DIP Technology for Cost Effective Printing and Writing Paper Manufacturing

Jukka Heimonen[1], Jouni Kaartoluoma[1] and NK Jain[2]

Costs for paper making have been increasing globally. However, as the final products' price trends show, markets have not enabled to compensate the increased cost structure. Operational costs for a specific furnish system consist of fiber raw material, electricity, chemical, steam, fresh water, white water and effluent treatment, waste and reject treatment, labor, and maintenance. Share and total sum of these costs vary geographically due to the availability of utilities and also depending on the legislation (taxes, environmental permits). In many areas, the availability of proper raw material, fresh water and electricity is limited, which affects also the cost of utility and makes the cost structure volatile. As well as industrial challenges also the competition is global. In India and in other regions local strengths and weaknesses must be recognized and the local strategies for sustainable business development must be found.

Depending on the paper grade, furnish costs can be up to 50...70% of the total variable manufacturing costs. Thus, the stock preparation plant which value is a fairly small fraction of the total papermaking line investment, is responsible for a major share of manufacturing costs. The conceptual and operational decisions made at stock preparation have also a major effect on PM runnability and total mill efficiency.

In this paper will be reviewed the tools to reduce DIP production costs for different printing and writing paper grades. Special attention is put on conceptual options and the latest development in different unit processes, especially highlighting the factors affecting system energy consumption and yield.

INTRODUCTION

Furnish costs can be up to 50-70 % of total variable manufacturing costs. The stock preparation plant, which value represents a fairly minor fraction of the total papermaking line investment, is thus responsible for a major share of total manufacturing costs. Conceptual and operational decisions made with respect to stock preparation also have a major effect on final paper quality, PM runnability and total mill efficiency.

The volatility of global paper markets and especially, the trend of decreasing market price, have caused that total furnish costs play an increasingly important role. Final product price trends (Figure 1) have been decreasing most of this decade while printing quality demands have simultaneously been tightening. That has driven both paper manufacturers and technology suppliers to search for more economical ways to meet the market's demands.

Furnish system operating costs consist of fiber raw materials (major factor), other utilities (electricity, chemicals, steam, fresh water), "auxiliary processes" costs (waste and reject treatment, white water and effluent treatment), maintenance and labour.

* Metso Paper P.O. Box 125,
37601 Valkeakoski, Finland
• Metso Paper India Private Limited
6th Floor DLF Gateway Tower DLF City Phase III
Gurgaon - Haryana - 122002 India

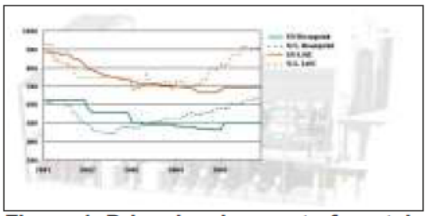


Figure 1. Price development of certain paper grades [1]

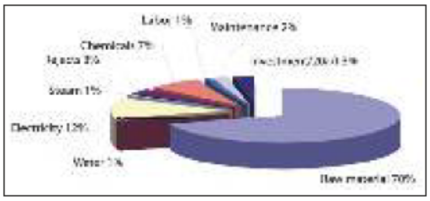


Figure 2. Example of DIP manufacturing costs

The relative shares and total amounts of these costs vary locally depending on the availability of utilities and on national legislation (taxes, environme--ntal permits). The availability of appropriate raw materials, fresh water and electricity is limited in many areas, which also affects the cost of utilities and makes the overall cost structure volatile:

- Recycled fiber raw material (ONP, ONP/OMG, SOW) ~ \$80-200/t
- Mechanical wood raw material ~ \$50-60/m^3
- Chemical pulp BHKP/NSKP ~ \$600/t
- Electricity \$36-100/MWh
- Fresh water \$0.2-2.2/m^3
- Steam \$9-12/MWh
- Reject disposal -\$24/t (sold to other mills) to +\$120/t (worst case, i.e. Landfill)

As the global competition has tightened it has become more and more important to utilise local (India, China, EU, US, etc.) strengths and at the same time to put more efforts to manage with local drawbacks. In some area e.g. the raw material cost/availibility/quality can be a strength and labour cost a disadvantage and vice versa. These factors affect also conceptual issues by simplifying or making the system more complex to fulfill the local customers' requirements.

The following section explores DIP concept options. After that, special attention is paid to the Latest development in chosen unit processes especially highlighting energy and yield aspects. Finally, experiences with existing papermaking lines and production strategies are addressed.

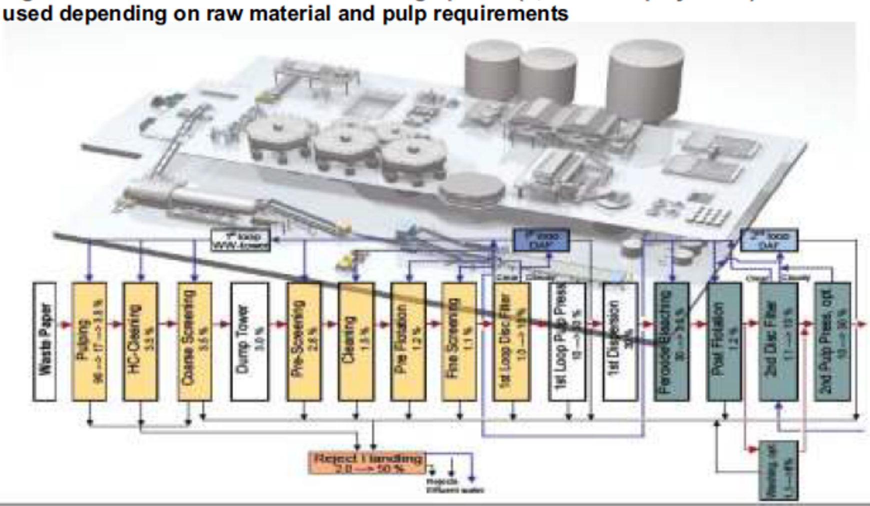
CONCEPTS FOR GIVEN RAW MATERIALS AND END QUALITIES

Different end products require different furnish to fulfill the end user's quality demands.Though the paper markets are global still end users value cost efficiency and hence, they are not ready to pay extra for exceeding quality

Table 1. Examples of pulp requirements for different type of DIP pulps

Property	Standard Newsprint PM	SC / LWC PM	Fine paper PM	Solution
Stickies, INGEDE 4, Somerville #0.15, mm^2/kg	<100 (<200)	<50 (<100)	<50	Screening
Strength & surface properties Tensile index (Nm/g) Tear index (Nm^2/kg)	>45 >8	>50 >8	NA	Raw material, refining
Brightness (ISO %)	58-63	66-68 / 70-72	>82	Flotation, bleaching
Light Scattering (m^2/kg)	50	50	NA	Raw material
Dirt Count (ppm, >0.04 mm^2)	<100	<75	<25	Flotation, dispersion
Ash max. (%)	14 < ± 0.5% at PM	16 < ± 0.5% at PM	5 < ± 0.5% at PM	Ash control loop, minimum variation
Yield, %	>82	>75	>70	Max. flotation and bleaching, min.washing

Figure 5. A basic DIP flow sheet including options (1, 2 or 3-loop systems) to be used depending on raw material and pulp requirements



demands. Following table 1 shows examples of pulp requirements for different type of high quality DIP pulps for high speed paper machines.

Depending of the pulp requirements and the available recovered paper quality the potential, right concept should be chosen. A basic flow sheet including process options for the DIP process is shown in figure 5. Possible options include 1, 2 or up to 3-loop systems. The basic approach used in all type of DIP plant designs is gentle processing in order to minimize the degradation of fiber and contaminants. This, in turn, allows for the production of high-strength And high-cleanliness pulp.

After manual or automatic dewiring, paper bales are fed into an OptiSlush OSD drum pulper, which operates at a consistency of about 16-20 % for efficient slushing and chemical mixing. In the screening section of the drum, fibers are separated from large-sized contaminants at ~4 % consistency. Pulper rejects are led to the end of the drum and further to coarse reject handling. The coarse screening of pulper accept pulp is done at 4 % consistency on OptiScreen CS screens. The screens are equipped with rotating baskets (Ø 2 mm holes) to remove coarse and heavyweight contaminants that have passed through the holes (Ø 7-9 mm) of the pulper screen plate. The accept from coarse screening is further screened either at 3.5 % consistency on OptiScreen FS screens with narrow slots (#0.15-0.18 mm) in three stages, or treated directly at 1.3-1.5 % consistency in a forward cleaner plant. The cleaner system is a 3 to 5-stage system designed with a partial or full cascade connection. The cleaners can be equipped with bottom dilution to improve sand and dirt removal efficiency, and to minimize losses. The next process step is the main flotation at 1.2 % consistency with multistage OptiBright MC cells where the ink detached from the pulp is removed, together with ash and some sticky materials. Accept from main flotation is fed to fine screening and reject to reject handling at 3-6 % consistency. Accept pulp from flotation is fine screened at around 1-1.1 % consistency with OptiScreen ProFS screens featuring advanced ProFoil and screen basket technology. The screens are equipped with narrow slot baskets (# 0.12-0.15 mm). After screening, pulp is dewatered to 10 % consistency with a disc filter and further with a screw press to optimum consistency (30 %) for OptiFiner OFD dispersion. Filtrate from the disc filter, together with dispersion press filtrate, is returned to the first loop dilutions. Part of the disc filter filtrate is cleaned with a dissolved air flotation (DAF) system. Screw press filtrate is fed either into the cloudy filtrate tank or into the dissolved air flotation feed tank. The "washing" effect of the system can be controlled through this piping arrangement, and its yield is also affected. Ink particles that are still attached to the fibers are detached in dispersion, and any remaining large specks and sticky contaminants are simultaneously dispersed into very small particles. Dispersion technology also enables the development of fiber properties. After dispersing the pulp is fed to a high-consistency peroxide bleaching stage. In 1-loop system this is the final stage before dilution to storage tower consistency.

In 2-loop system, after bleached pulp dilution, pulp is pumped further to post flotation at 1-1.2 % consistency. In a standard newsprint system, the flotation accept pulp will be thickened to 10 % consistency by means of a disc filter. Advanced final pulp ash control (for SC /LWC from 0 up to 40 % and SOW 100%) can be arranged by processing part of the pulp in an OptiThick GW washer, where the pulp is dewatered from about 1 % to 8-10 % consistency. Ink, ash and other small particles are effectively washed out during dewatering and collected into the cloudy filtrate tank. Unwashed part of the pulp from post flotation is thickened on a disc filter and combined with the washed pulp. This arrangement provides maximum flexibility in ash control with minimal loss of fines and fiber. After disc filter and/or ash control the pulp can be pumped with the help of an MC pump to a storage tower or to a screw press to be dewatered to 30 % consistency. Depending on the paper grade (e.g. High share of DIP in SC/LWC or fine paper), pulp can be fed to a second dispersion stage. After these treatments the pulp is diluted with paper machine filtrate to 10 % consistency. If needed, the brightness of pulp is adjusted with hydrosulfite or FAS bleaching. The final drainability (CSF) of DIP pulp is controlled at the paper mill by refining it at low consistency in an OptiFiner RF refiner.

Because a large amount of water is needed to perform the system functions, it is essential that process water can be reused for pulp dilution at an earlier stage of the process. This water, or filtrate, is removed from the stock flow by a disc filter, washer and a screw press. Any extra ash, fines and other "contaminants" in filtrates have to be removed with a DAF-type clarifier before reuse. The choice of water management practice will affect pulp quality, and also chemicals consumpti--on, both at the DIP plant and paper machine, and finally also paper machine runnability. The lower is the water consumption demand and faster paper machine, the more essential is proper design of water treatment system.

A modern DIP-based paper machine line is divided into three different loops, which are separated from each other by thickening/pressing unit processes. Thickening means increase of consistency from ~1 % (100 m^3/t) up to 10 to 14 % (10-7 m^3/t), and pressing from 8-10 % up to ~30 % (3 m^3/t). The water management of a modern paper machine line is based on the counter-current principle. This means that the amount of fresh water needed (the water amount going exiting the system with evaporation, the final product, reject flows, overflows/leaking) is added back into the paper machine loop (by showers), and that water is taken backwards in the process and finally rejected out through DIP plant reject flows. This strategy minimizes COD levels and anionic trash content in the paper machine loop. The better the separation between the loops, the bigger the reduction achieved in COD and anionic trash. However, it should be noted that thickening/pressing does not remove COD, but it minimizes the water flow forward. Neither does microflotation remove COD, but it removes solid material from filtrates, i.e. fines, ash, microstickies, and minimizes their ability to flow into the paper machine loop. The higher the fresh water consumption, the lower the COD levels that can be achieved. However, legislation and the economy of the process (yield losses, chemicals, heat energy) limit higher water consumption.

Loop 3 (PM) COD is the highest in a mill without presses at the end of the pulp lines. Without going into details on paper machine chemistry (fixatives, retention), it is well known that COD correlates with the demand for cationic retention chemicals (which is true with both mechanical and recycled fiber systems). The higher the anionic trash load, the more expensive the paper machine chemistry operating costs (amount/type of chemicals, additional cleaning needs). Microstickies cannot be removed at the DIP main line screening stages. They can be removed by separating them into filtrate fractions in thickening/ pressing and treating the filtrate in DAF. Metso has recommended the treatment of cloudy filtrate and part of the press filtrate to minimize chemical costs and to maximize paper machine runnability. In practice, good process engineering principle has been to design the pipelines so that the mill can choose the fractions to be treated depending on the operating situation. The main target is to maximize system yield without sacrificing paper machine runnability and total operating costs. The features of a properly managed water system can be summarized as follows:

- Reduction of COD, which keeps the wet end area cleaner.
- Reduction of microstickies in the water system (reduces stickies also in paper) to increase paper machine efficiency.
- Longer lifetime of dryer fabrics. One common reason for fabric changes is plugging, which causes deterioration of runnability component vacuums.
- Reduced need for calendar roll grinding. In Metso's experience, the build-up of stickies on calender rolls can lead to a deteriorating caliper profile and early roll grinding.
- Less chemical carryover.
- Better stability for wet end chemistry (pH, charge, conductivity).
- Savings in chemical costs and fabric Costs

The shortcomings of water manageme--nt do not necessarily reduce the maximum speed of a paper machine when paper machine chemistry and cleaning (washing chemicals and intervals) are optimized. However, investing in water treatment facilitates higher paper machine efficiency (reduced variation in the system, fewer breaks, less broke, more accepted production, less shutdown time) and longer washing intervals. Papermakers will ultimately determine which payback time is acceptable. The exact quantification of the increase in efficiency (+ % =>$) produced by increased investments on water management is challenging.

In reject treatment sludge is collected from various operating units into the sludge tank. The main sources of sludge are the water clarification and pulp flotation stages. After prethickening, sludge is further dewatered with a screw press-type sludge press to over 50 % consistency and transferred into containers for transport. System coarse rejects (drum pulping and HC cleaners) are collected into a dumpster for landfill, incineration, or further separation. Filtrates from the reject system are taken into DAF treatment and further into the mill's biological water treatment. Biological treatment reduces the COD load, and water can hence be recycled back into the DIP plant's first loop dilutions after secondary DAF treatment without a negative impact on the system's COD balance.

LATEST DEVELOPMENT IN UNIT PROCESSES

Common trend all around the world has been the increase of the electricity costs. The increase in electricity price has pushed companies to find more energy efficient solutions for pulp manufacturing (figure 6). In this chapter is highlighted some latest development in DIP processing technology that also affect the system energy consumption and yield.

Pulping is a key process stage for

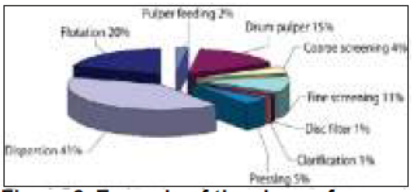


Figure 6. Example of the share of energy consumption between unit processes.

deinking line performance. The aim for pulping stage is transform the recovered paper into a pumpable form without excess degradation of impurit--ies. Pulping is also first screening stage to separate coarse impurities from pulp to be treated in forthcoming process stages. Major task for deinking line pulping is to detach ink from the fibers as completely as possible. The ink detachment in pulping depends on the mechanical forces and system chemist--ry. Traditionally HC-batch pulping has been considered as a solution for small lines only, because of relatively high investment cost. However, though the investment cost is higher than for batch system, the higher energy consumption of batchpulping will give a pay-back time less than 2 years for a line between 200-300 Bdtpd (table 2). Additionally, the fiber loss of drum pulping system is typically 50% less compared to batch pulping. In system comparisons it has been observed that sticky content is lower after drum pulping which is explained by more gentle treatment and less fragmentation of sticky material. Hence, when new production line or addition of capacity is planned, also drum pulper option should be studied.

In coarse screening conventional technology is based on rotating foils and stationary screen basket. Typically, in this type of coarse screening system is many times included also deflaking type screen. Modern coarse screening is based on inflow rotating screen basket technology with stationary Delta-foil (on accept side) which screens the pulp with maximum gentleness and gives good grid and stickies removal efficiency. The pressure pulse created by wide width foil located in accept side of the screen is completely different compared the more aggressive rotating foil. Hence, the comparable or even better quality can be achieved with hole size of 1.8 to 2 mm compared the 1.4 to 1.6 mm hole baskets in conventional screens. Besides the quality, major advantage of rotating screen basket technology is lower energy consumption. In OCC/MW systems the energy saving can be up to 50% and also in DIP systems up to 30%.

Table 2. Comparison of drum pulper and HC-batch system

	Drum Pulper OSD	HC-Pulper +rej.drum
Total investment	1.26	1
Installed power total [kW]	1	2.23
Total SEC [kWh/t]	1	1.65
Power consumption [MWh/year]	1	1.65
El price difference, $/year	-115,924	

Minimizing fiber losses and energy consumption concurrently with increased capacity and screening efficiency is the major issue in deinked pulp fine screening today. There are two critical tools in fine screening to achieve this goal; the screen basket design and the foil design. In extensive study [2], the foil shape was thoroughly studied with the following conclusions:

- Conventional foils react weakly to foil speed or gap changes. In adjustable screening, a stronger response to changing control parameters is needed to find the optimal operation point with respect to capacity and quality.
- An appropriate co-rotation level of the pulp between the rotating foils in a particular screening application is a key issue from both capacity and quality viewpoint.
- A relatively low level of pulp co-rotation can be utilized in DIP screening (figure 7), resulting in reduced energy consumption and increased runnability of the screen with the same quality standard.

Based on this study new foil design was launched. The major benefits of the new foil design are:

- Low level of thickening ⇨minor fiber losses
- Streamlined shape and low rotation speed ⇨low energy consumption
- Possibility to use ultra-narrow slots ⇨excellent quality
- Possibility to use higher slot velocities without blockage ⇨higher capacity or smaller screen size
- No blockage problems even at low rotation speeds ⇨excellent runnability in wide operation window

By using new foil technology in DIP screening, an optimum compromise between highest possible quality and capacity with lowest possible energy consumption can be adjusted process-specifically.

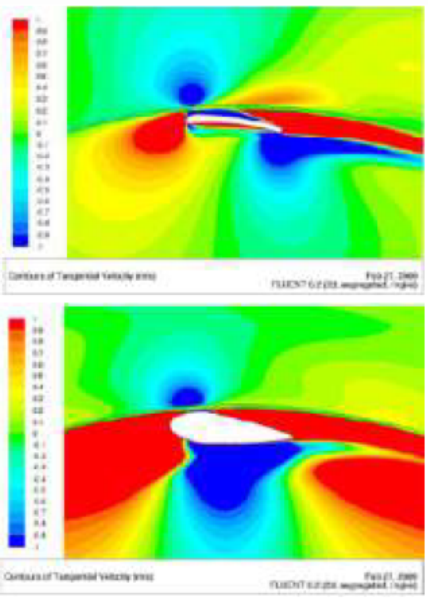


Figure 7. A new foil technology creates relatively low level of pulp co-rotation compared to conventional technology, which results in reduced energy consumption and increased runnability with the same quality standard.

Typically, highest amount of energy in DIP line is consumed in dispersion stage. The major tasks of the dispersion stage are residual ink detachment, specks and stickies disintegration, homogenisation of the pulp, chemical mixing (when applied together) and fiber properties development. Typical energy consumption in dispersion stage varies between 60 to over 80 kWh/t. Besides the operational conditions (consistency, temperature), the key factor is fillings design (figure 8). By development work done on dispersion fillings (shape of teeth, fillings materials etc.) excellent dispersion results can be achieved well below above mentioned range.

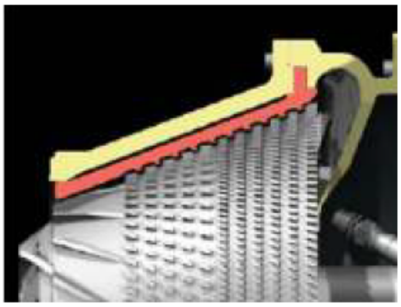


Figure 8. New type of disperger fillings give excellent dispersion result well below typical energy consumption from 60 to over 80 kWh/t

Conventional high speed washing is based on one-sided dewatering. Typical washing consistency is ~1%. Washing process based on gap technology utilises 2-sided dewatering, which enables lower operational speeds still maintaining good de-ashing efficiency. In "GapWasher" pulp is dewatered between two moving wires which creates high turbulence field and prevents the formation of a dense fiber net work which would decrease the washing efficiency. Further this technology enables to use high feed consistencies up to 2 to 3%. Additiona--lly the control of wire speeds gives possibility to adjust the turbulence, i.e. Washing efficiency in specified operational conditions. When process

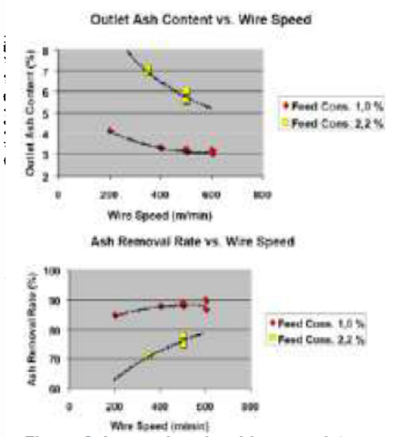


Figure 9. Increasing deashing consistency reduces energy consumption (MOW, CSF 420 ml, feed ash 20%).

consistency is increased, the power consumption per ton will reduce. At the same time also pumping costs are decreased.

Besides these examples, there are other solutions that give further saving potential for production costs. As well as in washing stage, also corresponding savings can be achieved by increasing process consistencies in pulping, screening and cleaning stages, when ever it is quality-wise possible. Another important process engineering princip - -le is minimisation the number of pumps and chests in the process. However, one must carefully evaluate the effects of simplification on system stability and performance. The import - -ance of automation tools is increasing as systems buffer capacity (chest volumes) is reduced. As is the case with water management solutions, also investment on automation (DCS, QCS) systems will pay-back, though the exact calculation of pay-back time is difficult.

The importance of chemistry optimiza- -tion both for deinking and water treatment can not be underestimated. Improper chemistry management may cause decreased quality and increased losses. Though not widely spread, neutral/semi-neutral deinking has obviously attractive features regarding the production costs. Neutral deinking (vs. alkaline) reduces chemical costs (minimised sodium hydroxide, hydrogen peroxide and sodium silicate dosages) and reduces system COD load. However, when neutral chemistry is applied it should be taken into account in system dimensioning.

As mentioned earlier, the major cost factor in DIP manufacturing is raw material quality. Hence, raw material quality vs. end product quality vs. process concepts should be well evaluated. The follow-up of pulping reject amount is important. Pulper station reject should be in reasonable range, i.e. mills should pay only about the material suitable for paper making not about impurities. As the typical reject rate for drum pulper is 1 to 3% occasionally values up to 9% pulper reject (still with minimum fiber losses) have been measured. Also important factor for the system performance is the age of raw material. In some markets where the local collection systems have not properly developed the age of raw material can be up to 6 months. The deinkability of old raw material is definitely lower than for raw material which age is less than 3 months. The high age of the raw material must be compensated both by adding bleaching capability and chemical consumption. Another deinkability factor is the flexo ink content of the raw material. When flexo ink is observed in system there will be increased need for washing and water treatment which will increase losses. Otherwise there is a risk for reduced brightness of the pulp. Fourth important factor related to raw material is it's ash content. For office waste there are clear differences between e.g. EU and US raw materials, i.e. typically in EU the ash content is higher. High ash in raw material typically yields lower yield and higher specific energy consumption, larger unit processes and even more complicated processes (2-stage washing).

TECHNOLOGY CONCEPTS IN ACTION

1-loop deinking line and short circulation system was supplied for the new PM production line which produces 45 and 48 g/m² standard newsprint from 100% deinked pulp. The 330 t/d deinking line uses recycled newsprint (ONP), magazine (OMG) paper and sorted white ledger (SWL) as raw material. The start-up of the line took place in June 2003. The key sub processes were delivered on a turnkey basis. Drum pulping is followed by coarse screening, a deinking flotation system, cleaning, fine screening and thickening equipment, a dispersion system and a high-consistency peroxide bleaching system. System final brightness is 58 to 60 ISO. In this simple system gives well enough quality with high yield for local markets.

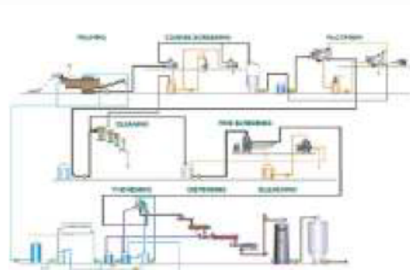


Figure 10. 1-loop deinking line for newsprint

Above mentioned concept is suitable for "local" markets utilising best possible way the available raw material and producing right quality for specified markets. At the other end is 1500 ADtpd DIP systems for producing newsprint at high speed paper machine for domestic and also for export markets. The scale of economics is the main driver in this type of investment.

2-loop deinking system was delivered for a modern swing machine capable of producing either high-quality newspri - -nt or LWC paper (dimensioned DIP capacity 330/265 BDtpd, 480 BDtpd achieved). Delivery included whole production line from DIP plant to paper machine, winder and additionally an OptiFeed stock preparation system, DNA automation Automation (for quality control, process control, machine control and information management systems), air systems, wet end chemicals system and color kitchen and several auxiliary systems.

The main furnish component for newsprint is deinked pulp. The rest is chemi-mechanical (CMP/CTMP) pulp with a small portion of kraft pulp. Because of the limited availability of wood and the increase in energy prices, the mill is today taking the maximum out of its DIP line capacity. For LWC base paper, the furnish includes mechanical pulp, a certain amount of deinked pulp and the rest is kraft pulp. In newsprint production the main grade has a basis weight of 48.8 g/m², and it is run at 1,500-1,550 m/min. Also 45 g/m² newsprint paper is produced at the same speed. LWC base paper is produced at 1,300-1,400 m/min speed, and the basis weights have so far been 58, 64 and 70 g/m², including coating. The two-sided coating accounts for 17...18 g/m² of the total basis weight. Grade changes are complete system changes as changes are needed in the composition of furnish and individual pulps as well. PM started with newsprint production and quickly reached and even surpassed its design speeds running at 1,600 m/min. PM has so far produced LWC paper for a limited period of time. The local market for LWC is just starting to emerge. LWC paper will be the key product for the mill in the future.

This DIP line produces efficiently and

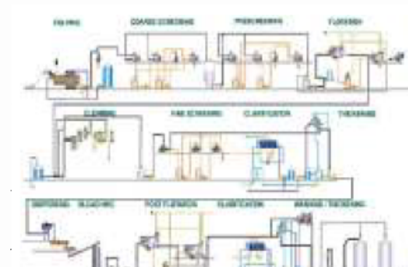


Figure 11. 2-loop swing deinking for newsprint and LWC

economically two different types of DIP by utilizing the features of the line. By combining the right DIP and mechanical pulp fiber fractions, the targeted end quality can be achieved while also optimizing the cost structure. When comparing furnish costs, the addition of DIP to furnish has brought significant cost savings compared to a completely chemimechanical furnish system. Chemical pulp costs are minimum 50 % lower. It can also be assumed that the newsprint surface properties are better. In LWC production only a minor addition of DIP brings significant savings in energy costs, 5 to 10 % savings in chemical pulp costs, and finally also in fresh filler costs. Any savings at the DIP plant are questionable if they increase costs at the PM area and total mill efficiency is reduced. A limited number of high-speed online lightweight coated and calendered paper machines are running DIP-containing furnish. However, operating efficiencies are well above the industry average of 80 % based on these reference machines. Operating speeds also range from 1,400 to 1,850 m/min. Based on this data it can be argued that DIP-based furnish does not differ from virgin fiber when the process is properly designed and operated. The quality of paper is always the result of all components and machinery. Based on current understanding, the maximum level of DIP in mechanical printing grades depends on the customer's final quality targets. Limiting factors can include base paper brightness when the target level is > 75 ISO, specks content, opacity, and bulk. Levels of 25 % to 30 % can be used without deviating from industry standards. Customers have acknowledged the properties of DIP-based papers, especially good printability, high printed gloss and high smoothness.

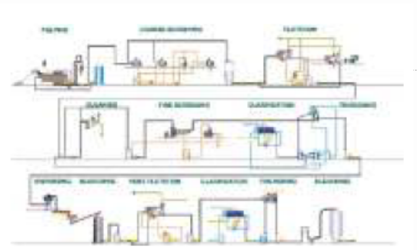


Figure 12. SOW-line for virgin fiber replacement

Fourth example is SOW line for virgin fiber replacement (figure 12). The line features drum, coarse and fine screens, flotation cells, washer, disperger and low-consistency refiners. The thickening, bleaching, microflotation units and reject handling systems were also delivered by Metso Paper. Stock brightness target is > 82 ISO for the SOW pulp. The pulp is used in multilayer board's top and back ply and also as a substitute for virgin pulp. The quality of SOW pulp would be enough also for printing and writing grades as well as tissue grades.

SUMMARY

The increasing cost of graphic paper manufacturing and decreasing prices of finished products have encouraged paper manufacturers and technology suppliers to search for more economical ways of reaching print quality demands. Newsprint has already for some time been manufactured from 100% DIP. Furnishes for higher graphic paper grades have traditionally been made of mechanical pulps, but the share of DIP is also increasing in these grades.

The major cost factor in DIP manufacturing is raw material. Hence, the market price of recovered paper and the yield achieved from the DIP process are of major importance. Market price depends on the availability of and demand for good-quality recovered paper. Yield affects both the total cost of incoming paper and reject disposal costs. Although investment costs represent a minor portion of DIP manufacturing costs, the concept and technology selected may have a significant effect on total operating costs.

By technology and concept solutions the investment and operational cost be affected. The standard DIP plant concept is one- or a two-loop system. When higher paper grade DIP is manufactured, the additional concept decisions to be made are the addition of a prescreening stage, the number of bleaching and dispersion stages and whether washing stage is needed.

There is clear saving potential in energy and yield brought by latest development in unit process technologies. Some of these tools were reviewed. Drum pulping has been typically considered a technology for higher production rates, the increasing energy costs has decreased the payback time for investment. New screening technologies give also tools for cost reduction. Rotating basket technology can give up to 30% reduction compared to conventional technology. New foil technology in fine screening gives 10 - 30 % energy saving through foil shape and up to 44 % energy saving when lowering foil speed to optimum level. With right screening connections and dimensioning 10-20% energy saving can be reached. Further, by proper process engineering (process consistency and temperature, number of chests and pump) energy can be saved. However, it should be remembered that typically energy input has an effect on system performance and pulp quality. Hence, it should be carefully evaluated when there is a question about process improvement or is it a question about compromise between costs and quality.

Contrary to paper machines, the role of automation has traditionally been underestimated in deinking. However, new automation and measurement solutions are needed to get the most out of the available raw material and to avoid unnecessary production costs.

There is a limited number of high speed online lightweight coated and calendered paper machines that use DIP-containing furnish. However, their operating efficiencies are well above the industry average of 80 % based on reference machines delivered by Metso. Operating speeds also range from 1,400 to 1,850 m/min. Based on this data it can be stated that when the process is properly designed and operated, DIP-based furnish does not differ from virgin fiber.

REFERENCES

1. Savcor Indufor
2. Minna Puro and Kati Lindroos; ProFoil – Superior tool for adjustable screening process, Proceedings, PTS deinking Symposium 2006