A possible premise for the lightweight papermachine

A calculation

If one starts with 42 lb linerboard and supposes a current configuration 20 feet wide by 200 feet long, one can make the following calculation. If one assumes the dryer section, due to its serpentine nature, holds twice as much paper as its length and the dryer section is 150 feet long, then the total paperboard in the machine, from headbox to reel, at any one time is nominally 200 – 150 + (150x2) = 350 feet long by 20 feet wide, or 7,000 square feet. Then, 7,000 x 42/1,000 = 294 pounds (for those unfamiliar with linerboard, the basis is 1,000 square feet). For freesheet, newsprint, tissue, coated pubs, and so forth a similar calculation can be made, I use linerboard here because (a) it is relatively heavy and (b) the basis of 1,000 square feet is easy to use.

Obviously, the massive structure of the linerboard machine and the building required to hold it serve a purpose other than supporting 294 pounds distributed over an area of roughly 4,000 square feet (20 x 200). In fact, just so the reader has it in mind, 294 pounds distributed over this area works out to 0.0005 psi. By reference, the heel on a woman's spike heeled shoe exerts a force of roughly 960 psi (assuming she weighs 120 pounds and is standing evenly on both shoes).

So why the massiveness of the papermachine?

Clearly, if one were interested in distributing a static, completed sheet of 42# linerboard over 4,000 square feet, one would need no foundation, no structure, in fact, most swamps could probably support this load without improvements. So why do we build these massive machines?

1. In the early stages of the process, the sheet is not formed and needs support.
2. Pressing equipment, as presently designed, requires weight of its own in order to function properly.
3. In order to keep the sheet level (which is believed necessary) in the Cross Machine Direction (CD) large beams (static and dynamic [cylinders]) are required to avoid deflection.
4. In order to reduce the potential for vibration in a papermachine that is nominally 25 feet above its foundations, mass has been added.
5. Dryers, in the form of cast iron cans, have been widely researched and are a comfortable, proven solution for evaporative drying.

Why change?

It is clear from the simple mental calculations here, that we have a case of the tail wagging the dog. The paper sheet, the objective of manufacturing here, is clearly miniscule compared to the variety and size of equipment gathered around it. We evolved to this place slowly from the first Fourdrinier Brothers continuous papermachine as we added speed, width and quality control to the process, weight was added without much

thought. It would be interesting to go back and calculate the weight of the entire Fourdrinier Brothers process, including building and foundations and compare that on a unit area of paper produced in say, an hour, to the weight of a modern machine, building and foundations with the same metrics. My guess is we will find this number has increased exponentially.

One can say other industries have a similar issue. For instance, injection molded plastic parts are manufactured in heavy presses. However, the case of the papermachine, at least on the surface, seems to be one that has gotten completely out of hand.

The papermachine designs, both of entire machines and component ancillaries, have, it appears without much thought, added mass to assure a safety factor in the performance of whatever manufacturing objective was at hand. However, whether static or dynamic mass additions, the result has been the same: more mass at the point of manufacture has subsequently "supersized" everything downstream from that point, be it foundations, bearings, lubrication systems, mechanical drives, electrical drives, power (thermal and electric) consumption and so forth. Added incrementally, each little component did not seem to be a large issue, however, we now find ourselves with an extremely large, complex, expensive to build and expensive to operate behemoth.

How to change?

The job of changing to a lightweight papermachine is bigger than one person, one research university or one company (either a paper manufacturing company or an equipment manufacturing company). Resistance and inertia will be fierce, coming from several quarters, including those that:

1. are comfortable with the "safety" of the status quo
2. have large investments in traditional assets
3. make traditional process equipment

These three stakeholders, and no doubt others not yet identified, stand to experience economic loss from such a change. Expect them to fiercely resist any change.

Change will have to come incrementally. Experts in the myriad and many details of papermaking and papermachine construction will have to "fight city hall" to make changes, at least until they prove to be economically advantageous. However, for those that prevail, the opportunities should be great.

So, in reality, the writer does not yet have a clear picture as to how to change, for the requirements are too massive, the idea too new. It is hoped this short paper, however, can be a spark that will initiate the process.

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