

Working Experiences with the TWIN-HSM

Kringstad Hans,* Emilsson Per* & Paczkowski Mike**

ABSTRACT:- The new transfer coater, TWIN-HSM, has now been in operation in the field for three years and a half. The TWIN-HSM is today used in the following applications:

- * *Surface treatment/ coating on extremely low grammage woodfree base paper.*
- * *Surface treatment/ coating on recycled base paper.*
- * *Precoating of on-line double-coated fine paper.*
- * *Pigmenting/ coating of on-line coated fine paper.*
- * *CF coating of on-line coated carbonless paper.*

The principle of the TWIN-HSM technique is described, and the main differences in comparison with premetered size presses are explained. The paper also presents experiences from the field and the pilot line.

Production aspects like: coatweight and coatweight distribution control, appropriate formulations, film splitting, service life, maintenance, speed, moisture, fiber picking and runnability are highlighted. It also deals with the results obtained by surface treatment of recycled base papers (mainly recycled newsprint). The treatments referred to are: surface sizing, pigmenting and coating.

The characteristics are compared with other "new graphical qualities", standard SC, and LWC papers at a basis weight of 60 g/m².

Considerations of the printing operation are also presented.

TECHNIQUE

Installation Layout

The TWIN-HSM allows great freedom and flexibility in choosing the layout. The web can run through the coater upwards or downwards. Most of our recent installations have an upwards web run as illustrated. This layout offers a number of benefits.

Application of color

The coating is metered into the pond on each side between the HSM roll and the transfer roll.

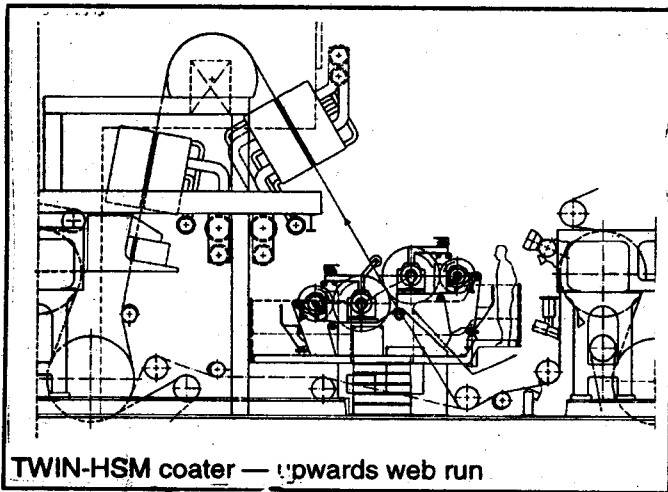
Premetering

The main technical innovation of the coater is the premetering technique. The premetering is done with a wire-wound roll

The most important advantages are the possibilities of **volumetric premetering** and **long**

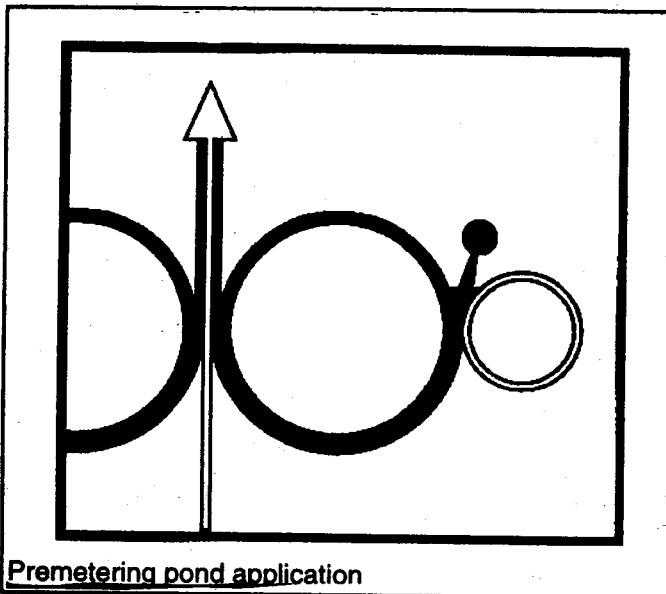
* **BTG Coating Systems**
Saffle, Sweden

** **BTG Inc.**
Atlanta, GA, USA



service life. The premetering is not, in practice, 100% volumetric. There is also a hydrodynamic component involved. Our experience though is that the best quality and distribution are achieved when the hydrodynamic component is minimized. The volumetric premetering gives a stable coatweight at low speed as well as at high speed.

Results from pilot trials give the following data:



Case one: Speed of 800 and 1100 m/min. pigmenting of old newsprint (ONP) base. The coatweights were 15.7 and 16.2 g/m² respectively.

Case two: Speed of 1000 and 1400 m/min. pigmenting of wood containing base. The coatweights are 5.2 and 4.8 g/m² respectively.

The same coatweight at high and low speeds demonstrates that the premetering was volumetric. It resulted in a good distribution in both cases at both speeds.

The HSM-roll is 400-700 mm in diameter, depending on the width and speed of the machine.

Transfer

The transfer to the paper or board is done with the transfer rolls. The TWIN-HSM offers the possibility of using a very soft rubber quality, as well as hard rubbers. The rubber hardness and the linear nip pressure determine the specific pressure at the transfer point. The specific pressure is important for the final quality of the coated or surface treated paper.

Rubber quality impact

- * Soft rubber gives:
 - low specific transfer pressure
 - good runnability
 - surface located coating
 - high coatweights
 - moderate dewatering
 - less dependence on water retention
- * Hard rubber gives:
 - high specific transfer pressure
 - less than optimum runnability
 - penetration
 - longer service life of transfer roll

Soft Rubber

A low specific pressure at the transfer point gives a more gentle transfer of the coating or size. This means that the dewatering is less developed. This makes it possible to run with higher solids level and higher pick-up without creating a film split pattern due to dilatancy.

The runnability of the paper is improved due to the fact that more of the dry strength of the base is kept. The low penetration by low specific pressure means that it is possible to run formulae with lower viscosity and still get a surface located treatment. The tackiness of the size will be less developed in the transfer zone, since it is less dewatered. This means that the forces on the paper are less in the

transfer zone, resulting in better runnability and less fiber picking.

Hard Rubber

Hard rubber is used when penetration is needed for improvement of the internal bond. This could be the case for high basis weights combined with weak fibers in the furnish.

Applications

The TWIN-HSM is versatile, and in the table below there are some guidelines for normal conditions in different applications.

In case A, an extremely low amount of surface size is used in order to avoid linting. In such applications, it is important to apply the size at the highest possible solids level. The solution is normally very low in viscosity, and the properties of the surface and pattern are less important. This allows us to go for the hydrodynamic premetering, which is achieved by a smooth premetering surface or a small premetering wire diameter. This surface sizing mode is similar to the surface sizing done on newsprint paper in Japan.

When a higher amount of surface size is of interest, as in case B, a pattern-free surface becomes more important. In this case we need to change to the volumetric method, using a wire-wound metering roll to accomplish the premetering. Cases C and D can be characterized as normal pigmenting and coating operations. Here a good coverage and pattern-free surface are essential. This calls for volumetric premetering.

In actual mill operation, surface sizing, pigmenting and coating are normally carried out without changing the wire diameter. The 0.43 mm wire size has been found to be ideal in most machines.

PRODUCTION ASPECTS

Coatweight/ Distribution

Control of Coatweight:

The coatweight is dependent on:

- * wire diameter
- * rubber hardness
- * solids/ viscosity
- * to a limited degree premetering pressure

The coatweight is in principle not controlled by any mechanical adjustments of the coating machine during production. This has a positive effect on the stability of the coater itself, and the variations in applied amount of coating will be small both in the machine and cross machine directions. There is, however, a small amount of coatweight control available by the adjustment of premetering pressure.

Cross Profile Adjustment

The cross profile is controlled with a skewing mechanism. This is described in the following diagram:

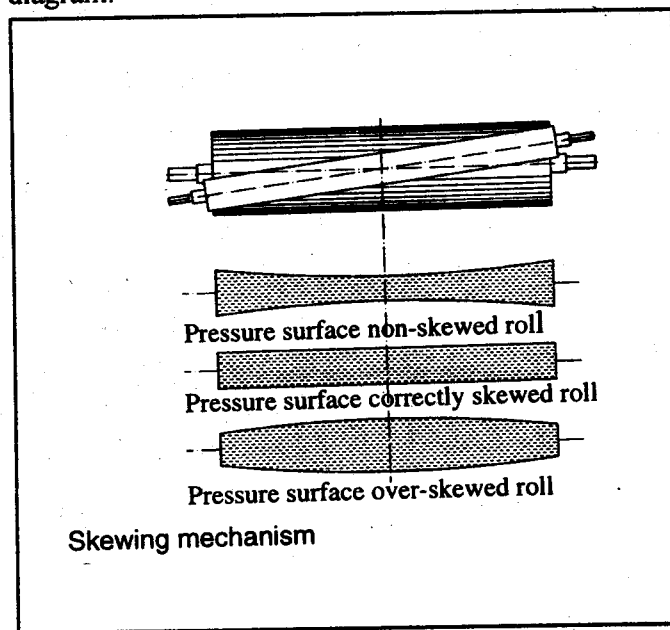


Table-1

Guidelines for Different Applications

Case	Application	Coatweight	Function	Solids	Viscosity	Wire diam.
A	surface sizing	0-0.3 g/m ²	avoid linting	0-5%	20 cPs	0.0-0.25 mm
B	surface sizing	0.5-1.5 g/m ²	linting printing	5-15%	150 cPs	0.25-0.43 mm
C	pigmenting	2-6 g/m ²	printing & optical characteristics	20-45%	50-400 cPs	0.35-0.43 mm
D	coating	6-12 g/m ²	precoat C-2-S	45-64%	100-1200 cPs	0.43-0.6 mm

The linear pressure between the metering roll and the transfer roll is adjusted to achieve the best coatweight profile. As previously mentioned, the nip width in the premetering zone has an influence on the amount but it also has an impact on the premetered film quality. Our experience is that the film is best when a mirror-like application is achieved on the transfer roll. Another sign of good premetered quality is when the HSM-roll returns clean after the application of coating to the transfer roll.

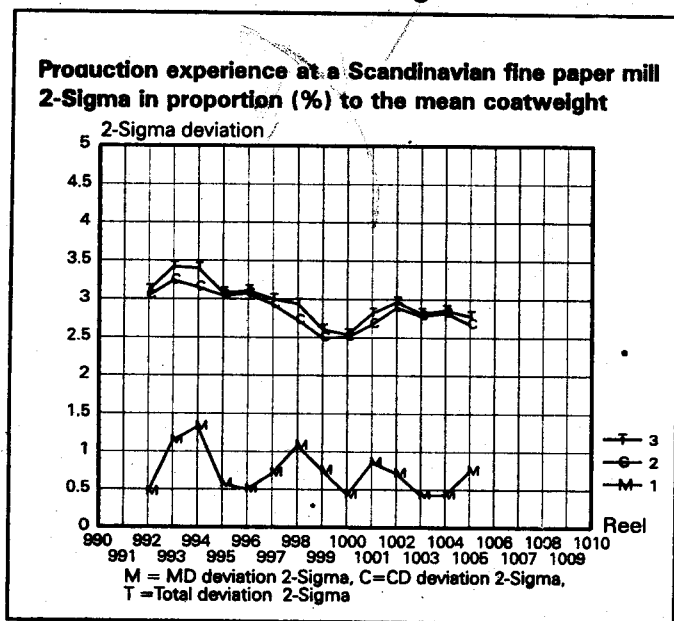
Machine Direction profile

The coatweight is dependent on the solids level of the solution. This means that the coatweight is as stable as the solids content in the coating system. Due to the nature of the premetering, (major premetered amount stays with the paper and a minimum amount is returned), it is clear that the color or size system is not dewatered. Therefore the solids level and mix are stable.

CD/MD Deviation within the reels (mill experience)

We have got data from a Scandinavian mill describing the coatweight by production of 14 reels of one paper grade with a total coatweight of 28 g/m². The data concerns the production of reels 992 to 1005. The data are gathered by the Lippke measuring systems.

It can be seen in the diagram below that the



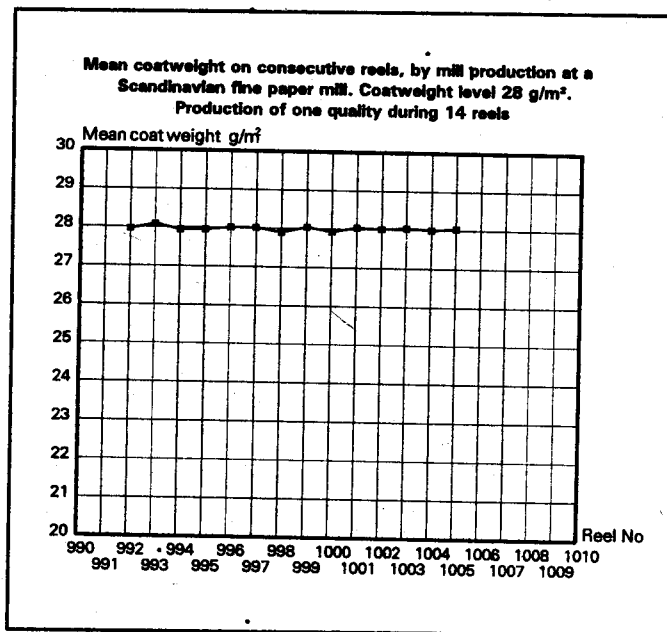
2-Sigma deviation in CD-direction (C-curve) is expected to be lower than 3.5% of the mean value. The 2-Sigma MD deviation (M-curve) within the reel is lower than 1.5%.

The total deviation (T-curve) is an expression for both the MD and CD deviation within the reel. The 2-Sigma total deviation is less than 3.5% of the mean coatweight.

MD-Deviation between the reels (mill experience)

The deviation of the coatweight in the machine direction is stable due to, as mentioned above, the volumetric premetering followed by the indirect transfer giving stable color system.

The diagram below describes the mean coatweight level in the above mentioned 14 consecutive reels by the production of one paper quality. The target coatweight level was 28 g/m².



The mean value of the coatweight is 27.996 g/m²
 The standard deviation is 0.0522 g/m²
 The minimum is 27.9 and the maximum is 28.08.

This means that the deviation of the coatweight between the reels is 0.37% of the mean weight expressed in 2-Sigma.

It can be concluded that, as expected, the deviation is very small between the reels.

Film splitting

Roll coaters and size presses are well known to create film split. This is especially true for the standard size press. Film split can be classified in two categories:

- * the ones caused by too much coating applied on the surface in relation to the base paper absorbency
- * the ones caused by dilatancy

This means that there are several ways of avoiding film split:

- A press the premetered coating amount into the body of the sheet or increase the absorbency of the base paper
- B apply less
- C avoid dilatancy at the transfer point.

The TWIN-HSM has all these possibilities. A and B mean that the surface coverage will be less well developed. The way of avoiding dilatancy in case C, is to dewater as little as possible at the transfer point by low specific pressure.

Formulations

The TWIN-HSM is used for applying standard formulations typical for both size press applications and blade coaters. The normal behavior of the color is shear thinning.

Service life of the metering surface

The long service life of the metering surface is mainly due to the large diameter of the metering element itself.

Stainless steel wire

The special stainless steel wire will last for a very long time, if the applied solution is a size. In Spain, one BTG installation has experienced a two year wire life on an HSM roll applying starch.

With abrasive coating colors at high solids level (60%) and high speed, approx 800 m/min, a "worst case" service life of 10 days can be expected.

Chrome plated HSM surface

The latest development of chrome plating of

the HSM surface gives a life time of 40 days by abrasive colors at high solids and high speed, 800 m/min.

Maintenance of the HSM-surface

The wire winding is normally done at the mill. The chrome plating is carried out by a sub-supplier. (The cost for the wire is approx US\$ 600 for a 4 m wide HSM roll. The cost for the chrome plating is estimated at US\$ 2.100 for the same width).

Speed

The TWIN-HSM is used today at speeds up to 750 m/min commercially on recycled base from 35 g/m². It is also run at 600 m/min on very low basis weights (22 g/m² woodfree).

In pilot trials BTG has run 1400 m/min on a wood containing, low basis weight paper

The fastest TWIN-HSM in operation (Oct 1995) is running at 850 m/min and is producing CF coated and backside starch treated paper.

Fibers in the coating system (fiber picking)

There is a well-known problem concerning the premetered size presses. The problem is that the surface treatment of a base paper, consisting mainly of recycled fibers, results in the collection and retention of fibers in the color system.

During the initial production period of the TWIN-HSM, BTG experienced the same phenomena, but improvements in the applicator have eliminated the problem associated with this phenomena. Another remedy is to decrease the tackiness of the starch itself. Filters in the return flow are also essential.

Moisture into the coater

A base paper of recycled fibers is strongest when the moisture level is about 8%.

The deviation of the moisture is normally greater at the 8% level compared to the 2-3% level, which normally would mean greater pick-up deviation at the 8% level.

However, in our premetering system the premetered amount is mostly applied to the paper.

This means that the transferred deviation is as good as in the premetered film. The distribution by premetering is very uniform due to the volumetric principle. We can therefore allow a base paper with a moisture content of 8% (strong sheet) into the coater. However, from a drying point of view the moisture content (%) of the base paper entering the TWIN-HSM should be lower than the final moisture content (%) of the coated paper on the pope reeler.

Calendering

The products coated in transfer coaters are normally on-line products. The surface will come out better by soft calendering compared to steel roll machine calendering. The steel roll machine calendering develops, in a lot of cases, a galvanized structure in the surface. The steel roll machine calender demands a better formation.

The on-line roll coated sheet can also be combined with super calendering. This is especially of interest when producing paper for rotogravure printing. There is an ongoing development of on-line soft calendering for achievement of higher pressure and temperatures. This is being done to achieve near

super calendering effects.

New graphical paper qualities

The TWIN-HSM offers the possibility of combining types of fiber furnish and surface treatments, which has been impossible up to now.

A base paper of recycled fibers has normally low dry and wet strength properties. The good runnability of the TWIN-HSM is therefore very important for the development of surface treated or coated recycled base sheets.

BTG has, together with the paper industry, made a study of this and evaluated the new possibilities.

Recycled base

In the study we investigated three different treatments: surface sizing, pigmenting and coating on a base with a furnish consisting of recycled fibers (26% recycled news +12% recycled SC +12% recycled LWC +42% groundwood +8% longfiber). The results are presented in table 2 on the opposite page.

Table-2

Upgraded Newsprint Paper (Base recycled fibers), TWIN-HSM

Characteristics	Base Paper	Surface Sized 0.5+0.5 g/m ²	Pigmented 5+5 g/m ²	Coated 8+8 g/m ²
Grammage g/m ²	49	50	59	65
Brightness %	61.4	56.6	62.2	67.7
Opacity %	96.3	94.7	96.7	97.4
Gloss %	13	27	40	48
IGT pick cm/s	15	62	60	53
Print gloss %	26.4	53	69.8	72.7
Smoothness PPS	3.4	2.2	1.7	1.9

New Graphic qualities in comparison with standard products

Characteristic	TWIN-HSM treated products			Commercial product	
	Pigmented newsprint TMP based 5+5 g/m ²	Pigmented newsprint recycled furnish 5+5 g/m ²	Surface sized SC base 0.5+0.5 g/m ²	Standard SC	Standard LWC
Grammage g/m ²	59	59	58	60	60
Brightness %	61.2	62.2	66.7	67.2	72
Opacity %	96	96.7	95	93	91.5
Gloss %	36	40	42	26	55
IGT pick cm/s	88	60	62	30	52
Print gloss %	70.8	69.8	48	49	74
Smoothness PPS	1.7	1.7	2.2	1.3	1.3

The paper was soft calendered (two nips) before printing. The main rule of the calendering was that it should be easy to apply in a mill, meaning low temperature and low linear pressure.

From table 2 on page 7 it can be concluded that a surface treatment or coating means:

Print gloss

The print gloss becomes much higher by the surface treatment and coating.

Surface strength

The surface strength is also improved by the surface treatment coating operation.

Smoothness

The surface treatment gives a smoother surface compared to the untreated base. A light soft calendering results in a smoothness level of 2.2-1.7 PPS.

Opacity/ brightness

A pure surface sizing with starch results in a lower opacity and brightness. Increased amount of pigment recovers and improves these characteristics.

The quality achieved on recycled base paper was compared with the quality achieved by treatment on base paper from:

(1) 100% virgin TMP fibers and (2) base for SC-paper. It is also of interest to compare a couple of standard qualities (LWC and SC) with the new generation of printing grades at the same final basis weight 60 g/m². The table above shows the characteristics.

The pigmented newsprint in general gives an interesting high print gloss on a matt surface. It also has high opacity. The combination of matt paper and high print gloss is very interesting. The achievements on recycled base paper are not far from that of virgin base. The main difference is the higher surface strength of the virgin base. Another difference is the presence of spots in the deinked fiber furnish (deinking procedure is essential).

There was no exact testing data done for the

stiffness of the paper, but a subjective feel shows it to be high. Another good property is the good print-through characteristic.

The surface sized SC paper was only soft calendered. Supercalendering would have improved the quality.

Printing of the new generation of newsprint papers

The surface treatment means that the absorbency of the base paper is changed. This means that the drying sequence after the print operation is slower. This has created a problem with the printing in cold set web offset. Ink set off is observed during the folding and cutting of the printed paper. There are two ways of solving the problem:

- * install drying facilities in the printing machine (go over to heat set web offset)
- * design the coating formula to be more absorbent.

We have made trials using formulations with a very absorbent characteristic. The interesting result is that it is possible to create a much faster ink set even compared to the non-treated sheet. Another interesting experience is that the amount of ink absorbed is accurate. Meaning that if the right amount of ink is applied, then the absorbency is done quickly and the dots are very well defined, giving a better sharpness of the pictures.

To get the most advantage of the better surface of the new generation of newsprint paper, new printing inks have to be used. New types of environmentally friendly inks are being developed for this very purpose.

Offset/ rotogravure

The quality achieved with TWIN-HSM or a premetered size press is well suited for offset printing. However, a roll type of coater or premetered size press does not give the same surface smoothness as a blade coater. A very smooth sheet is a normal demand for rotogravure.

However, BTG already has the TWIN-HSM operating in the production for some specific super-

calendered packaging paper for rotogravure printing. This is achieved by the choice of base furnish and by optimizing the coating formulation and coat-weight pick-up.

The future

We are only in the beginning of the develop-

ment of the new generation of printing grades. A trend to install drying equipment in the newsprinting machines for the drying of inks has already started.

The TWIN-HSM has opened new possibilities!