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High vacuum sheet dewatering

Scope

This TIP outlines procedures for determining the water removal performance of the flat box section of sheet formers. The objective of the TIP is to provide a high-resolution method to maximize dewatering and minimize frictional drag load, fabric wear, airflow and vacuum requirements, and required on-machine hardware. The method can be used to design a new installation or optimize the operation of an existing installation.

The method described is based on empirical work on a pilot machine, verified on many commercial paper machines. Data was acquired on the pilot machine and regression analysis was used to reduce the data to an easily usable form.

Safety precautions

This TIP outlines a calculation procedure. No safety precautions are required.

Definition of flat box dewatering

On a paper machine former before the sheet is removed to the presses, there is an opportunity to remove water from it for relatively little cost. This dewatering is accomplished with application of vacuum up to substantially the highest conventional levels on a paper machine, and when the sheet is between 4% to 6% and up to about 25% solids. (Consistency levels are highly dependent on furnish, weight, and the machine.) The vacuum is applied to the underside of the fabric on which the sheet was formed, through a structure commonly called a flat box or high vacuum box. These boxes are covered with a wear material over which the fabric is dragged. The wear material is conventionally high density polyethylene or more commonly ceramic. The covers are slotted such that the span of vacuum over which the fabric must pass is not too stressful; slot widths usually range from 12 to 25 mm.

Dewatering curves

It has been experimentally determined that flat box dewatering performance is influenced by numerous variables, the most important of which are:

- Vacuum
- Furnish
- Basis Weight
- Dwell time
- Incoming sheet solids

Dwell time is the amount of time the sheet is exposed to vacuum over a given box. It is a combination of two important parameters, total slot width and speed. Experimentation has shown that dwell time summarizes slot width and speed perfectly. It was found that dewatering of the sheet was determined only by total dwell time, and that the configuration of the slots regarding their width had no effect. In other words, dewatering over two ½ inch slots is the same as a single one inch wide slot. Results are summarized in for the tested grades and basis weights in Figures 1-5. Dwell time is in seconds.

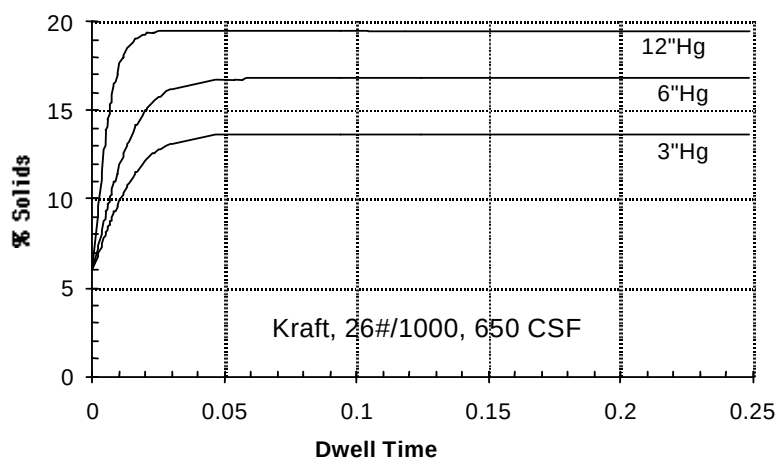


Figure 1

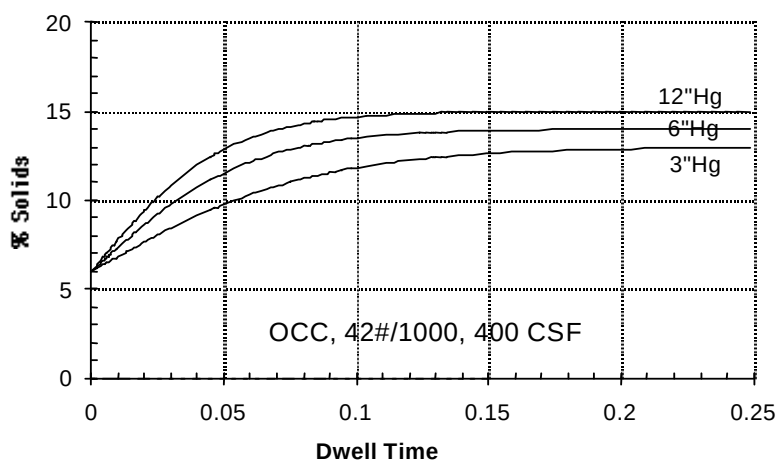


Figure 2

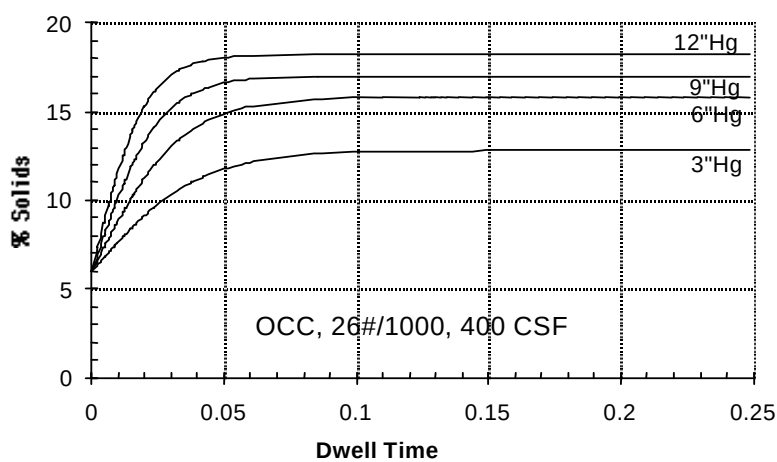


Figure 3

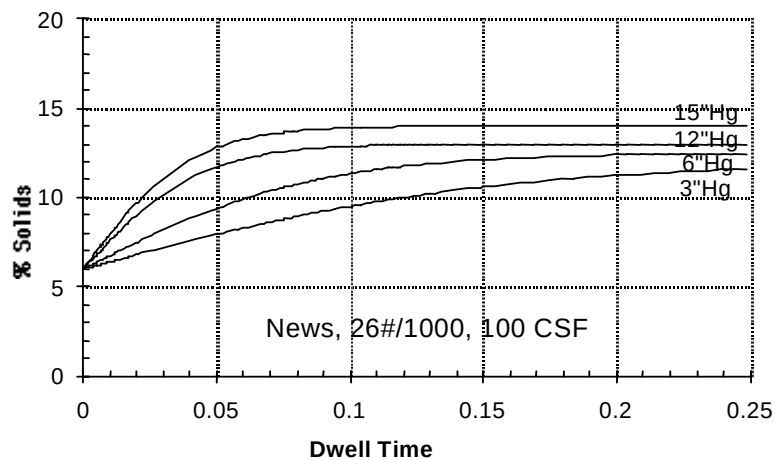


Figure 4

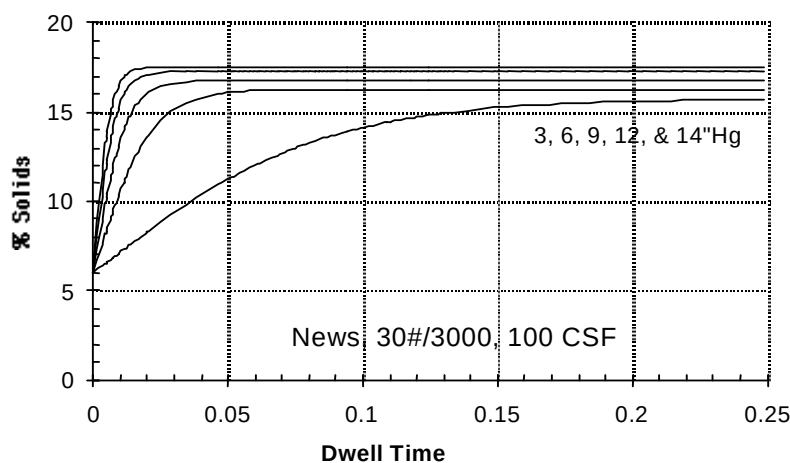


Figure 5

These curves are actually regression fits of data. The equations for the curves are summarized in the Table 1.

The equations have two basic variables: %-solids and dwell. "Dwell" is the total amount of time, in seconds, that the sheet is exposed to vacuum in a given box, as discussed above. %-solids is the sheet solids content after the box. Note that each curve starts at a "zero dwell" level of 6% solids. This implies an ingoing sheet solids of 6%, which was the preliminary state of the sheet before the flat boxes during the experiment. It is safe to extrapolate the curves downward below 6% as long as the system of concern remains in a high vacuum dewatering regime, that is, as long as the sheet is substantially consolidated and not in a fluid state.