DESIGN FOR THE FUTURE: WHAT TO EXPECT IN THE NEW GENERATION OF PAPER MACHINES

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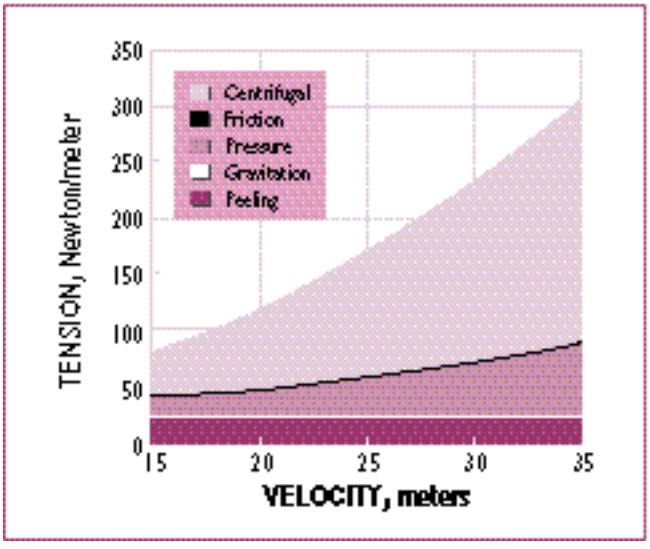
FASTER, SHORTER PAPER MACHINES WILL EMERGE FROM TODAY'S DESIGN DEVELOPMENTS.

WHAT WILL THE NEW GENERATION PAPER MACHINE look like? What kind of paper will it produce and from what raw material? The answers depend on many unknowns: emerging communication technologies, economics,and changing preferences,to name a few. The best we can do is to assume that future trends and developments in the paper industry will not change dramatically from the recent past.

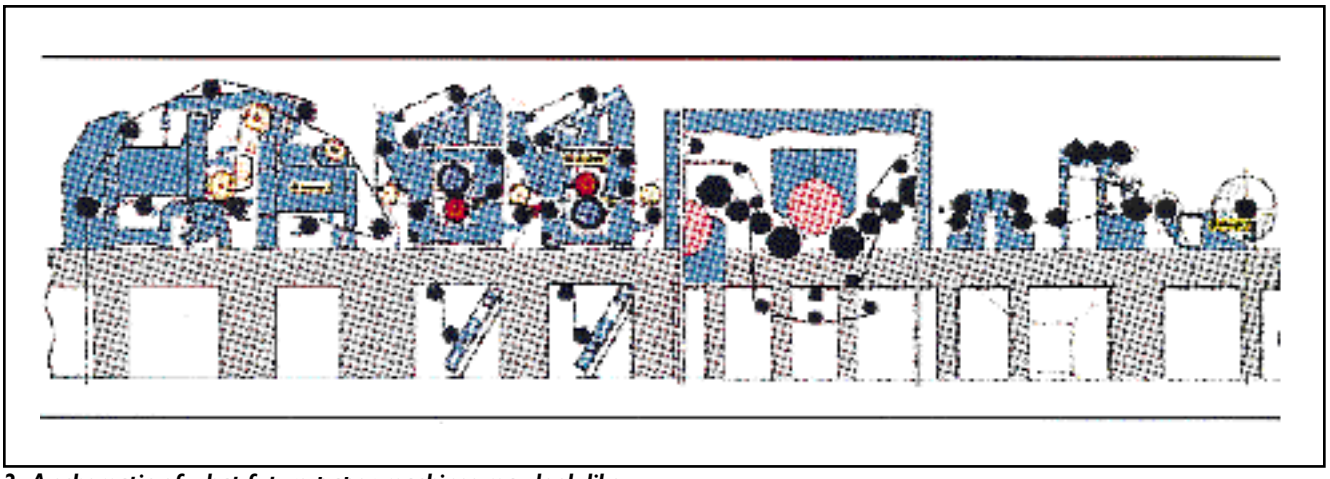
The raw material for making paper will shift more and more to recycled fiber and to nonwood/nonfibrous materials.It is predicted that by the end of this century paper and board products produced worldwide will contain 40% and perhaps as much as 50% of something other than wood fiber. At the same time,the demand for higher quality and productivity will increase. In other words, there will be a continued pressure to produce superior quality products from inferior raw material at higher speeds and lower cost.Who said papermaking was easy?

Considering the already very high level of present day papermaking technology, this represents quite a challenge for everyone in the business of making paper, not the least of which is the machine builder. Our projections indicate that paper machine developments in the 1990s and beyond will continue to be primarily based on evolutionary developments from existing technologies. A number of major breakthrough developments will be required to push the present paper machine technology into the next generation.The areas most likely to benefit from such developments will be:

- Web runnability
- Paper drying,instrumentation
- Automation.



1. Tension acting on a typical newsprint machine



2. A schematic of what future paper machines may look like

THE CHALLENGES

The constantly increasing speeds of today's paper machines continue to challenge our engineers and scientists to resolve various new problems created by higher speeds. How fast can a paper machine run and what are the bottlenecks? There are many challenges, among which the following stand out.

One of the more complex bottlenecks involves peeling the web off the surface of a roll and transferring it to the next section. Unfortunately, a paper machine contains a great number of such transfers, so if we are to increase its speed, we must resolve this problem. To do this,however, we must first understand the fundamentals involved.

Figure 1 shows tensions from various sources,acting on a newsprint web in an open draw, at increasing speeds. The total tension in the web contains various components, two of which are speed related: pressure and centrifugal force. The centrifugal component increases exponentially with speed and is by far the dominant component.

Subjected to these tensions,the web will break at its weakest point—normally at some local flaw. Similarly, flaws in basis weight, moisture or fiber orientation profiles, or in their complex interdependence, become potential bottlenecks in high-speed operation. Higher speeds will require even better small-scale web uniformity and profile stability than is presently achieved. In addition to quality and web runnability, there will be many other speed-related matters to resolve, including high hydraulic pressures in the wet end, huge amounts of air pumped around by rolls and machine clothing, structural integrity of support structures, high inertia rotating masses,and vibration,to name a few.

The development of new transfer belt technology is a major step toward having a fully supported web throughout the entire paper machine.This development can be categorized as a major breakthrough and one which will be widely implemented in the next generation paper machines.It may also be an attractive alternative to upgrade the operation of existing presses,judging by the increasing interest shown in this technology by you,our customers.

The new requirements for paper machine and process automation is another challenge which should be singled out.Future paper machines will require new, on-line monitoring and automatic control systems with faster response times and higher resolutions to take care of the future demands for higher product uniformity and faster speeds. This means new sensors, new control strategies,and new automation,as well as a better understanding of the papermaking process.At the risk of overstating the obvious,if we do not understand the process, we cannot control it.

THE OPPORTUNITIES

Resolution of these,as well as many other problems not mentioned, requires an increasing expertise in an increasing number of areas. Recognizing that we cannot do everything ourselves, over the past few years machinery manufacturers have entered into a number of on-going collaborations with universities and research centers. The research centers concentrate on pure research to explain the process,while manufacturers concentrate on the development of the machinery.

One example of this is the new generation drying technology, where we are studying the process conditions, development of paper properties and runnability of various impingement drying concepts in collaboration with outside research centers.This technology offers not only a shorter dryer section but also new possibilities to effectively control many important paper properties, such as CD shrinkage.

THE PAPER MACHINE

What will the new generation paper machine look like? How wide, how fast, and how long will it be? Chances are, once the present runnability bottlenecks are removed, the design speed will increase dramatically to perhaps as high as 2500 m/min. The machine will be

within 10 meters in width and considerably shorter than the present machines in length. All open draws will be eliminated and,from headbox to reel,the paper machine will be fully equipped with on-line instrumentation to monitor and automatically control its operation and most of the important paper properties. **Figure 2** shows what the new generation paper machine may look like.

The forming section consists of a hydraulic headbox, with or without dilution control, depending on paper grade,and a roll and blade gap former. This is followed by a no-draw press with long nips, high-temperature pressing incorporating the transfer belt technology. The web is then transferred by vacuum to a dryer section consisting of a group of symmetrically arranged impingement dryers,using high-temperature air or superheated steam as the drying medium. Finally, the web is soft calendered and wound on a new generation reel into a uniformly profiled,constant density jumbo with no waste.

Most of the components in this machine already exist, or are being developed. So the new generation machine is almost here.Given the paper industry's traditionally conservative response to new technologies,however, the most likely scenario is that the new components will first be tested out commercially one-by-one prior to being assembled into one whole and sold as a complete new paper machine. **TJ**

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