

The information and data contained in this document were prepared by a technical committee of the Association. The committee and the Association assume no liability or responsibility in connection with the use of such information or data, including but not limited to any liability or responsibility under patent, copyright, or trade secret laws. The user is responsible for determining that this document is the most recent edition published.

Press section economic evaluation

Scope

Because of the importance of wet pressing to the overall economics of the papermaking process, the Water Removal Committee of TAPPI saw a need for some guidelines in this area. The purpose of this effort was to provide a uniform method of evaluating the performance of a paper machine press section in terms of economic factors. The following items were to be included in the final result:

1. A list of factors which are of economic importance to the operation of a press or a press section
2. Explanation of the importance of each factor
3. Suggested methods for evaluating or estimating each factor
4. A uniform method for reporting the results.

This TIP is the result of the task group's efforts.

It is recognized that each mill has its own methods of cost accounting, and there is probably no such thing as “typical” in this regard. As a result, the outline shown in the Introduction will need to be adapted by each user to his or her own particular needs.

The example which is attached is intended only to illustrate the use of the suggested procedure and is in no way typical of any given mill. While this particular example deals with evaluating press clothing, the same general techniques can be applied to any process change, equipment change, etc.

It is hoped that these guidelines may prove helpful in putting economic studies of wet pressing on a common footing in order that mill-to-mill comparisons might be more meaningful.

Safety precautions

No specific safety requirements apply to this TIP. Mill safety requirements should be followed when installing monitoring devices or collecting information relative to press section economic evaluation.

Significant factors used in evaluating press section economics

In general, the cost of water removal increases in each successive step as the sheet advances from the headbox to the reel. Thus, drainage on the wire is quite inexpensive, wet pressing costs are more significant, and drying costs represent one of the major expenditures in the production of the sheet.

For the present purposes, the factors of importance to wet pressing economics can be classified as follows.

I. Primary paper related variables

- A. Production rate: speed, trim, basis weight
- B. Sheet dryness: into and out of the press (or press section)
- C. Downtime: loss of production

- D. Fiber source
- E. Secondary fiber content

II. Operating costs

- A. Press clothing costs
 - 1. Press fabric costs
 - 2. Fabric installation costs
 - 3. Fabric cleaning costs
- B. Maintenance costs
 - 1. Vacuum boxes
 - 2. Rolls
 - 3. Pumps and motors
 - 4. Showers, doctors, oscillators
- C. Water costs
 - 1. Fresh water
 - 2. Clarified white water
- D. Cost of lost production (machine efficiency)
- E. Chemical cleaning costs

III. Energy costs

- A. Press drives
- B. Vacuum pump and vacuum blower drives
- C. Water pump drives
 - 1. High-pressure showers
 - 2. Low-pressure showers
 - 3. Tray water
- D. Heat input to sheet (to lower water viscosity)
- E. Heating of shower water
- F. Heat to press rolls

IV. Potential savings

- A. Savings in steam costs
- B. Savings due to increased production (dryer limited machines)
- C. Savings due to quality improvement

Each of the above factors will be discussed in the order indicated, together with suggested methods for evaluating each factor. Finally, a method will be suggested whereby all of these inputs can be reduced to one figure-of-merit which could be applied either to an individual press or to an entire press section, as illustrated in the example. In order to have a common denominator, all costs will be expressed as U.S. dollars per ton of paper or board produced.

Metric conversions are included at the conclusion of the text to allow computations to be performed in SI units.

I. Primary paper-related variables

A. Production rate

In view of high capital investment in the paper industry, production rate on a given paper machine is of prime concern. It therefore is important in any economic evaluation to tie the results as closely as possible to the production rate. For example, press clothing life or even press clothing costs per ton of production is not nearly as important as the rate at which that production was achieved. In view of the fact that production rate often varies with the grade being produced, it is desirable to determine an average daily production rate, P_d , normalized over a suitable period of time (say, one month or the life of a press fabric), L_f (days). The average daily production rate can then be computed as:

$$P_d = \frac{P}{L_f} \text{ or } P_d = \frac{P}{T} \text{ (tons/day)}$$

where P is the total production in tons during the time interval L_f (or T) in days. (In the interest of simplicity in later calculations, it is helpful to express P_d on an oven-dry basis by multiplying the daily production rate by one minus the average moisture ratio at the reel.)

NOTE 1: One of the keys here is to establish a “normal” period of production for time averaging. In mills where a variable production rate budget is utilized, it may be desirable to consider the “percentage of standard production achieved” in determining the appropriate value of P_d .

B. Sheet dryness

Probably the single most important measurement for evaluating the economics of a press (or press section) is the dryness of the paper web as it leaves the press (or press section).

Whether obtained by appropriate instrumentation or by grab samples of the sheet, accurate web moisture contents are a must for any economic evaluation of the press section. A suitable means of collecting press moisture data is outlined in TAPPI TIP 0404-01 “Determination of Water Removal by Wet Presses.”

C. Downtime

The cost of downtime for a given paper machine producing a certain grade of paper is often difficult to determine. The engineer would be well advised to consult with the mill cost accounting department in developing these data. The methods used to determine downtime costs vary widely from mill to mill, but the following factors are often considered:

- Depreciation on buildings and equipment
- Taxes and insurance costs
- Wages of paper machine crew (including labor overhead)
- Lost profit of utilities costs (steam, electricity, gas, etc.)
- Lost profit (often expressed as standard profit per ton for given paper machine and grade of paper)
- Office personnel, miscellaneous stores, general overhead.

Regardless of the factors which are included in the analysis, for any given situation the downtime costs can be reduced to an hourly charge, $D(\$/h)$. This figure is useful in evaluating the cost of interrupted production for press fabric installation, for sheet breaks, for press fabric cleaning, etc., and is therefore a rather basic input for evaluating the economics of a given press or press section.

D. Fiber source

The type of fiber being utilized, i.e., bleached and unbleached HWK, SWK, Sulfite and GWD, dewater differently. The degree of benefits achieved will be affected by the fiber, its blend, and the degree of refining required for the product being manufactured.

E. Secondary fiber content

There is a trend to use secondary fiber as a portion of the furnish for both economic and ecological reasons. The resulting furnish, depending on type and percent used, will dewater differently. In addition, there is the potential for contamination of felts with materials such as waxes, stickies, and hot melts which will require specialized treatment (mechanical and/or chemical) resulting in additional costs.

II. Operating costs

A. Press clothing costs

While the cost of a press fabric, in terms of dollars per ton of paper produced, is a relatively easy figure to derive, it also can be quite misleading. There are many factors and many interactions which must be considered to

determine the cost benefits of a given fabric design. For example, when determining the cost benefit of a fabric which has a long life, one must consider the dewatering performance over the entire life. The increase cost associated with reduction in dewatering near the end of the long felt life, may outweigh the cost saving realized for running the felt longer. Because of the economic leverage in wet pressing, the cost of clothing must be tied rather closely to production rate or rate of water removal. This is particularly important to those paper machines which are limited in production by their drying capacity.

1. Press fabric costs

The specific cost of a press fabric is derived easily from its total costs, C_f (in \$), its life on the paper machine, L_f (in days), and the average daily production rate P_d (in tons/day) during its life.

$$k_f = \frac{C_f}{P_d \cdot L_f} \text{ ($/ton)}$$

This basic cost should be modified by the following considerations.

2. Fabric installation costs

Since some fabrics go on the machine quite easily while others are difficult to install, this cost can logically be attributed to the fabric. If the cost of downtime on the paper machine is D (\$/h) and the fabric installation time is T_i (h), the installation costs can be computed as:

$$k_a = \frac{D \cdot T_i}{P_d \cdot L_f} \text{ ($/ton)}$$

where L_f is the fabric life (in days) and P_d is, again, the average daily production rate (in tons/day).

3. Fabric cleaning costs

Under consideration here are: (a) the cost of chemicals for continuous and batch cleaning and (b) the cost of downtime for special washups attributable to the press fabric. The first factor is simply the average daily cost of cleaning chemicals, C_c (\$/day), divided by the average daily production rate, P_d (ton/day). If the number of special washups, N , lasting an average of T (h) are required during the life of the fabric, L_f (days), then the total fabric cleaning cost can be expressed as:

$$k_{fc} = \frac{C_c}{P_d} + \frac{D \cdot T_c \cdot N}{P_d \cdot L_f} \text{ ($/ton)}$$

Total press-fabric-associated costs can be calculated as: $k_f + k_{fi} + k_{fc}$

B. Maintenance costs

The costs of maintenance is often difficult to allocate, but with proper maintenance records a reasonable estimate can be made. Depending on the detail required, it may be desirable to subdivide maintenance labor into categories dependent on the item being serviced, e.g., rolls, vacuum boxes, pumps, etc. In any case, the maintenance cost (in any detail desired) can be computed as:

$$k_m = \frac{D \cdot T_m}{P_d \cdot T} + \frac{C_L \cdot T_m}{P_d \cdot T} \text{ ($/ton)}$$

where T_m is the total hours of maintenance required in some time period T (in days) and C_L is the total hourly cost of maintenance labor. As before, D is the cost of downtime (\$/h) and P_d is the average daily production rate (ton/day).