RETENTION AND DRAINAGE AIDS –
From Laboratory Testing to the Real World!

Foto. Spiola

The use of retention and drainage aid systems has been well documented over the past 30-35 years. The chemistries available are now extensive and varied.

Technology has moved on from single addition cationic or anionic polyacrylamides through to the microparticle/micropolymer and multi microparticle systems available on the market today.
Identifying the correct retention and drainage aid system in conjunction with the most suitable addition points and the dosage levels required is an essential part of a supplier commitment to the customer.

Laboratory Testing
Free Drainage and Retention

The initial work focuses on determining which products are substantive to the papermaking stock. This is usually measured using free drainage testing. The equipment used for this type of testing would typically be either a modified Schopper Reigler or Canadian Freeness Testing apparatus (rear orifice blocked).

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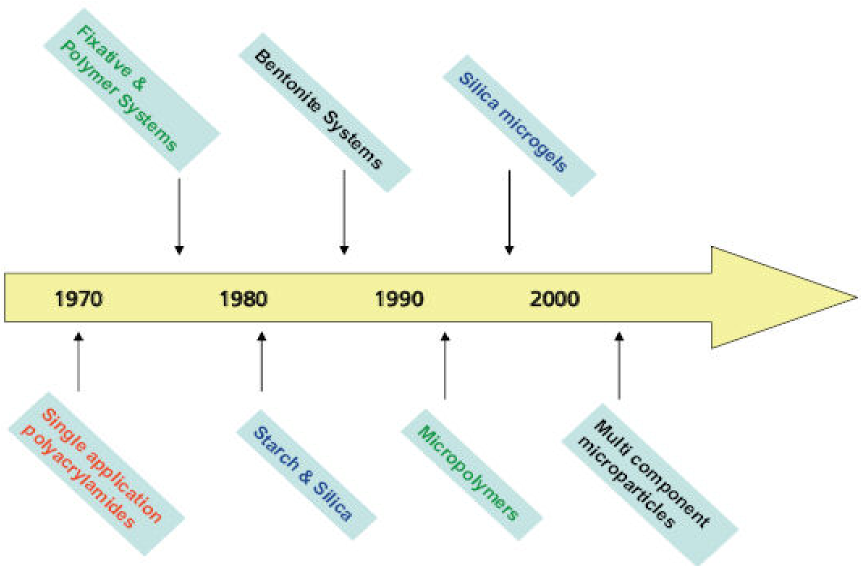

Key retention and drainage aid milestones:

The time taken for a fixed amount or amounts of backwater to drain through the apparatus can be taken leading to a plot of volumes of backwater with time. This data can give an insight into such areas as the initial dewatering level. This can be very important when working with Fourdrinier forming sections where rapid dewatering can lead to premature sheet setting and poor sheet formation.
To compliment the free drainage testing it has been traditional to then move forward with the best products/systems and test these for first pass retention and in some cases first pass ash retention. This is particularly true for paper grades such as uncoated fine papers.

The standard Britt Jar is used for first pass and first pass ash retention test work.

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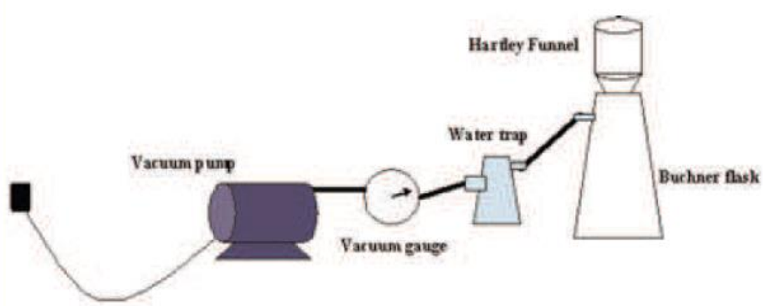
Those skilled in the art can with careful adjustment of addition point simulation and dosage predict how a system will perform under different wet end conditions and therefore recommend the best retention and drainage system for each machine and wet end chemistry.

For many paper machines and paper grades the above testing can be sufficient and during the testing the tester can gain a good insight as to which chemicals should be utilised and in which order and also how much of each should be used to achieve the requirements of the customer.
However for certain paper grades or more specifically paperboard grades further testing can reveal the true requirements needed from the retention and drainage aid system. Higher grammage grades particularly board grades need careful investigation.

The limitations of the free drainage testing become apparent as you continue to increase the dosages beyond those normally used on the machine. For all retention and drainage aid systems the time taken for a fixed volume of backwater to collect becomes lower and lower as the dosages are increased. See the graph above.

On the paper machine running systems at such high levels of flocculation (>1.5kg/t polymer) would tend to lead to poor sheet formation with areas rich in fibres and areas with very little fibre at all. As a consequence these large floccs would tend to give a wetter sheet entering the press section. This, as papermakers well know is an undesirable situation. The large floccs tend to drain very well in the wire section however these large floccs will tend to hold a substantial amount of water inside the flocc. This water can be very difficult and crucially expensive to remove in the pressing and drying sections of the paper machine.
Testing can be performed to differentiate between systems to see how wet the sheet will be entering the press section of the paper machine. In ACAT we call this vacuum drainage testing.

A Schematic for Vacuum Drainage testing



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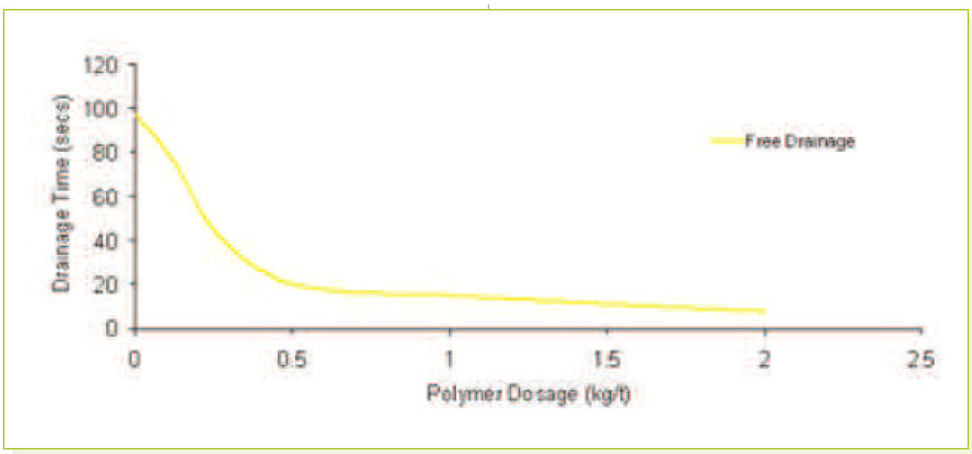
Vacuum Drainage

Vacuum drainage testing involves treating the paper machine stock in exactly the same way as for the free drainage tests. Instead of draining the stock through a Schopper-Reigler apparatus the treated stock is poured into the Hartley funnel and the drainage time under vacuum is measured along with the wet weight of the formed pad after drainage and the weight of the dried pad. From the latter two readings a percentage pad solids level can be determined. The higher the pad solids the drier the paper sheet will be entering the press section.

able to drain away very quickly. From the yellow curve the optimum polymer dosage could be considered to be ~0.5kg/t. Looking at the vacuum drainage results (pink line) the optimum polymer dosage would be in the region of 0.20kg/t which is substantially lower than for the free drainage. In the vacuum dewatering testing, dosages above 0.50kg/t give inferior vacuum dewatering performance. This is due to over flocculation of the stock leading to air being drawn through the pad rather than being used to remove the water.



A comparison between free drainage and vacuum drainage results can be seen in the graph above.
The free drainage performance of the system continues to improve as the dosage (polymer in the case) is increased. The floccs increase in size and the free water around the floccs is

From laboratory to the real world

A retention and drainage aid system was proposed by a competition company for trial on a paper board machine. The incumbent system was a microparticle system supplied by ACAT. The proposed system was based on very high molecular weight anionic and cationic polyacrylamides. The proposed benefit from the

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system was reduced white water solids and improved drainage.

Laboratory work showed that the proposed system would be very good at reducing the white water solids on the machine and that the free drainage would be very good also. However the vacuum dewatering results were very poor indeed.

The results of the vacuum dewatering tests are shown in the graph.

The pad solids for the proposed dual polymer system were significantly lower than those of the current microparticle system – at the same vacuum dewatering times. This suggested that the sheet would be much wetter entering the press section with the proposed dual polymer system.

The machine trial was run with the proposed dual polymer system the results are below.

The dual polymer system trial was stopped as production capacity was lost due to reduced machine speed. The machine speed had to be reduced so that moisture control could be achieved on the machine.

The laboratory vacuum drainage testing showed that the floccs formed by the proposed dual polymer system would hold water trapped inside them. As a consequence the floccs would be too large to press efficiently. This was seen in the machine trials.
The free drainage and retention testing in the laboratory was also exactly in line with the results achieved on the paper machine.

Laboratory work, when performed using suitable tests for the machine and the paper grades in question can give a great deal of insight into what will happen during a trial and beyond.

System	Wire drainage	Retention performance	Sheet solids to the presses	Machine speed
Microparticle system	good	good	good	good
Dual polymer system	very good	very good	very poor	machine speed reduced