# Workshop on "Energy Conservation" Applied to Pump Technology Related to Paper Industry

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SUMMERY

The subject of "Energy Conservation" in Industry is receiving more and more importance especially in lieu of the fact that the natural energy resources are bound to decrease day by day and needs to be carefully utilised. Similarly energy utilisation also leads to pollution of environment i. e. of noise, air and water, therefore, excessive utilisation is to be avoided.

The optimum utilisation of energy applied ta centritugal pump technology leads directly to best efficiency of pumpset, proper selection for the application, preventive maintenance to achieve best efficiency over a prolonged period of life & clean environment. We shall be discussing, how to monitor each of the above, in subsequent write up in corelation to initial investment cost of the machinery. It is needless to state that the pumpset must be reliable under all above conditions and in some cases reliability plays a more predominent role over energy conservation.

We have drawn an action plan to conduct energy audit in paper mills related to existing pumps and recommendation for energy saving.

## SELECTION CRITERIA OF CENTRIFUGAL PUMPS

The selection of an optimum pump for the desired application calls for the knowledge of not only, what happens within the pump but also what happens in the pumping system. It has become more and more complex, especially with technology advance and variety of choice made available by pump manufactuiers. Therefore, following details are to be observed while preparing the specifications :

### A) CHARACTERISTIC OF PUMPING LIQUID

The characteristic of liquid such as chemical, physical properties in terms of PH value corrosivity, solids in suspension and dissolved condition, specific gravity, viscosity, temperature, aerated or non-aerated etc., should be clearly defined. Each of the above affects design, construction, material selection, lubrication etc.

The incorrect temperature often leads to cavitation of the pump due to higher vapour pressure of the liquid. Cavitation leads to vibration, erosion, heavy mechanical losses, reducad bearing life etc., all adverse to the saving of energy. Therefore, perfect suction conditions, coupled with judicial piping selection and layout is extremely important.

Invariably it has been seen that no proper piping is considered at planning stage and the pump is then somehow connected to the suction tank and delivery point.

### B) MECHANICAL RIGIDITY

Centrifugal pumps unlike positive displacement pumps are basically designed to operate in a defined zone of the Q–H characteristic as shown in Fig, 1.

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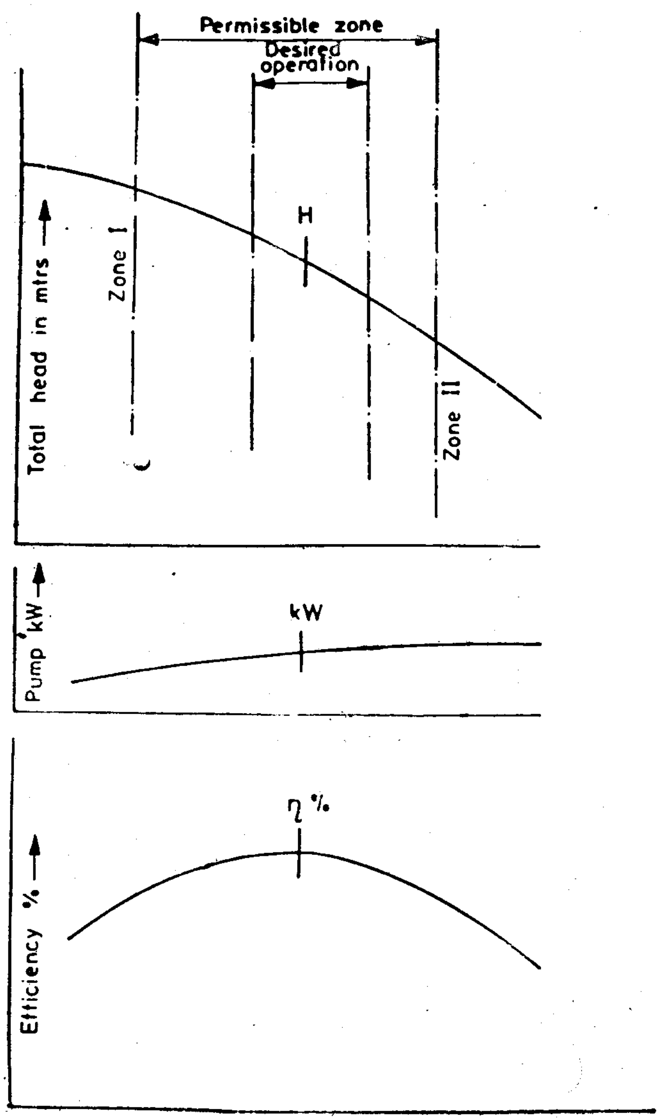
This implies any duty condition beyond this zone leads to higher radial forces effecting reduced bearing life and higher mechanical losses leading to loss in energy. The user/manufacturer should ensure proper duty parameter selection to satisfy this condition. The practice of imparting "so called" rigerous conditions in the specification such as "motor should be rated to operate for the entire range of the curve" should be avoided for above reasons. Instead an emphasis on proper computation of duties by the process designer is to be ensured.

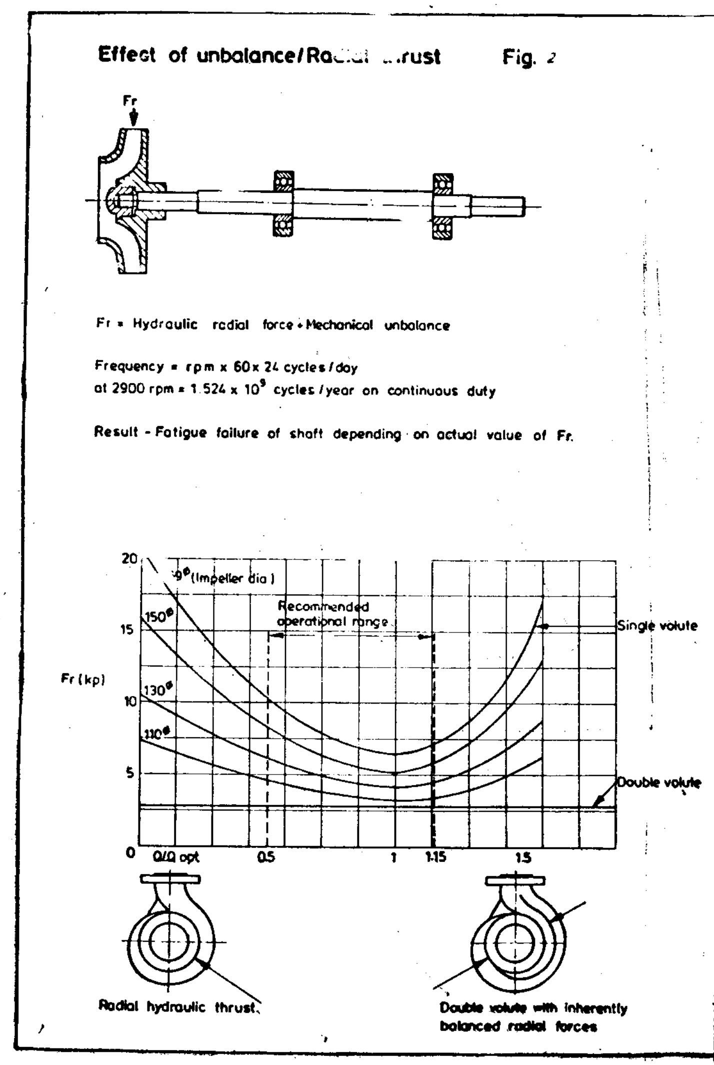
Fig. 1
RANGE OF OPERATION OF CENTRIFUGAL PUMPS
—desired and permissible—




Discharge in $m^3$/hr→

## PUMPS IN PARALLEL

Pumps to operate in parallel is a subject of study by itself. Quite often the designer selects one pump to meet present demand and keeps another pump installed to meet future demand, If judicial piping selection is not done, it can create enormous problem in the system, This is also clearly shown in Fig. 2. Excessive piping sizes also leads to problems when only one pump is running in addition to higher investment cost



## THROTTLING OF PUMP DISCHARGE VALVE

It is a wellknown fact that the pump output is defined by the system head. Invariably it has been observed that due to improper calculation at the enquiry stage, the pump is required to work at adverse site conditions. The operating staff then tries to find a via-media by throttling the discharge sluice valve and creating artificial frictional head, leading directly to excessive power loss, vibrations transmitted from valve to the pump etc. In such cases it is advisable to use another impeller in the same pump which can actually give less head avoiding throttling.

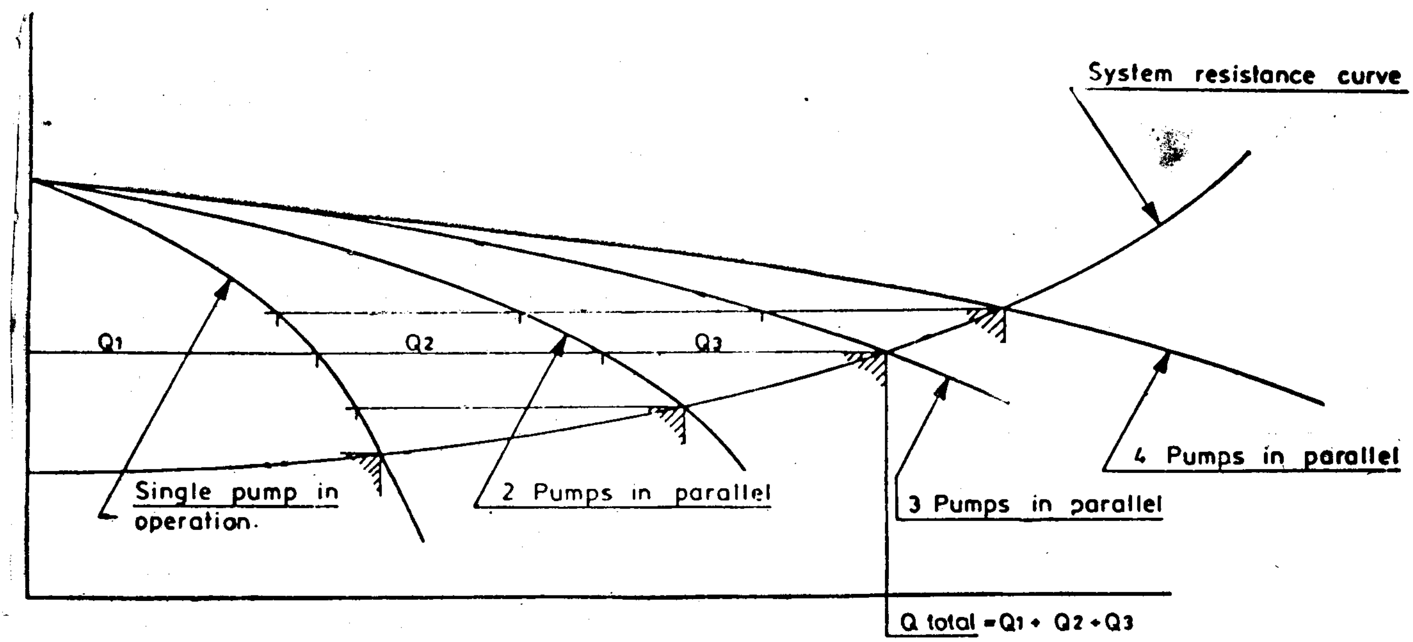
## OVERALL COST CONCEPT

It is a wellknown fact that pumping system in a process or power industry constitutes to 5 to 10% of capital investments, however, the power consumed by pumps is even 30 to 40% of total power requirement, hence highly efficiency and reliable pump, duly maintained can save approximately Rs. 6000/KW/annum, which is almost 30 to 40% of pump cost itself. Hence an approach for reliable and efficient pump must have much more importance than the cost compared with the competitors. This also applies to correct size and designed piping system to save lot of energy consumption which is a recurring expense

## PREVENTIVE MAINTENANCE

It is needless to say that any machine in operation needs preventive maintenance, which invariably is not done for simple machines such as pump. However,

Fig. 3
Effect of parallel operation
on individual pump



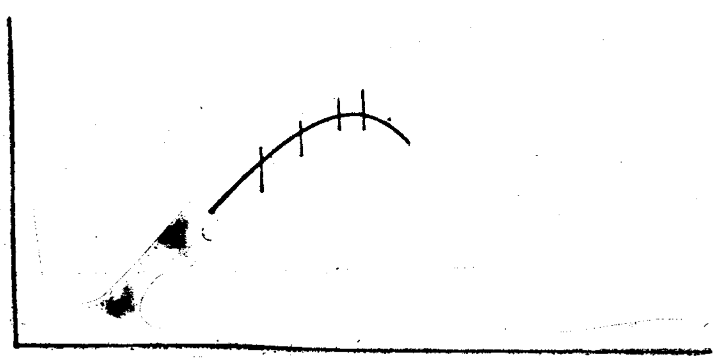
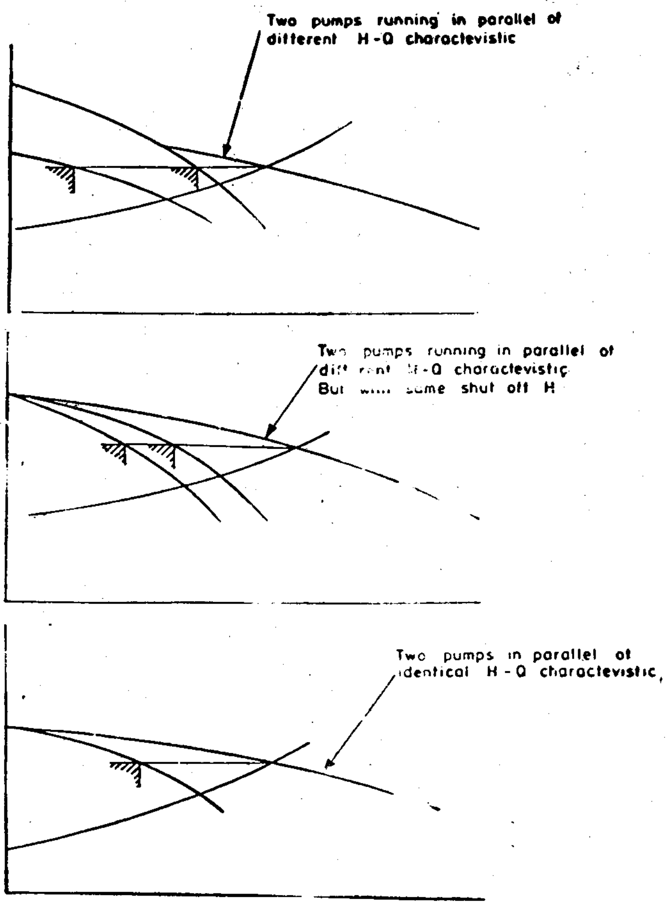



Fig. 4

Effect of paraller operation on individual pump




it is extremely important to avoid breakdown of pump which directly leads to loss of production. It is advised to train the user's maintenance staff by the equipment manufacturer to reduce percentage of breakdowns and preparing and using preventive maintenance schedule. A proper logbook with useful records of current drawn, pressure, temperature measurements give advance notice of likely problem.

## ACCESS TO ADVANCED TECHNOLOGY

The regular upgradation of pump design and simplified operations and maintenance should be known to the user and the manufacturer should impart such knowledge by technical seminars etc. A culture of updating of our knowledge should be built in the organisation to realise importance of various concepts.

## SELECTION CRITERIA OF PUMPS FOR PULP & PAPER

1. Stock co..sistency in percentage bone dry.
2. Stock type—Sulphate or sulphite, bleached or unbleached, raw or boiler wood pulp (cleaned or uncleaned old paper) air free or air trapped pulp.
3. Degree of grinding in SR (Schopper — Keigler..
4. Contents of additions in percentage e.g. Caolin or China clay, etc.
5. Working temperature.
6. Specific gravity.
7. Material of construction.
8. Location of pump in case total head is to be worked out by us.
9. Nominal size and length of suction, discharge piping and type of valves and material of piping.
10. Static head at suction, Minimum and Maximum static head between pump centre line and end of discharge piping.

## ENERGY AUDIT OF PAPER MILLS—ACTION PLAN

### A. SITE ACTIVITIES

1. Identify locations and duties of various pumps in :
   a) pulp mill
   b) paper machine
   c) auxiliary
   d) boiler house
2. Prepare rough schematic process flow diagram for (a) to (d) above.
3. Obtain data from pulp mill and paper machine operation incharge to establish mass balance of the liquid in terms of tons of paper produced (of a variety) in corelation with raw material and water quantity required.
4. Detailed liquid characteristics at all locations to be obtained.
5. This mass balance will help in fixing required flow rates of each pump depending on pulp stock consistencies used while pumping.
6. Discuss these findings with process people and ask for variance likely in consistency of stock and paper production depending on type of paper.
7. Ask customer to fix-up pressure gauges temporarily on suction and discharge side of the pump with an

isolating cock. This will lead to actual operating pressures.

8. Take ammeter readings for each pump along with power factor of respective motor and its operating voltage to work out power consumed.
9. Identify locations where capacities of pumps can be altered to work the same at optimum efficiency (only transfer duty from one chest to another).
10. Dsscuss with process people why are they operating the pumps at specific consistencies. can they use high consistency pumps to improve upon economics ?
11. Note how much time the agitator is in action and suggest how much time it need not be operated based on field trials and stock properties.
12. Identify total power consumed by pumps based on volume pumped indicated or found out by plant people.
13. Make sketches and note sizes of suction and delivery pipelines and observe its orientation.
14. Check up minimum chest stock level customer wants to maintain and whether that level is sufficient suction head for pump.
15. Check up maintenance standards of customer and suggest improvements, if any.
16. Check whether impeller adjustment with axially adjustable bearing bracket will be used by customer or not.
17. Check up logbook of various pumps if maintained; if not, convince customer why it is important to monitor power consumption.

B) EVALUATION.

1. Based on collected data from site finalise first duty parameters which are optimum for process and pump itself to the extent possible.
2. Select appropriate pump models and speeds alongwith material of construction.
3. Alternative suggestions should be made for better performance based on piping modifications
4. Compute power consumption.
5. Work out capital investment Vs running cost and find out payback period based on present and computed future consumption.

C) SUBMISSION OF REPORT.

1. Brief note on existing pumps.
2. Mass balance layout diagram.
3. Selection and parameters of new pumps.
4 Modifications required in piping, maintenance schedules
5. Computation of power consumption and comparison with existing consumption.
6. Total modernisation cost.
7. Payback period.