

An Approach Towards Improving Chemical Recovery Efficiency

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ABSTRACT

In the present industrial scenario of liberalised economy and growing environmental awareness, the large Indian pulp and paper industries should be economically viable with efficient recovery of Kraft chemicals and energy. At ITC Bhadrachalam Paperboards Limited, innovative steps have been taken to improve the chemical recovery. These improvements in the process have resulted in benefits like an increased percentage of recovery efficiency of 95%, elimination of Caustic make-up, higher Sulphidity resulting in better pulp strength and a reduced quantity of pollutants discharged into the environment.

INTRODUCTION

To be economically viable, the Kraft pulping process requires an efficient recovery system for chemical and energy. Recovery systems also provide the key for making Kraft pulp mills environmentally compatible, as required by authorities and public. In general, an efficient system for recovery of chemical and energy, is a key element in resource management (1).

Non-availability of bamboo and its rising cost has forced the industry to increase the proportion of Hard wood in the furnish to 80%. The properties of Black liquor are changing with the change in raw material composition and characterised as follows:

- Higher viscosity at given solids content is due to varied polysaccharides content.
- Reduction in Silica content resulted in lesser problems with scaling in evaporators.
- In spite of low swelling index, burning of black liquor was not a problem in the recovery boiler.

Following are the brief description of the equipment installed in Pulp Mill and Recovery:

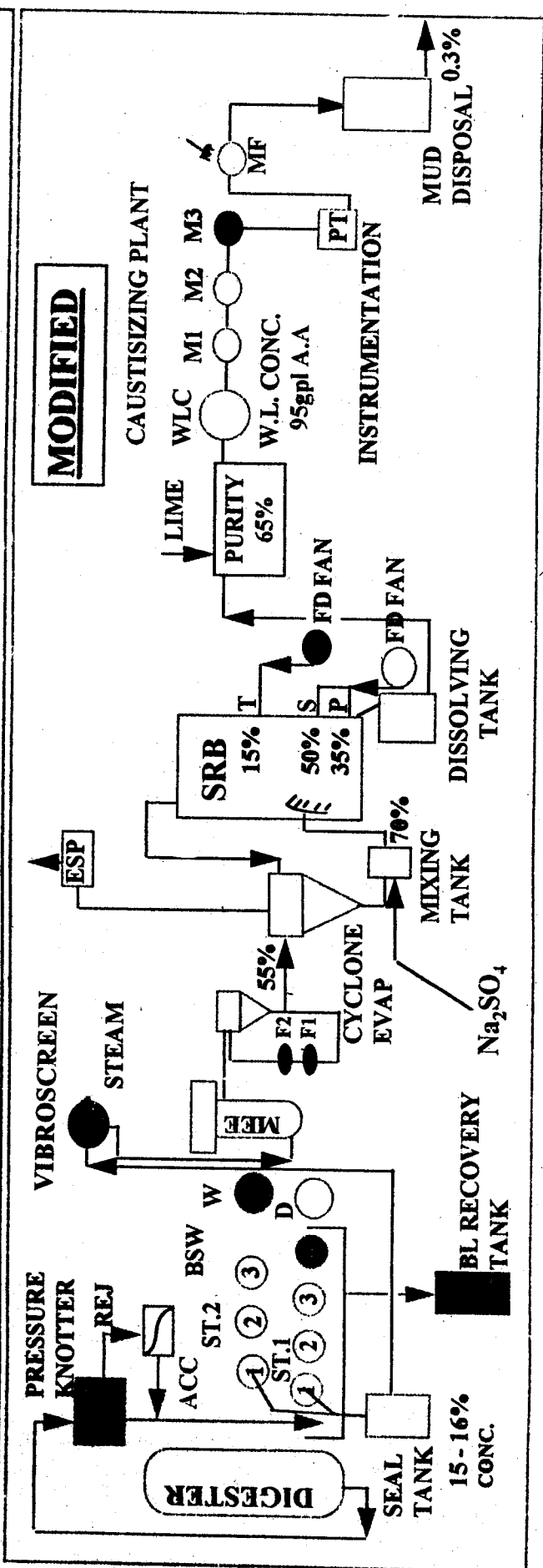
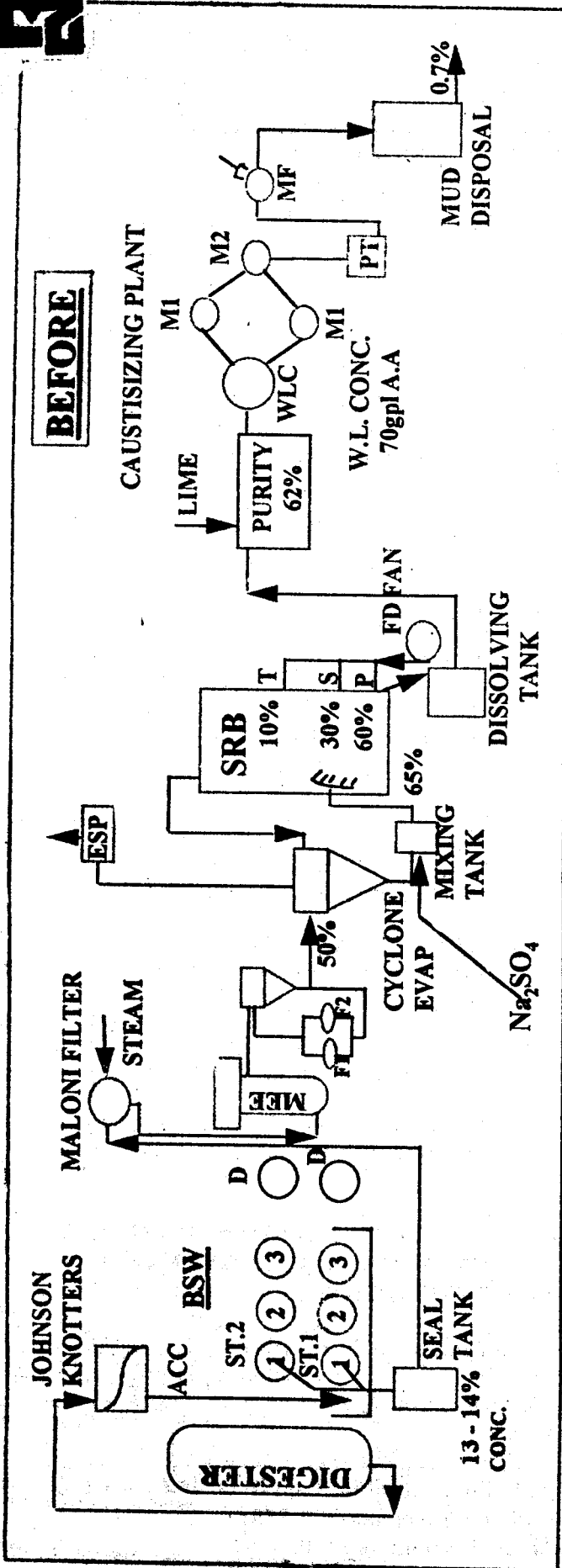
- (i) *Digester house:* Conventional Six Number vertical batch digesters of 80 cubic metres volume each.
- (ii) *Jonson Knotter:* For separation of knots from fibre.

- (iii) *Washing of pulp:* Two streets of washing viz. St-1 and ST-II, capacities are 120 TPD and 60 TPD respectively. Both of them are three stage counter current rotary vacuum brown stock washers. In addition to these, there are two streets of screening with a thickener.
- (iv) *Maloni filter:* For the removal of fibre from black liquor.
- (v) *L.T.V. Evaporator:* Quintuple effect mixed feed evaporator with a finisher to handle 70 T/hr of black liquor at 13% solids.
- (vi) *Recovery Boiler:* Tomilson-type boiler with a 200 T solids firing capacity.
- (vii) *Causticizing Plant:* Conventional causticizing plant with two stage mud washing and mud filter.

STEPS TAKEN TO IMPROVE RECOVERY EFFICIENCY AND STEAM GENERATION AND CONSUMPTION

To optimise recovery efficiency and steam generation and utilisation the following major steps are implemented, which are shown in the flow sheet (No.1).

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STEPS TAKEN IN PULP & RECOVERY FOR IMPROVED PERFORMANCE
Flow Sheet.1

Replacement of Jonson Knotter by pressure knotter

It has yielded the following benefits:-

- Being a closed system, air entrainment is minimum resulting in less foam generation at the washing stage.
- Better separation of fibre from knots.
- More environment friendly.
- Reduction in over flows.

Introduction of Fourth Stage Washing

The existing thickner of St-II screening has been converted into fourth stage washing in St-II which has resulted in a reduction of Soda loss from 18 kgs as Sodium Sulphate per ton of pulp to 8 kgs as Sodium Sulphate per ton of pulp. To further improve the efficiency of St-I washing recently a fourth-stage brown stock washer has also been added. This has resulted in higher concentration of black liquor and a reduction in carry over of chemicals from 16 kgs as Sodium sulphate per ton of pulp to 8 kgs as Sodium Sulphate per ton of pulp. Reduction in carry over Soda losses at the brown stock washing stage is shown in fig. (1), where the carry over loss on overall soda losses efficiency has been brought down from 1.87% in the year 1994 to 0.9% in the year 1997. Besides chemical saving there is a substantial reduction in water consumption in the Screening section. According to Smook (2) Chemical carry over losses of 6-9 Kgs as Sodium Sulphate per ton of pulp means a washing efficiency of as high as 99%. It is reported that at least one kg of Chlorine is consumed by two kgs of sodium Sulphate per ton of pulp. Cullinam (3) has shown that soda loss is a linear function of C.O.D. by reducing carry over losses, thus there is a lower environmental impact by discharging less pollutants.

Substitution of Maloni filter by Vibro Screen

It has been observed that the fibres coming with the black liquor causes jamming of evaporator tubes and affects the runnability of the evaporator. The Maloni filter was replaced by a Vibro Screen which is more efficient. Another advantage of a Vibro Screen is that it does not require steam for processing black liquor.

Increased concentration of black liquor from Evaporator

After commissioning the fourth stage washer in Pulp mill, the concentration of black liquor has gone

as high as 15.5-16% solids against previous 13-14%, which has given substantial reduction in steam consumption in evaporation. Till recently one finisher was in circuit while the other was kept as a standby. With this sequence the outlet concentration of black liquor was 50%. Recently the flow sequence was modified to allow both the finishers to operate in series. With this flow sequence the outlet concentration of black liquor has increased to 55% solids.

Increased black liquor concentration to furnace and change in air distribution

The solids coming from evaporator has gone as high as 55% and after cyclone evaporator, the final concentration of black liquor to furnace increased from 65% to 70%.

Change in air distribution system

Air distribution system has been modified by

- (a) Changing Primary and Total Air ratio.
- (b) Intruduction of an Auto Control loop with black liquor firing.
- (c) Introduction of cold air at tertiary stage by a separate fan.

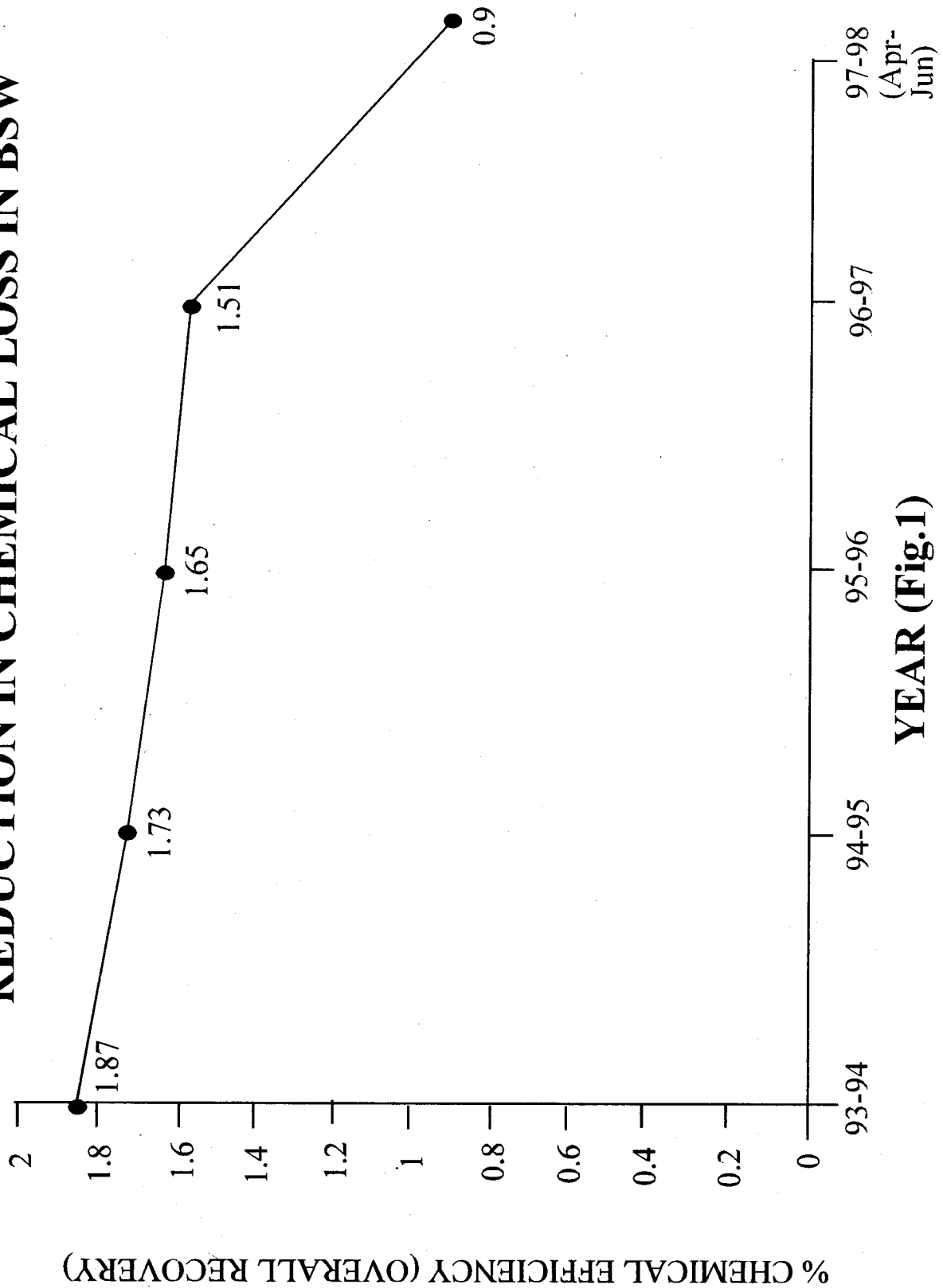
The above changes in Recovery Boiler has resulted in:

- Higher steam generation per ton of black liquor solids.
- Increased runnability of the boiler.
- Improved efficiency of E.S.Ps.
- Increased percentage of Sulphidity: as shown in fig (2), where the sulphidity has increased from 20.23% in the year 1994 to 24% in the year 1997.
- Reduced emission of gases.
- Better pulp strength because of higher Sulphidity.

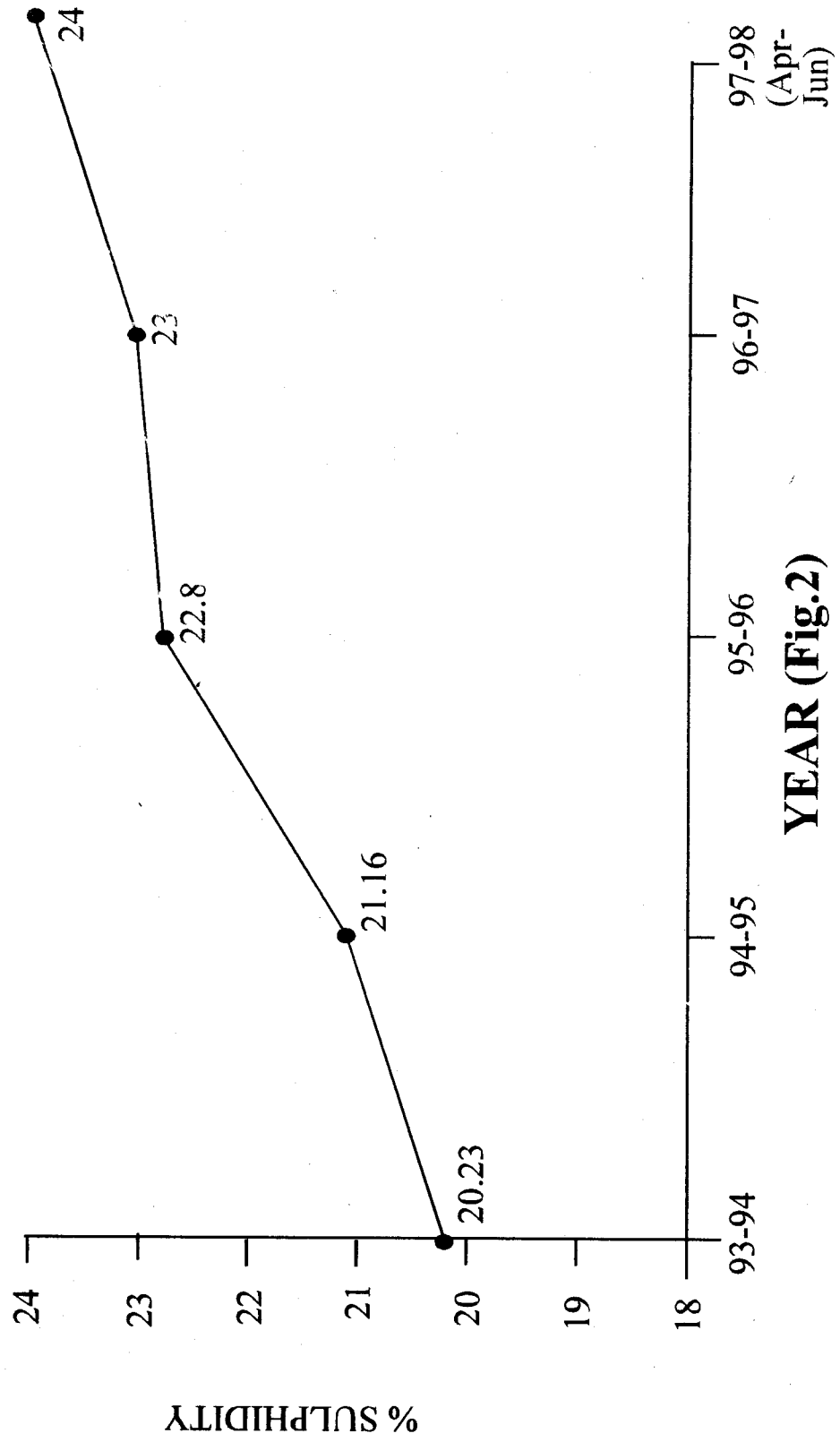
Higher concentration of White liquor and Additions: Instrumentation in Reausticizing Plant:

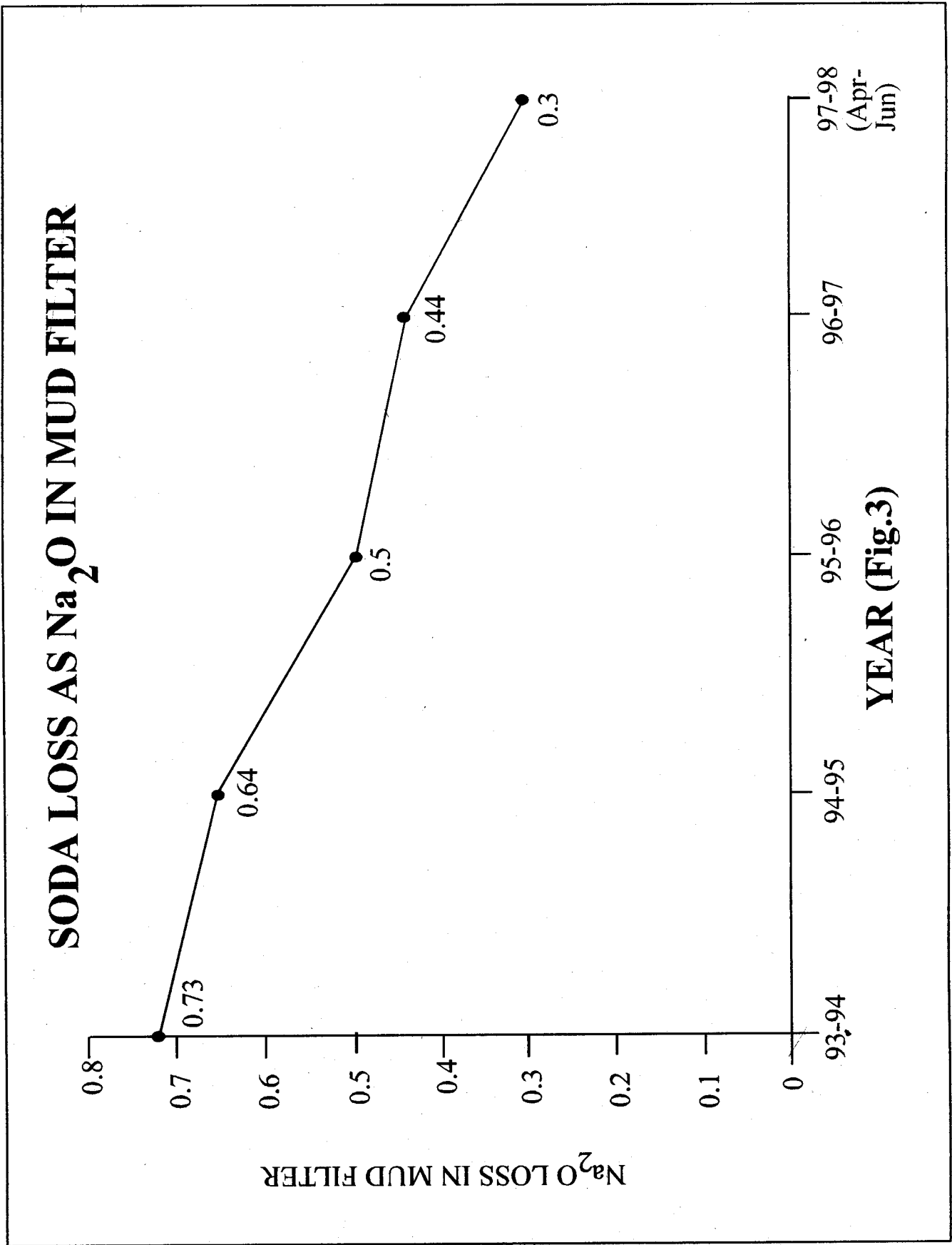
- (i) The concentration of Active Alkali in White liquor has been increased from 70 gpl to 95 gpl which has reduced Hydraulic load on the clarifiers and mud washer. When the concentration of Active Alkali in the White

REDUCTION IN CHEMICAL LOSS IN BSW



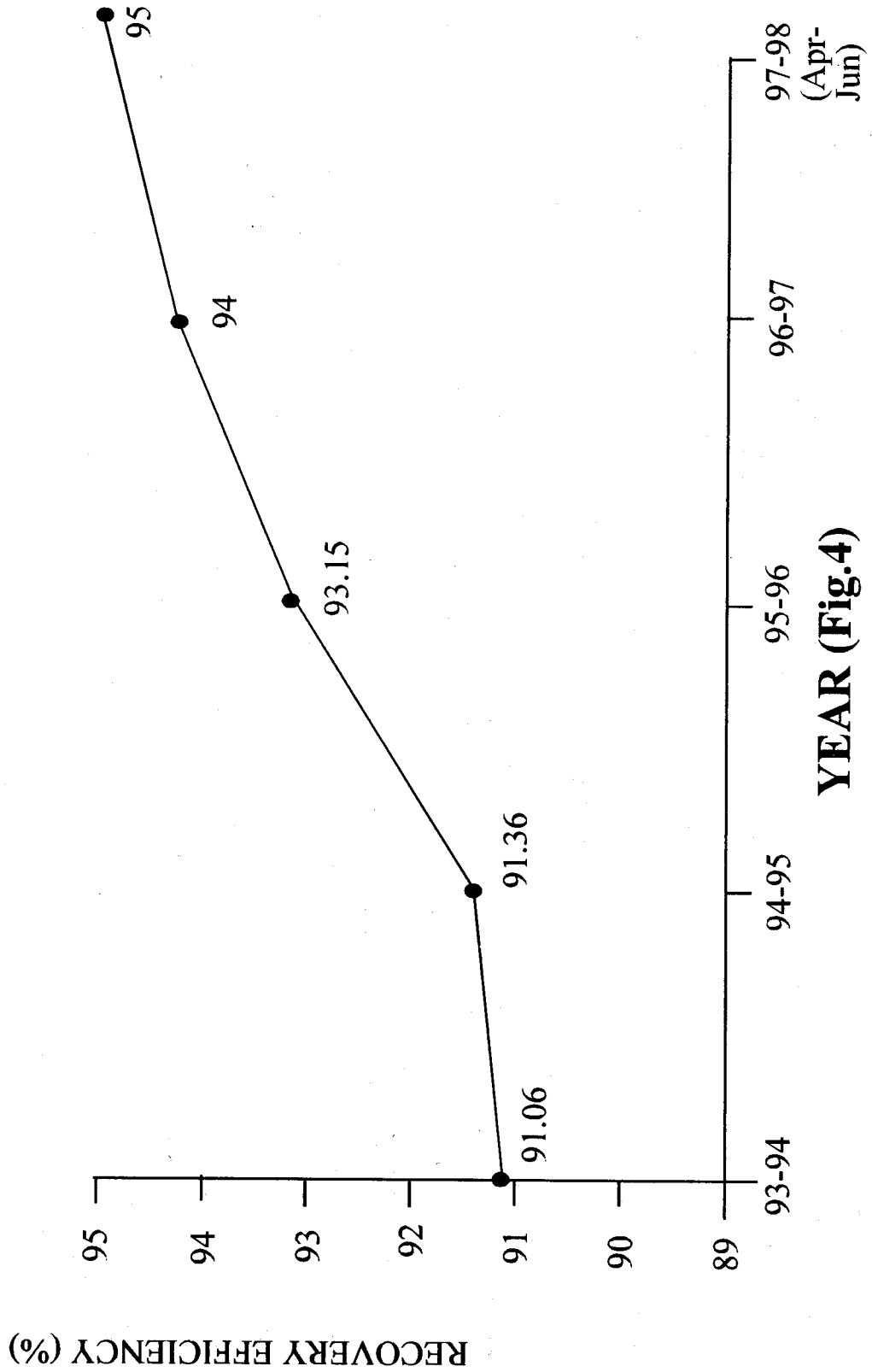
IMPROVEMENT IN SULPHIDITY



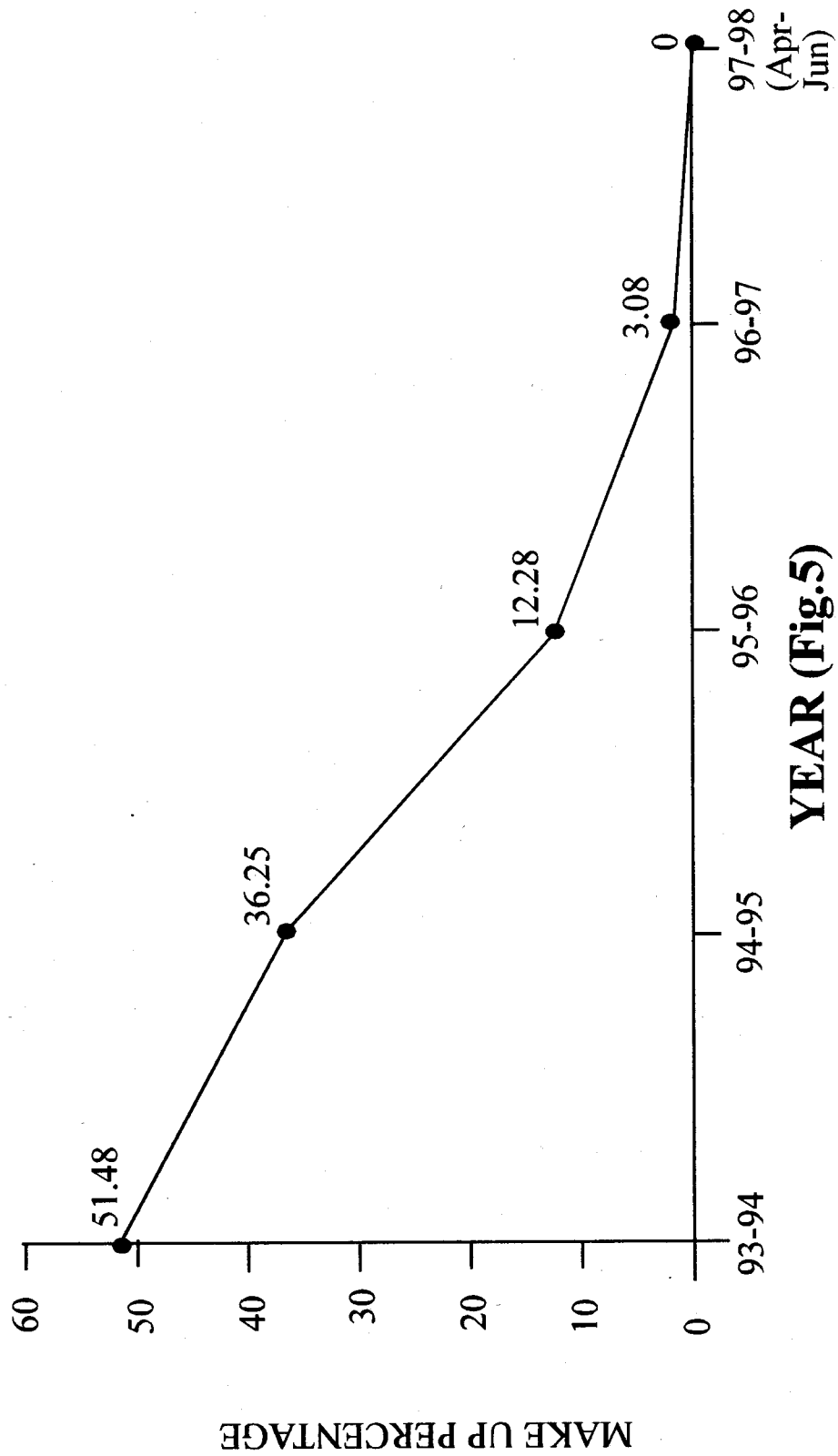


YEAR (Fig.3)

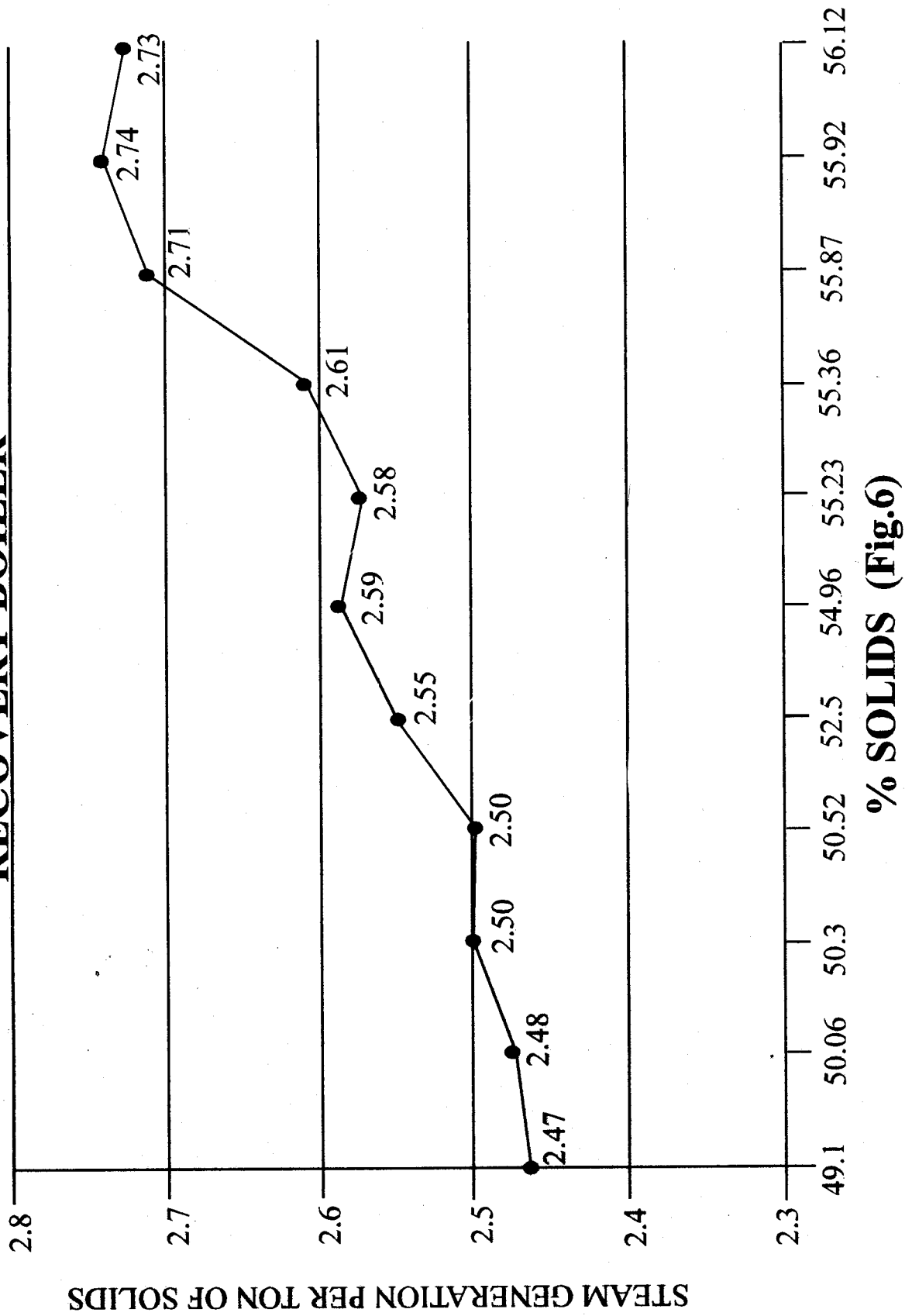
CHEMICAL RECOVERY EFFICIENCY



CAUSTIC MAKE-UP

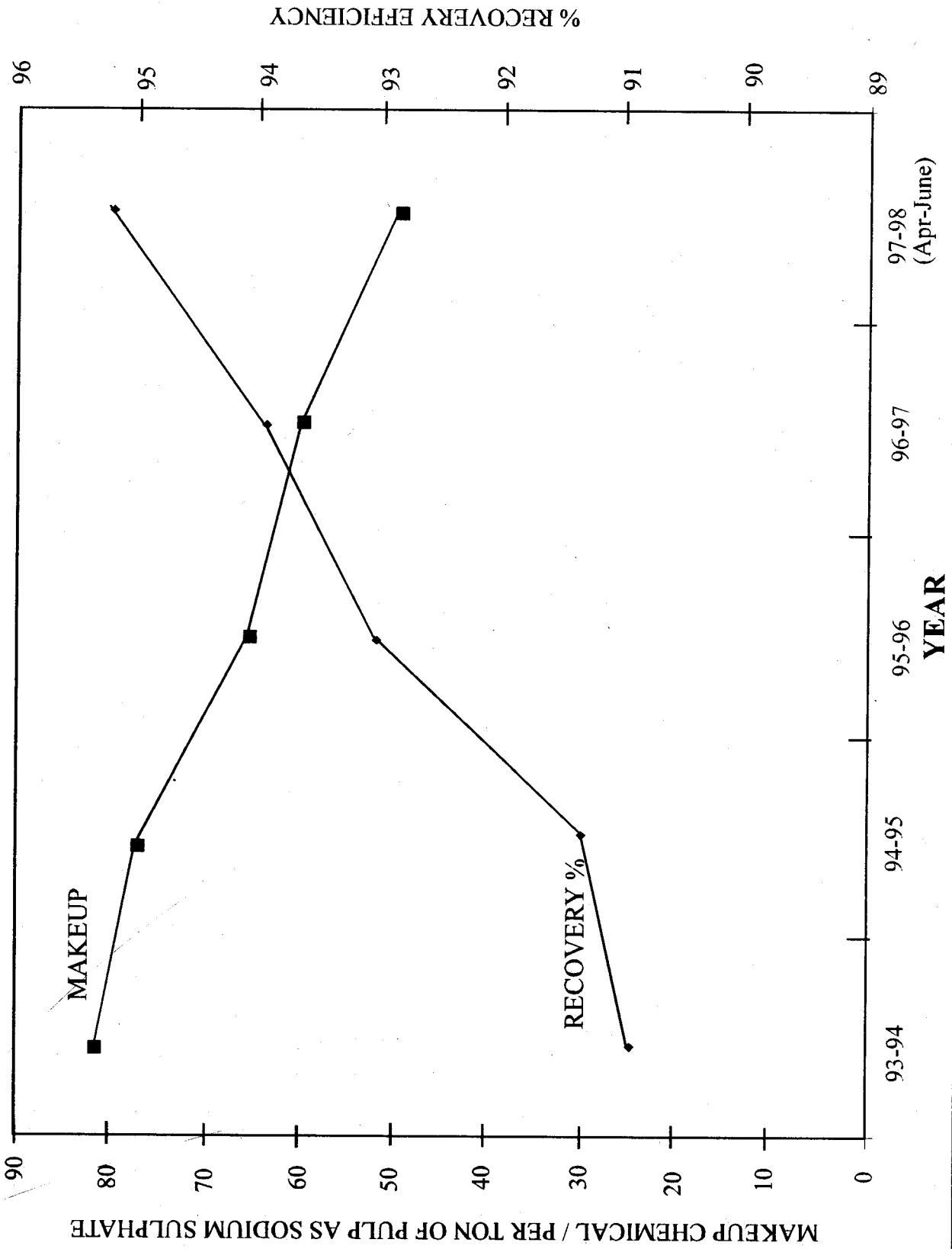


STEAM GENERATION PER TON OF SOLIDS FROM RECOVERY BOILER



% SOLIDS (Fig.6)

MAKEUP CHEMICALS PER TON OF PULP FIG. 7



liquor was 70 gpl, two mud washers were operated in parallel. The White Liquor from these two mud washers were taken for a second stage of mud washing. With the increase in concentration of Active Alkali in White Liquor to 95 gpl the hydraulic load on the mud washer has reduced. This has enabled to utilise the two mud washers which were hitherto in parallel in series. Thus an additional stage of washing has been incorporated into the system.

- (ii) Lime purity has been increased from 62% to 65%
- (iii) Addition of Green liquor density controller.
- (iv) Variable frequency drive (V.F.D.) has been installed for better control of lime input.

The above changes has resulted in:

- Reduction in Soda loss through mud cake from 0.7% to 0.3% as shown in the Fig (3) over the period.
- Reduction of steam consumption.
- Uniformity in white liquor concentration.

The cumulative effect of all the above steps and day to day improvements in operation and maintenance systems have resulted in an overall Recovery Efficiency as shown in fig (4). Where the chemical recovery efficiency has been improved from 91.06% in the year 1994 to 95% in the year 1997. Apart from this, the Caustic make up has been brought down from 51.48% in 1994 to nil in the year 1997. This has also resulted in higher steam generation per ton of solids fired as shown in Fig. (5). This has also

resulted in higher steam generation per ton of solids fired. The increase is from 2.47 to 2.73 tons of steam as shown in Fig (6). A graphic representation is also shown in Fig (7), the reduction in make up chemical as Na_2SO_4 and increase in Chemical recovery efficiency over the period.

CONCLUSION

The Kraft pulping process is a century old one, integrated pulp and paper mills should aim to optimise their pulp and recovery systems in order to make the pulp-making process more environmentally-friendly and improve the economies of operation. ITC Bhadrachalam Paperboards Limited has implemented steps to improve every stage of the Kraft process like Pulp Washing, Evaporation, Recovery boiler and Causticizing. The net result of these measures is an increased recovery efficiency of 95%. This has been achieved with the support of the Management and Employees who have worked dedicately towards this goal:

ACKNOWLEDGEMENT

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