Improved Environmental Management in an Agro Based Mill – A Case Study

SRINIVASAN, G.K. AND CHATTERJEE, A.K.

ABSTRACT:- The paper deals with the control measures adopted by Shiva Paper Mills to achieve better mill management and environmental protection.

The measures included:

Maximum recycling of process effluents especially in bleach plant with an ultimate objective of achieving minimum discharge of process effluents to the treatment system.

Process modification by introducing Hydrogen peroxide in the earlier system of C-E-H sequence of operations (viz C-EP-H system).

Hydrogen peroxide addition, thus has resulted in higher brightness ceiling limit to the level of 78-82% with minimum reversion for developing value added products. Reduction in chlorine consumption especially in oxidative hypochlorite stage.

Reduction in colour and COD, by 30-40 percent in the E-stage effluent discharged.

Finally the standardisation of workable parameters for successful launching of Innovative Lignin removal process (LRP) on plant scale.

With the above measures undertaken in Shiva Paper Mills, there is visible all round improvement in mill management with greater achievement in pollution abatement in the foreceable future.

INTRODUCTION

With environment pressure increasing and stringent new clean water rules and acts. being updated by Environmental protection Agencies (EPA). the benefits of conserving water. one final step to closure. are becoming more attractive than ever before. The advantages of operating a closed water cycle include. considerably reduced energy and operating costs in certain process areas especially in the waste water treatment plant. Sustained efforts are under way worldwide to reduce overall water consumption mainly in Kraft pulping & bleaching area. with a view to close up effluent streams. New processing techniques or approaches have taken a shape with the sole objective of eleminating Dioxine and other toxic chlorinated compounds formed in a reaction between chlorinated compounds and organ-

SHIVA PAPER MILLS LTD.
15 Kms, Rampur-Bareilly Road,
Rampur (U.P.), INDIA
PINCODE - 244901

ics in pulp. In concept. Aox emissions in bleach plant streams would be zero.

INDIAN SCENARIO

The current installated capacity of the Indian pulp & paper Industries is 3.55 millions tonnes. of which wood based unit account for 40.8 percent. Agro based 33.53 percent and waste paper based 25.83 percent respectively. (1) [TABLE NO. 1]

The effective capacity. excluding the mills non-operational is only 2.7 million tonnes. giving an operating rate of 78% based on future projection at a projected industrial growth target of 8% production level of 4.2 million tonnes with an estimated installed capacity of 5.6 million tonnes is anticipated by the year 2000 (1). Such a rapid industrialisation as projected. calls for planned but sustainable development in all spheres with an ultimate objective of achieving environmental pollution abatement.

POLLUTANTS GENERATED IN PAPER INDUSTRY

Water consumption in the Agro Waste paper mills vary from 150-250 KL/Tonne of paper and 100-300 KL/Tonne is discharged into natural water bodies. Major pollution parameters. colour. suspended solids (SS). BOD & COD in combined waste waters. expressed as KL/Tonne of paper. are presented as in TABLE NOS.2 & 3 (A & B). Pollution due to

TABLE-1.

INDIA GENERAL DATA (1)

	UNIT	1988	1989	1990	1991	1992
LAND AREA	MILLION HA	329	329	329	329	329
FOREST COVER	MILLION HA	51	37	39	36	36
POPULATION	MILLION	797	812	827	850	880
GDP	BILLION RUPEES	3.761	4.280	4.949	5.435	7.313
PER CAPITA INCOME	US$	4.733	5.275	5.985	6.390	8.443
GDP	BILLION US$	270	264	283	239	238
PER CAPITA INCOME	US$	340	325	342	281	275
MANUFACTURING	% OF GDP	24	25	20	29	21
CPI	% INCREASE	9.4	6.2	9.0	13.9	10.5
CURRENCY VALUE	US$1	13.9	16.2	17.5	22.7	30.7
FOREIGN DEBT	BILLION US$	59	64	70	77	78
P & B DATA						
NO OF MILLS		300	300	310	320	327
CAPACITY	1,000 TONES	3,014	2,760	3,014	3,014	3,300
PRODUCTION	1,000 TONES	1,972	2,040	2,185	2,360	2,410
OPERATING RATE	%	65	74	72	78	73
CONSUMPTION						
TOTAL	1,000 TONES	2,432	2,595	2,738	2,890	2,970
PER CAPITA	KG.	3	3	3	3	3
RELATIVE TO GDP	Kt/bn US$ GDP	9.0	9.8	9.7	12.1	12.5

TABLE-2.

CHARACTERISTICS OF EFFLUENTS GENERATED FROM PULP AND PAPER INDUSTRIES

PARTICULARS	KGS./TONNE OF PAPER		
	S.S.	B.O.D.	C.O.D.
LARGE PAPER MILLS (BAMBOO AND HARD WOOD BASED)	100-150	35-50	150-200
AGRO WASTE BASED SMALL PAPER MILLS	90-240	85-270	500-1100
NEWS PRINT MILLS	100	45-50	135-140
SMALL PAPER MILLS (BASED ON WASTE PAPER)	50-80	10-40	50-90

SOURCE: DATA TAKEN FROM "ENVIRONMENTAL POLLUTION DUE TO PULP AND PAPER INDUSTRY", IPPTA SEMINAR 1989 SILVER JUBILEE INTERNATIONAL SEMINAR & WORKSHOP. SEPT' 1989.

TABLE-3A.

COLOUR LOAD DISCHARGED IN WASTE WATERS FROM PULP AND PAPER INDUSTRY IN INDIA.

PARTICULARS	COLOUR. KG./TONNE OF PAPER
KRAFT PULPING	25-150
KRAFT BLEACHING	100-150
NSSC PULPING RECOVERY	100-125
SULPHITE PULPING RECOVERY	15-100
SULPHITE BLEACHING	25-150

TABLE-3B.

COLOUR DISCHARGED FROM VARIOUS SECTIONS OF LARGE KRAFT PAPER MILLS

SOURCE	COLOUR. Pt-Co UNIT
WASHING AND SCREENING	2.000
CHLORINATION	280
CAUSTIC EXTRACTION	20.000
RECOVERY SECTION DRAIN	200
PAPER MACHINE	10
MILL COMPOSITE	1.000

small and medium mills based on agricultural residues is more serious, as recovery of chemicals from black liquor, is still an unsolved problem. Main constraint lies with the dilute and weak black liquor going to sewer from the potcher washing system as existing in Agro Based Paper Mills in India. For want of a proven and economically viable Soda Recovery System in toto or processing of typical black liquour from these mills, the excessive weak black liquor (WBL) after internal usage as diluent in digesters and blow tank, can not be treated directly in conjunction with combined process effluents in the conventional effluent treatment system.

The SS, BOD and COD loads from Agro residue based mills are reproted to be 2.2, 3.4 and 2.7 times the corresponding load from that of large integrated paper mills (2). A number of treatment alternatives for Agro residue based and waste paper, based mills have been prescribed (3). While S.S. and BOD could be removed by conventional treatment alternatives, colour and COD removal even with best available technology is a cost prohibitive exercise for Agro paper mills (4).

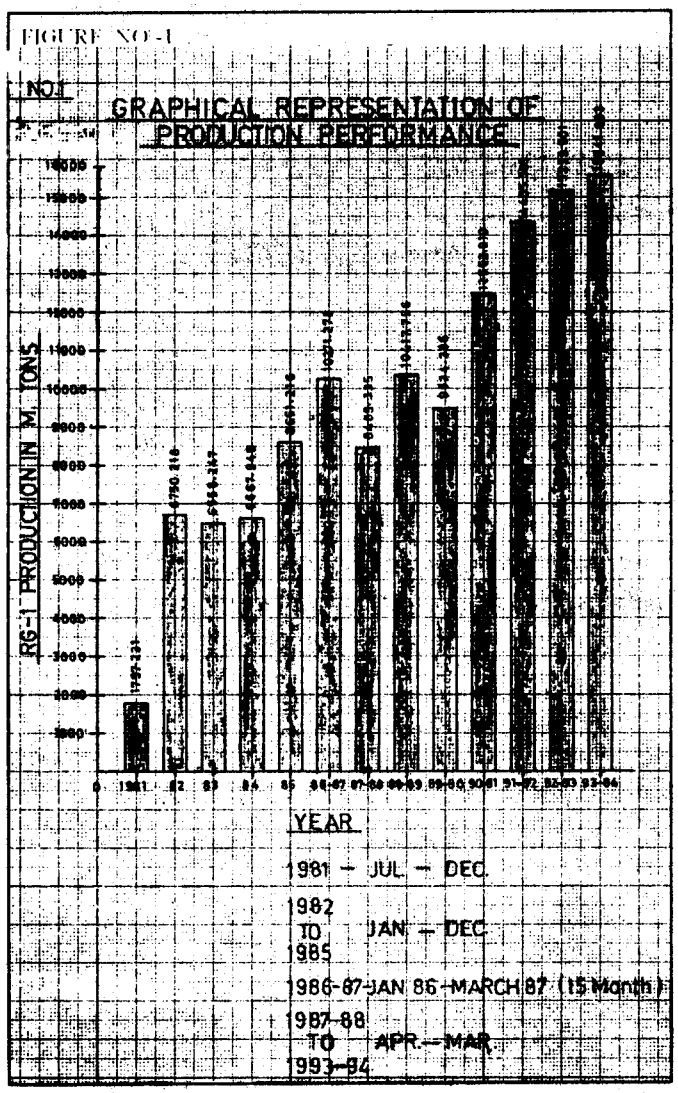
IMPROVEMENTS IN PROCESS MANAGEMENT IN SHIVA PAPER MILLS LIMITED. RAMPUR-PRELUDE TO BETTER AND EFFICIENT MANAGEMENT

SHIVA PAPER MILLS (SPM) in a nut shell

SPM is located in a backward village. Dhamora, situated 15 Kms. Away from Rampur city.

Originally a 30 TPD writing & printing grades manufacturing mill, commissioned in the year 1981, has grown to a 65 TPD mill on date, marching a head to achieve new heights in future. The present installed capacity of the mill is 19,800 tonnes per annum.

The production performance, since its achieving commercial production is graphically depicted as in FIGURE NO-1.



It is environmentally friendly, producing paper from agricultural wastes, a departure from forest based pulp and paper mills, thus preserving large virgin forest and indirectly contributing to preserving wild life.

The mills has adopted environmentally friendly pulping process by which the ambient air quality is maintained pollution free off sulfurous smokes.

Shiva Paper Mill Limited, is a model mill by itself, as it is one of the few mills in the state, with a creditable record of having a very harmonious and tension free atmosphere, thus offering an era of industrial peace-a pre-requisite for an effective mill management.

With the earlier system of pulping and bleaching prior to process modification, major constraints observed in brightness and brightness stability due to reversion, or poor shelf life of creamwove/writing paper made therefrom, leading to customer's complaints and subsequent problems on marketability.

In a planned systamatic operation, SPM has steadily moved forward in the direction of value added products for which higher brightness/whiteness and printability requirements are the pre-requisite. Key action plans under taken in these direction are :

Improvement in raw material treatment systems (Depithing and dedusting) and subsequent loading into digesters.

Chemical process modification for uniformity in cooking (lower kappa number) with higher pulp output.

Modifiying the bleaching system to tune from the conventional C-E-H sequence of bleaching operation to C-EP-H.

Maximum recycling of back waters generated within the process thereby reducing the pollutant loads in the effluent stream and subsequent reduction in fresh water requirement.

Change in marketing strategy in resonance with production and quality capabilities and problems.

New product developments, a departure from the conventional creamwove and writing paper grades to value added products. Exploring all avenues for bringing down the day today cost of production through raw material furnish with less imported pulp usage, chemical imputs with ultimate objective of achieving optimum production and quality.

Above all, motivated work force offering a consistant record of industrial peace :

a participative management.

ENVIRONMENTAL MANAGEMENT STRATEGY :

For improved water pollution control and prevention, SPM, has followed a three point Key action plans.

(1) Maximum recycling of waste waters generated from individual sources from the major processing centres within or other operative systems and reduce fresh water usage.

TABLE-4.

FRESH WATER CONSUMPTION AND EFFLUENT DISCHARGE ACHIEVED FOR 4TPD PAPER PRODUCTION.

	FRESH WATER CONSUMPTION M³/DAY		EFFLUENT DISCHARGED M³/DAY
(A) PULPING & BLEACHING			
DIGESTER			
As diluent thru blow heat recovery	170	WBL to LAGOON	840
Potcher Dilution	70		
B.S.W.-II Washer Showers	408	TCC Reject	84
Vacuuam Pump sealing water	240		
Unbleached decker +Vib. screen Shower	288	Seal Pit Water	220
BLEACHING			
C-E-H Washer showers	1080	C-Stage	2980
Bleached Decker washer	240	E-Stage	744
Hypochlorite Plant	160	Hypo Sludge	10
(B) STOCK PREPARATION			
Dilution of Chemical, S S Powder etc.	48	Krofta Drain	120
		TCC Reject	48
(E) M.F. MACHINE	1800	Excess B W	960
Wire Showers		Paper moisture	3
-Pope Reel Cooling		Evaporation	115
-Cooling Dryers			
+Part of Vacuaam sealing			
(D) M.G. MACHINE	1440	Boiler make up	96
Showers in wire Part		Condensate	
(E) BOILER HOUSE	288	Blow Down	48
(F) DOMESTIC & ETP.	120	Misc.	48
	6352		6316

Details of process water going to effluent treatment plant and fresh water consumption at different sections are as presented in TABLE NO.-4.

(2) Process modifications in bleach plant.

(3) Proper utilisation of waste black liquor with the sole objective of minimizing the problamatic pollution enhancing role in the combined effluent.

PROCESS MODIFICATIONS IN BLEACH PLANT SYSTEMS

As part of our intensive efforts to reduce the pollutant loads at different sources of effluent in the mills, incorporation of process modification in the bleaching process operations was considered the best option.

The conventional C-E-H sequential bleaching system of operations was modified to C-EP-H system where in standard Hydrogen peroxide bleaching system was incorporated.

Since December last, the continuous regulation of Hydrogen peroxide in the Caustic extraction tower adhering to standard conditions, has resulted not only in the improved brightness/whiteness of bleached pulp with good stability but has also caused phenomenal reduction in colour and COD load of the E-stage effluent (TABLE NO-5).

With only 30 percent of Extraction stage effluent amounting to 720 Cu.m/day, there was over all reduction in colour and COD load by 37% & 32% respectively.

PROPER TREATMENT OF WASTE BLACK LIQUOR, MAIN OBJECTIVE FOR BETTER ENVIRONMENTAL MANAGEMENT

With the ever increasing cost of Caustic Soda Lye (47.5% W/W) and Caustic Soda solids (100%) at regular intervals, recovering Sodium (Caustic) from waste black liquor Containing 17.3% Sodium on Solid basis, in a proven and economically viable recovery system of operations, is the only option, to the pulp and paper industries based on bagasse and other agrowastes.

Due to lack of proven and technologically viable alternative process options for processing Agro based black liquors, none of these mills are equipped with Chemical recovery systems. Covnventional recovery system, involving evaporation and incineration of Concentrated spent pulping liquors followed by lime Causticization of dissolved smelt, suffers severe set back due to the fact that spent liquors from pulping of agro residues entirely differ substantially compared to Wood base spent liquors. (5)

The mills (SPM) spare no efforts in making it a reality and explore all avenues in setting up a technically viable new alternative in processing of spent liquors.

Table-5.

EFFECT OF HYDROGEN PEROXIDE BLEACHING OF EFFLUENT DISCHARGE

PARAMETERS	UNIT	C-EP-H			C-E-H		
		C	EP	H	C	E	H
EFFLUENT FLOW	M^3/Hr	135	127.5	117	142	135	128
SUSPENDED SOLIDS (SS)	mg/L	420	520	365	660	740	478
S S LOAD	Kg/TONNE	31.5	36.8	23.72	46.86	55.5	33.99
COD	mg/L	1700	1600	240	2100	2800	460
COD LOAD	Kg/TONNE	127.5	113.3	15.8	161	204	32
BOD	mg/L	400	380	92	560	680	196
BOD LOAD	Kg/TONNE	30	33.70	5.98	42.98	49.6	13.56
COLOUR	Pt-Co Units	--	2200	--	--	3500	--
QUALITY OF PAPER : SUPER PRINT 54 GSM					CREAMWOVE 56		
PULP BRIGHTNESS REQUIREMENT	77-79%				73-74%		

With no immediate solution to the vexed problem of a proven recovery system is in sight. SPM has geared it self to combat the pollution menace arising out of the waste black liquor entering the effluent system by suitable new process approach, so for evading the Indian agro based paper industry as a whole.

LIGNIN REMOVAL PROCESS (LRP) A NEW BUT PROVEN APPROACH IN THE TREATMENT OF BAGASSE/STRAW BASE BLACK LIQUORS STANDARDISED BY SHIVA PAPER MILLS

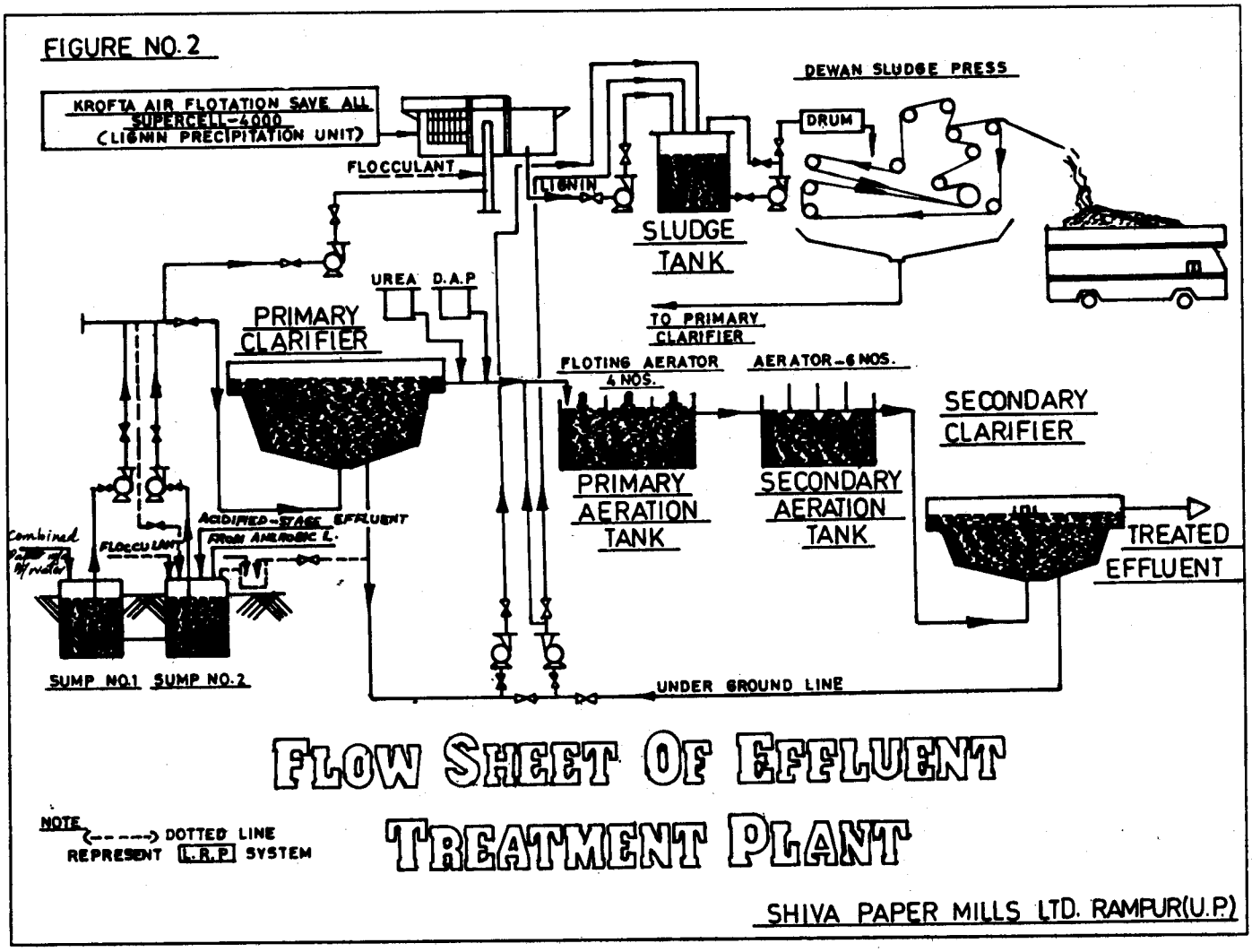
Comprehensive effluent treatment system for treating Combined waste waters with pretreated black liquor is as represented in FIGURE NO 2.

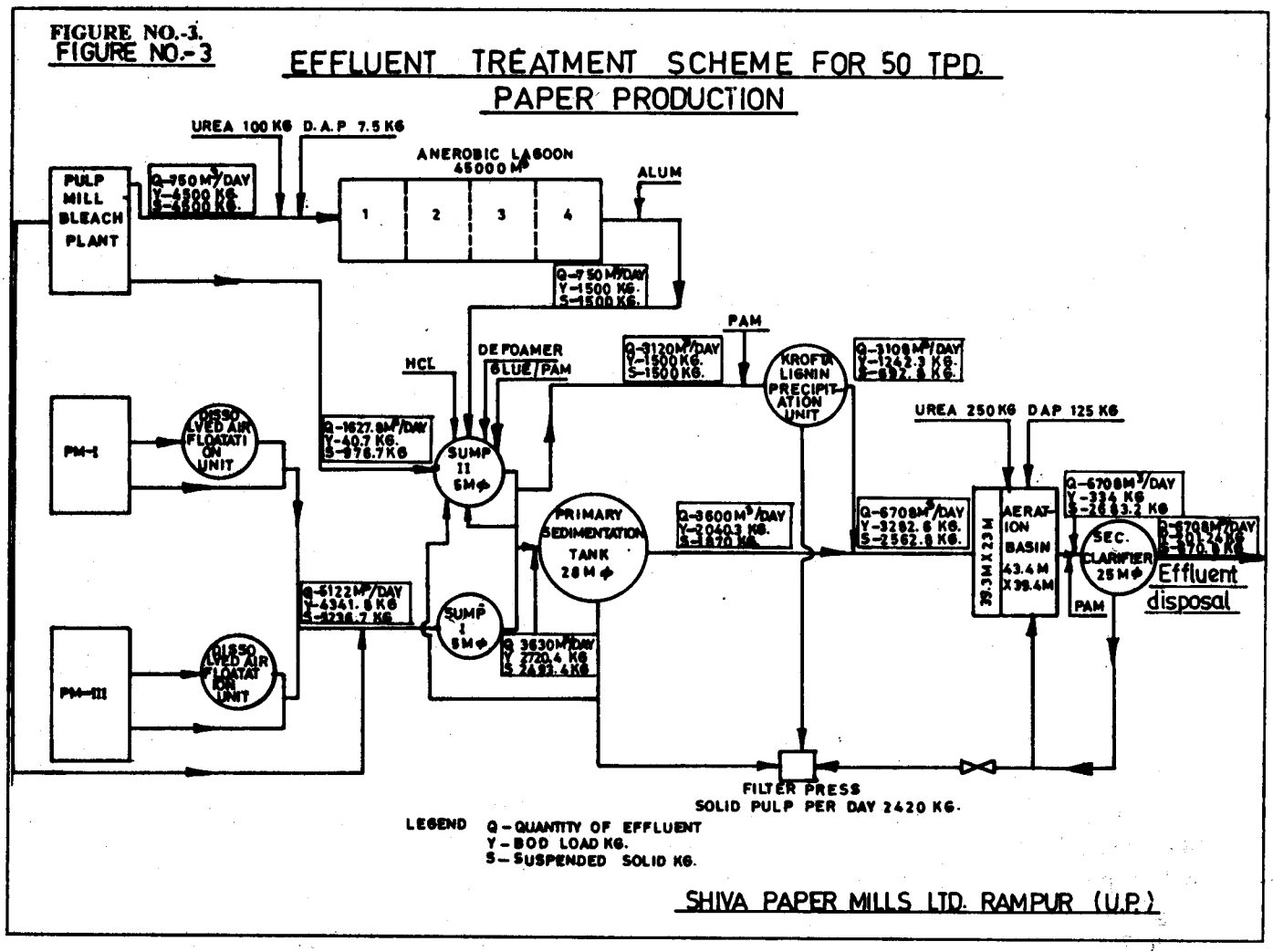
The actual mass balance Computed for a 50 TPD production is also presented in FIGURE NO 3 which will throw enough light on the systematic approach standardised in SPM.

Even through a number of treatment alternatives for Agricultural residue based paper mills have been proposed, actual practice, quite a number of problems encountered in processing black liquor containing bio-refractory lignin which could not be sloved without innovative technological approach.

While pollution load with respect to all other parameters can be Controlled to the Consent Conditions of U.P. State pollution Control and prevention board (UPSPCPB), the treatment with respect to Colour and COD removal has not been tackled.

LIGNIN REMOVAL PROCESS (LRP) a recent innovative development in this direction, originally patented by the inventor Pertti Hynninen under





US Patent documents (6) for removing organic substances from effluent from pulp and paper manufacturing process based on softwoods.

A technical paper on "LIGNIN REMOVAL PROCESS" with respect to Agro residue based paper industries has been presented earlier at "PAPEREX" International conference held at New Delhi (7)

The present article mainly deals with the extension of research studies undertaken in CPPRI, Saharanpur, Finland Shiva Paper Mills Laboratory under the able guidance of Dr. P. Hynninen to standardise on a plant scale on continuous basis.

BASIC PRINCIPLE INVOLVED IN LIGNIN REMOVAL PROCESS

A new method modified from the originally patented process (6) to suit the characteristics of organic pollutions generated from agro residue based furnish.

The process is based on the ability of acidified fibrous sludge to initiate precipitation of macro molecular lignin with the achievement of zeta potential of the fibrous suspension to zero. Precipitation of lignin on the lighter fibrous suspension is total which by treatment of proper flocculants (Poly acrylamides), the lignin carrying sludge can easily be floated by air floatation technique in Krofta Saveall and by sedimentation in Primary clarifier. Use of Aluminium sulphate along with HCl for acidification of C-Stage effluent further enhances the precipitation.

To introduce LRP method of treatment of alkaline effluents (black liquor), the effluent treatment system as in Shiva Paper Mills has been

modified from the earlier system. The dotted lines (routing) in the flow sheet (FIGURE NO 2) indicated the LPR functioning system wherein anaerobically treated black liquor is well agitated/recycled with acidified sludge.

Diverting of the combined acidified effluent into Primary clarifier and Krofta Air floatation system in 60:40 proportion has brought about uniform loading in the system with maximum colour and COD load reductions.

The lignin precipitated sludge simultaneously processed in the Sludge dewatering double felted press system to 30 percent cake for regular disposal to nearby board mills.

Following inferences can be made from the successful plant treatment by LRP method.

1.0 Only C-Stage effluent having pH of 3.0 to 4.0 is best suited for LRP basics as the acid and alum consumption found to be almost half compared to bleach plant effluent contaminated with E-Stage effluent.

2.0 For maximum reduction in color, COD and BOD, black liquor must be anaerobically treated by best possible way. Reduction of COD from 20 g/l to 8-10 g/l and BOD from 6.0 g/l to 1.8 to 2.0 g/l after anaerobic treatment of black liquor in lagoons, has yielded best results.

3.0 Best possible colour and COD reductions achieved by proportionate use of sludge (Dry basis) with respect to COD load of the effluent

g.COD to g.Sludge : 2.0 : 1.0, actual plant control.

4.0 Cost for treating 800-900 Cu.m. of anaerabically treated black liquor by LRP systems alone works ou to Rs 3000/- (About US$ 100)

5.0 As a further step in the direction of conserving water, SPM explores all possibilities of reusing part or whole of process water presently going to drain.

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