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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

Sheet rewet can be separated into three different processes: internal rewet, external rewet and separation rewet:

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. Rewetting starts as the pressure is reduced in the nip between mid-nip and the point of sheet/fabric separation (Figure 1). Rewetting in this area is thought to depend on the rate of relative expansion of the sheet and fabric, and on the nature of the fabric. The film of water between the sheet and press fabric is interrupted (sheet splitting) at the point where the sheet separates from the fabric. It is assumed that a large proportion of this interfacial water film remains with the sheet since it has smaller capillaries and thus generates greater capillary forces (2, 3). Some experts believe that sheet expansion is not important and that rewet is caused almost entirely by film splitting (4), i.e. separation rewet.

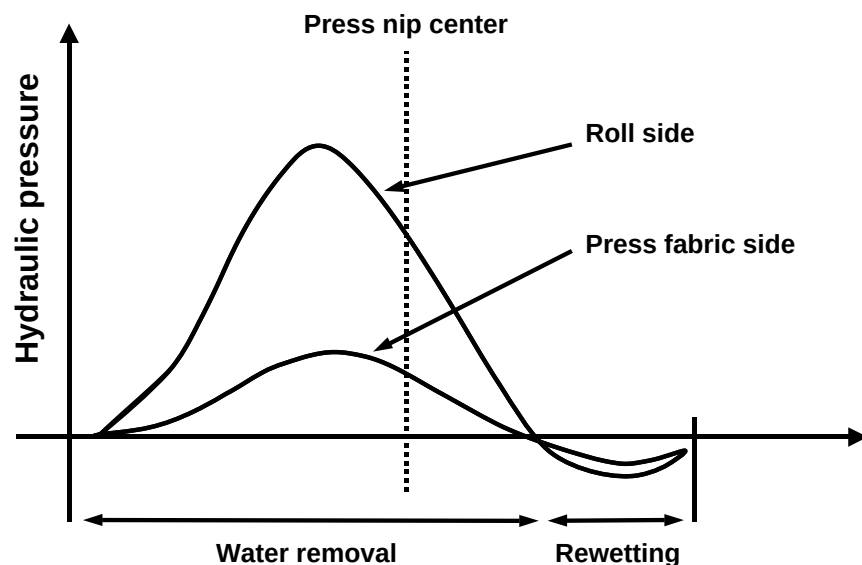


Fig. 1. Rewetting in the expanding side of the press nip

The degree of consistency change due to internal rewet has been debated over the years (5). However, it is generally believed that the level of moisture regain is significant. It was concluded from low speed single-nip lab pressing experiments that a maximum web dryness of 70-80% could be obtained in the web after the roll centerline (nip) in low speed pressing (6). In the expanding zone of the nip, the quantity of water going back into the sheet was estimated in one study to be 4-35 g/m²; in another, it was concluded that as much as 30% of the total water removed in pressing is returned as rewet in the expansion side of the nip (7-9). Recent work reported a rewet value between 9 g/m² and 23 g/m² for pilot paper machine measurements and of 3 g/m² for commercial machines (10, 11). The authors, who summarized previous studies of rewetting within the expanding press nip, believe that the lower number is probably more representative for the operation of commercial machines (10).

The physics and theory behind intranip rewetting mechanisms continue to be debated. The sheet can have a dominant role in controlling rewet given that the capillary forces in the sheet far exceed those in the fabric.

External rewet is the moisture gain by the sheet following the press nip due to contact with the press fabric (Figure 2). Rewetting is less pronounced after the pressing zone than within (2). It increases with time, moisture content, and rougher fabric surfaces, and can depend on the surface and compression characteristics of the sheet (2,12). As an 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 (9). Similarly, with regard to post nip rewet, it was estimated that for 200 g/m² (42 lb/1000 ft²) liner, only six percent of all water removal was related to rewet after the nip (13).

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.