Methods to minimize sheet rewet in the press section

Scope

This TIP discusses intra-nip and post-nip rewet of paper in press nips and reviews options to minimize rewet.

Safety precautions

Paper machines in general, and press sections in particular, are dangerous (1). Before any measurements are made, safety must be considered. The following list contains only a part of the safety issues that must be addressed:

1. The mill safety procedures should be known before working on the machine.
2. Personal protective equipment, such as safety shoes, safety glasses, and earplugs, should be worn.
3. Make sure machine crews know what is being done and when.
4. Operators using instrumentation should be well trained.
5. The condition of the footwalks and ladders should be checked.
6. Make sure that any chemicals being applied to the press area are harmless.
7. Measurements should not be taken ahead of in-going nips.
8. Do not hang over in-going nips or climb precariously around framework, drive shafts, etc.

Background

The degree of consistency change due to rewet has been debated over the years (1). However, it is generally believed that the moisture regain is significant. In a number of laboratory and pilot-scale, rolling nip press studies summarized in (2), rewet ranged from 2 to 45 g/m² (2). Rewet between 9 g/m² and 23 g/m² was reported for pilot paper machine measurements (2, 3) and these numbers are probably representative of the operation of commercial machines (3).

Rewet can be separated into three different processes: internal rewet, external rewet and separation rewet (4-6):

Internal Rewet (rewet in the expanding press nip) is defined as the reabsorption of moisture by the sheet prior to sheet exit from the nip. On the incoming nip side all the air and a portion of water contained in the sheet and in the press fabric are squeezed out. In the middle of the nip all voids in the sheet/fabric sandwich are filled by water. New voids are created and filled with air as the sheet and fabric expand on the outgoing side of the nip. Internal rewetting starts as the pressure is reduced in the nip between mid-nip and the nip exit (Figure 1). Rewetting depends on the sheet properties and the dwell time in the expanding nip (6).
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The physics and theory behind intra-nip rewetting mechanisms are described in (6). The sheet has a dominant role in controlling rewet because the capillary forces in the sheet far exceed those in the fabric (4, 6).

External (or post-nip) rewet is the moisture gain by the sheet following the press nip due to contact with the press fabric (Figure 2). Rewetting after the pressing zone increases with time and moisture content (1, 6, 7). For example, a contact length of 1 m following the nip could lower the web solids content by 5 percentage points for 49 g/m² newsprint (900 m/min) and by 2 percentage points or more for linerboard (8, 9).

Separation rewet is the moisture transferred to the sheet when the sheet separates from the press fabric. The surface layer of water in the interstices of the sheet and the felt is thought to split at the moment of separation, some going to the sheet, the rest to the fabric. This type of rewet is sometimes referred to as film-splitting. A large proportion of this interfacial water film remains with the sheet since it has smaller capillaries and thus generates greater capillary forces (4, 6).
Factors affecting rewet

Factors affecting rewet include fabric and sheet characteristics and the distance and time that the sheet remains in contact with the fabric.

Sheet Run Effects – Minimizing sheet-to-fabric contact outside the nip is the most practical approach to reducing post-nip rewet. However, in some cases sheet rewet is unavoidable because of required press geometry, fabric runs, and sheet runnability. Rewet after the last press nip is most critical since this water must be evaporated in the dryers (10).

Speed also has an effect on the amount of rewet. At high speeds, good machine runnability should take precedence over rewet considerations. Pilot machine experiments with newsprint indicated that the amount of post-nip rewet is lower at higher machine speeds because of lower sheet-fabric contact times on the outgoing side of the nip (6, 7). Post-nip rewet should not increase the moisture content of newsprint more than 1.5 percentage points if the fabric and sheet are separated immediately on emerging from a press running at 900 m/min (7, 11).

Since the late 1990’s, transfer belts became an alternative to press fabrics for support and transport of the web, e.g., between the presses or between the last press and dryer sections (12). Transfer belts receive no water and hence do not contribute to rewet.

Fabric Effects – Rewet, especially after the last press nip, can be reduced with attention to fabric construction (13).

Rewet can be reduced by minimizing the available water at the felt/sheet interface using as fine a batt fiber as possible without increasing wear, fill-up, compaction and excessive felt-hair loss. Fabric moisture level has little effect on intra-nip rewet for lightweight grades (<60 g/m²) in a vented press, even when the nip is saturated (14) but might be a factor for heavier grades.

Effects of Press Impulse and Pressure Profile – Bench tests on bleached softwood kraft found that rewet (internal) is independent of press impulse for a constant amount of water removed during compression (15). For shoe presses, modifying the pressure profile to move the peak pressure closer to the nip exit will minimize in-nip rewetting (16).

Sheet Effects – The amount of water transferred to the sheet by rewet is independent of sheet basis weight (2, 3, 6, 13, 17) which means that rewet is less significant for heavyweight grades than for lightweight grades (18). For a given grade, the amount of rewetting is somewhat greater for less consolidated sheets leaving the nip with lower exiting solids (6, 7). The lower rate of post-nip rewet of high solids content sheets allows for the construction of shoe presses with no open draws, in which the sheet is not separated from the felt at the outgoing nip side.

Keywords

Pressing, Press, Rewetting, Dryer felts, Felts, Nip, Water removal

Additional information

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Literature cited