

EKA'S Compozil FX System For High Speed Fine Paper Machines

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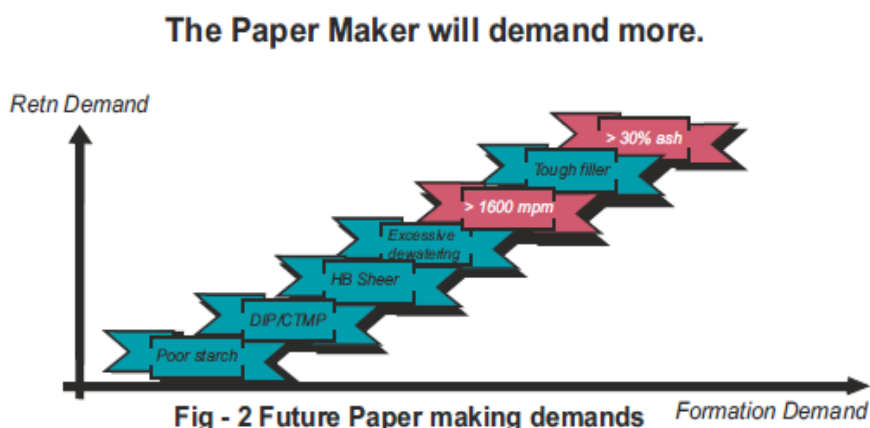
ABSTRACT

The **Compozil Fx** system was developed to meet the new customer demands of modern fine paper making. These include machine speeds in excess of 1500 mpm, target ash contents in excess of 30%, increasing use of recycled fibres, achieving stable retention with excessive dewatering and the retention of more challenging fillers. The Compozil Fx components are added and controlled to achieve agreed specific customer goals.

A key advantage of Compozil Fx is the ability to 'decouple' the retention and dewatering characteristics of traditional systems, thus providing the optimum balance between retention, dewatering and formation. This in turn has allowed the customers to enjoy cost efficient, stable retention at paper high ash and high machine speed conditions, leading to stable machine runnability optimum sheet quality. The ability of Compozil Fx to do this has allowed it to become the system of choice for modern fine paper machines in Asia/Pacific.

1. INTRODUCTION

Compozil is one of the well-known brand names for retention in the paper making industry. It has been introduced in the early 1980's to become a standard for many fine paper mills today. But, the currently used systems have only very little in common with the first version of silica based Compozil. Eka was only able to grow and gain additional market share through the continuous development and improvement of this system. Today, Eka is one of the biggest suppliers of silica based retention systems.



Un-coated Mkt 60mln t

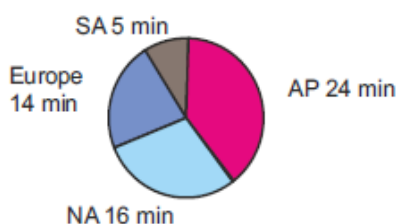
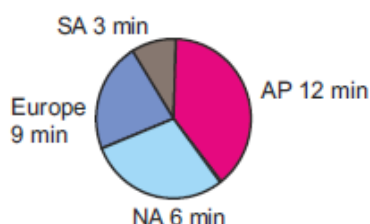


Fig -1 World wide fine paper market.

The development of Compozil has been most dominant on the fine paper segments. Currently the fine paper market has a production capacity of 90 mln tonnes, with a geographical split high-lighted in figure 1.

This fine paper market is expected to grow to 150 mln tonnes by 2020, driven

Coated Mkt 60mln t



by growth in China, India and Russia. This additional 60 mln tonnes will be produced on state of the art high speed machines, exceeding machine speeds of 2000 mpm, requiring a new generation of retention system.

The development of Compozil was, however, mainly driven by the continuously increasing demands of the market and they have been focussed not only on improved dewatering, retention and improved formation.

Independent of these very essential expectations, the new developments have had to cope with a number of other challenges such as:

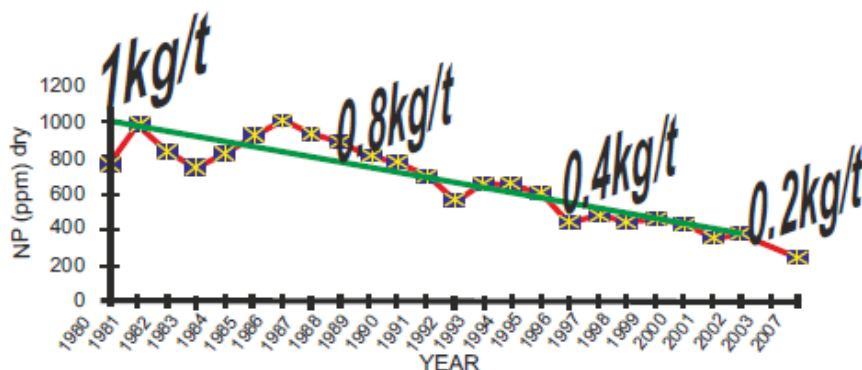
- o Continuously increasing speed of machines which gives only milliseconds time for chemicals to give the desired effects
- o Increased head box shear forces as a consequence of the high speed
- o Increased utilisation of recycled and CTMP pulps
- o Application of more challenging fillers as precipitated calcium carbonate (PCC)
- o Increasing proportion of ash content in paper sheet with the latest goal in many mills in Asia of over 30 % of PCC and GCC (ground calcium carbonate)

These demands are high-lighted in figure 2.

These challenges place extreme demands on the wet end retention, the sheet formation and on the machine runnability. Again, demands that can not be met with standard retention systems.

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Figure 3. Average dosage of silica sols per ton of paper (board)



Apart of these technical demands, paper mills looked also – as usual – for cost reduction. These market demands had the main impact on the development of more efficient silica sols and polymers which later were called the Compozil system. Today's systems are quite complex and a number of parameters have to be optimised during the trial period to achieve their full efficiency before implementation. How big the progress has been made can be observed best over the addition rates of the silica nano particles per ton of paper and board as shown in Figure 3.

Today, only one fifth of the silica sol amounts, in combination with new polymers, is needed to give the same if not better effect and this is achieved at considerably lower costs.

The combination of all these demands has resulted in the development of the Compozil Fx system.

2. Composition of the new Compozil Fx

The first version of Compozil Fx was introduced in Asia approximately 3 years ago. The goal for this version was to develop a system for high speed machines (> 1000 m/min) with considerably increased content of ash – up to 30 % of PCC or GCC and to reduce not only the production costs but also the costs of the paper board itself. Improvements of runnability or formation are always expected or at least these features shall not become worse.

Compozil Fx has today been fine tuned to give the optimum technical and cost performance. The components of this system are:

- Anionic trash collector, ATC
- Cationic polyacrylamide, Cpam
- Anionic polyacrylamide, Apam
- Nano Particle silica sol NP

These are added and controlled to achieve agreed specific customer goals.

3. The Compozil Fx mechanism

3.1. Dual polymer and nanoparticle system To understand the new improvement and progress which has been made the precursors of Compozil Fx are introduced first starting with the

dual polymer system as shown in Figure 4.

The system comprises of ATC which is added very early to be adsorbed mainly on filler but also on furnish – typically to white water – followed by cationic polyacrylamide to build flocs. These flocs can be easily destroyed under the shear forces in pumps and screens to be again flocced under influence of anionic polyacrylamide which is added typically after cleaners.

The nanoparticle system differs only – as shown in Figure 5 – that cationic starch as alternative for cationic polymer can be used and instead of the anionic polymer an anionic silica sol is used. The Eka NP is typically added very late, even later than polymers, just before the head box – after pressure screen.

3.2. Fx system

The next few figures show the mode of the Compozil Fx system action. While the operating window for such a complex system is rather big it has to be always optimised to achieve highest efficiency and the most economical way to use it.

Figure 4. Dual polymer system

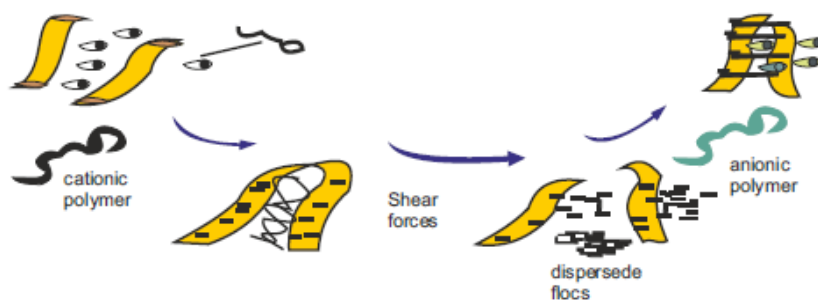


Figure 5. Nanoparticle system

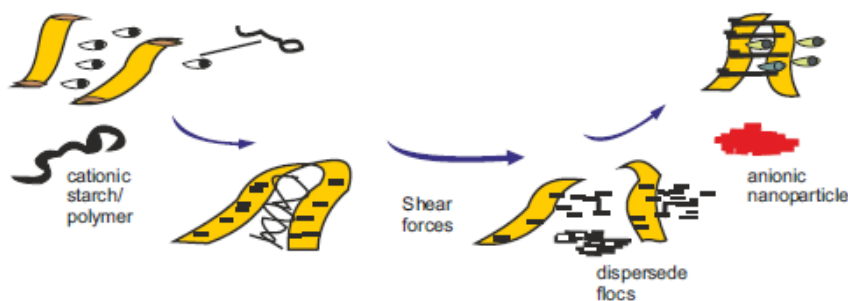
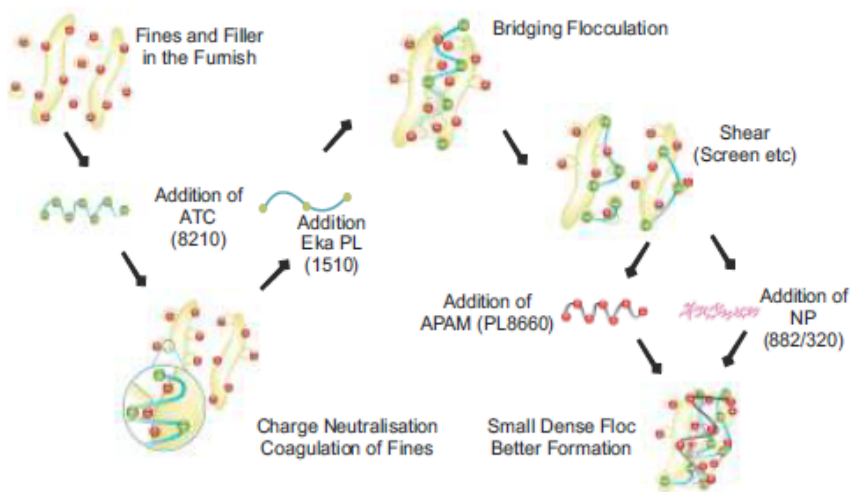


Figure 6. Compozil Fx System



Cationic starch can probably also interact here with the anionic PAM as seen in other applications

As a result the anionic PAM contributes to an overall retention through interaction with the cationic polymer (dual polymer mechanism).

This complex system gives more flexibility: C-PAM amounts can be reduced to reduce fiber-fiber flocculation and to give improved formation while retention can be still controlled by the A-PAM interaction with the furnish components.

In very simple words: this system can be described as nanoparticle system which is enhanced by the effect of

The Compozil Fx system is a system comprising of ATC, cationic polymer and/or starch and anionic polymer and nanoparticles as shown in Figure 6. The addition points are as follows: PAC as ATC is added as in the other systems very early into furnish white water to allow its adsorption on the fibres and filler. It is believed that both - PAC and/or other organic ATC - are preferably adsorbed onto the fines and filler.

In the next step cationic polyacrylamide is added to initiate flocculation. In this step called bridging flocculation – the interaction of fibre and filler with the cationic polymer of high molecular weight – a big part of furnish is floccled (to “loose flocks”).

Since the forces keeping these flocks together are not very strong they re-disperse under the high shear of the pumps and screens. The addition of the anionic silica (Figure 6) in combination with anionic polymers leads again to a very rapid and strong flocculation and to the much more stable flocks which resist very high shear forces (dense flocks).

A more simplified view of the Compozil Fx system shows that it is simply an extension – of the standard polymer or nanoparticle systems. Addition points for PAC and C-PAM are more or less the same and their function has not changed. The big change is the use of starch and of the combination of silica sol and anionic polymer in a structured way with the other additives.

Figure 7. Retention of GCC versus PCC with Compozil FX

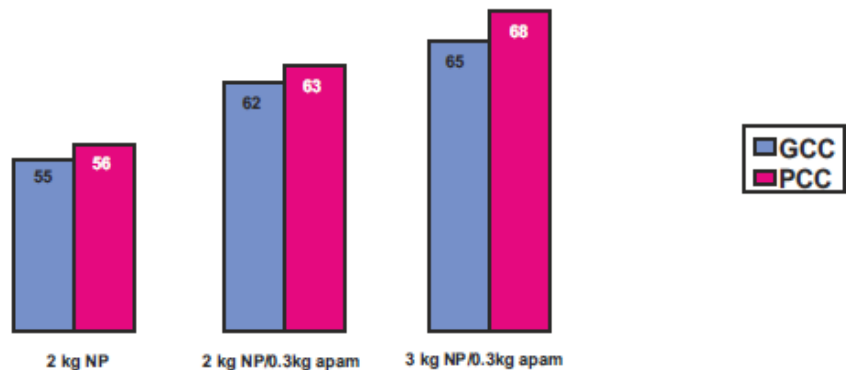
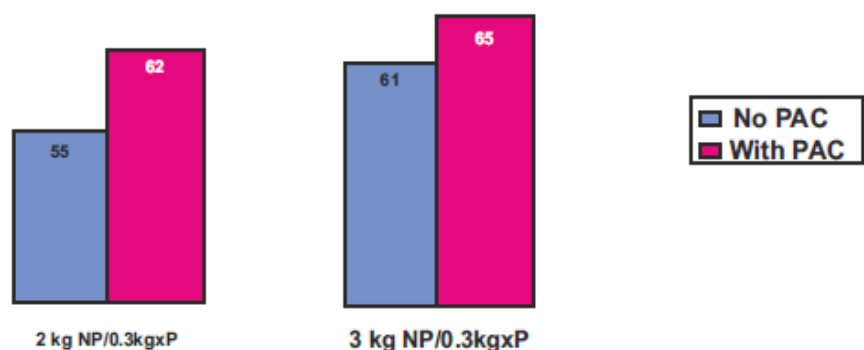


Figure 8. PAC effect on Fx retention



There are some new effects not seen before:

It is believed that anionic polymer can interact between cationic aluminum sites on filler and excess of cationic sites on C-PAM

anionic polymer (dual polymer mechanism). No need to stress that the addition sequence plays the key role in the system and allows for some selectivity in filler and fines retention.

3.3. Lab investigations with Compozil Fx- There are meanwhile some general rules worked out in the laboratory for the use of Compozil Fx. These have

then been tested and verified in numerous paper machine trials.

Two lab evaluations show how effective Compozil Fx is if applied on GCC versus PCC filler. They demonstrate also a powerful effect of PAC. Both effects are measured as retention in dependence from addition levels. For both systems standard conditions have been applied: 200 ppm C-PAM, 8 kg/t Cstarch and 500 ppm PAC is used.

The new system is generally a little bit more efficient on machines which use PCC instead of GCC. The effect can be strongly improved for both fillers with small amounts of anionic PAM. Further increase of silica sol from 0.2 to 0.3 % gives another boost especially on PCC which increases from 63 to 68 % as shown above.

The retention can, however, be considerably improved in much cheaper way over the addition of PAC as shown in Figure 8. The retention effect can be improved from 55 to 62 % by the addition 500ppm of PAC when 2kg NP and 0.3 kg apam are utilised. The impact of the PAC addition can be

used to replace 1kg/t of extra NP, a very cost effective replacement.

General application strategy

A key advantage of Compozil Fx is the ability to 'decouple' the retention and dewatering characteristics of traditional systems. Increasing retention usually means increasing dewatering and this then being at the detriment of formation.

Two examples listed below show how many options are available to adopt this system to any high speed machine and demonstrate its capability and flexibility.

In figure 9 on the Schopper Riegler dewatering and on the retention in % (FPF) are measured. The addition of apam is constant during the trial with 0.3 kg/ton and the NP amount increases from 1 kg to 2 kg and 3 kg/ton. The observed effect: with increasing amount of NP the dewatering can be improved from 450 mls to 530 mls but retention increases to 65 % compared to 55 % at 1 kg NP or 57 % of reference. Thus higher retention no longer means

excessive dewatering and the subsequent deteriorated formation.

To make these effects better understandable and comparable the next figure presents lab results of trials where dewatering is presented as a function of retention. In both trial rows one of the components is kept constant and the other one is continuously increased. The steepness of the lines says about the effects: increase (change) of the addition of the apam at fixed amount of NP gives big changes of retention and minor changes of dewatering and opposite: increase of NP amounts at constant amount of apam causes big changes in dewatering and minor ones in retention as shown in Figure 10.

NP is used to enhance the dewatering and the apam used to enhance the retention. Together these two chemicals can be adjusted to find the optimum formation.

Since 2005 Eka has gained with this system 17 new machines, producing over 3,5 mln tons production in the Asia/Pacific region.

Figure 9. Control of dewatering and retention with Fx

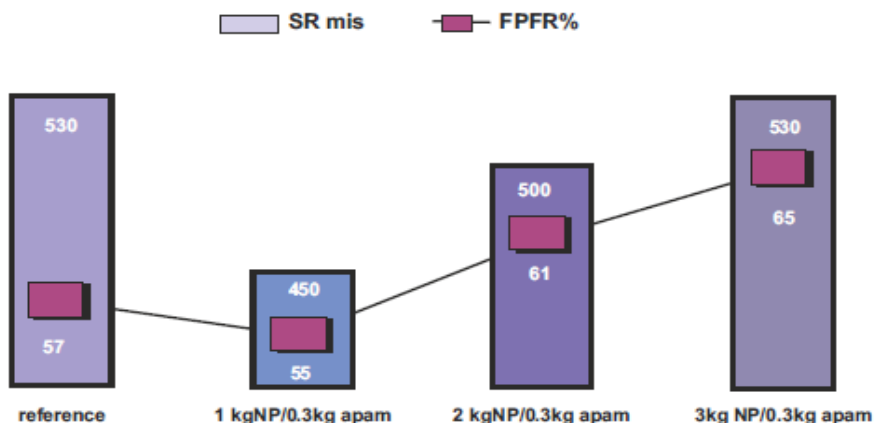
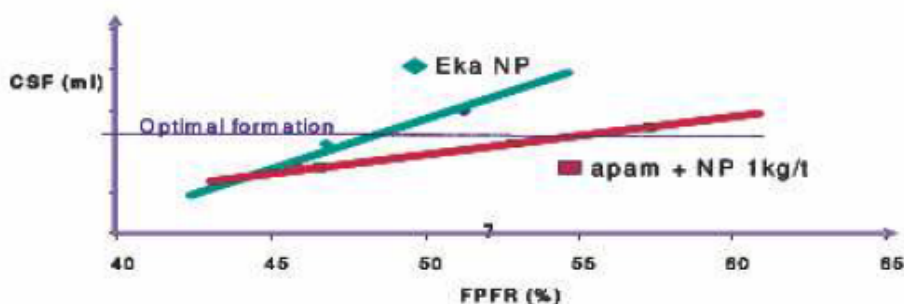


Figure 10. Application strategy



Case studies

5.1. Compozil Fx on high speed fine paper machine- The addition points for all chemicals are shown in Figure 11. This production is run since a couple of years on 10 m width gap former machine with the production of 80 t/h and speed of 1500 m/min. Printing and writing paper with 20 % of PCC is produced without any problems on this machine since 2005 .

The benefits of the transfer to Compozil Fx against the other system are summarised in Figure 12. The ash retention has been improved by 5 points and the amount of added chemicals has been reduced considerably: NP by 30 % and C-PAM by 40 % meaning cost savings in total of 20 %. Additionally, AKD and OBA have been reduced and runnability of machine improved.

5.2. Compozil Fx on coated base paper machine (CBP)

The other conversion demonstrated on the gap former machine with width of 8 m which is run at the speed of 1200 – 1250 m/min and which produces up to 40 t/h of coating base fine paper. The produced quality contains 9 – 13 % of GCC. The addition points of the most

Figure 11. Compozil Fx on high speed fine paper machine

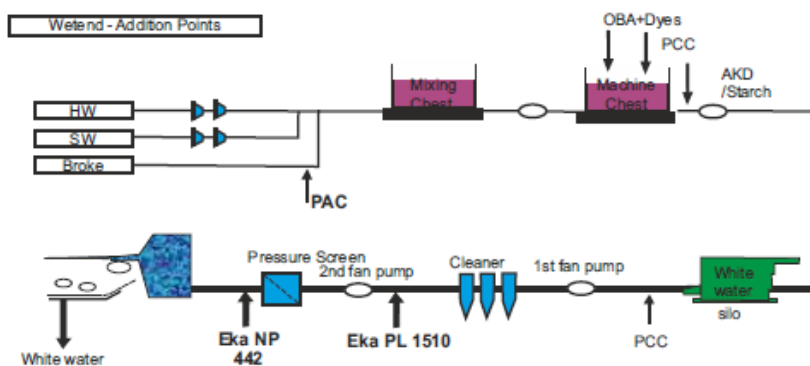


Figure 12. Benefits of use Compozil Fx

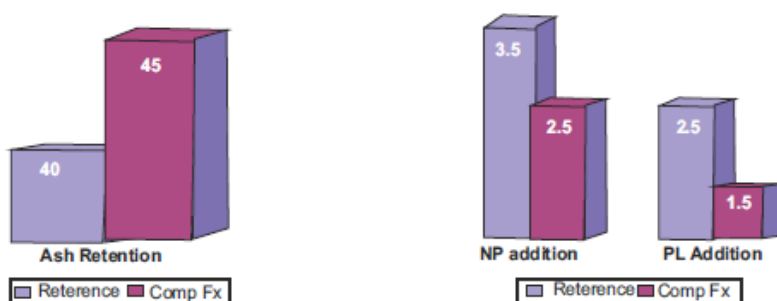


Figure 13. Compozil Fx on coated base paper machine (CBP)

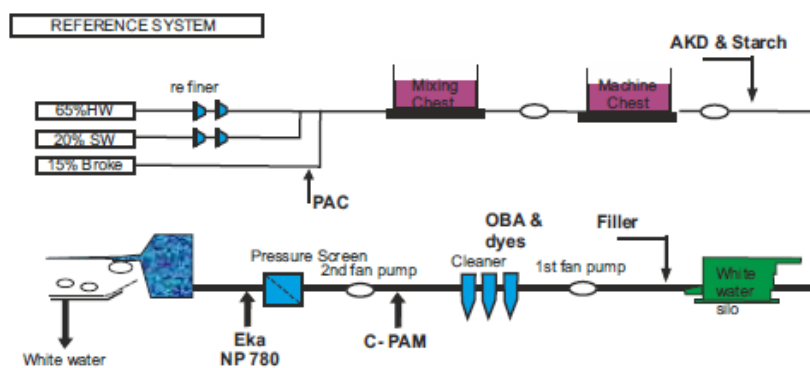
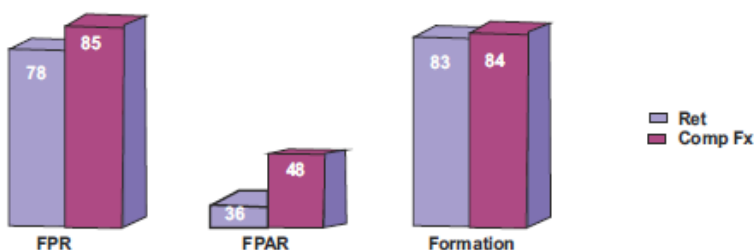


Figure 14. Benefits of use Compozil Fx (1)



important chemicals as shown in fig.13.

The result of this conversion for retention and formation is summarised on the 70 gsm quality – in fig. 14.

The total retention was improved by 7 points, but what is more important: the ash retention was improved by 12 points without any detrimental effect on formation. The savings for this conversion are summarised in Figure 15.

There is an additional cost of the new anionic polymer Eka PL 8660. But the amount of added silica NP was reduced by 45 % and C-PAM by 34 %. Keeping in mind that anionic PAM is a relatively low application cost within the system it is also here clear that considerable net cost savings has been achieved.

5.3. Compozil Fx versus competitors
Both examples mentioned before have shown the improvements which have been achieved against own Eka system. It is also interesting to have a look how competitive this system in the market is.

The conversion – it means Eka has gained this customer – was again finalised on gap former machine of 6 m width and speed of 1350 m/min. This machine produces Coated base paper with 14 % of GCC and up to 20 % of CTMP. The addition points to the system shown in Figure 17.

The introduction of the Compozil Fx system brought a number of improvements:

The number of reels with more than 10 holes per reel went down from 42 to 7 (per month)

The number of breaks per month went down from 38 to 26

The ash retention was improved by 4 – 5 points

The amount of added C-PAM was reduced by 20 %

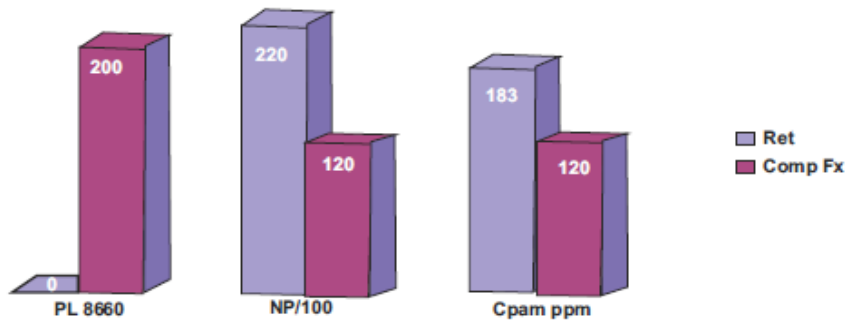
The addition levels of sizing agent (AKD) was reduced considerably

The runnability and brightness have been improved

Summary and Conclusion

The demands from modern paper

Figure 15. Benefits of use Compozil Fx (2)



making of increased sheet ash and increasingly higher machine speeds, in conjunction with lower cost fibers and cheaper starches have put pressure on the machine retention, formation and runnability. The Compozil Fx system has been developed to not only meet these challenges but also to offer improved cost efficiency. Its ability to do this has allowed it to become the system of choice for modern fine paper machines in Asia/Pacific.

Figure 16. Compozil Fx versus Competitive micro-particle

