Computer Applications in Paper Industry

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ABSTRACT

Computers have revolutionized the material world. Computers are the brains, which experience fatigue. There is no sphere in the world that is untouched by computers, and paper industry is no exception. Computers are initially introduced for office automation. Then the computers are put to use in data base management. Data base management is one of the critical areas of application in the paper industry, which would dramatically improve the inventory content and the returns are clearly visible. Networking has added to improved functioning due to faster communication. Networking database has improved the stock management in geographically distant to locations leading to better availability of product to the customer. These are some of the examples in commercial application of computer in paper industry.

In addition to these commercial applications, the computer made inroads into process control optimization. Process forecasting is a method to study the influence of various process parameters on product properties. This process is known as mathematical modeling which is gaining importance to develop and test new process technologies.

INTRODUCTION

Business in India is changing very rapidly and offices are seriously working to get more efficient. Like other industry, paper industry of India is also looking for increase in productivity and improvement in the quality of the products. Use of computer will give multiple effect on both these parameters as it has shown in the developed countries. Paper industry also has tremendous applications of computers in almost all sections. Right from office to all other sections like pulping, bleaching, paper machine and recovery plant, can take the advantage of it in one way or other. Each application will be discussed separately in the following sections.

In general, computer applications can be classified as under and each field is discussed separately:

1. Office automation.
2. Computers for data/drawings storage.
3. Computers for automations. (artificial intelligence).
4. Computer Simulation.

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5. Internet access.

OFFICE AUTOMATION

This is being practised by many paper mills and offices.

COMPUTERS OF DATA/DRAWINGS STORAGE

All the data generated on daily basis is collected and tabulated in the specific file. This is known as data base. Various sections like pulping, bleaching, drying etc has different data like kappa number etc. These parameters can be stored and further analysis can be done using these data base. Data base of this kind are of much important to keep the track of the trend of the quality as well as quantity of the products.

The second application is the storage of all the drawings of all the sections of paper mill. The maintenance department can have the maximum use of it at the time of downtime. At such times all the drawings will be available to the engineers instantly and they can rectify the problem immediately. At present maintenance department has to search for plant draswings or equipment manuals[1]. Th time required for this exercise is much more and causes loss of revenue in the form of downtime. If all these drawings and manuals are stored in computer, downtime can be reduced to a considerable amount because maintenance staff will be able to get immediate access to the information they need to make repairs. The potential for errors will be reduced by the fact that the computer always provides accurate and up-to-date information.

COMPUTERS FOR AUTOMATION

Automation Application, Inc provides pulp and paper solutions (computer softwares) for many processes of paper mill[2]. Right from Batch Digester Optimisation to Recovery Boilers Production Rate Control. All these solutions have many advantages. In case of Batch Digester Optimisation it claims to have reduced chemical dosage, cook cycle and steam consumption. It minimised the variation in pulp quality etc. Similarly, in case of recovery boilers it claims increased throughput, thermal efficiency, run-time; improved green liquor reduction; reduced pollutant and process variability. Similarly, there are solutions for stock preparation, continuous Digester optimisation etc with many advantages.

Likewise, there are many companies which are providing software solutions to various processes of paper mill the list of which is given in Annexure 1.

COMPUTER SIMULATION

Modular computer simulation has been successfully applied to understand problems in complicated process efficiently and cost effectively. Simulation software WinGEMS, which is the most widely used modular computer simulation software in pulp and paper industry[3]. For instance, this software has models related to mill closure options such as VOC emission models. These models are aimed at reducing water usage (hence reducing effluent volume) as well as saving fibers, chemicals and energy.

David M. Upton of Harvard Business School has made very interesting study with the computer simulation. He studied the pattern of paper-break and found that changes in colour, furnish, basis weight causes these paper-breaks. He then tried to determine relative importance of each of these factors statistically and finally developed simulated model to reduce these paper-breaks frequency[4].

Simulations essentially helps to understand both positive and negative aspect of any process.

Central Pulp and Paper Research Institute, Saharanpur has done some work on computer simulation for Indian Pulp and Paper industry[5]. Two non-wood based pulp and paper mills were selected for developing the computer simulation program for energy conservation.

In one mill, computer simulation program was developed for material energy balance of the mill based on system flow sheet prepared during the visit to the mill. The details about the mill and its boilers are as follows:

Mill: Shiva Paper Mill, Rampur is located in the eastern part of U.P. the mill has capacity of 15,000 T/year. This is a non wood based mill and the main raw materials are rice straw, sarkanda and bagasse. The mill generates its steam energy on waste boilers which are fired by rice husk, pith and coal. The electrical energy is supplied by its external grid.

Boiler House: the mill has four boilers. One boiler was shut for modification.

Rice Husk consumption : 60-70 T/day

Bagasse pith consumption : 15 T/day

Initial firing by charcoal upto : 400°C

Condensate recycling:

55 gsm	4.35 - T/hr.
52 gsm	4.1 - T/hr.
45 gsm	3.88 - T/hr.

The details of the boiler are given below:

Boiler Number	Specification	Fuel	Capacity
1.	Shut		
2.	Lippi Steam generation at 10.5 kg/cm^2	Rice husk +Bagasse pith	6 T/hr
3 & 4	Fluidcon & Fluidpac fluidised bed combustion boilers designed for 17.5 kg/cm^2	Rice husk	6 T/hr. (Each)

Using these details, simulations were carried out and sensitivity analysis was exercised.

The sensitivity analysis of these programs showed that computer simulation programs are very useful to the mill personnel to reduce the energy consumption. For example, by decreasing the moisture content of the fuel from 40% to 25%, excess steam (68.9 t/day) generation is possible (see Annexure 2).

Similarly, in another mill, these programs were developed for heat and water balance of the mill.

Similarly, other areas of the processes like steam consumption in bleach plant can be studied using these computer simulation programs and lot of energy can be saved.

INTERNET APPLICATION

This is one of the most important application for paper mill. Internet is 'networking of network' is it does not have any central computer. Anybody can float its website and anybody can have access to these websites from anywhere in the world.

Email is prevalent and is the most popular Internet feature. You can have contact with important persons in your industry or interest area./ as well as receive useful technical information through the use of email mailing lists (also known as discussion groups).

With the help of internet any mill can have access to all leading mills, organisations and research institutes of national as well as international stature. At present all the mills and leading organisations like TAPPI, IPST, PIRA, STFI in western countries are already on net.

In indian context there are many mill which are already available on net like TNPL, HNL, Amol Paper Mill, APPM, Pudumjee Paper Mill, Sudhir Papers, West Coast Paper Mill etc and organisations like IAMPA etc.

Central Pulp and Paper Research Institute, Saharanpur has internet installed and we had our web site (www.cppri.org) so as to help paper industry in India. With this website, we are in contact with all the paper mills all over in India (i.e. those mills which has its own website). Similarly, communication and interaction with international organisations like TAPPI, APPITA, IPST has also increased. The most promising application of this feature is to have discussion with groups of any other research institutions who are having the common interest. For example we can discuss with the research team of IPST, Atlanta, USA on oxygen bleaching and interact on various aspects of it.

CONCLUSION

1. Indian paper industry has the potential for computer applications in almost all areas.
2. The Indian government will provide conducive atmosphere for computer software and hardware used in paper industry.
3. Use of internet is very important for having access to various technical information available worldwide.

ANNEXURE 1

List of companies who provide software solution for various processes of paper mill

- Acrowood Inc. Manufactures wood processing equipment including direct, on-line moisture and density measurement of Wood Chips.

  Website : www.acrowood.com

- Adirondack Machine Corporation Manufactures trade; wet-end laboratory equipment for the pulp and paper industry.

  Telephone: 518-792-2258 fax: 518-792-2274

- ABB Manufactures, distributes a wide array of sensors and control instrumentation for the pulp and paper industry.

  Website : www.abb.us.com

- Apogee Systems Inc. A scanner based gray scale image analyzers for the pulp, paper, and paperboard industries. Measures, counts and sorts dirt specks, residual ink, pulp shives. Printability.

  www.mindspring.com

- APPA. Manufactures a rotating consistency transmitter.

  support@appasys.com

- AVS (Applied Vision Systems). Scanner and analyzer systems for particle and ink counts, formation and printability.

  Contact : www.jeffavsi@avana.net

- BTG (BTG a Division of Spectris Technologies): In-line freeness control, pulp brightness, residual peroxide, retention monitoring and control systems, residual transmitter, consistency, kappa analyzers.

  Contact: www.BTGinfo@Spectris Tech.com

- Chemtrac Systems, Inc. Manufacturer and supplier of streaming current monitors, particle counters and monitors for the water and pulp and paper industries.

  www.chemtrac.com

- Chemtronics SE. Instrumentation for the wet-end of the paper machine. Retention floc measurement, zeta potential, broke monitoring.

  www.chemtronics.se

- Cole-Palmer Instrument Company - 30,000 products. cole-parmer Instrument Company

  www.coleparmer.com

- Conmark Manufactures and supplies sensors, software and instrumentation for solution-oriented systems for the pulp and paper industry.

  www.conmark.com

- Custom Sensors and Technology- Designs and manufactures optical sensors for many applications.

  www.customcensors. com

- CyberMetrics Designs, Manufactures, distributes and services laboratory instruments and on-line sensors for use in the pulp and paper industry.

  www.cyber-metrics.com

- Dantec Measurement Technology Specialists in the development and manufacture of advanced instruments and systems for the measurement of flow, velocity of moving surfaces and particle characterisation.

  www.dantecmt.com

- Dresser Industries. Pressure and temperature instruments and switches including Ashcroft®, Heise®, Ebro™ , Willy® and Weksler™ brand names.

  www.dresser.com

- Dynametrix Corporation. A virtual company that is developing and commercializing the refiner Gap and Wear measurement technology for refiner control.

  www.dynametrix.com

- Electron Machine Corporation (The). refractometer, polarimeter, kraft black liquor analyzer and other instruments for measurement solids.

  www.solidsanalyser.com

- Elsag Bailey Process Automation - Liquid Analysis Manufactures, distributes an wide array of sensors (on-line quality measurements for paper thickness, moisture content, color, and texture), software, distributed systems, and control instrumentation for the pulp and paper industry.

  www.teampaper.bailey.com

- EG&G Berthold Manufactures non-contacting technologies for on-line level, density and mass flow. Wood chip moisture measurement.

  www.berthold.com

- Fibro System Instrumentation for the evaluation of dynamic fibre rising(linting), dynamic contact angle (wetting) absorption and adsorption as well as dynamic dimensional stability for testing of hygroexpansivity, cockling and curl.

  www.fibro.se

- Fisher-Rosemount Manufactures, distributes an wide array of sensors and control instrumentation for the pulp and paper industry.

  www.frco.com

- Foxboro-Pulp and Paper Applications Manufactures, distributes an wide array of sensors and control instrumentation for the pulp and paper industry.

  www.foxboro.com

- GLI (Formally Great Lakes Instruments): GLI manufactures on-line instruments used for liquid quality analysis in the water, wastewater treatment, and process industries.

  Email Info@gliint.com

- Gurley Precision Instruments, Inc. Paper-testing instruments for measuring physical characteristics such as stiffness, flexibility, water absorption, softness, porosity, air-permeability and smoothness.

  www.gurley.com

- Hartmann and Braun Manufactures, distributes an wide array of sensors and control instrumentation for the pulp and paper industry.

  www.hub.de/index

- Honeywell Manufactures, distributes an wide array of sensors and control instrumentation for the pulp and paper industry.

  Honeywell.com

- Honeywell-Measurex Manufactures, distributes a wide array of sensors and control instrumentation for the paper industry.

  Measurex.com

- Iggesund Tools. Manufactures ChipScan on-line chip size scanner.

  boisfer@infornie.fr

- Innomatic Instrument Company (Innomatic AB) Innomatic Freeness Tester continuous on-line measurement of pulp freeness or drainage in the manufacturing of pulp and paper. On-line measuring device for fiber charge (Streaming Potential).

  Contact : info@innomatic.se

- Jay Industrial Technologies Group Valves, pressure, temperature, level and flow sensors.

  Phone: 1-800-543-8200 Fax: 1-800-554-3299

- Kalamazoo Paper Chemicals: On-line and laboratory instrumentation for paper quality; porosity sensor, MacMillan Bloedel Linting Dusting Tester.

  email@kalpaperchem.com

- Lechintech Manufactures streaming current and zeta potential ion charge analyzers.

  www.user.iafrica.com

- Milltronics-Sherrex Manufactures level and flow measurement and control.

  www.compusmart.ab.ca

- Neles Controls is a leading supplier of industrial valves, valve controllers and other accessories for flow control in process industries. Makers of Nels-Jamesbury valves.

  www.neles-jamsbury.com

- NDC Infrared Engineering is one of the world's leading suppliers of on-line gauging and control systems. Industrial gauging for measurements & control of moisture, thickness & basis weight.

  www.ndcinfrared.com

- Omega Engineering Inc. Worldwide leader in Process Measurement and Control.

www.omega.com

- OpTest Equipment Laboratory and on-line instrumentation for fiber and paper quality.

  www.optest.ca

- PAPER CHEMISTRY LABORATORY, INC. Zeta potential and streaming potential instrumentation.

  www.papermaking-chemistry.com

- Technidyne Laboratory instrumentation for pulp brightness, fiber and paper quality.

  www.technidyne.com

- Testing Machines Inc. Laboratory instruments for testing pulp and paper properties.

  www.testingmachines.com

- Thwing-Albert Instrument Co. Laboratory equipment for pulp testing including Self-Contained Semi-Automatic Sheet Machine; Hot Disintegrator with Water Heater; Automated Laboratory Beater; Standard Disintegrator; Standard Sheet Press; Speed Dryer.

  E-mail: info@thwingsalbert.com

  Thompson Equipment Corporation (TECO) Refiner Control, Freeness, consistency, flow sensors.

  www.tecon.com

- Valmet Automation Pulp bleaching, fiber and paper quality, consistency, level and pressure.

  www.valmet.com

- Zeta Meter. Off-line electrokinetic instrumentation.

  www.zeta-meter-com

- Chemical Online Listings under products includes over 700 entries related to instrumentation. Automated requests to supplier companies for literature.

  Contact : www2.chemicalonline.com

ANNEXURE-2

Steam consumption Sensitivity Analysis by Computer Simulation

Case Study results, conducted to determine the sensitivity analysis of process variables, are given below:

- Decreasing water to CRM od.ratio from 4 to 2.55, steam saving 50.5 t/day.

  (CRM - Cellulosic Raw Material)

- Decreasing digester radiation losses from 7% to 4%, steam saving 4-6 t/day.

- Blow steam can be used to produce 615.2 t hot water (80°C).

- Increasing last press pulp consistency from guessed 35% to 40% , steam saving 10 t/day.

- Decreasing paper dryness from 91% to 90%, steam saving 12 t/day.

- Decreasing brokes from 10% to 5%, steam saving 6 t/day.

BOILER SENSITIVITY ANALYSIS

- Decreasing fuel moisture content from 40% to 25%, excess steam production 68.9 t/day.

- Decreasing airsurplus from 40% to 20%, excess steam production 5.4 t/day.

- Decreasing flue gas end temperature from 200 to 140°C, excess Steam production 22.6 t/day.

- Decreasing radiation and convection heat losses from 10% to 5%, excess steam production 5.3 t/day.

- Increasing feed water external temperature from 70°C to 100°C, excess steam production 23.2 t/day.

- Decreasing blowdown external temperature from 180°C to 100°C, excess steam production 5.6 t/day.

REFERENCES

All the following references except number 5 were collected through internet.

1. Paper Mill Reduces Downtime by Providing Maintenance Staff With Instant Access to Drawings and Manuals.

2. Pulp and Paper Process Solutions by Automation Applications Inc.

3. Application of Modular Computer Simulation to Aid Development of Pulp and Paper Mill Closure Technology: VOC Prediction.

4. Computer integration and catastrophic process failure in flexible production, David M. Upton, Harvard Business School.

5. Computer Simulation and It's Application in Pulp and Paper Industry - report number 3 under project "Assistance to non-wood based pulp and paper industry in India."

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