Integrated control system at west coast

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SUMMARY

West Coast, with an initial installed capacity of 20,000 TPA, in the year 1958-59, had the functions of process & quality control centra ised in Central Laboratory. With steady rise in production and increase in the magnitude of services, quality control department was formed in 1963 and Research Centre in 1970.

West Coast, as of today, with about 60,000 TPA capacity, has a well established integrated control system administered through Central Laboratory, Quality Control, Research Centre and Cost Accounts department. During the last two decades, West Coast, as is true of the Indian Paper Industry, has been facing various constraints such as scarcity of conventional raw materials, usage of unconventional quality demands of the product, statuatory requirements under production control ordinance and pollution control act. These challenges have been met with varying degree of success by setting up statistical quality control systems at various lev ls.

This paper describes the integrated control system in operation at West Coast. It has given fair y satisfactory results in the production of regular varieties of paper and also in the production of varieties tailor made for specific end users. The system, with the co-ordination of various departments has been useful in developing new grades of paper, which have received wide acceptance with the consumers. It has accomplished major objectives such as awareness of quality consciousness among the personnel minimising the rejections and optimising the production cost. It has given confidence to try to manufacture new grades of paper having stringent quality specifications, inspite of the prevailing constraints. With the introduction of computer in the mills, efforts are afoot to computerize the process data for quick and effective control of the process data for quick and effective control of the process, production scheduling and retrievals of best operation parameters. However, as in any endeavour for perfection, it is realised that there is enough yet to be accomplished.

Pulp & Paper manufacture, being essentially a chemical process utilising diverse materials, operations and processes, is subject to various physical and chemical factors. The occurance of variations in the properties of materials, operations & processes is a natural phenomena well-recognised in process industries Detection of the variations, identification of the responsible factors and follow up of corrective measures are the basic functions of a control system. Paper industry being highly capital, material and energy intensive, controls at every stage of the manufacture assume great significance in achieving optimum utilisation of resources, quality of products and productivity of the industry at most economic cost level.

The field of process control and quality control in paper industry has come a long way, from simple mechanical feed back systems to the use of computer systems in advanced countries. Indian paper industry is making rapid progress in this area. At West Coast Paper Mills, instrumentation of the plant is done to a fair degree with substantial advantages. Statistical Quality Control techniques, Standard analytical procedures, R & D and cost & work study methods constitute the control system adopted in the mill with an integral approch to this vital aspect.

ORGANIZATION FOR CONTROLS

Since different means, techniques and disciplines are employed in the Integrated Control System as adopted in the mill, it is administered through various departments of the mill.

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Instrument Department

As one of the progressive mills in the country, West Coast started though over quarter of a century ago, has consistently kept pace with technological progress and opted to go in for instrumentation of the plant in right earnestness. There is now a fairly well established instrumentation in the plant and the instruments department which is well staffed with trained personnel, maintain, plan and expand the scope of applications.

Central Laboratory

It is one of the well-equipped and pioneering Laboratories of the Indian Paper Industry, having produced substantial work and trained men. Initially, most of the technical control functions were centralised in the Central Laboratory and with increase in production of the mills and magnitude of service demands, Quality Control was created in 1963. Material acceptance, analytical work, water & waste water treatment, lab scale process studies are the areas served by this department.

Quality Control department

The concept of Quality Control is well accepted in the mill and one of the achievements of Quality Control department is the development of quality consciousness among personnel. The department is staffed with trained persons in statistical quality control methods and it maintains control laboratories in chemical plant and paper mill. It functions in close liason with process departments and carries out control sampling and testing and communicates results speedily for the guidance of plant. It maintains data of plant conditions, product specifications and makes them available to plant when needed. Training programmes in the methods of quality control are conducted for updating the skills of staff and line crew.

Research Centre

It is one of the most modern and well equipped research centres having excellent facilities for research and development work. It conducts research on medium and long range projects and undertakes investigations on problems encountered in the mill. It conducts experiments aimed at process and product development, improvements on the existing quality and identification of new avenues of raw materials, processes and products.

Cost Accounts department

The day to day manufacturing performance of the mill is analysed by the Cost Accounts department, cost implications are computed and cause-wise financial impacts are explained. It advises on most favourable product mix and assist in production planning.

CONTROL SYSTEM AT WEST COAST

The control system is conceived with an integral approach to the subject of controls of materials, processes, products and cost of production through the application of analytical techniques, statistical methods, instrumentation and cost analysis.

Control of materials

Fibrous raw materials constitute largest single source of material input. For proper utilisation the various types of materials, woods are segregated and stored in the yard. To maintain uniformity of the furnish, inspection is carried out in the yard for deciding the type and proportion of the feed to the process. The quality aspect is checked in Central Laboratory by chemical analysis and pulping experiments and the findings are communicated to the pulp mill for their guidence.

Chemicals, minerals and fuels which form the bulk of non fibrous input materials are inspected analysed and approved by Central Laboratory as per the standard sampling and testing procedures. The substandard materials not conforming to the specification are segregated and dealt with separately. In case such material is to be used for some reason it is with the full knowledge and necessary care the materials is used in the plant in such proportion that the quality of the process and product is not affected. Table I gives schedule of materials testing.

Control of operations and process

Instruments have a significant role in the process industry in keeping the conditions of operation and process within control. At West Coast instrumentation of the plant is done to a fair degree. The instrument department maintain the instruments, and calibrate them periodically to ensure proper working.

The flow chart of materials, operations and processes of the paper mill along with control sampling points is given in Fig. 1. Samples are drawn from various points for control tests. The schedule of sampling is shown in Table 2.

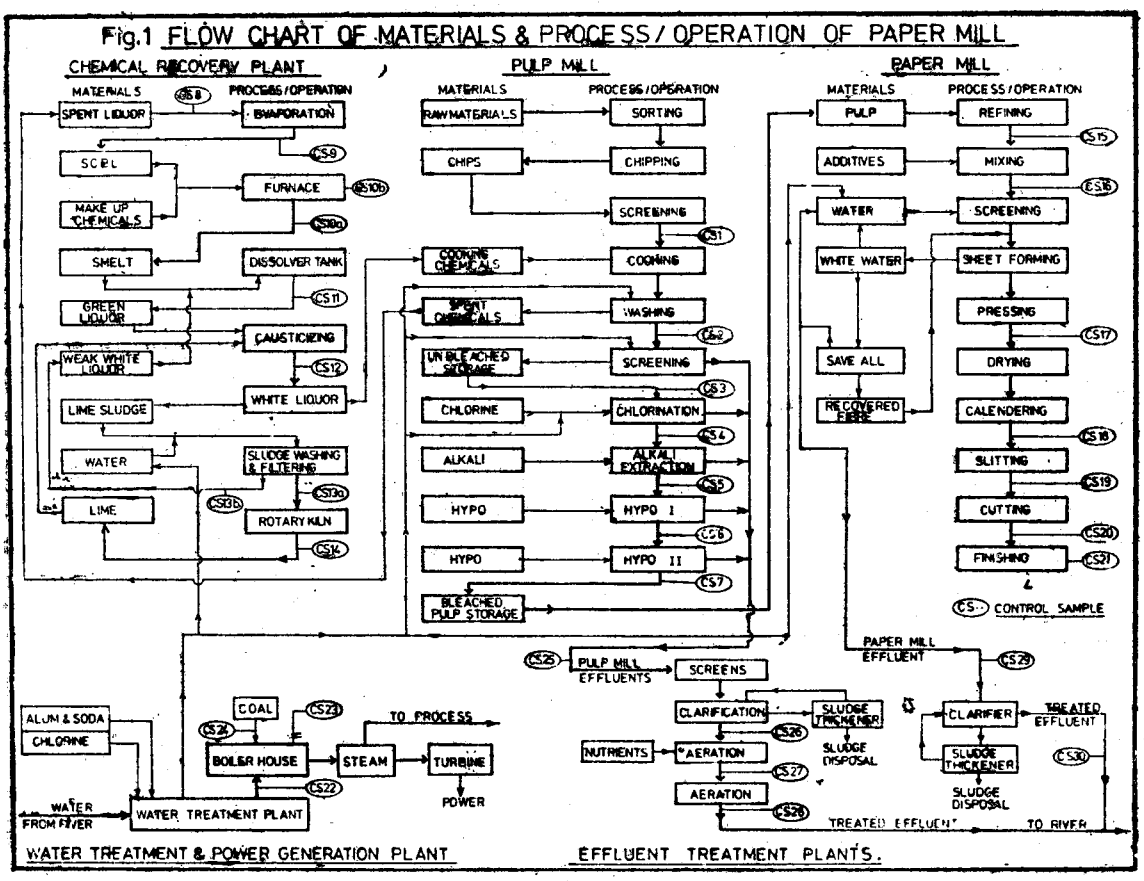
The results of the control samples are communicated to the plant, with recommendation. The performance of the plant is compared with the norms. The norms for various operations are

fixed based on past performance and capability studies. The norms are reviewed periodically and new goals are set to meet specific results.

Statistical methods, such as sampling plan, control charts, analysis of and test of significance are applied to analyse and interpret the results. A few case studies with examples are given.

TABLE–I. SCHEDULE OF MATERIALS TESTING

Materials	Tests	Frequency
1. Fibrous Materials		
a) Bamboo, hardwoods, casuarina, eucalyptus, mesta, bagasse etc.	a) Moisture b) Degree of decay c) Pulping properties	Consignment as required
b) Paper cuttings	a) Moisture b) Ash c) Strength properties d) Contraries	Consignment wise
2. Non-fibrous materials :—		
a) Industrial chemicals, additives	a) As per specification	Consignment wise
b) Minerals	As per specification	—do—
c) Fuels	—do—	—do—



TABLE—II SCHEDULE OF CONTROL TESTING

A—Pulp Mill :-

No.	Materials	Tests	Frequency
1.	Chips	a Moisture %	Every cook
		b. Size & size distribution	8 hrly.
		c. Physical & chemical pulping test on composite sample	Weekly.
2.	BSW pulp	a. Consistency	Every cook
		b. Kappa No.	—do—
		c. Chemical loss	8 hrly.
3.	Screened pulp	a. Consistency	4 hrly
		b. pH	—do—
		c. Kappa No.	—do—
		d. Strength properties	8 hrly.
4.	Chlorinated pulp	a. Temperature	2 hrly.
		b. pH	—do—
		c. Residual Chlorine	—do—
5.	Alkali Extracted pulp	a. Temperature	2 hrly.
		b. pH	—do—
		c. Kappa No.	—do—
6.	Hypochlorite I pulp	a. Temperature	2 hrly.
		b. pH	—do—
		c. Residual chlorine	—do—
		d. Brightness	—do—
		e. Viscosity	4 hrly.
7.	Hypochlorite II pulp	a.) b.) c.) As in No. 6 d.) e.)	—do—
		f) Strength properties	8 hrly.

B—Chemical Recovery :-

8.	Spent liquor	a. Specific gravity	2 hrly.
		b. Temperature	—do—
		c. Chemical analysis	8 hrly
		d. Calorific value	Weekly.
9.	SCBL	a. Solids %	2 hrly.
10.	a) Smelt	a. Chemcical analysis TTA, NaOH, Na_2S, Na_2SO_4 reduction %.	Weekly.
	b) ESP dust	a. TTA, Na_2SO_4, Nacl	Weekly
11.	Green liquor	a. Chemical analysis as in 10.	2 hrly.
12.	White liquor	a Chemical analysis Causticity & Sulphidity	2 hrly.
		SO_4 & Cl.	Weekly
13.	a. Lime sludge composite sample	a. Moisture % CaO & Na_2O %	Daily.
	b. Weak white liquor	a. TTA	2 hrly.
14.	Lime	a CaO %	2 hrly.

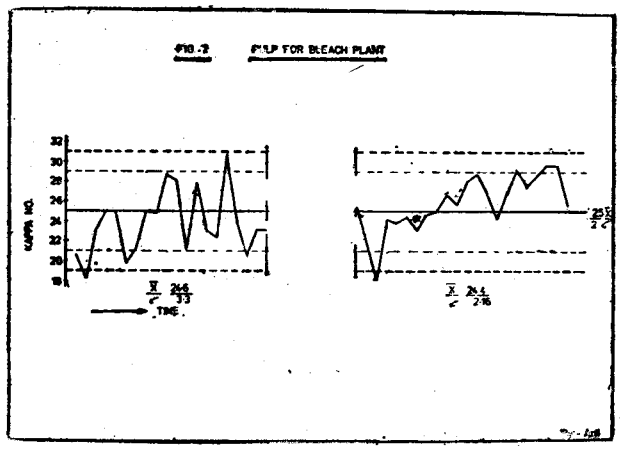
	Materials	Tests	Frequency
	C. Paper Mill :-		
15.	Stock after refining	a. Consistency b. Freeness	2 hrly. —do—
16.	Finished stock	a. Consistency b. Freeness c. pH d. Acidity	2 hrly. —do— —do— —do—
17.	Wet web after press	a. Conistency	Periodically
18.	Paper at pope reel	a. Basis weight b. Caliper c. Physical and optical properties d. Chemical Properties	at change of roll/break —do— 2 hrly. As required
19.	Paper after slitting	a. Size b. Defects	Set wise/reel wise
20.	Paper after sheeting	a size b. defects	During operation and every stack.
21.	Paper after finishing	a. Defects b. Count in ream c. Labelling d. Certification	Random reams Finisher wise
	D, Water Treatment and Power House :-		
22.	Process water	a. Turbidity b. pH c. Residual chlorine d. Alkalinity e. Hardness	8 hrly/as required
23.	a. DM water	a. Silica	4 hrly/as required
	b. Feed Tank water	a. T. solids b. Hardness c. Silica d. pH	8 hrly.
23.	c. Boiler water	a. T. solids b. Hardness c. Silica d. Alkalinity e. Residual sulphite f. Phosphate g. pH	8 hrly
	d. Condensates	a. Sp. conductivity b. pH	Daily
24.	Coal and Cinder composite sample	a. Ash b. Heat value c. Volatile matter d. Sieve analysis e. Unburnt combustibles in cinder.	Daily Boiler wise

Materials	Tests	Frequency
E. Effluent Treatment Plants		
25. Pulp Mill effluent	a. Flow.	2 hrly.
	b. S. solids	8 hrly.
	c. pH	—do—
	d. Fibre grit	Daily
	e. BOD	Fortnightly
	f COD	—do—
26. Clarified effluent	a. S. solids	8 hrly.
	b. pH	—do—
	c. BOD	Fortnigtly
	d. COD	—do—
27 & 28. Aerated effluent	a. S solids	8 hrly.
	b. pH	—do—
	c. BOD	Fortnightly
	d. COD	—do—
29. Paper Mill effluent	a. Flow	2 hrly.
	b. S. solids	8 hrly.
	c. Fibre/filler	—do—
	d. pH	—do—
	e. BOD	Fortnightly
	f. COD	—do—
30. Clarified effluent	a. S. solids	8 hrly.
	b. pH	—do—
	c. BOD	Fortnigtly
	d. COD	—do—

CASE STUDY

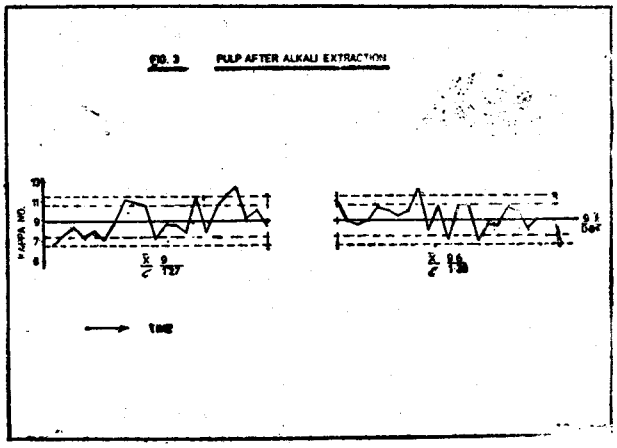
For the purpose of case study, bleach plant and causticizer from chemical plant and AOQL of paper from paper mill are taken :—

1. The quality and uniformity of unbleached pulp has a great bearing on the performance of bleach plant. Among the eharacteristics of unbleached pulp Kappa No. is a major factor for the purpose of bleaching. The norms for Kappa No. are worked out on the basis of cost of lignin removed in digester vis a vis in bleaching and pulp yield and quality. On the basis of bleach plant process capability studies and cost analysis, the norms of Kappa No. for bleaching purpose, are set at an average of 25 with a standard deviation of 2 Kappa No. Fig. 2 gives the control chart for the bleach plant run of two periods. It can be seen that while averages in both the periods are very close to the norm, the spreads of results represented by standard deviation are larger at 3.3 & 2.16 Kappa No. than the norm of 2.0. It was due to an external cause acting on the process and was traced back to the mixed variety of woods. Proper segregation of wood, eased the problem and restored uniformity.

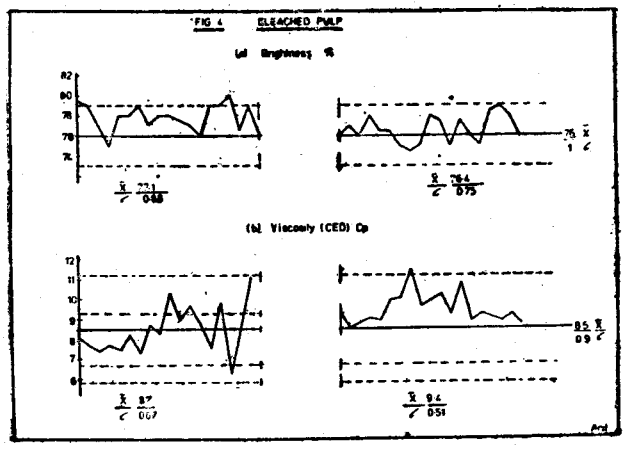


2. The effect of variations in the Kappa No. of unbleached pulp is reflected in the chlorination and extraction s ages This is well brought out in the Kappa No. results of pulp after alkali extraction. Fig. 3 gives the control chart, for Kappa No. of extracted pulp for two periods. The norms for this characteristic set at 9.0 with a standard deviation of 0.8 Kappa No. The same

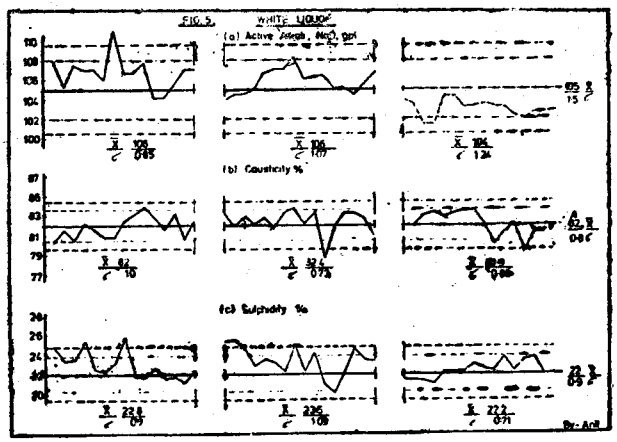
pattern as in unbleached pulp, is seen here, with averages being in close conformity with the norm and spread being large at 1.27 & 1.38 as against 0.8 Kappa No. When the unbleached pulp quality was brought under control, the situation in extraction stage responded well.



3. In the bleach plant hypochlorite stage is perhaps the most critical in as much as it can either retain fairly well the properties brought forward by unbleached pulp or it can make the pulp unfit for paper making purpose. Fig. 4 gives the control chart for brightness and viscosity of bleached pulp after final Hypochlorite stage. The norms set for brightness are average of 76% with a standard deviation of 0.9 cp. It can be seen that brightness has been maintained well in respect of averages and the spread has in fact been narrower at 0.88% & 0.75% standard deviation as against 1.0%. Similarly, the viscosity has remained well within control limits. The averages are in conformity with norm and spread is very much narrow at 0.67 & 0.51 as against 0.9 cp.



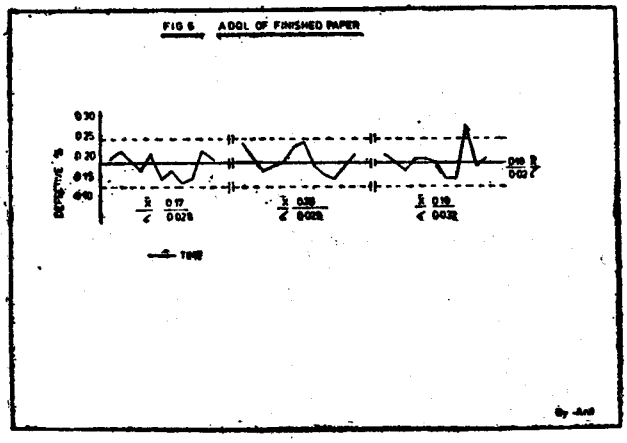
4. The quality and uniformity of white liquor is one of the decissive factors in pulping. Fig. 5 gives the concentration, causticity and sulphidity of white liquor as obtained from chemical recovery plant. The norms of averages and standard deviation set for concentration are 105 & 1.5 gpl, for causticity 82 & 0.8% and for sulphidity 22 & 0.9%. The results as obtained during 3 run periods show close conformity with the norm except stray streaks, indicating that the process is well within control.



5. The outgoing quality of the finished product has to meet some specification in respect of defective proportion and involves certain degree of risk on the part of both manufacturer and consumer. The concept of average outgoing quality limit (AOQL) is very useful in expressing this aspect of quality. An interesting relationship exists between the fraction of defectives in the product before inspection and the fraction of defectives remaining after the inspection. When incoming quality is perfect, obviously, the outgoing quality must be perfect. However, when the incoming quality is bad, outgoing quality will also be perfect, because the sampling plan will cause all lots to be rejected and inspected in detail. This at either extremes—incoming quality very good or very bad, the outgoing quality will tend to be very good. It follows that, between these extremes is the point at which the percent defectives in the outgoing material will reach its maximum, and this is known as AOQL.

At West Coast the norm for AOQL for finished paper is set at an average of 0.18% with standard deviation of 0.02%. Fig. 6 shows control chart for AOQL of finished paper. The results of the three periods given in the chart show that while the norm for average is met, the spread is

wider than the norm. In the third run, the control limit is not met on one occasion and it was possible to locate the cause and rectification was done.



CONCLUSION

The need for controls is well recognised and a system with an i. tegral approach to various aspects of the paper manufacture is functioning at West Coast, with fairly satisfactory results. The integrated control system, comprising the areas of instrumentation, material control, operation and process control, quality control, Research Control and development and cost analysis is a collective endeavour to achieve basic objectives of the Company. With the introduction of computer in the mills, work has been initiated to computerize the process data for quick ard effective control of the process, production scheduling and retrieval of best operation parameters. It is realised that endeavours for perfection are a continuing process and there is enough yet to be accomplished.

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