Nip impressions—a tool for troubleshooting and maintaining quality

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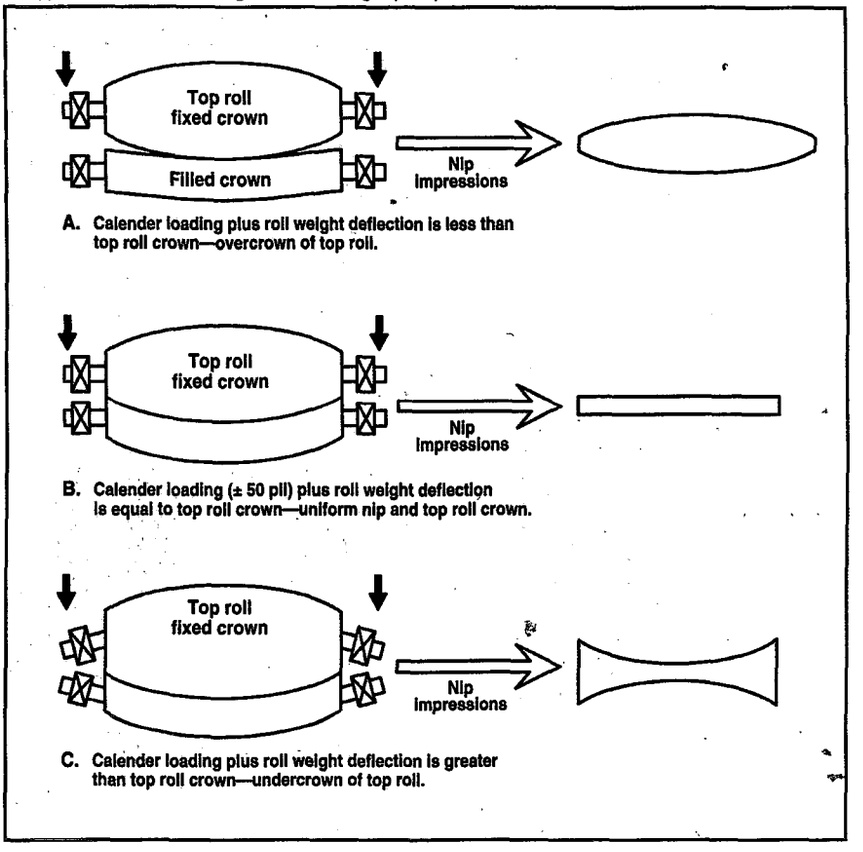
Nip impressions are an important tool for optimization or troubleshooting of the press section, size press, or calendering operation. It is a straightforward process that can be performed by either the mill or as a service of an equipment or filled-roll supplier. Detailed instructions for nip impressions discussed later are specifically developed for a supercalender but can easily be adapted for use in other nip-related applications.

Through the use of nip impressions, linear forces within the calender nips can be analyzed and the control parameters can be adjusted to achieve nip profiles that are as uniform as possible. This will provide an additional tool for any mill's quality control, engineering, and maintenance departments to monitor and assure that calender process parameters are optimally adjusted and that the highest-quality paper is being produced.

Detailed instructions for taking dynamic and static nip impressions can be found in the accompanying stories.

1. Typical calender loading with resulting nip impression



Background

Roll deflections caused by roll weight and linear loadings on the roll ends create the need for roll crowning of the top and bottom iron rolls or the use of deflection-compensated rolls in the calender. **Figure 1** illustrates typical nip impressions as they relate to roll crowning. The roll crown is the diameter difference between the center of the roll and the ends. Crown will compensate for roll bending to produce a straight nip profile at a given linear loading. With a fixed crown roll the flat nip is achieved over a very narrow linear loading range—typically within about 50 pounds per lineal inch (pli) or less for a given design load. For an adjustable crown, a deflection-compensated roll maintains equal nip pressure across the roll face over a wide range of linear loadings (e.g., 500–2000 pli).

While an adjustable-crown roll will theoretically give an even nip profile, any roll type—whether fixed crown or adjustable—will be affected by practical mechanical limitations of the supercalender. For example, overhanging loads resulting from the mounting of nip guards, flyrolls, and other auxiliary equipment create additional loading on the bearing housings and create different bending characteristics between the various rolls in the stack. Other variables include roll stiffness characteristics of each of the various calender roll types, as well

as possible binding between the slides and ways. These are a few examples of parameters that can affect nip impression results.

Nip impression tests for the rolls in a supercalender give a method for evaluating roll crown magnitude and the mechanical condition of a stack. Interrelationships between rolls in the stack, basepaper coming to the stack, and mechanical condition of the stack all contribute to the effects seen on the filled roll and can prove to be very complex when trying to interpret results.

Supercalender nip-impression results obtained by following the detailed procedures outlined in the accompanying stories can provide useful information that is consistent and provides the necessary historical database for troubleshooting calender problems such as excessive friction between the slides and ways, loading cylinder inaccuracies, filled roll problems, or improper crowning of king or queen rolls. Once the particular problem has been correctly identified it can then be remedied accordingly. Should the problem be bigger than that which can be addressed with given maintenance resources, this same historical nip-impression documentation can assist with justification of calender rebuild projects.

Static or dynamic nip impression test?

There are two types of nip impressions, static and dynamic.

Static impressions are taken between the nips of a nonrotating supercalender stack and are used only to measure nip width. The nip impression paper is placed between two rolls, loaded up to typical operating pressure, and nipped for 60 seconds. The resulting nipped paper is evaluated by taking nip width measurements with a dial calipers across the paper length.

Dynamic nip impressions are used to verify cross-direction (CD) nip uniformity. The dynamic test is taken with a preloaded slowly rotating stack. Brightness measurements taken of the nipped paper every 6 in. will give the CD loading characteristics for the nip in question. Brightness variations across the length correlate with nonuniformities in CD linear pressure.

Advantages of the static test are the relative ease of testing and lower manpower resource requirements compared with the dynamic test. The main disadvantage of the static test is that filled rolls and polymer covered rolls are easily damaged by loading the stack when it is not running. Additionally, static

impressions give no way to check dynamic CD nip uniformity.

The dynamic nip impression overcomes these shortcomings and gives a true representation of what is occurring in the rolling nip.

Nip impressions—before or after?

The question as to whether to take nip impressions before or after a filled roll change is best answered in two parts:

1. Nip impressions should always be taken after a filled roll change to see how the supercalender is set up mechanically, and
2. It is a good general practice to run nip impressions after the last set before changing out filled rolls. This would be done to see the effect the paper web or mating iron roll has had on the filled roll and for historical tracking purposes.

Taking nip impressions both before and after a filled roll change also gives the opportunity to evaluate whether in fact there has been any improvement by replacing the filled roll or if the same problem (or even worse) exists.

Nip impression paper

A number of potential nip impression papers have been investigated for their suitability for use in the supercalender: traditional 2-sheet carbon paper systems, carbonless papers, and foils. Detailed investigations have shown that a couple of possibilities exist that accurately indicate minor pressure variations in both low and high linear loading applications that are characteristic supercalender operating modes. TJ

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