Capacity Utilization—A Management Tool

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SUMMARY

The capital investment for 120 Tonnes per day Paper Mill has increased considerably from late fifties (10 crores) to early eighties (38 40 crores). This has resulted into higher breakeven capacities for newer mills compared to older mills. The sales price of finished paper is same for new and old mills. So from profitability point of view the major solution available for newer mills is higher capacity utilization and better efficiencies.

A method for evaluating individual plant performance with respect to capacity utilization is discussed in this paper. The use of loading factor for finding the designed capacity is shown with an example.

The operating capacity of a plant is calculated by running rates of different plants and operating time availability. The maximum achievable capacity is computed by considering maximum achievable rate and maximum plant availability. A method is shown for identifying bottleneck plant. The bottleneck plant determines the whole mill capacity. Some methods for improving the capacity are mentioned, e.g. Inter Plant storages and Preventive Maintenance.

The importance of Process Parameter on plant capacity is shown. The internal and external factors affecting plant availability are discussed.

INTRODUCTION

The object of this paper is to outline and formulate an information system to evaluate individual and sectional performances with respect to capacity utilisation.

Old mills (those established in 1955-56) had to invest 8–9 crores of rupees for a plant producing 120 Tonnes per day. New mills established in 1965-66 had to invest 16-18 crores of rupees for the same capacity. For newer mills, in late seventies, the investment for the same capacity 120-130 T.P.D., increased to 40—42 crores. Looking at these figures, one can see that the older mills have a much lower breakeven capacity (50-52%) than the newer mills (82-83%). Modern machinery and technological break throughs have not significantly resulted in lesser consumption of chemicals. Thus, in order to be able to compete in the market, the main solution left for such mills is higher capacity utilization, in addition to the fiscal concessions. When we realise the low levels of productivity being achieved in Paper Mills, it is easy to understand why fewer mills are being built now a days. A 3% increase in efficiency (operating capacity) of the mills on annual production of 15 lakh tonnes, will mean additional production of 45,000 tonnes. This will save the cost of 140 T.P.D. Paper mill (40 crores rupees). This will also improve the productivity of the capital already spent.

Capacity can also be expressed in terms of total tonnes produced for a given product mix. In some instances by changing a product mix for better varieties, the production capacity may

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change marginally. Since part of the production is converted to special grades giving much higher returns and the break-even point may come down.

Very often, the capacity of a plant is not fully utilised, owing to various factors. In order to achieve maximum production it is necessary that all the available capacity is fully utilised.

The capacity of a mill is registered with the Government, for a broad range of varieties. This is sometimes referred to as *Licensed Capacity.* However, in practice, the actual capacity may be considerably different from licensed capacity. The actual capacity of a mill may also be different for various grades of paper and a particular product mix will determine the actual output.

THE DESIGN CAPACITY

Very often, the designers, in order to cope up with contingencies or variations try to give 10-15% more built-in capacity than that stated in the plant manuals, so as to guarantee the average production performance. The maximum capacity may not always be properly visualised by the operating personnel, who may stick to the same methods of production, irrespective of actual potential of the plant. The design capacity of a plant is greatly influenced in both the directions by the local conditions such as change in the quality of inputs or product quality change. For example, introduction of hardwoods might result in lower digester capacity or higher brightness level requirements might put restraints on bleach plant capacity or vice versa.

OPERATING CAPACITY

The actual operating capacity is governed by running rates of different plants and availability.

RUNNING RATES

Estimation of Optimum Operating Rates and Equipment Loading Factors :

Major equipment capacities are also expressed in terms of production per unit of controlling parameter of the equipment. This is known as *Loading Factor.*

For an example, a pulp washing plant, capable of washing 300 ADT per day pulp, having surface area of 950 sq.ft. per washer, will have a loading factor of 0.316 ADT/day/Sq.ft. washer area.

Similarly, the loading factors for various equipments can be determined. A table showing, paper machine dryer loading factor for some machines is given in Table 1. The wide range, in loading factors (0 26—0.40) signifies the real potential for many cases.

EFFECT OF PROCESS CONTROL PARAMETERS

Process parameters also have their influence on capacity utilisation. Important process parameters should be periodically evaluated with respect to final product.

A table showing some process control parameters is given in Table—II.

TABLE—I PAPER DRYING CAPACITIES-COMPARATIVE STUDY

Machine	Effective Dryer Area – Sq. M.	Max. Paper production in Tons per day,	Loading Factor Dyer=Max. Tones of paper dryed/day/ Sq. meter.
A.	253	72	0.28
B.	481	150	0.31
C.	348	90	0 26
D.	239	90	0.40
E.	278	72	0.26

Note : For the above machines, the moisture content of paper, before and after Dryer section is 60% and 7% respectively. The grade of paper manufactured is Maplitho White 70–90 G. S. M.

TABLE—II PROCESS CONTROL PARAMETERS

		Period I	Period II	Period III	Period IV
1.	Raw material per ton Screened Pulp.	2.94	2.81	2.75	2.40
2.	White Liquor, Tons Na_2O (TTA) per ton Screened Pulp.	0.337	0.294	0.287	0.306
3.	Lime for causticising, Tons per Ton White Liquor.	1.0	0.9	0.9	0.95
4.	Paper producd, Tons per Ton Slush Pulp.	1.07	1.07	1.05	1.06

DISCUSSION ON PROCESS CONTROL PARAMETERS

For mills having Raw Material Shortage, increase in pulp yield, will result in improvement in overall mill capacity and vice versa. Similarly for a mill having pulping as a bottleneck, any decrease in pulp consumption per ton of paper, will help in improving capacity.

PLANT AVAILABILITY

Although the installed capacity of a given unit may be high, lower, equipment/plant availability may result in lower capacity utilisation.

Availability is dermined by 1) external factors and 2) internal factors.

GENERAL FACTORS

Mill productoin can be less due to 1) external factors and 2) internal factors.

External factors include causes like power cuts, raw material shortage, chemical and fuel shortages and natural calamities and market conditions etc. *Internal factors* include mainly breakdowns, maintenance shuts etc. In addition to these relations may also affect production.

EQUIPMENT AVAILABILITY

Individual equipment availability is also affected by external and internal factors.

External factors include causes like power and utility, sectional storages, non-availability of feed materia and break-down in other plants, resulting in idle time.

Internal factors include mainly breakdowns and maintenance shuts.

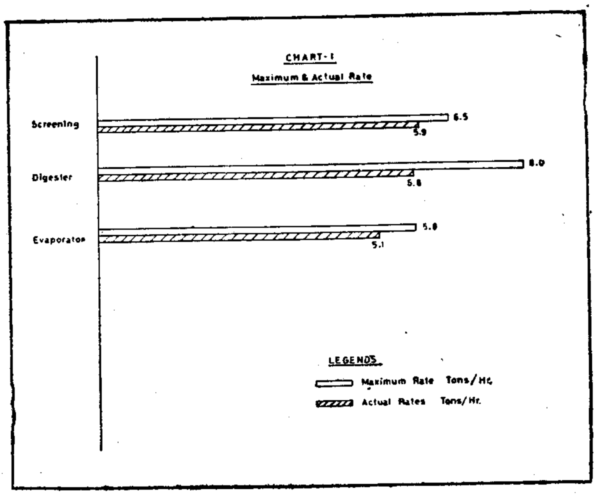
ANALYSIS OF CAPACITY UTILISATION

Running Rates Potential and Actuals :

Graphical representation of running rates, plant availabilities and capacity utilisation are given for various plants, as a typical case studies.

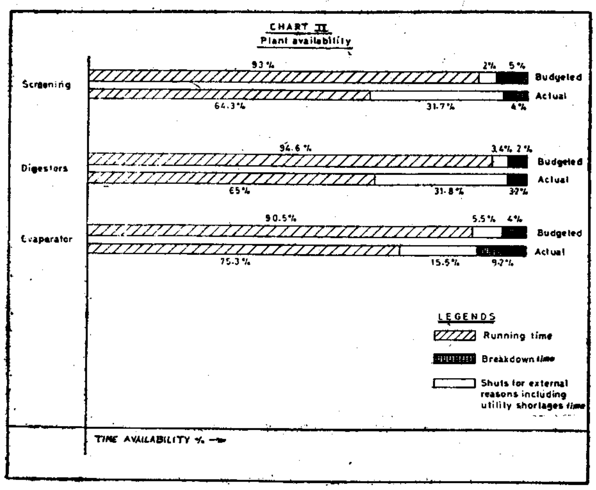
RUNNING RATE POTENTIALS

Maximum potential and Actual Rates are shown in Bar Chart-I. A pulp and paper mill involves activities of various sections, i.e. Chipper, Digester, Recovery Boiler, etc., Total capacity of a mill depends on the performance of different sections. The maximum potential of a plant as stated here, has been carefully determined by comparison of loading factors and design factors with various units. The plant, where there is least difference between the two (maximum potential rate and actual rate), has maximum rate utilisation. This is the bottleneck plant, where maximum attention of operating personnel and management is required, as this plant will decide the whole mill capacity. Any increase of running rate at the bottleneck plant, will improve the mill capacity.



PLANT AVAILABILITY

After considering running rate performances, the next important factor in capacity utilisation is the utilisation of available time. The maximum availability of a plant is likely to differ from plant to plant, and budgetting for the same will be absolutely necessary. In turn, this necessitates budgetting of breakdowns and maintenance. In practice, it is not possible to simultaneously utilise all the plants to maximum budgetted availability and hence the actual performance of the plant, when plotted against the budgetted, will give a scope of various plants, for additional time availability (scope for idle time utilisation). Bar Chart-II. Any idle time due to non-availability of feedstocks or space at the bottleneck plant cannot be made up and will result in net loss of production, whereas in the other plants, it is possible to some extent to make up for the lost time. Careful analysis of idle time and the time lost in break downs and maintenance, will be a very vital factor. This idle time will give information about higher possible capacity.



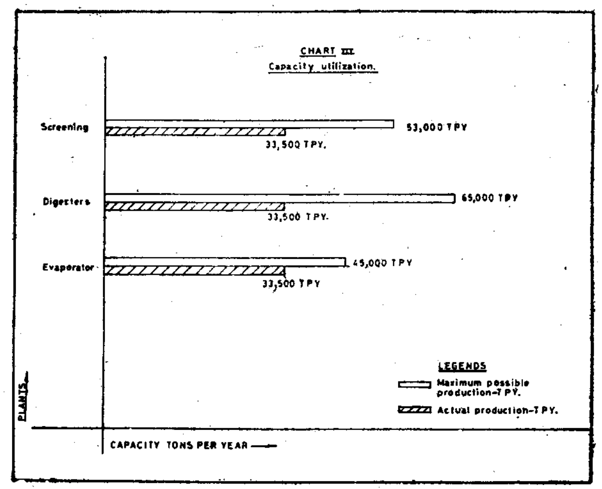
OVERALL CAPACITY UTILISATION

Maximum available capacity is computed by considering maximum running rate potential (from Chart 1) and budgetted plant availability, (from Chart 2), and similarly, the actual operating capacity is computed. In Chart 3, the maximum available capacity and operating capacity, as stated above, is plotted. Such analysis on a periodic basis (monthly, yearly, etc.,) will reveal important information from capacity utilisation angle. This chart will again confirm the bottleneck point, and the scope for future capacity planning. Periodic analysis should be done to determine the bottleneck point as the bottleneck point may change because of changes in process parameters, raw materials and product mix.

SOME MEASURES TO IMPROVE OPERATING CAPACITY

(I) **Analysis of Break-down** :

Detailed data for various plants should be collected and analysed according to the time



lost due to various breakdowns and idle hours. Proper budgetting for different types of down-time (mechanical, electrical, process) is most essential.

(II) **Preventive Maintenance** :

It should be stressed that to improve production levels, the maintenace and operating personnel should see that equipments are kept in good condition with daily checking of all equipments, and have routine preventive maintenance. If frequency of a particular breakdown is more, efforts should be made to provide standby equipment or better equipment. The bottleneck plant should be kept running maximum and can not be made available easily for preventive maintenance. Such a plant thus requires maximum attention for providing standby equipments. Also, careful preventive maintenance schedule will help to minimise the breakdowns: Overlapping of various preventive maintnance jobs is important, as this will save time. For this, there must be complete coordination of maintenance and operating personnel.

(III) **Inter Plant Storages** :

The bottleneck plant should not suffer for breakdowns in other plants due to non-availability of feed material or product space. By providing sufficient storage before and after the bottleneck plants, this problem could be reduced to a large extent. Storage capacities before and after bottleneck plants will require rechecking. As a thumbrule one can consider having storage capacity before bottleneck plant, equal to one and half times the normal interruption in preceeding plant, (Break down time x rate = Tonnes of material) and also one and half times the largest breakdowns in succeeding plant (Break down time x rate = Tonnes of material).

Under such circumstances, the preceeding and succeeding plants will have to be operated in such a way that feed and product tanks are kept two-thirds and one-third full respectively. Similarly, the storages between the other plants can be worked out on the basis of actual operating experience.

CONCLUSION

Capacity utilisation of different plants should be evaluated periodically. This gives clear idea about bottleneck plant, which limit the whole mill capacity. By improvement, modification and changes in process conditions, the bottleneck plant may shift its position, and will change mill capacity.

The idle time lost for all the plants and bottleneck plant in particular must be reviewed periodically, and remedial action should be taken to reduce it. The idle time lost for bottleneck plant must be kept to minimum level, as time lost at this location will result in total loss of production (for that time). As the cost of energy has gone up, higher production levels will reduce energy consumption per ton of product substantially.

The preventive maintenance schedule should be carefully followed, as this will reduce breakdown time considerably.