Co-Generation and feeding of excess power to Grid-Triveni experience

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Introduction

The industrial growth and the consequent spurt in economic activity in our country over the last four decades has resulted in the continuous rise in demand for power and the power sector has registered a phenomenal growth rate. Power shortages, however, continue unabated inspite of growth of the power sector. It is the considered opinion of the experts in our country that the power shortage is here to stay in the forseeable future. Considering that the power situation in India has been rather dismal especially since the fuel crisis of 1973 and there are yet no signs of any major change in the position, it is high time, co-generation is considered as a means to substantially ease the situation. The industry which can generate more electricity than it consumes can feed the excess power into state grids. The economics of using co-generation, ensures that the additional financial requirement to a new plant or the existing one, is generally recovered within a reasonable time (from 1 to 5 years). This option will be still more attractive when the industry has waste heat resources such as furnace gases, exhaust from gas turbines or fuel input from agricultural waste, i.e. non-conventional source such as bagasse and rice husk.

In a co-generation concept it is possible to bring together a fuel, a need or use for heat and a place to use excess power generated. This can make tremendous economic and environmental sence in the present subject of co-generation in any country's power situation.

Co-Generation Defined (Refer Fig.1)

Co-generation is most simply. the co-incident generation of process steam-heat energy and electricity by an industry with or without the involvement of electricity board. In the 'Topping cycle' (Fig.2) steam is pressure reduced through a steam turbine generator set befor e being used for a heating or process work. In the 'Bottoming cycle' (Fig. 3) waste heat available as a by product of a process is used to produce the steam that runs the turbogenerator sets. In either case, co-generation can provide electricity at a fraction of the cost of purchased power.

Co-generation can provide the much needed relief to state owned central power stations and to the benefits of industry, agriculture and national development as a whole. The accepted advantages of co-generation by industry are:

a) Ability to generate power at a lower cost than possible by electricity boards.

b) The ability to use bio-mass extensively and thus reduce dependence on conventional fuels.

c) The ability to place co-generation plants on grids with no restraints from various factors which is presently affecting power generation at central power stations.

d) Provides a technically and commercially viable project with short and predictable pay back periods.

e) Provides an economical and timely solution to energy problems facing the country.

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In order for a co-generation project to be successful,one has to conduct a technical and economic feasibility study. An over view of technical and economic feasibility assessment is given in fig-4.

Technical and economic assessment in Co-generation involves basically 3 steps.

I. Collection of Data
II. Technical Feasibility
III. Economic Aspects

Collection Of Data:

a) **Electricity Board Data:**

— Standard electricity tariffs

How Co-Generation Works ?

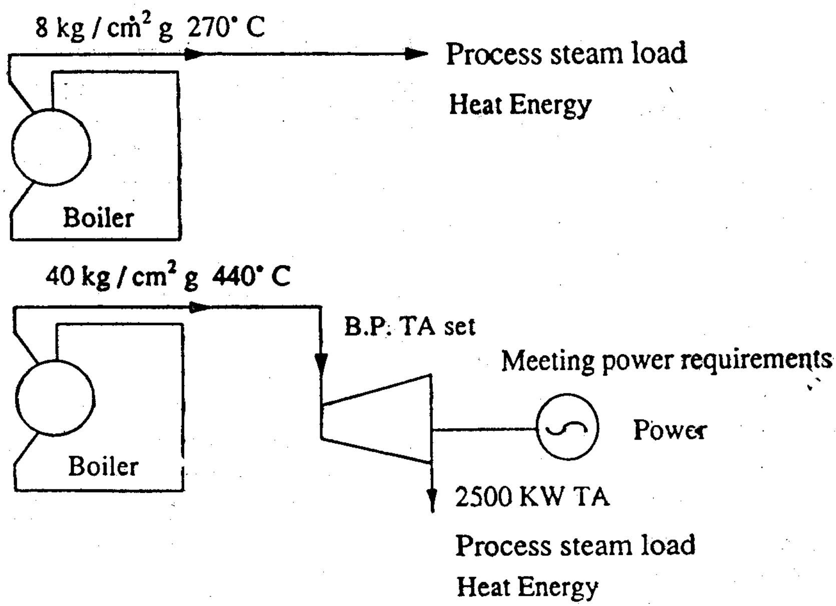


FIG. 1

Topping Cycle

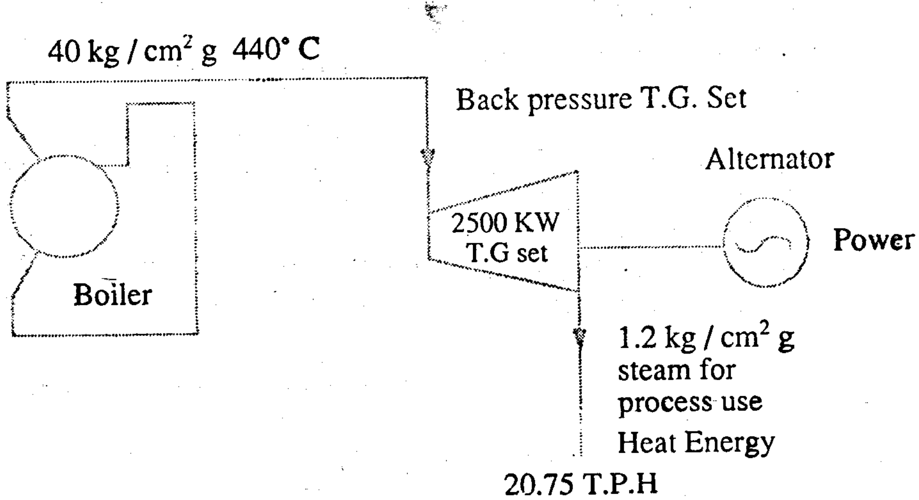


FIG. 2

Bottoming Cycle

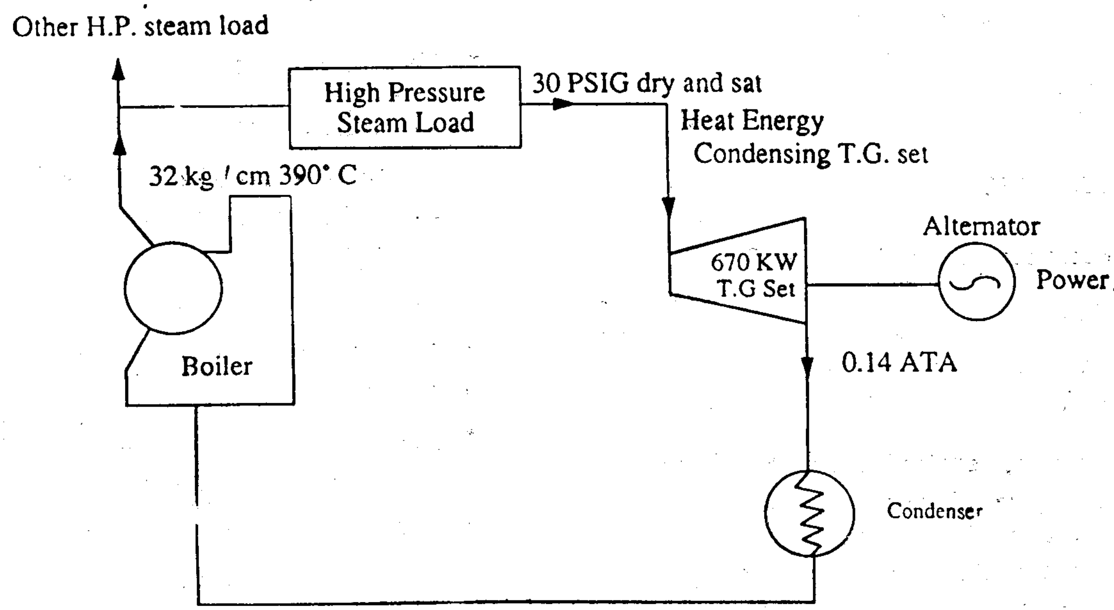


FIG. 3

Overview of Technical and Economical Assessment in a Co-Generation Project

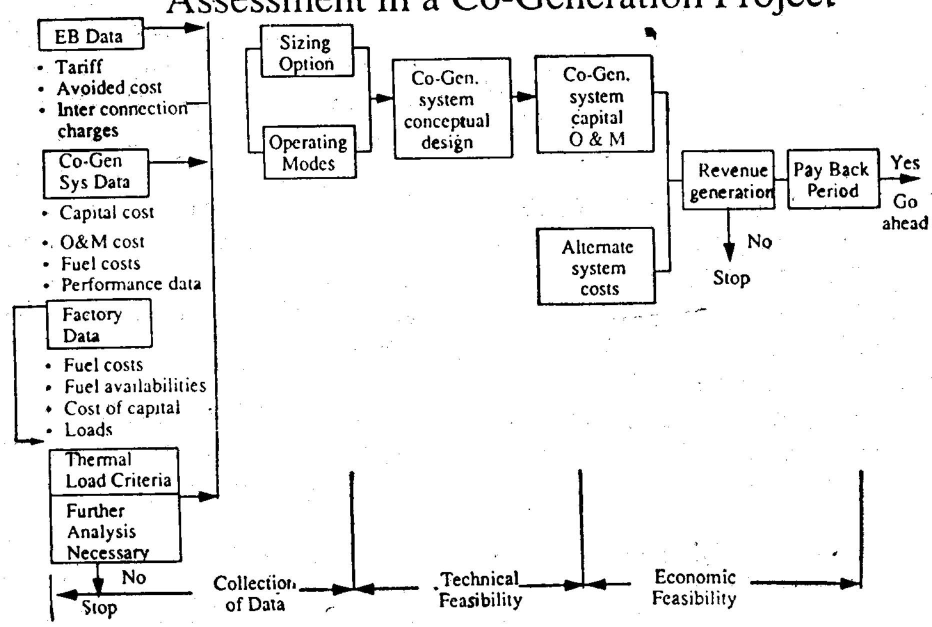


FIG. 4

— Tariff which an EB is prepared to pay to a co-generation facility. In India, many of the EBs are accepting Banking and Wheeling concept whereby a cogenerator is directly billing to the ultimate client and giving a certain percentage of bill to the EB as banking and wheeling charges.

— **AVOIDED COST:**

Avoided cost means the incremental costs to an electricity board for electrical energy or capacity or both which but for the purpose from the co-generator would be generated by the electricity board itself,

In our opinion, avoided costs should generally come into picture where supply of electricity is more than demand. In India, where demand is many times more than supply, the talk of avoided cost need not exist. The effort of all involved agencies must be generate, transmit to and supply cogenerated power through EB lines as the only agency available for this purpose. In India, EBs suffer from shortage of both capacity and energy, and at the same time, they are strapped for funds for capacity expansions.

— **Interconnection :**

It is the most vital link between the co-generation plant and electricity board. This allows co-generation plant to sell excess power to grid and in return EB/Nation gains additional capacity from interconnecting.

The protection standards/requirements for the tie-up or interconnection are presently not defined anywhere and are primarily dictated by EB. Most commonly EB distribution systems are not designed to accommodate interconnection of generation. Some typical complications which can arise include voltage control, faults currents, over voltages, harmonics, unbalance and other characteristics of the generation may cause complications.

EB normally advice after studying the co-generator's system any modifications/inclusion of equipments necessary for the purpose of interconnections and all these interconnection changes between co-generation and EB will have to be borne by cogenerator.

b) Co-Generation system data

1 Capital Cost :

* Hardware costs :
  - — prime mover
  - — electrical generation and control
  - — boilers and heat recovery equipment
  - — fuel storage requirements
  - — pollution control
  - — backup systems
* installation cost
* operating and maintenance (O&M) costs
* Fuel cost and availability of fuels
* Performance data
  - — power generated
  - —operation at part load
* Expected service life

C) Factory Data :

Process steam requirement/heat energy—should be large enough to justify the construction of capital intensive co-generatian plant rather than relying on less expensive (but also less efficient) conventional system.

For example, it is known that big hotels in India use steam for many purpose, but hourly steam demand and the quantity is not large enough to justify a cogeneration plant using steam turbine topping system. Perhaps, a Diesel engine topping system, wherein, hot water derived from water cooled exhaust manifold of the Diesel engine should work. At present, these hotels are operating on stand alone Boilers and generate steam at the required pressure for their use as and when demand exists in a particular day.

Further information includes process steam usage per hour, monthly steam usage, peak steam demands as well load profile data, load magnitute and timing.

Projections of future etectricity and process steam demand will also be required. These projections will be important in sizing the co-generation system or allow its expansions to satisfy future as well as current demands.

An analysis of the above data collected will lead us to the following:

i) Possible size of the Co-generation plant
ii) Type of Prime Movers required
iii) Possible choice of fuel

In addition to the above. the following elements should be obtained.

a) Fuel cost
b) Cost of capital

II. Technical Feasibility :

After collecting the above data, in order to evaluate engineering feasibility of cogeneration plant, a cogenerator has to go through a design selection process involving two basic steps;

a) Determining appropriate size
b) Operation mode.
c) Identifying prime mover type.

a) Sizing option:

Has to necessarily cater for process steam requirement/power integration and should answer critical duty requirement of dependability, reliability and flexibility. Sizing option primarily depends on the portion of thermal needs, that is to be met by the co-generation systems.

An optimal sizing of Co-generation plant makes maximum sequential use of heat input starting from Boiler. All heat is added at the beginning of co-generation Cycle and flows through the power generating and heat using equipment before being rejected from the system.

For example, in a typical sugar factory it is a foregone conclusion that the cogeneration system must be such that the heat energy recovered from the prime mover will meet the entire thermal load. Further, the next option is that after meeting the entire thermal load of the plant, if extra live steam is available the same can be sent through a condensing TG set to generate further power.

b) Operating modes :

3 basic modes are available :

i) Thermal despatch mode priority :

In this mode thermal despatch is the main inten as in a sugar plant and when the thermal demand of the plant is met and any excess cogenerated power is sold to EB

ii) Electric despatch mode priority :

In this mode electric despatch gets priority and the plant may have to dump the excess steam at times of low thermal demand operation. This mode is not usually cost effective.

iii) Hybrid strategy :

Hybrid strategy means operating the cogeneration plant to produce maximum electricity output during the EBs peak requirement and thermal following mode during the other times. If the cogenerator has a contractual obligation to deliver a minimum amount of power to the EB ultimate client during peak periods, then a hybrid strategy shall be followed.

c) Identifying Prime mover type : (Refer Fig.5)

a) Gas Turbine topping system :

In this system Gas turbo generator is first used to generate power and the high temperature (800-1000 °F) exhaust heat from the gas turbine can be used as a heat source for waste heat boiler to generate steam for the use in the process.

b) Diesel engine topping system :

In the system shown above, the high temperature exhaust from the Diesel engine is passed through waste heat recovery boiler and the process steam or the hot water (depending upon the heat input available from the exhaust gas from the Diesel engine), can be made available for use in the process.

C) Steam turbine topping system :

Steam turbine topping cycles represent the most widely used method accounting for about 80% of

Different types of Co-Generation Systems

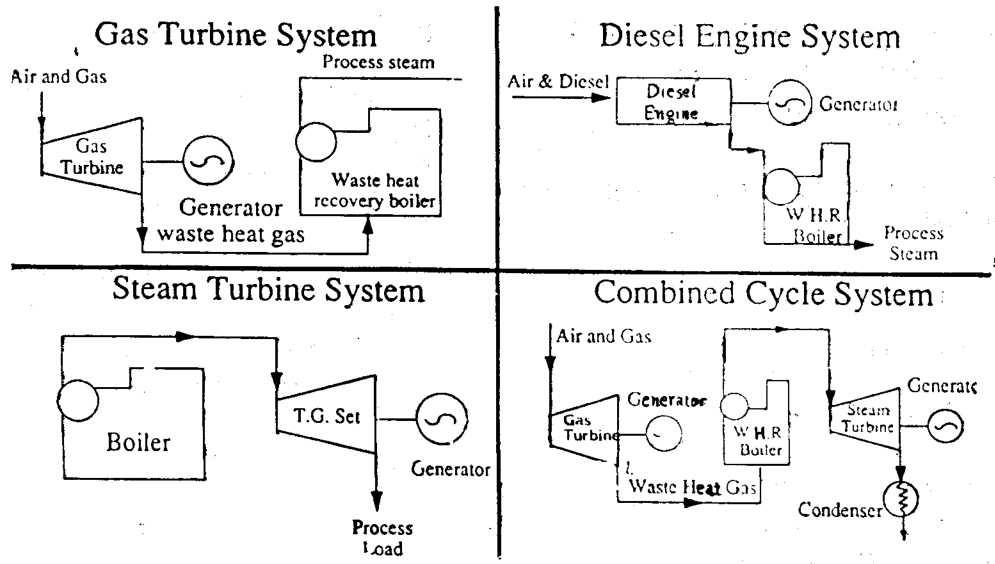


FIG. 5

electric power generated in co-generation system. The projected sketch gives the necessary information.

b) Combined cycle system

In a combined cycle co-generation, a gas turbine with a waste heat boiler is combined with a steam turbine generator. In a combined cycle system, the Gas turbine drives an electrical generator and the rejected heat is recovered by a waste heat boiler. The recovered steam is used in a steam turbine driving a generator to produce additional power.

Further the back pressure steam from the turbine is then used directly in the industrial process or for heating,

At Triveni, we have been supplying steam turbines for cogeneration duty in the last few years for sugar, chemical, petrochemical, fertiliser, paper and other allied industries. In the last four years, there have been some interesting examples of which the following is worthwhile to be mentioned.

a) A 6 mw cogeneration plant including for feeding of excess power to Grid in Tamilnadu Sugar Corporation at their Chidambaram plant. This is an example from Sugar industry and other schemes for 2500 TCD and 3500 TCD Sugar Factory. (Refer Fig. 6. 7. & 8.).

b) 4 to 5 mw TG set for Carbon Black plants at Phillips Carbon Black Ltd. Durgapur and Oriental Carbon and Chemicals Ltd. Ghaziabad where our condensing TG sets have been put in operation in bottoming cycle mode. In these projects. special boilers are installed to burn carbon monoxide and produce steam. This is an example wherein waste heat is recovered and power is generated. These are examples from Carbon black industry. (Refer Fig. 9)

c) M/s. Sesa Goa Ltd. has set up a pig iron plant at Goa wherein the gas from the Mini-blast furnace is passed through boiler and steam geneated which is passed through a condensing turbo generator supplied by us. This is an example from Pig/Sponge Iron industry wherein power is generated through bottoming cycle mode. (Refer Fig. 10)

d) For M/s. Harshavardhan Chemicals, we have supplied low pressure condensing TG set and the input steam for the same is supplied through waste heat recovery system of the plant itself. This is an example from Chemical industry. (Refer Fig. 11)

e) For M/s. Atul Products Ltd. Gujarat, we have supplied a 5000 kw pass-out back pressure turbo-alternator for steam conditions of 64 ATA and 500 Deg. C with facility for controlled extraction and back pressure. The TG Set will be run in parallel with the State Grid. (Refer Fig. 12 & 13).

Co-Generation for 2500 TCD Sugar Factory

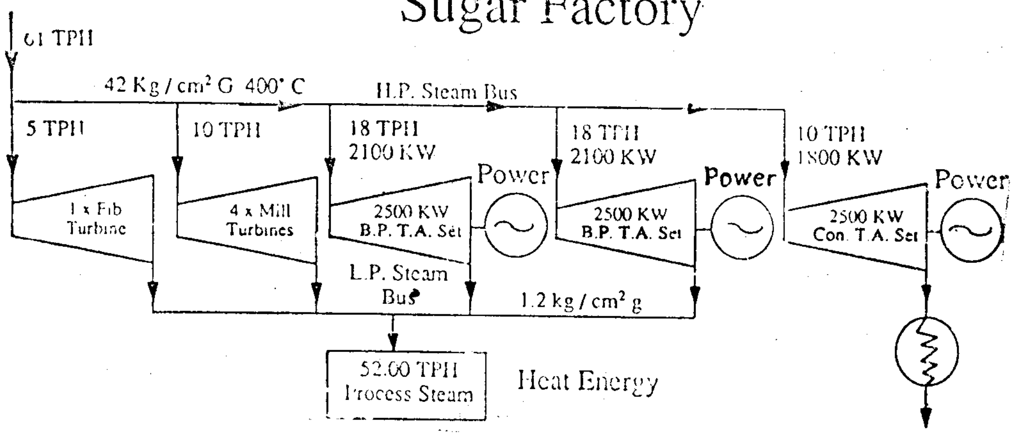
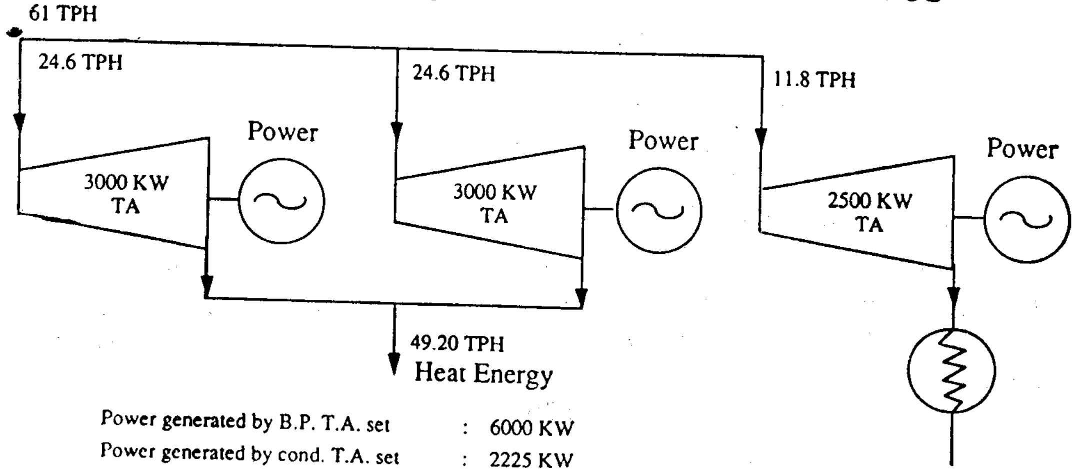


Fig. 6

Power generated by B.P.T.A. set (2 nos.)	: 2100 KW	:	4200 KW
Power generated by cond. T.A. set (1 no.)	:	:	1800 KW
Total	:	:	6000 KW
Less power to sugar plant/Aux.	:	:	2000 KW
Power to grid	:	:	4000 KW

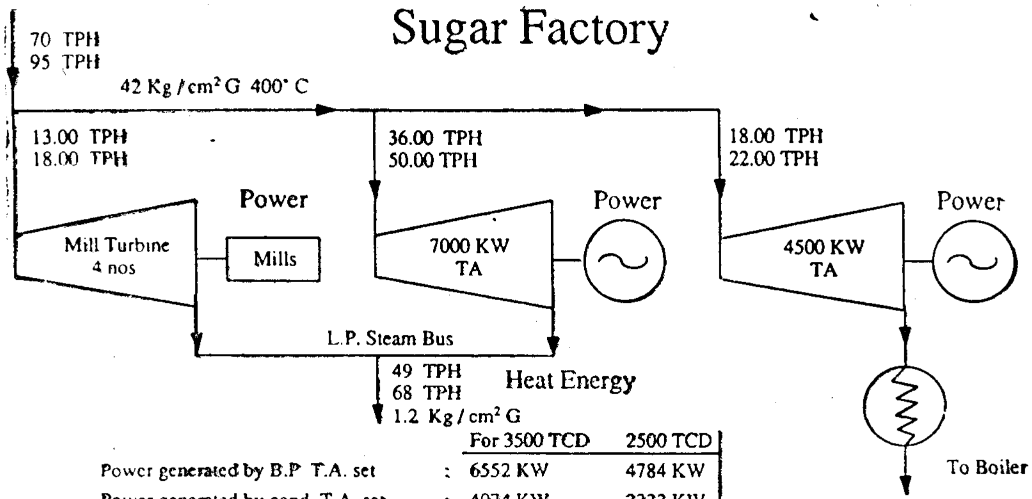
Co-Generation for a 2500 TCD Sugar Factory with DC Motor Drives



Power generated by B.P. T.A. set	: 6000 KW
Power generated by cond. T.A. set	: 2225 KW
Total	: 8225 KW
Less power to sugar plant / Aux.	: 3850 KW
Power to grid	: 4375 KW

Fig. 7

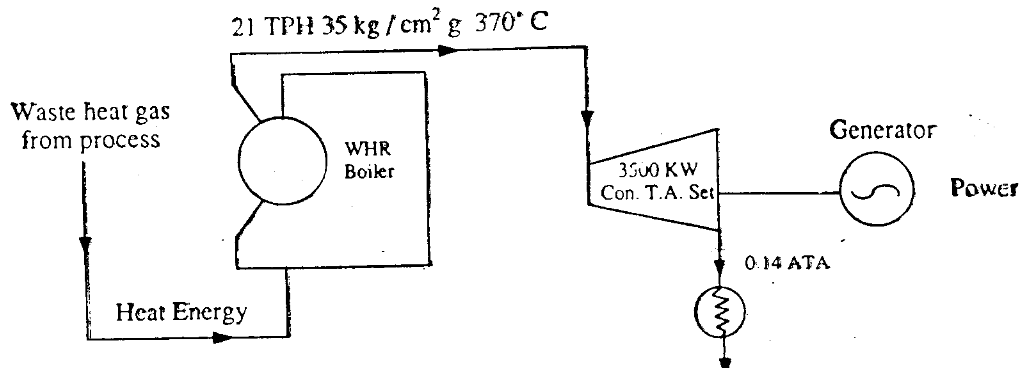
Co-Generation for 3500 TCD Sugar Factory



		For 3500 TCD	2500 TCD
Power generated by B.P T.A. set	:	6552 KW	4784 KW
Power generated by cond. T.A. set	:	4074 KW	3333 KW
Total	:	10626 KW	8117 KW
Less power to sugar plant / Aux.	:	3567 KW	2567 KW
Power to grid	.	7059 KW	5550 KW

FIG. 8

Bottoming Cycle Co-Generation for Carbon Black Project

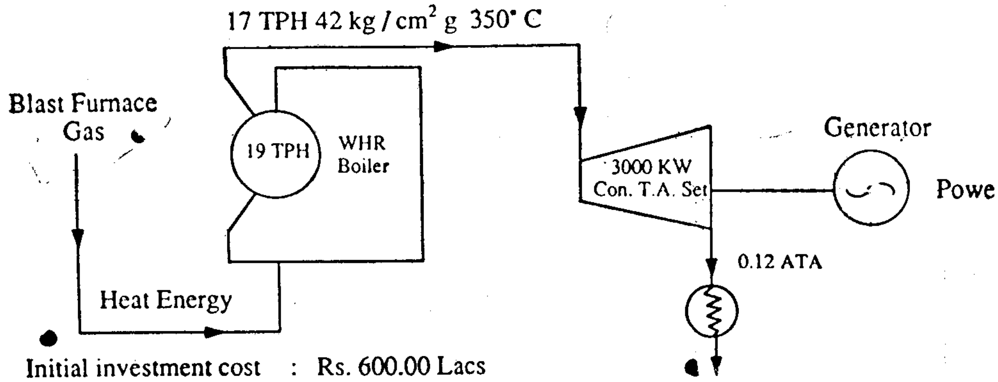


Initial investment cost : Rs. 500.00 Lacs
Cost per unit : 80 paise
Power generated : 2500 KW
Client is self sufficient in power. No export to grid
Pay back period : 4 / 5 years

Current Generation
Steam Quantity – 15 TPH
Power Generated – 2500 KW

FIG. 9

Bottoming Cycle Co-Generation for Pig-Iron Project

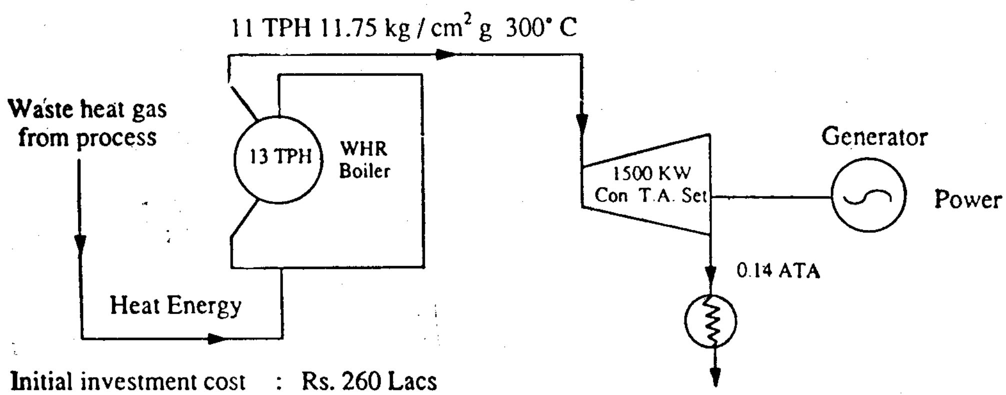


Initial investment cost : Rs. 600.00 Lacs
(with boiler)
Cost per unit : 60 paise
Power generated : 3000 KW
Client is self sufficient in power. No export to grid
Pay back period : 3.5 years

Current Generation
Steam Quantity – 17 TPH
Power Generated – 3000 KW

FIG. 10

Bottoming Cycle Co-Generation for Chemical Project

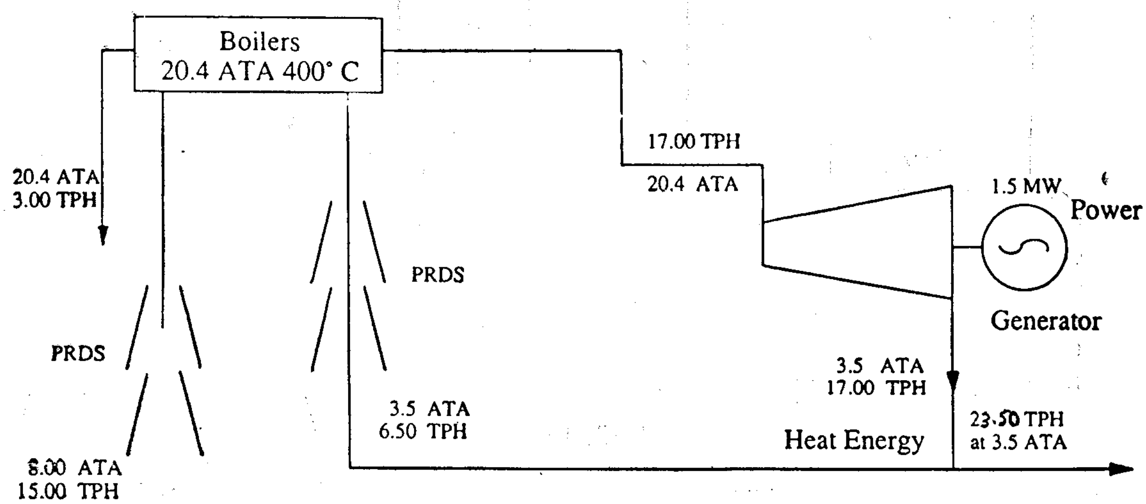


Initial investment cost : Rs. 260 Lacs
(with boiler)
Cost per unit : 46 paise
Power generated : 1500 KW
Client is self sufficient in power. No export to grid
Pay back period : 2.5 years

Current Generation
Steam Quantity – 11 TPH
Power Generated – 1500 KW

FIG. 11

Topping Cycle Configuration (Old Scheme) for Chemical Project



EIG. 12

Iopping Cycle Configuration (New Scheme) for Chemical Project

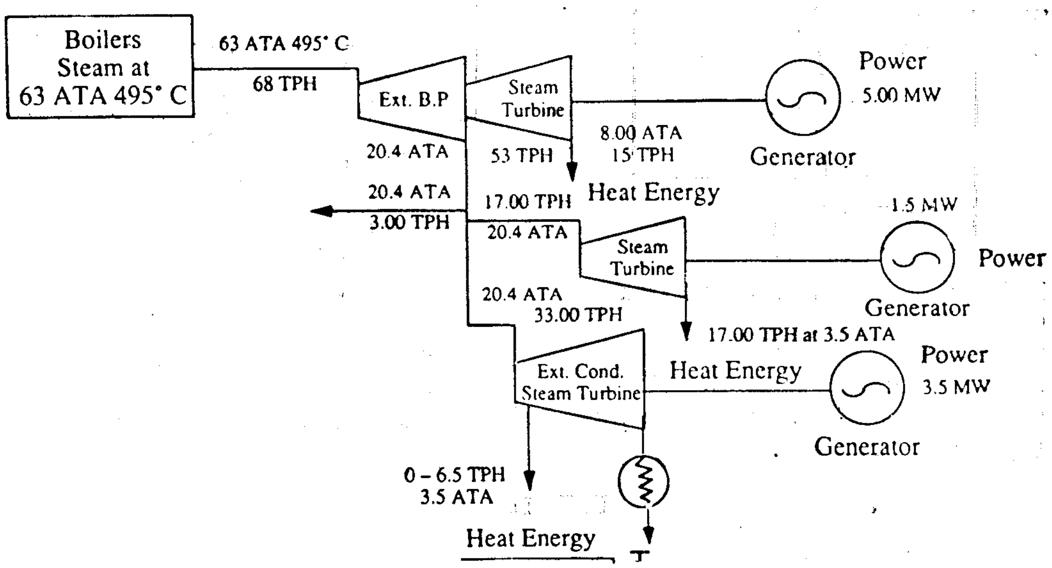


FIG. 13

f) For M/s. The West Coast Paper Mills Ltd., Dandeli, Karnataka and Satpuda Pulp & Paper Project, Maharashtra. We have supplied a pass out back pressure 5.3 MW and straight back pressure 3 MW TG sets respectively for steam conditions of 39 ATA 390°C±10°C and 45 kg/cm² 440°C respectively. This is an example from the paper & pulp industry (Ref. Fig. 14 & 15).

Fuels :

Various different types of fuels especially alternative fuels should be of interest to us. Given below are some of the typical fuels :

a) Bagasse
b) Corn husks
c) Cotton seed hulk
d) Municipal refuse
e) Crop residuals
f) Rice husk
g) Peanut hulk

Apart from the above, conventional fuels like Coal and Fuel Oils are already known two the industry.

Performing the Energy Analysis :

After completing the above collection of data plus technical feasibility, it would be necessary to do an analysis of all energy inputs and outputs.

Enclosed herewith in Fig. 16 is a simple energy balance diagram for a sugar factory which indicates excess power available after meeting the factory demand for a conventional sugar factory operating at 18/21 kg/cm² g. 340 Deg. C and for a factory operating at 45 kg/cm² g 440 Deg. C.

As you can see excess power available in the region of 2200 kw for 45 kg/Cm² g 440 Deg. C steam condition sugar factory and NIL power for a conventional 18 kg/cm² g steam condition sugar factory.

III Economic Feasibility Concepts in Co-generation

The aim of this exercise is to determine whether investment in a co-generation plant would be a cost-

The West Coast Paper Mills Ltd.

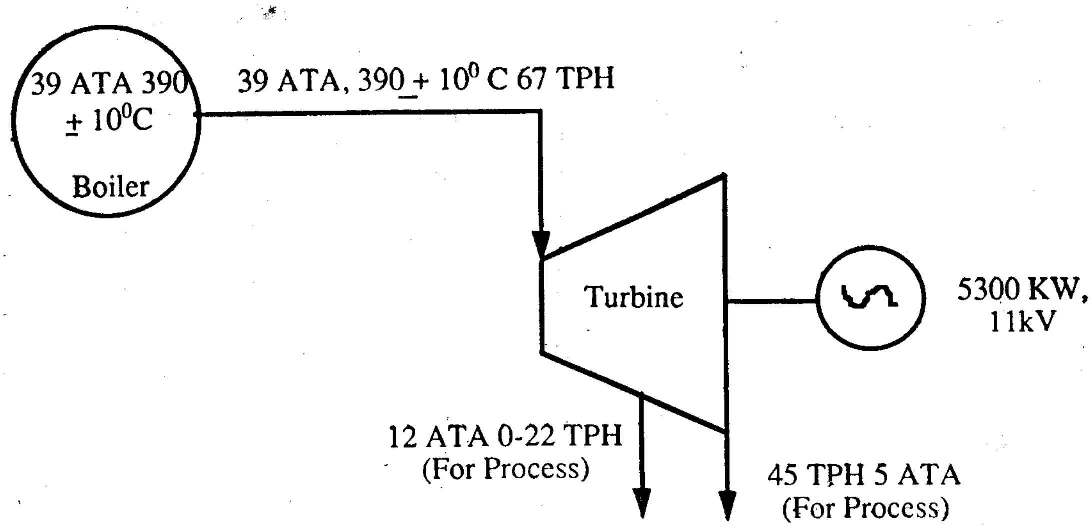


FIG. 14

Satpuda Pulp & Paper Project

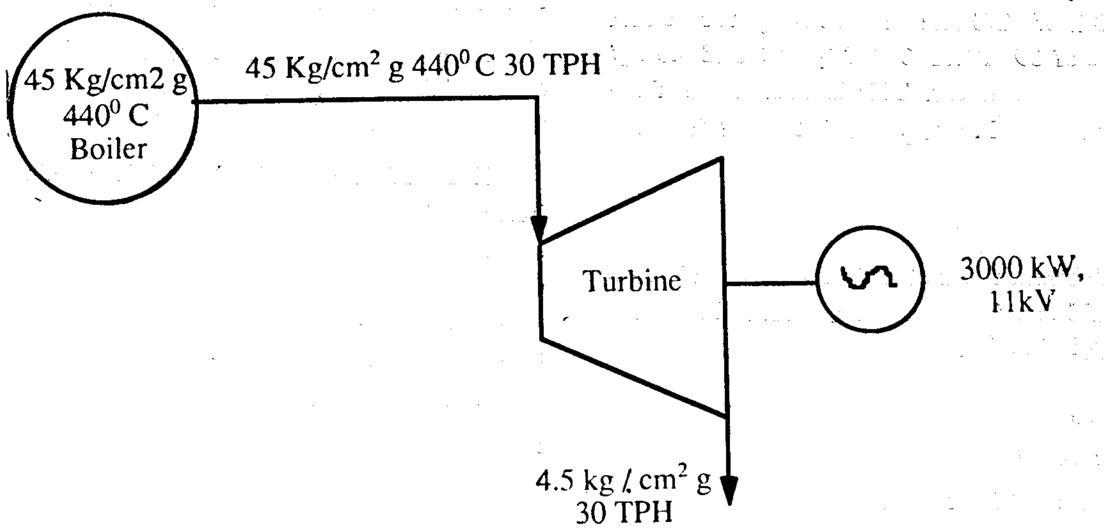


FIG. 15

Energy Balance Diagram for a 2500 TCD Sugar Factory

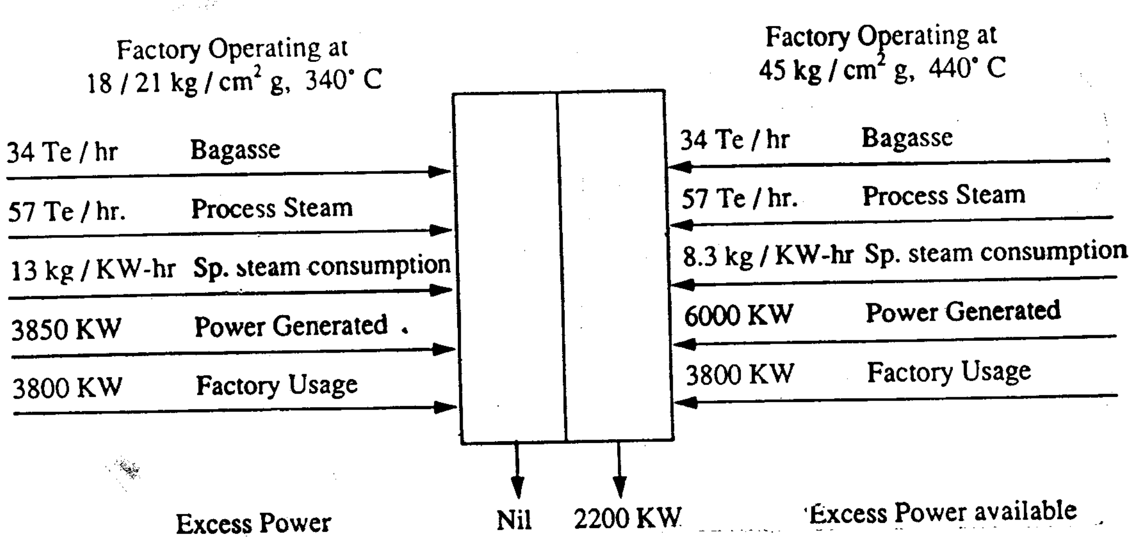


FIG. 16

effective means of meeting a particular site's energy requirement. Any industrial plant can be supplied with energy using conventional methods. For cogeneration to be feasible, the long-run costs of reliability meeting the energy needs of a particular plant through co-generation must be less than the corresponding cost of conventionally provided services. For example, in a sugar factory the conventional method of meeting both power and heat energy has already been existing in India in the last many decades (18 kg/cm² g steam condition). However, the intent should be able to examine whether investment in a new breed of cogeneration plant for both meeting the energy needs of factory and also feeding of any excess power to grid can be economically feasible. The 45 kg/cm² g 440 Deg,C. co-generation plant in a sugar factory generates direct revenue through the sale of excess power to grid and thus enhancing the total revenue of the sugar plant through the sale of both sugar and power Similar analysis about projections of return could be done for cogeneration plant as applicable to any particular industry.

Economic feasibility study should establish two important criteria for making co-generation plant investment decisions.

i) Co-generation plant operations must produce cost savings and/or additional direct revenue that exceed the incremental investment and operations cost incurred to construct and operate the plant.

ii) Revenue or benefits must exceed incremental investment and these must be equal to or greater than similar measure on alternative application of such funds.

A number of methods can be used to evaluate the feasibility of Co-generation investments. Commonly used methods are discounted cash flow analysis (DCF) and play back analysis.

Sensitivity Analysis :

Economic feasibility study often depends largely upon assumptions used in the business environment in which the co-generation plant will operate. There can be substantial uncertainity sorrounding the values of key parameters in the future periods.

It is possible that alternative configurations of a co-generation project may alter the economics of co-generation system significantly.

The following parameters can substantially alter the economics due to their variation in cost, availability etc.

1. Fuel
2. Electricity Board Tariff
3. Capital cost based on different types of prime mover size used for particular project.

For a specified cogeneration sytem configuration, it is very important to predetermine how well the system could perform if everything goes " right" and how poorly it could perform if everthing goes "wrong" This analysis will provide both the opportunities and the risks that are being assumed. These are three steps:

i) Fuel costs, size of load and load profile, operating conditions in the plant and day to day working relations with EB, etc.

ii) Identifying the most extreme conditions for each of the above. This step requires considerable judgement to determine extreme values that may be reasonably expected to occur.

iii) After the above analysis, one has to recalculate the cash flow analysis. The best or worst rasults obtained will indicate the levels of opportunities or risk involved.

Pay back analysis:

Fig.7 is a model of cogeneration plant in a sugar factory which has been selected by us to give an idea about pay back analysis. The model is from sugar industry wherein a cogenerated equipment cost has been worked out at a figure of Rs.439.38 lakhs making certain assumptions.

S.No.	Co-generation equipment	Cost Rs.lakhs
1.	Project cost	439.38
2,	Power to grid in kw	4750 kw
3.	Power to grid in units considering 4000hours per annum as the season for sugar plant	190 lakh (units)
4.	Revenue from power (190 × Rs.1.25 per unit)	237.50
5.	Expenditure per annum (excluding depreciation)	96.81
6.	Net cash revenue.	140.69
7.	Pay back period in seasons	

$$\frac{\text{Increment cost}}{\text{Net cash revenue}} = \frac{439.38}{140\ 69} = 3\ 12 \text{ Seasons}$$

From the above figures. the cost of generation per unit can be arrived by considering variable costs like labour. stores, consumables, fuel, etc. and various fixed costs and the figure is O 63 paise per unit.

Critical Factors Effecting Viability of Co-generation Projects:

1. **Realisation of surplus power:**

   In developing countries, this would play key role in the development of co-generation schemes. Realisation against energy sold by a factory could be on two lines, i.e.

   a) Direct sale of Electricity Board

   b) Through Banking and Wheeling sold to 3rd party.

   In our opinion Banking and Wheeling will be the best option available to our country wherein a co-generator can bank-in and wheel the power through the EBs transmission lines to the 3rd party.

   For example, a co-generator in a remote sugar factory in Karnataka State of India can sell his co-generated power through Banking and Wheeling concept using EB transmission lines to an industry in Bangalore at a unit cost which can be less than the Diesel Energy cost.

In the Banking and Wheeling concept, the most attractive part is that a co-generator and the buyer of power can negotiate and enter into an agreement regarding cost of power per unit This means power will become a commercial commodity using EB transmission lines.

Of course, a co-generator will have to pay wheeling charges to Electricity Board.

It would be of interest to note that M/s. Mysore Paper Mills Ltd. Bhadravati and M/s. Mangalore Chemicals and Fertilizers Ltd., Mangalore, have sold excess of power available to them from their plants through Banking and Wheeling scheme of Karnataka Electricity Board and are supplying to various other firms.

Incentives From Financial Institutions:

Co-generation schemes must receive special attention from financial institutions in the form of concessional loans to enable quick returns and to attract more entrepreneurs to venture for such projects.

Future Of Co-generation

Co-generation has extensive future potential technical and institutional barriers have to be closely studied in the context of the present power scenario and removed. This is one of the major constraints standing in the way of active implementation of co-generation projects in India. The relevance of removing institutional barriers need to be discussed at all levels and decisions, ensuring promotion of power generation taken.

Co-generation by industry is a very meaningful and natural economic activity and no attempt must be spared by all leading institutions involved to make this concept a total success.

It is an exciting field calling for attention from Government, Institutions, manufacturers, Electricity Boards, Consultants and Bankers. They have to interact with each other and produce legislation which will give co-generation of power by industry its right place in the economic activity of the nation.

Energy management in pulp and paper industry

Basudev Prasad*, N. Patro*

Energy is a basic natural resource for development of any nation. In developing countries like ours, the role of energy has been assuming increasing significance as the availability and reliability of energy resources, both in term of quality and quantity are deteriorating.

Energy conservation has wide scope and is multifaceted. It covers the entire spectrum ranging from important house-keeping practices to retrofitting of energy recovery devices to radically new energy technology. Strategies for achieving effective energy conservation are based on thermo-dynamic and thermo-economic considerations and hence it is of utmost important for energy experts to come to grips with the thermo-dynamics of energy conservation process and the economic evolution of the different technological options.

Energy Management Scenario in Indian Pulp and Paper Industries:

pulp and Paper Mills in India constitute one of the major portions of industrial sector and these are basically power intensive, consuming about 15-25% of the production cost. Most of the Indian Pulp and Paper Mills have old and obsolete technology due to many constraints. Updating of process technology has not been taken care of in India to the desired extent and as such the specific energy consumption is more than developed countries. To oite an example, an average integrated pulp and paper mill in India consume 6 5 - 9 5 giga calories/tonne of finished paper against Swedish pulp and paper industries of 4.5 — 6.0 giga calories/tonne. Hence, it becomes imperative and need of the hour to make vigorous efforts on energy conservation. As energy in India is costly and availability is difficult, any saving on this account means direct profit.

There is less effort on this front due to protected market, lack of awareness, lack of funds, etc. The government of India has taken a few measures to promote energy conservation such as providing custom duty reduction/exemption, 100% depreciation allowance on energy saving equipments, soft loans, setting up energy conservation funds and statutory provision for projection of energy conservation measures in company's balance sheet. There have been various training programmes, seminars, workshops, etc.to create an awareness in the concerned people. The government bears a part of energy audit expenditure if carried out by recognised agencies.

Measures to Promote Energy Management :

Pulp and Paper Mills lack in 'Energy Professionals' and as such there is no systematic approach and all efforts are made haphazardly. In most of the cases, there is no energy auditing, no energy conservation department and no definite management policy on energy conservation. We feel that the following measures will promote energy conservation drive.

i) Awareness :

There is no or very little energy conservation awareness in pulp and paper mills, specially in small and medium size mills. Experts are also not available with them to assess the pattern of energy consumptions and to take suitable measures to reduce energy consumption. Even in many large mills, energy conservation approach is in primitive stage and needs radical change in management policy. Therefore, all efforts should be made in bringing awareness among the people at all levels.

ii) Educational Programmes in Schools and Colleges :

(a) In syllabus of professional courses at IIT'S,

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Engineering College, Institute of Paper Technology, Polytechnics, etc., energy conservation must be included as a compulsory course and sufficient knowledge should be given on this subject.

(b) Seminars, training programmes, correspondence courses, workshops, etc., must be arranged for different level of employees. Management must encourage their employees to participate in these programmes, and see that suitable opportunities are given to them on return to conceive new ideas and implement them in the best interest of the organization.

iii) Policy Formulation for Energy Conservation

Government of India or Apex Body of the industry must arrange meetings and seminars with policy makers like managing directors, bank authorities, pollution control agencies and concerned authority of government to formulate policies in this re pect.

iv) Publications :

Circulation of books, articles, magazines, literatures, etc., published in this regard should be carried out extensively.

v) Publicity :

Promotional publicity campaigns such as slogans posters, essay competitions, rewards and incentives, suggestion schemes, quality circles, etc . should also be carried out.

vi) Specialised Man-Power in Energy :

Recruitment of specialised man-power for energy conservation should be done with specific responsibility.

vii) Research and Development :

Promotional activities through research & development, higher studies etc., should also be started.

viii) Energy Culture:

To motivate energy culture amongst the employees, which will help not only implementation of energy conservation schemes, but they may also come out with new schemes, and will take steps to stop wastage of energy.

Action Required to Implement Energy managment :

Energy Management can be successfully implemented only when the mission of the company is well defined and the energy management system works directly under the Chief Executive of the mill. A separate "Energy Management and Conservation Cell" must be created in each mill, headed by an experienced engineer. The main activities of this department should be :—

i) To analyse, set targets and monitor power consumption figures on daily basis and to report to the Chief Executive of any abnormalities.

ii) To check inefficient use of energy in the mill.

iii) To check wastages of energy by taking remedial measures with regard to steam traps, steam valves, steam joints, insulations, unburnt coal in ash' idle running of equipments, less capacity utilisation, power factor, etc.

iv) To prepare energy conservation projects and implement them in time.

v) To implement projects and suggestions given by external energy auditors.

vi) To arrange seminars, lectures, literatures, etc. from outside experts.

vii) To help quality circles and suggestion schemes for energy conservation schemes and co-ordinate activities of sub-committees of departmental energy conservation cells.

viii) To forecast energy requirements from State Electricity Boards from time to time.

Energy Management means that the operating personnel should be able to monitor and control energy generation and consumption in the mill efficiently The Energy Audit is the key to systematic approach for decision-making in the area of Energy Management. It attempts to balance the total energy inputs with its use. Its basic functions are planning, decision-making, organising, controlling, substituting with cheaper energy, energy costing and ultimately reduction in production cost due to reduction in energy consumption. Maintenance procedures should be reviewed and introduction of energy monitoring instruments should be encouraged.

Energy Management Activities at J. K Paper Mills :

There is an Energy Conservation Cell headed by a senior and experienced engineer, who directly reports to the Chief Executive. The main activities of this cell are as follow :—

i) To apprise daily regarding plant working with reference to steam and power generation and their consumption, inclunding plant stoppages, equipment break-downs, etc.

ii) To make energy consumption projects and ensure their implementation.

iii) To follow up integrated energy management system of M/s. Sagric process Analysist.

iv) To implement the Audit Report submitted by M/s. Balmer Lawrie & Co. Ltd.

v) To analyse and assess performance of C.F. Boilers as per the report of Tata Energy Research Institute.

vi) To synchronise power generation from T.G. Sets in such a manner that power generation from D.G. Set is minimised and power consumption from Grid is maintained as per allocated load by Orissa State Electricity Board.

vii) To keep track of energy consumption i.e. power, steam, coal and fuel oil.

viii) To point out idle running of equipments to save energy.

ix) To point out follow-up jobs relating to steam leakages. condensate leakages, insulations, etc., with various departments.

x) To forecast power requirements from State Electricity Board.

xi) To arrange energy conservation seminars, special lectures etc.

xii) To co-ordinate energy conservation sub-committee meetings and to take steps to implement suggested projects.

xiii) To help quality circle members in energy conservation schemes.

xiv) To point out and follow-up regarding steam and condensate flow meters, Co_5 meters, energy meters, etc.

Besides the above Energy Conservation Cell, there aer 5 sub-committees in various plants. A senior person from process the respective area is the Convener of the sub-committee and there are members from electrical. mechanical, process and all concerned departments. The members meet once in a month and minutes are made, which are sent to the Chief Executive for his perusal. The co-ordination of activities of these committees is the responsibility of Energy Conservation Cell. Progress on energy conservation and new proposals are sent to the Director every month with estimated expenditure and savings and probable time schedule of completion.

Achievements on Energy Consumption :

Some of the energy consumption figures of our mills are as follow :—

1) Cost of total energy is 12.35% of the total cost of production for the year 1991-'92 (Annexure IA, IB, IC).

2) Cost of energy has reduced from 14.51% in 1989-90 to 13.93% in 1990-'91 to 12.35%in 1991-'92. in spite of rise in coal price, increase in transportation and electricity tarsiff (Annexure IA,IC).

3) Total process steam used/Ton of finished paper is 7.697 Tons of steam, equivalent to 5 58 Giga Calories in 1991-'92 (Annexure 2A).

4) Steam used for co-generation is 2.45 Tons/Tonne of finished paper which is about 1.76 Giga Calories in 1991-'92 (Annexure 2A).

5) Total steam used/Tonne of finished paper including co-generation is 10.15 Tonne, equivalent to 7.35 Giga Calories (Annexure 2A).

6) Purchased power used is 479 KWH/Tonne of finished paper in 1991-'92, equivalent to 0.412 Giga Calories (Annexure 2A).

7) Co-generation is about 70% of total electrical consumption and 30% electrical energy is purchased from State Electricity Board.

8) Total Heat energy consumed including co-generation and internal fuel generation like black liquor is 11.62 Giga Calories/Tonne of finished paper in 1991-'92 (Annexure 3A, 3B).

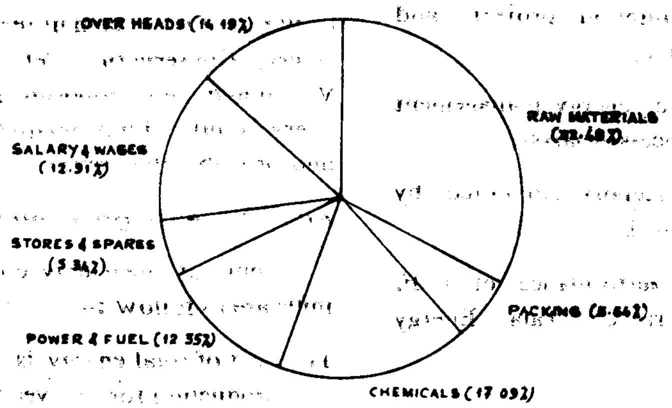
ANNEXTURE-1A

BREAK-UP TO TOTAL COST OF PRODUCTION

SL. No.	PARTICULARS	% ON TOTAL COST 1991-92	1990-91	1989-90
1	RAW MATERIAL	32.48	33.32	32.59
2	CHEMICALS	17.09	15.76	14.96
3	POWER & FUEL	12.35	13.93	14.51
4	STORES & SPARES	5.34	5.34	5.17
5	SALARIES & WAGES	12.91	11.51	11.69
6	OVER HEADS	14.19	14.73	15.46
7	PACKING COST	5.64	5.39	5.42
8	TOTAL COST OF PRODUCTION	100.00	100.00	100.00

ANNEXTURE-1B

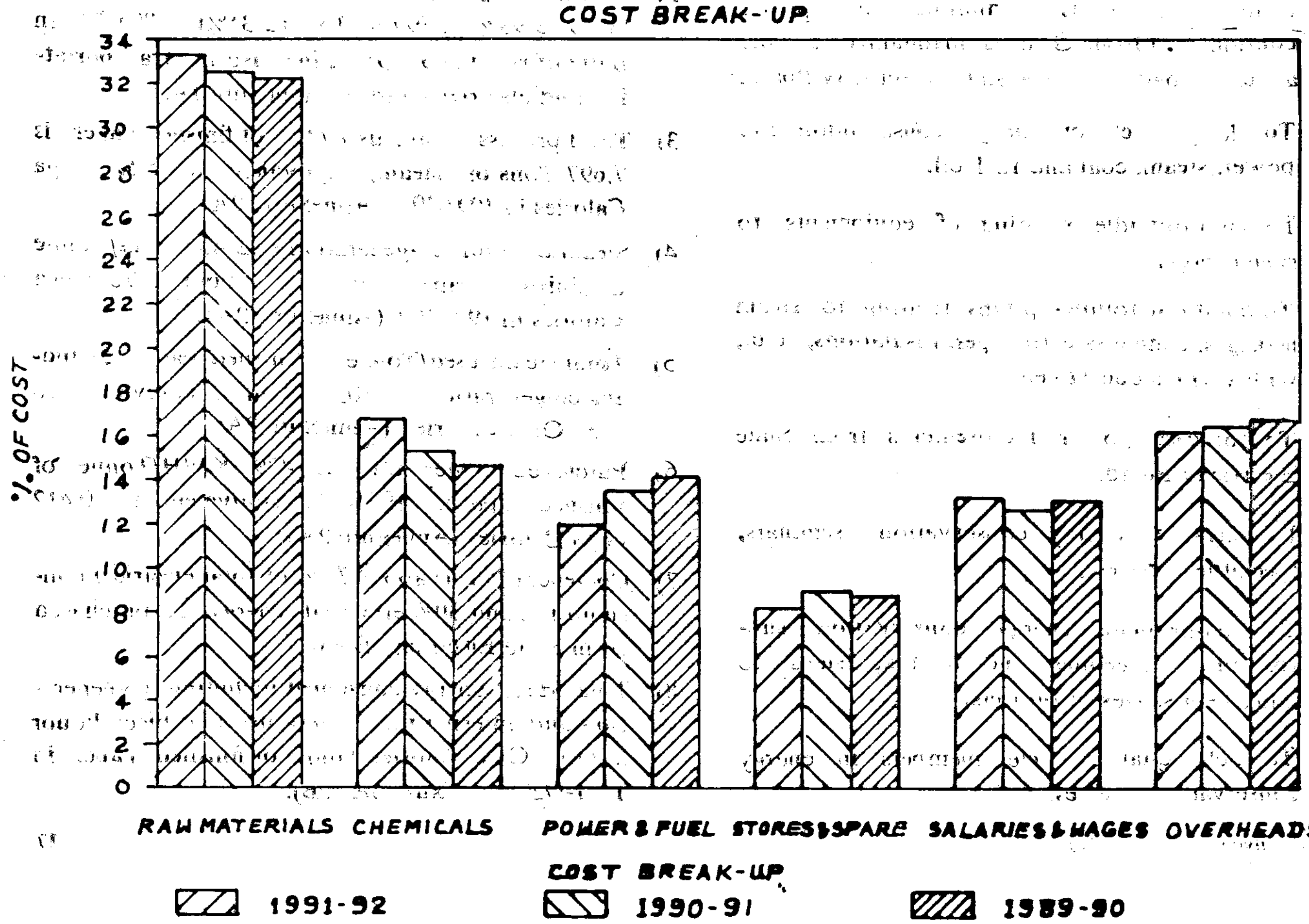
J.K. PAPER MILLS - JAYKAYPUR
COST BREAK-UP FOR 1991-92



Annexure IC

J.K. PAPER MILLS — JAYKAYPUR

COST BREAK-UP



ANNEXTURE 3A

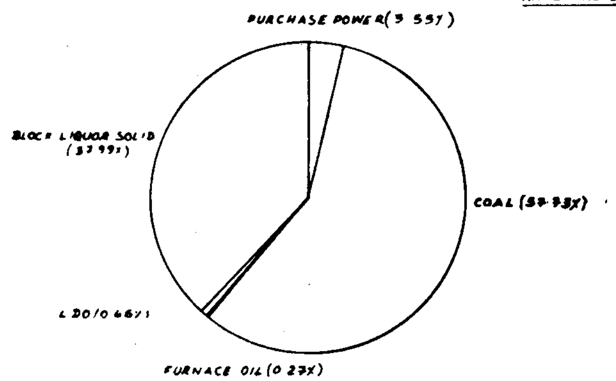
J K PAPER MILLS JAYKAYPUR

TOTAL ENERGY INPUT/KG OF FINISHED PAPER

SNo	PARTICULARS	89 90		90 91		91 92	
		K CAL	%	K CAL	%	K CAL	%
1	PURCHASE POWER	398	3 20	431	3 54	412	3 55
2	COAL (STEAM+ SELF GEN)	7629	61 38	7276	59 76	6709	57 73
3	FURNACE OIL	52	0 62	60	0 49	51	0 27
4	LDO	160	1 29	99	0 82	54	0 46
	SUB TOTAL	8239	66 29	7866	64 61	7206	62 01
5	BLOCK LIQUOR SOLID	4190	33 71	4309	35 39	4415	37 99
	GRAND TOTAL	12429	100 00	12175	100 00	11621	100 00

ENERGY INPUT/KG OF FINISHED PAPER

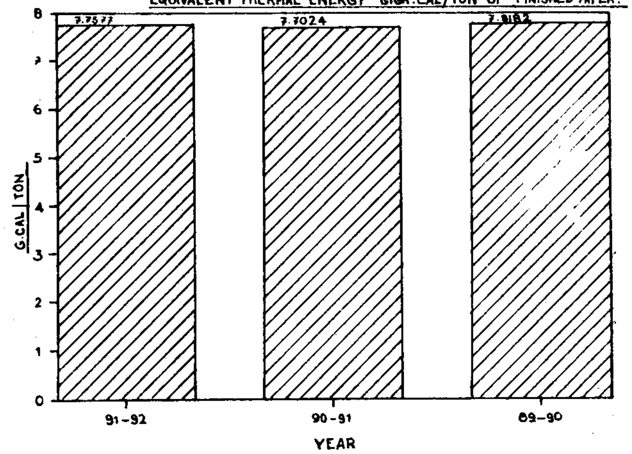
ANNEXTURE 3C



Annexure 2B

J.K.PAPER MILLS – JAYKAYPUR

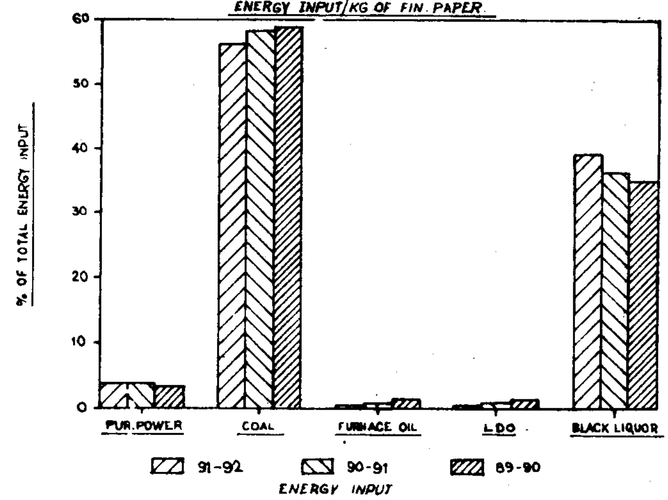
EQUIVALENT THERMAL ENERGY GIGA.CAL/TON OF FINISHED PAPER.



Annexure 3B

J.K.PAPER MILLS – JAYKAYPUR.

ENERGY INPUT/KG OF FIN. PAPER



9) Heat energy available from internal fuel like black liquor is 38.0% of total heat required in 1991-'92 (Annexure 3A, 3B).

Energy consumption figures plantwise are given in Annexure 2A. There is a constant effotr to reduce energy consumption and management is putting their effort to create awareness among the employees at all levels and many energy saving schemes are in hand such as conversion of chain sroker boilers into FBC boilers, replacement of inefficient pumps and motors, application of energy saving equipments, etc.

Conclusion :

Almost all the mills in India have plenty of scope for energy conservation. It is a matter of management policy to focus on this subject. The targets and goals are to be defined. Both operating and maintenance employees must be motivated. The new technology has to be adopted.

House-keeping has to be upgraded. Each mill should employ energy experts or should take help from outside agencies. The economical pay-back period for most of the energy conservation schemes are within 2-3 years. We feel that with earnest effort good results can always be attained.

Annexure—2A

TOTAL ENERGY USED FOR PRODUCTION

SL. NO.	PARTICULARS	91-92		90-91.		89-90	
		H.P. STEAM/ TON OF FIN. PRODN.	EQ.THERMAL ENERGY G.CAL/T	H.P. STEAM/ TON OF FIN. PRODN.	EQ. THERMAL ENERGY G.CAL/T	H.P. STEAM/ TON OF FIN. PRODN.	EQ.THERMAL ENERGY G.CAL/T
		TON	G.CAL	TON	G.CAL	TON	G.CAL
1	Pulp Mill, including Digester	1.1700	0.8424	1.1700	0.8424	1.1340	0.8160
2	Evaporators	1.5500	1.1600	1.6370	1.1780	1.7330	1.2480
3	Causticizers	0.4400	0.3170	0.4100	0.2950	0.4600	0.3310
4	P M I	1.3530	0.9740	1.4080	1.0140	1.3540	0.9750
	II	0.3195	0.2300	0.2810	0.2020	0.2610	0.1880
	III	0.8921	0.6423	0.9040	0.6510	0.8640	0.6220
	IV	0.3429	0.2470	0.3621	0.2610	0.4620	0.3330
5	C.F.Boilers (Int. consumption)	0.7700	0.5500	0.7660	0.5510	0.7820	0.5630
6	L.F.Boilers (Int. consumption)	0.8600	0.6190	0.7490	0.5390	0.7690	0.5540
7	Total Process Steam	7.6975	5.5817	7.6871	5.5334	7.8190	5.6300
8	Power House (Co-generation)	2.4500	1.7640	2.4180	1.7410	2.4860	1.7900
9	Sub-Total	10.1475	7.3457	10.1051	7.2744	10.3050	7.4200
*10	Purchased Power(kWH)	479	0.4120	501	0.4310	463	0.3982
11	Total G.Cal		7.7577		7.7054		7.8182

* Excluding Colony, P.D. Plant and Coating Plant.

BASIS : 1 Kg. H.P. Steam = 720 K.Cal (50 K.Cal considered for condensate).

1 kWH = 860 K.Cal.
