

g) The total dissolved solids in filtrate going to evaporator is almost same as the dissolve solids in the liquor from blow tank.

Conclusion

1. The extended inlet wedge zone, allows for a higher through put and renders the washer more flexible with regard to fluctuations of the inlet consistency and dewatering of the fibrous stock.
2. The double wire washer shows that total dissolved solids in wedgezone filtrate very close to dissolved solid in the liquor from the blow tank.
3. Low dilution factor, reducing load on evaporators, consuming less steam.
4. Washing efficiency upto 90 percent can be achieved without addition of wash water and this because of the high consistency dewatering at the press zone.
5. Displacement washing in bagasse pulp is superior among the three followed by wheat and rice straw, because of the permeability characteristic of the fiber.
6. Pressing action removes further, the loss liquor which is close to the fiber and contains most of the solids after washing. However the TDS reduction is not proportional to increase in consistency of the pulp.
7. Soda loss in Double wire washer is comparatively lower than a conventional drum washer, resulting higher percentage of TDS in black liquor going to Recovery. Chemical carryover in rice straw is comparatively higher than wheat straw and bagasses pulp due to the higher surface specific area of rice straw fiber in comparision to wheat straw and bagasses.
8. It is suggested that there is sufficient scope for the Indian paper industry to utilise the double wire washer for small mill as well as big mill for energy conservation, with less capital investment, higher output and less chemical losses. Further investigation is being carried on with different agriculture residue pulp with emphasis on a viable chemical recovery plant for small paper mills.

Acknowledgement

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TABLES and FIGURES

TABLE NO.1

PHYSICAL CHARACTERISTICS OF AGROBASED RAW MATERIALS

S.No.	Raw Material	Cooking Condition			Kap.No.	Free-Ness ml.	Drainage Time Sec.	Permeability		Fibre	
		% NaOH used as AA	Bath Ratio Ratio	Cooking Time Min.				Sp. Sur-face area Cm^2/gm	Sqp.Vol Cm^3/gm	Length	Diameter M
1	Rice Straw	10	1 : 5	150	20	150	19.83	49848	2.59	800	5
2.	Wheat Straw	12	1 : 5	210	42	290	5.68	19636	3.62	1100	13
3	Bagasse	16	1 : 4	210	38	570	3.70	15249	2.67	1400	26

TABLE NO.2

FIBRE FRACTIONATION FOR AGRO BASED RAW MATERIALS

S.No.	Raw Material	Fraction on the Mesh Size				
		+ 30 in %	-30/+50 in%	50 + 50 in %	- 100 + 200 in %	-200 in %
1.	Rice Straw	14.21	16.70	28.30	18.20	22.51
2.	Wheat Straw	20.70	15.80	22.20	16.40	24.90
3.	Bagasse	23.80	20.20	26.10	18.50	11.40

TABLE NO. 3

PRODUCTIVITY ON BROWN STOCK WASHING FOR DIFFERENT TYPES OF PULP

PULP TYPE	VACUUM WASHER SPECIFIC LOADING TON/M²/d	DOUBLE WIRE WASHER SPECIFIC PRODUCTION ton/m/d	M/C SPEED MT/MIM.
BAMBOO	3.1--4.8	---	---
BAGASSE	2--4	31.1	23
RICE STRAW	1--2	22.4	24
WHEAT STRAW	1--2	22.5	21

TABLE NO. 4

WASHING RESULTS ON DOUBLE WIRE WASHER

RUN NO.	RAW MATERIAL C.S.F. KAPPA NO.	INLET CY. %	BASIS WT. GSM	PRODUCT-CTION KGS/MIN	OUT LET CY. %	DILUTION FACTOR	D.R.	EFFY %	TOTAL SODA LOSS AS Na2O Kgs/MT	AVERAGE SUSPENDED SOLIDS %
Ia	Rice Straw	2.59	525	3.46	29.42	---	0	90.77	31.00	1.2-1.5
	237 ML	"	"	"	29.65	1.5	0.27	91.31	28.98	
	30.0	"	"	"	30.08	2.0	0.36	92.43	25.88	
		"	"	"	29.05	2.5	0.42	93.02	25.61	
		"	"	"	30.95	3.0	0.44	93.48	25.47	
Ib	245 ML	3.30	850	4.89	30.2	---	0	89.24	37.47	1.3-1.5
	27.5	"	"	"	30.3	1.5	0.19	90.52	35.40	
		"	"	"	29.4	2.0	0.30	91-45	30.60	
		"	"	"	34.5	2.5	0.34	92.05	29.38	
		"	"	"	31.5	3.0	0.26	92.65	28.57	
Ic	241 ML	2.79	650	4.07	31.6	---	0	89.81	37.47	1.3-1.5
	27.6	"	"	"	31.0	1.5	0.32	92.50	30.40	
		"	"	"	30.4	2.0	0.41	93.27	26.15	
		"	"	"	29.4	2.5	0.45	93.48	25.61	
		"	"	"	32.1	3.0	0.46	93.69	25.20	

1	2	3	4	5	6	7	8	9	10	11
II	Wheat Straw	2.91	750	4.22	32.7	---	0	90.74	31.67	1.0-1.2
	255 ML	"	"	"	32.4	1.5	0.26	92.29	28.03	
	33.0	"	"	"	33.7	2.0	0.37	93.36	25.34	
		"	"	"	33.4	2.5	0.45	93.90	24.00	
		"	"	"	34.1	3.0	0.48	93.95	23.59	
III	Bagasse	3.33	900	5.68	31.1	---	0	92.80	26.08	0.7-1.0
	530 ML	"	"	"	29.0	1.5	0.41	94.00	24.80	
		"	"	"	26.7	2.0	0.48	95.42	23.05	
		"	"	"	25.2	2.5	0.51	95.60	22.51	

" - " INDICATES NO WASH WATER ADDITION.

TABLE NO. 5

PER CENT TOTAL DISSOLVED SOLIDS AT VARIOUS ZONES

S.N	RAW MATERIAL	CONSISTENCY			TOTAL DISSOLVED SOLIDS %				TDS REDUCTION %			
	C.S.F. KAPPA NO.	INLET %	WASH SHOE %	OUT LET %	INLET %	WEDGE %	WASHER STREAM %	PRESS WATER	WEDGE ZONE %	WASH ZONE %	PRESS ZONE %	OUT LET
1.	RICE STRAW 241 ML 27.6	2.79	15	30.4	4.14	3.83	0.5	2.71	84.95	1.98	6.35	6.73
2.	WHEAT STRAW 255 ML 33.0	2.91	16	33.7	4.08	4.03	0.5	2.9	84.46	11.91	6.99	6.64
3.	BAGASSE 350 ML 29.0	3.33	16	26.7	3.85	3.38	1.4	2.1	84.12	6.59	4.71	4.58

Sunds Defibrator Dewatering Press

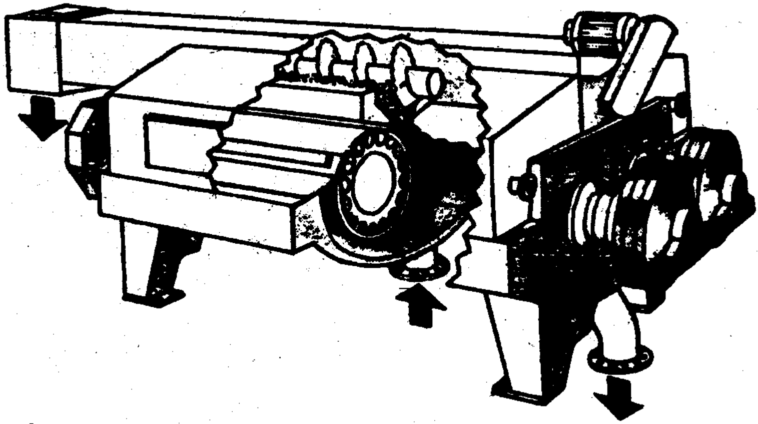
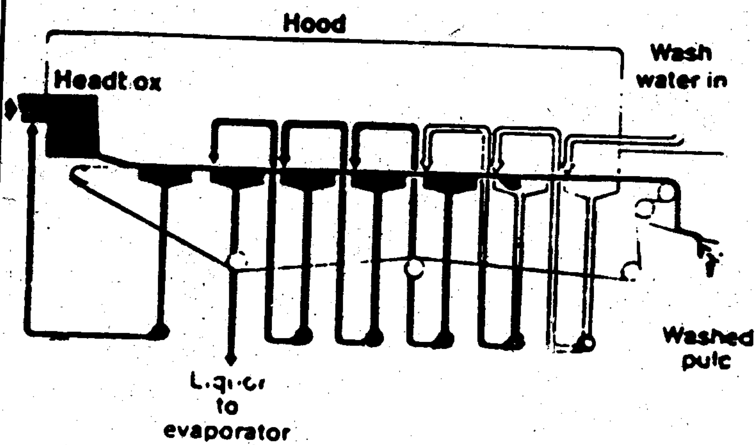


FIG. 1

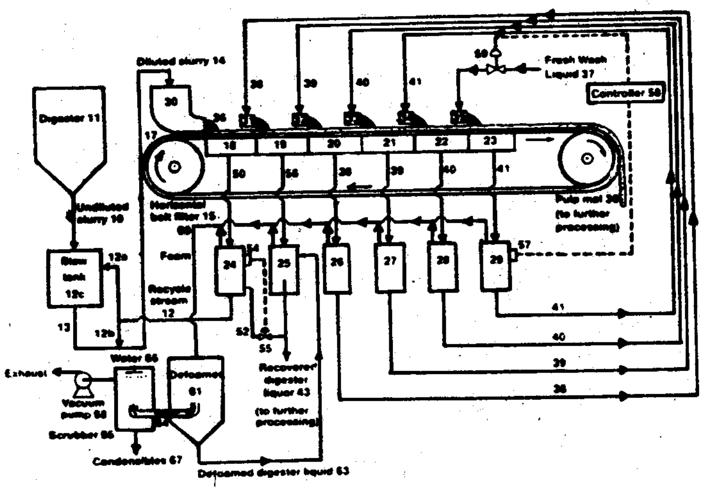
ULTRA WASHER

FIGURE NO. 2



FLOW DIAGRAM OF A ULTRA WASHER

FIGURE NO. 3



PRESSURE WASHER

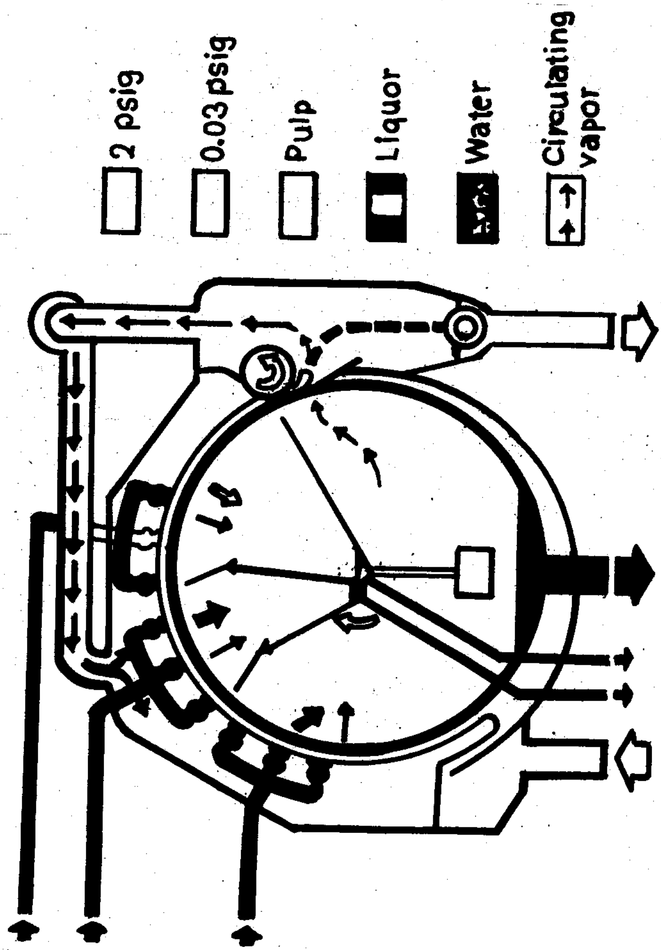
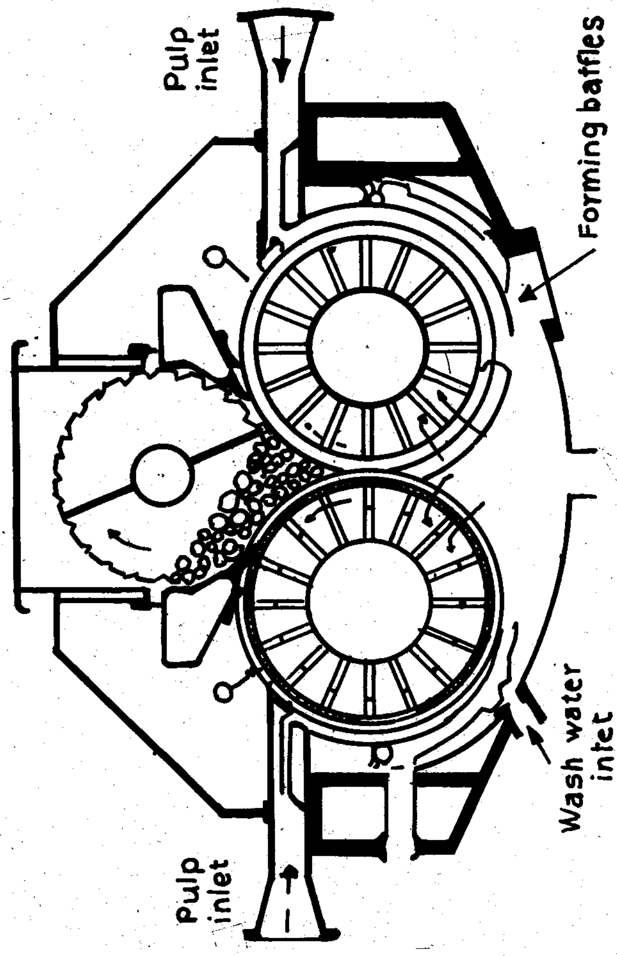


FIGURE NO. 4

TWIN - ROLL WASHING PRESS

FIGURE NO. 5



FIBERFUGE WASHER

FIG. 6

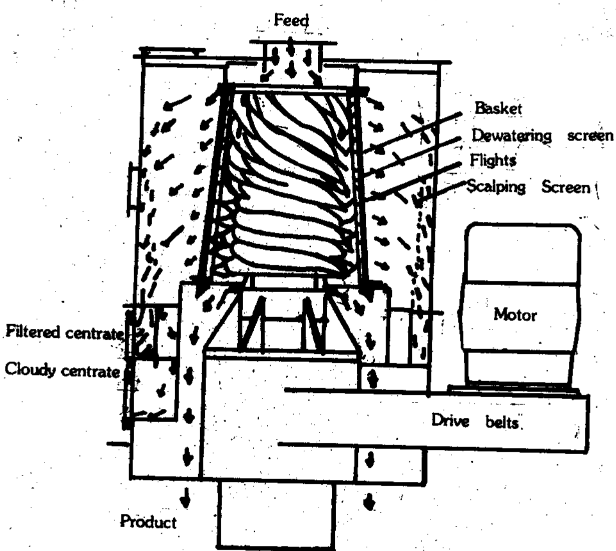
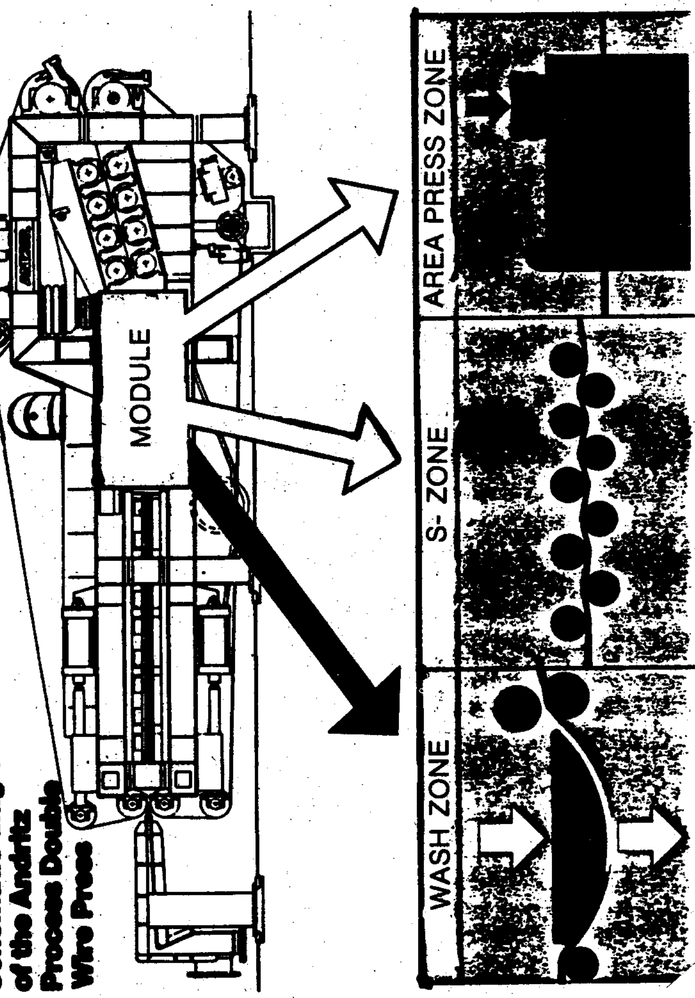


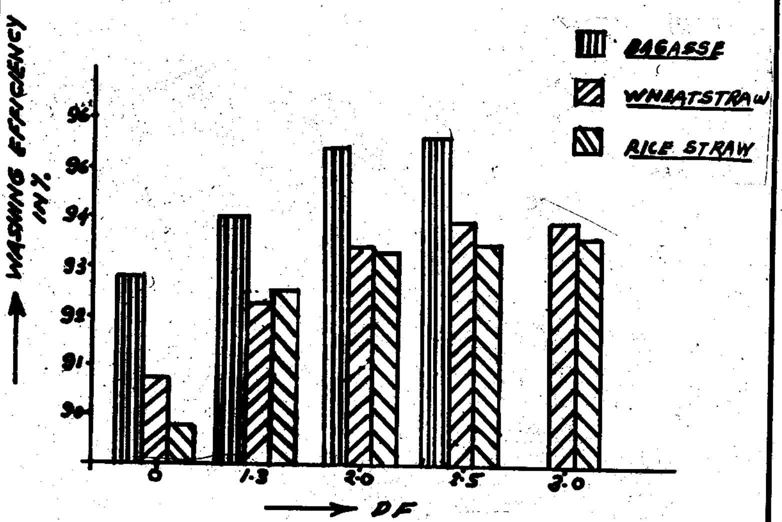
FIGURE NO. 7



Schematic diagram of the Andritz Process Double Wire Press

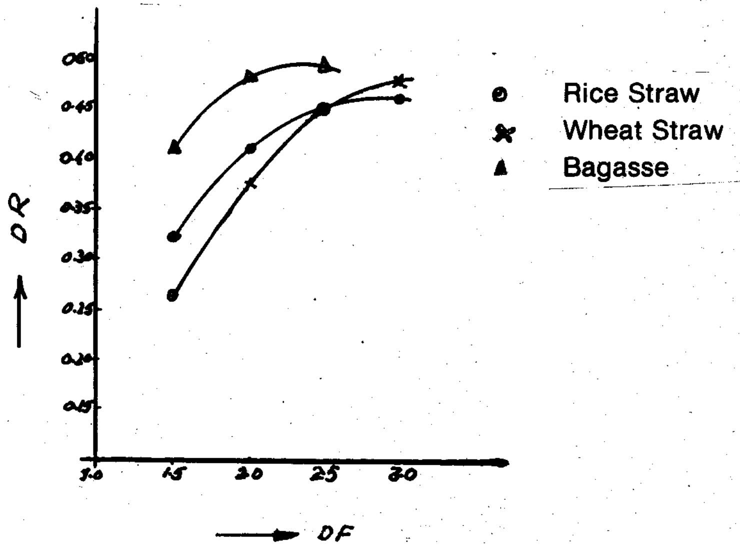
WASHING EFFICIENCY VS DILUTION FACTOR

FIGURE NO. 8



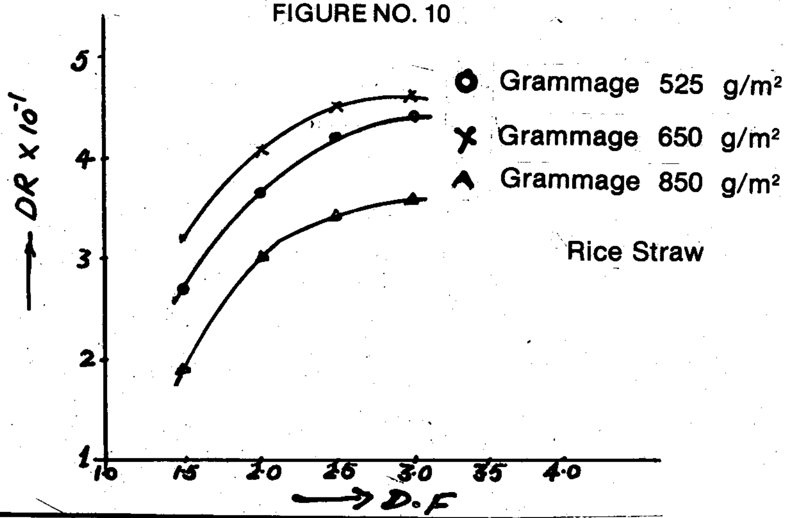
DISPLACEMENT RATIO Vs DILUTION FACTOR

FIGURE NO. 9



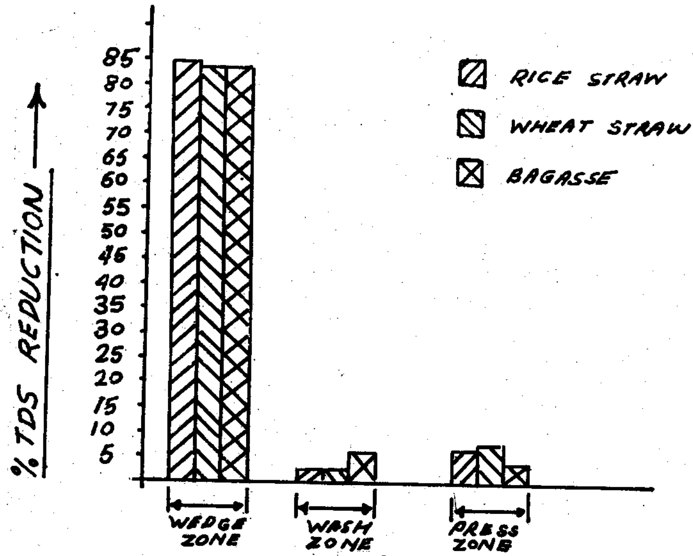
DISPLACEMENT RATIO Vs DILUTION FACTOR

FIGURE NO. 10



% TDS REDUCTION AT DIFFERENT ZONES

FIGURE NO. 11



TOTAL SODA LOSS DILUTION FACTOR

FIGURE NO. 12

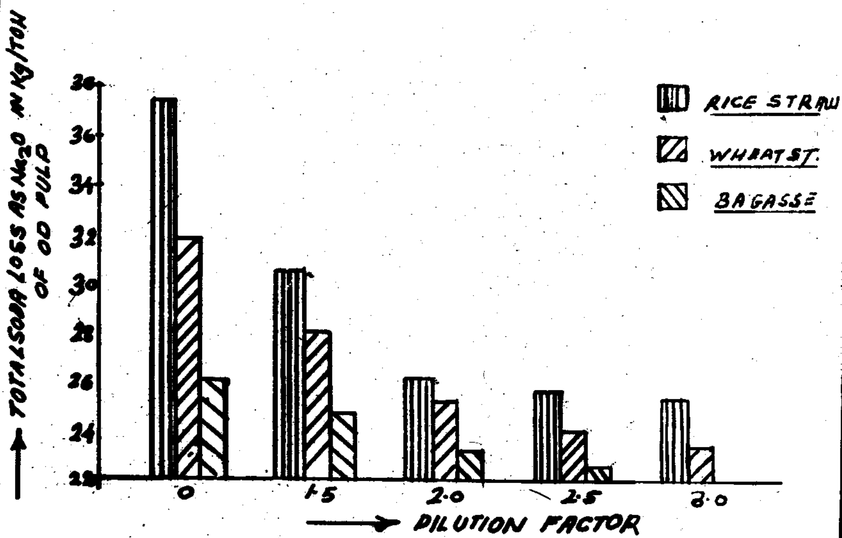
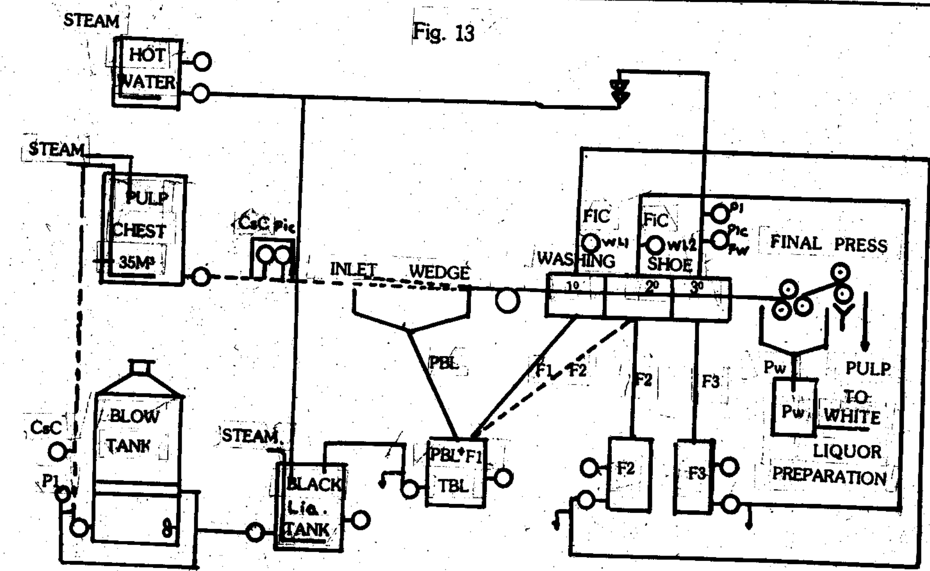


Fig. 13



F1 — FILTRATE FROM 1* WASHING
F2 — FILTRATE FROM 2* WASHING
F3 — FILTRATE FROM 3* WASHING
WL1 — WASHING LIQUOR 1* WASHING
WL2 — WASHING LIQUOR 2* WASHING
Fw* — FRESH HOT WATER
PBL* — BLACK LIQUOR FROM WEDGE
Pw* — WATER PRESSED IN FINAL PRESS

LEGEND

------ PULP SLURRY
—— PULP SHEET
—— FILTRATE F3 & F2
—— BLACK LIQUOR (B.L. B.F1)
—— HOT WATER
—— STEAM
—— DRAIN

FIC — FLOW INDICATOR CONTROLLER
P1 — PRESSURE INDICATOR CONTROLLER
CsIC — CONSTSTENCT INDICATOR CONTROLLER

CPPRI, SAHARANPUR			
DRN	SIMPLIFIED FLOW SHHEET OF		
CHO	ANDRITZ DOUBLE WIRE WASHER		
APPO	SCALE NTS	DATE 8.8.88	DRG. No. CRP.009/A2