No Draw Drying-A Review

LITTLER, B. G.*, HEBBLETHWAITE, G.*

SUMMARY

Importance of No Draw problems andtheir solution have been described. Effect on drying, uneven drying, dusting of the sheet surface and sheet feeding have been discussed and solutions suggested. No Draw has definitely proved advantageous in case of high speed machines.

INTRODUCTION

The idea of NO DRAW, with one dryer fabric wrapping both the top and the bottom drying cylinders, is now well established, and is in use or has been tried on some 400-500 paper and board machines around the world. The advantages have already been well covered in print so will not be listed again in this article. It is now worth taking a look at the results to try and establish the boundaries to successful No Draw operation.

No Draw was developed to give sheet support on high speed machines making lightweight papers, and almost without exception it is very successful and reduces the frequency of breaks. The areas where problems can occur has been described in the following paras.

THE EFFECT ON DRYING

One big question is the effect on drying. Some of the explanations of how No Draw can improve drying unfortunately tend to stretch the laws of physics. In one case air and water vapour are shown to pass through the fabric and the sheet. This will not happen as wet paper has an extremely low air permeability—say 1 cfm ($16m^3/m^2/hr$ at 10mm).

In No Draw the paper loses contact with approximately half the cylinders. In compensation the fabric covered wrap of the top cylinders is increased by some 35-40% (Diagram 1). The role of the fabric has been the subject of much discussion. The rate of heat transfer through all dryer fabrics is poor, compared to the rate of heat transfer from the cylinder shell. This is clearly shown by the higher temperatures of the fabric covered cylinders, which shows that they are transferring less heat. Special dryer fabrics with a higher rate of heat transfer have veen proposed, and it is possible by changing the babric design to increase ihe rate of heat transfer through a fabric by some ten times. However, when this rate of heat transfer through the fabric is compared to the rate of heat transfer through the drying cylinder shell such fabrics are still good heat insulators.

The question which has not been answered, and to which there may be different answers depending on conditions is : "At what rate can the sheet accept heat from the cylinder, or from the fabric ?" This may be the controlling factor in the heat transfer from the cylinder to the paper.

The condition of the air adjacent to the sheet in No Draw is of great importance in promoting the removal of moisture from the sheet. It has been found that generally both the air temperature and relative humidity adjacent to the sheet are lower. Certainly there is freer movement of air around the bottom cylinders than when a bottom fabric is in use and this helps to maintain the drying when No Draw is in use.

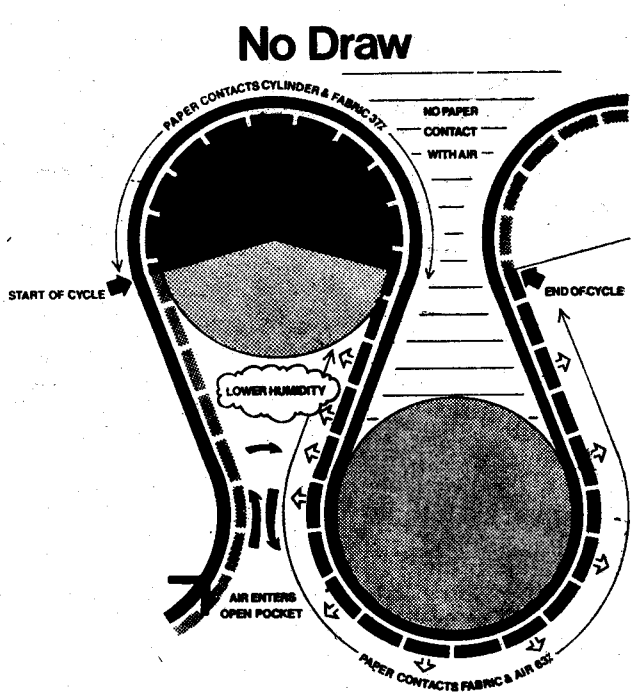
Moving from theory to practice, drying has been lost on a few machines, but the great majority have not lost drying, or have been able to make it up in the following sections. A number of machines are now running No Draw on both 1st and 2nd sections without affecting the drying. The real criterion in this matter is of course the number of non-contact cylinders as a percentage of total cylinders on the machine. This total figure should only include the cylinders up to size press or coater, (if there is one), and can vary from less than 10% to 25%. Trials after a size press or coater, where it is the last section before the reel, are most critical because there are no following cylinders to compensate for any loss of drying. As a result a greater percentage of failures have occurred in last sections. From our knowledge of the numerous trials now carried out, it is possible to predict when a loss of drying may occur, but because of the great variation in cylinder temperatures and air conditions between machines only a trial will give a definite answer.

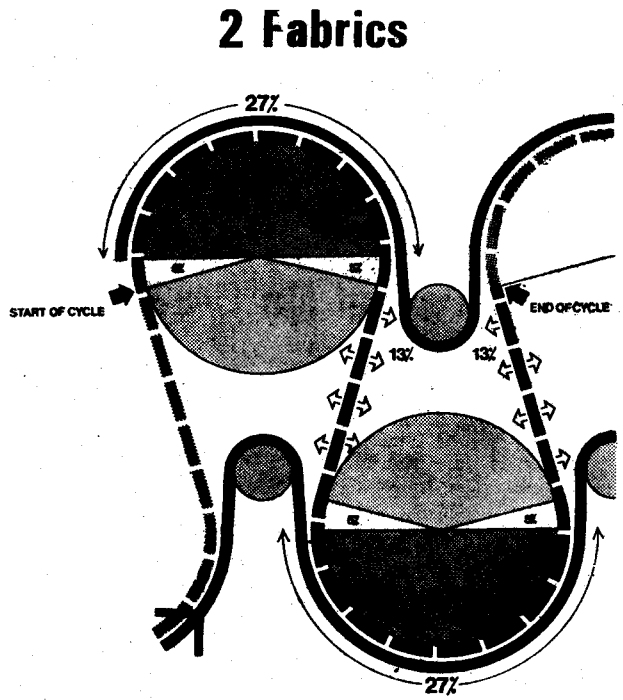
OTHER PROBLEMS

Apart from the question of drying, other problems

*Scapa-Porritt Ltd., U.K.

Diagram – 1





have occurred though generally only in isolated instances.

Because the sheet is only heated from one side uneven drying can occur. In an extreme trial, which was one of the early No Draw trials, 12 out of a total of 17 cylinders on a slow kraft paper machine were covered by No Draw and sheet curl and loss of drying resulted. From information since gained this was obviously too high a percentage of non-contact cylinders, approximately 35%. In general however, curl has not been a problem, because the sheet moisture, if uneven, can be corrected by the remainder of the drying cylinders.

In one mill more dusting of the sheet surface which contacts the No Draw fabric occurred, presumably because this surface had not been consolidated by being pressed against the cylinders. The asymmetric heating of the sheet with a No Draw has not generally caused problems because it occurs early in the drying cycle. An attractive idea is the use of No Draw to combat curl tendencies, as different top and bottom cylinder temperatures are often used for this purpose. A top No Draw fabric gives a lower temperature contacting the top side of the sheet.

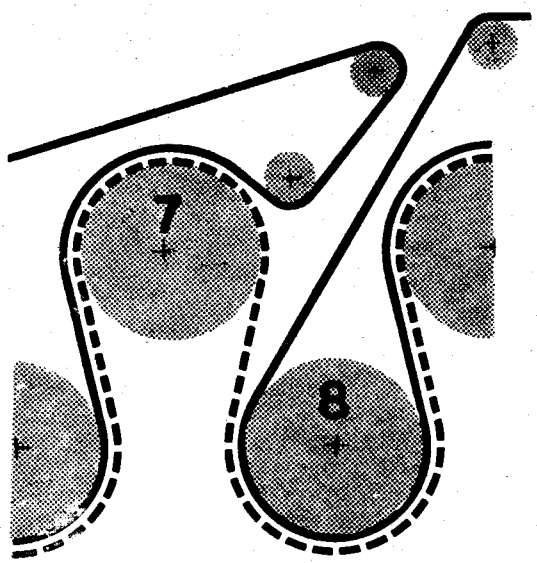
On a fine paper machine holes in the sheet developed after some 45 minutes of running. The fabric surface was a good one but it seems that a gradual build-up of moisture in the fabric caused the problem. There was no fabric drying cylinder. In No Draw the fabric is heated by direct contact with the bottom cylinders, but cannot loss moisture freely because the wet sheet is in contact with the other side. Better fabric conditioning is indicated in such a case, perhaps by using a blowing roll, together with the finest fabric surface.

Sheet feeding has been more difficult in some mills because under the bottom cylinders the sheet is not held by a fabric. If the rope grooves are too deep, so that the ropes are well below the level of the cylinder surface, the sheet has to climb over the edge of the cylinder itself. Building up the grooves has helped in such a case. Generally it is possible to overcome this problem by the use of a wider tail.

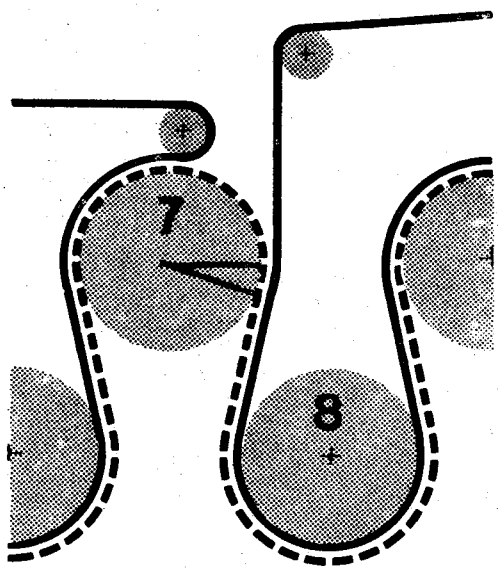
VARIATIONS

No Draw is in use on 1st and 2nd sections and the transfer of the sheet between the sections can be done in different ways. An open draw is an obvious method, but at high speeds the sheet may be affected by flutter. On some machines this draw has been eliminated by the 2nd No Draw fabric licking the sheet from the last cylinder of the 1st section. The contact with this cylinder is only for a short distance of some 1-2 cm, and a draw of 1-3 m/min between the sections helps to keep the sheet tight (Diagram 2).

Diagram—2



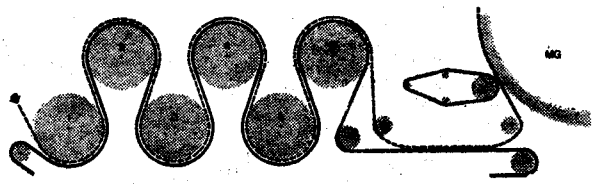
Open Draw



Lick up - Closed Draw

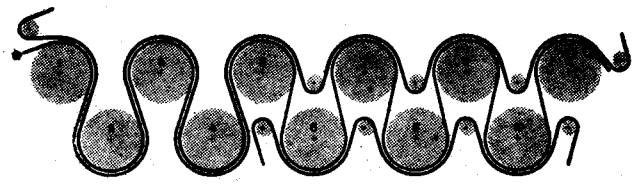
Inverse No Draw (Diagram—3) is in use on several machines, but may have the problem of sheet separation. This is because between the cylinders the sheet is under the fabric and gravity may cause separation of the sheet from the fabric. The advantage of Inverse No Draw is that the sheet is freely exposed to the air around the top cylinder, so that the moist air coming from the sheet can be directly removed by the hood.

Diagram—3



Partial No Draw (Diagram—4) uses a toy fabric which only wraps part of the bottom cylinders so that the sheet is supported where it is most needed. An example of this is a long first section of 11 cylinders where the first 2 bottom cylinders and all 6 top cylinders are covered by a No Draw fabric. The sheet is there ore supported in the early draws where it is most liable to flutter and breaks, and the final 3 bottom cylinders may be unfelted or may use a short bottom fabric. This idea is worth studying where there has been a loss of drying, or the danger of lost drying is too great a risk.

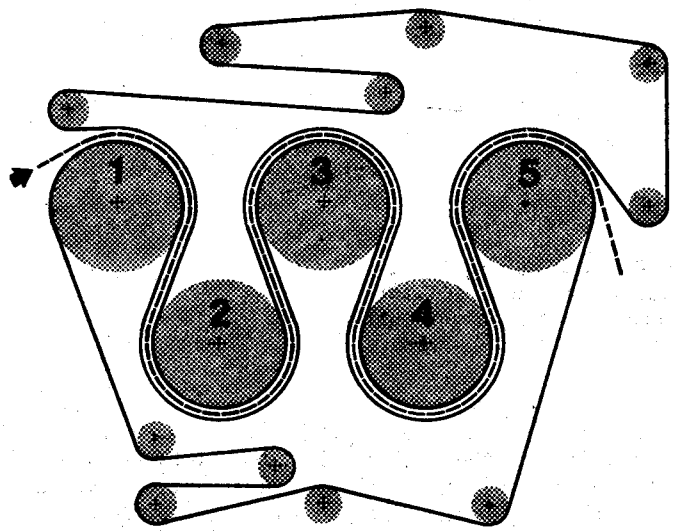
Diagram—4



Partial No Draw

Sandwich drying (Diagram—5). with the sheet sandwiched between two facrics which run around the top and bottom cylinders, has also been tried. In this case sheet support is complete, but the effect is to seriously reduce drying. The sheet is not contacting any cylinders so is only heated by the fabric and by the air which surrounds it. Except in special circumstances this is a way to ensure less heating and drying of the sheet, though if a machine has too much drying this could be an advantage. In addition, problems of sheet dusting or surface disturbance due to the slight speed differences between the two fabrics have occurred.

Diagram – 5



Sandwich Drying

No Draw can be run on machines where there are no feed ropes. A tap is installed to follow the fabric run around the cylinders and return in the basement. This simple system holds the tail between the tape and the fabric for sheet feeding. The tape continues to run when the machine is making paper.

DIRTYING

On machines wheer first section fabrics become dirty No Draw fabrics have been similarly affected The dirtying of No Draw fabrics seems to occur at a similar rate, but may be more critical in terms of causing breaks. When bitumen from a waste furnish builds up heavily on a fabric there is effectively a layer of pitch covering only about 5% of the total surface, and with air between the sheet and the fabric over the rest of the surface. The "surface" of spots contacting the sheet is very uneven and will not press the sheet evenly to the cylinder surface. It is suspected that this is the cause of the loss of drying, rather than the more obvious loss of air permeability. The conclusion has to be drawn that dirtying of first section fabrics is bound to affect drying as well as sheet quality, and ways need to be found to disperse the bitumen or clean the fabric.

SPEED DIFFERENCES

A lot has been written about the effect of speed differences both on the sheet itself and on the drive via the fabric.

The sheet follows a longer path around the bottom cylinders covered by the fabric and a shorter one around the top cylinders. However, with a fabric of maximum thickness (3mm) this difference is only 0.4%. There is also an effect from the top cylinders because they are at lower temperatures. For a 30°C difference (bottom 110°C, top 80°C) this only adds 0.03% to the speed difference. The elasticity of the wet paper will easily compensate for such differences.

Speed differences may also affect the drive and this is a far more important point. A good article concerning this is "Positive and negative aspects of Serpentine felt drying-benefits outweigh detriments" by Sam Palazzolo of Beloit (Paper Trade Journal, May 16th-31st, 1978). The several factors which can lead to failures of small idler shafts or bearings are reviewed in this article. These mechanical failure have occurred only in a few cases on machines over 6M wide running at above 700 m/min. To reduce the chance of gear damage fabrics should have maximum elasticity to absorb as much as possible of diameter variations, and such fabrics are available.

Because the problem areas of No Draw are the most interesting and most important for anyone considering it, this article may seem to give a "black" picture. However, it is true to say that No Draw has given benefits in the great majority of trials, with some running to better and no worse, and only 5 or 10% having had to return to 2 fabric operation. For the first section of high speed machines it is used on the majority of machines around the world and new machines have been starting up in this way for the last two years. On older machines the practical advantages of less breaks, less felt rolls, guiding mechanism etc., are equally of value. The paper machine has again proved how varied an animal it is, but in the majority of cases No Draw has led to increased production, less downtime and definite advantages to the papermaker.