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# Flexo Gravure Int'l

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# Drying at the speed of sound

*Innovative drying technology can improve productivity and save energy*

Gene Plavnik

*In today's mercurial economy, it is increasingly difficult for any printer/converter to remain profitable. Pressures come from multiple sources: the fluctuating cost of utilities, the rising costs of raw materials and the continuous demand for better utilisation of ecologically friendly resources from consumers and vendors. Therefore, it is important for the printers/converters of flexible materials – whether décor paper or aluminised film – to keep abreast of available and innovative technologies, which can help him satisfy his customers while conducting a successful and profitable business.*

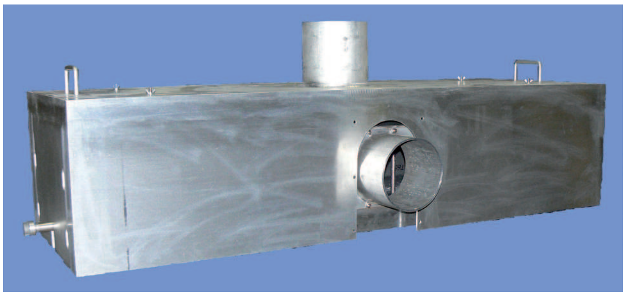
The choice of press operation is driven by the demand for quality and the specific end-use of the printed material. That translates into using solvent or water-based inks, which require some method of drying versus using UV or EB curing inks, which are cured using mercury lamps or an electron beam. Solvent-based ink technology has its own Regenerative Thermal Oxidiser (RTO, or incinerator); associated maintenance costs; and environmental compliance requirements – which have become even more complex as the world moves towards the use of »greener« materials.

### Comparing the alternatives

The utilisation of water-based inks, in general, does not require RTO, and thus costs are lower than the operational cost of printing equipment using solvent-based inks. Continuous improvements in the quality of water-based inks are noticeable, and they have broadened their applications. However, to have successful transfer from one type of ink to another, one needs to have efficient drying technology at their disposal. It is well known, that drying water-based (or sometimes even solvent-based) ink is a challenge because of the increased residence time, when a heavy load of inks or coatings is applied. This really translates into slowing the web speed of a press to accommodate the drying.

The reason for more residence (drying) time is the formation of a boundary layer on the material during the printing process. What is a boundary layer? Imagine for a minute, a large lake. In the summer, the sun comes up and begins evaporating moisture off the lake. After a few hours, a sunny day turns into a cloudy day because as the moisture rises from the lake, clouds are formed. These clouds then act as a barrier. So later in the day the sun is above the clouds delivering the same amount of energy but less of the sun hits the lake directly so less moisture is removed. Similarly, the boundary layer forms on the surface of the material as it moves through the production process and acts like an invisible shield against hot air coming from the drying station. This invisible shield does not allow air to penetrate the surface of the ink and start the evaporation process. Increasing heat and air increases the amount of moisture which is evaporated but at a lower efficiency until the process flat lines. OEMs of printing equipment used increased volume of air, increased temperature, even angle of attack, to tackle this problem, but it had a rather limited effect.

*Figure 1:*
***Side view of 63" (1600 mm) booster section and exhaust shroud (top portion).***



### Using acoustics for drying

So how can sound technology benefit drying? First some background. Think of sound which is experienced at a loud rock concert – sound that can be felt as you walk closer and closer to a large speaker which is filling the concert hall with someone's definition of music. That feeling is a pressure wave brought about by the movement of air created by the speaker. Now, certainly, no manufacturing operation is looking to increase the amount of noise. However, that sound power can be harnessed in a very careful way, so it is harmless to human hearing and is safe in the workplace.

In addition, you might notice that the pressure as you approached that speaker wasn't constant. Rather, it fluctuated or varied. The oscillation of pressure is another important thing to consider. Think of things where pressure is not constant – a jackhammer, hammer drill and impact wrench, for example. These devices make it possible to achieve a result that the same amount of constant pressure couldn't achieve. It is the same with drying, the oscillation of ultrasound adds to the effect. Heat and air are more efficient at removing moisture in the presence of sound because the oscillating pressure wave affects the boundary layer.

### Some background

The acoustic drying technology developed by *Heat Technologies Inc* had its beginnings with pulse combustion which accelerates heat and mass transfer by appropriate utilisation of acoustic oscillations with mean flow of the combustion gases. This was successfully applied in water heating, boilers, drying of minerals, sand, sludge etc. However, the company's original technology cannot be applied in flexible packaging, converting and coating because of oscillating flame directly impinging on the material. The reason is simple – it is a fire hazard.

Driven by actual demand for accelerated drying of water and solvent-based inks and adhesives,

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| Web width Inch (m) | Dry weight lb/ream (g/m²) | Percentage of solids % | Application adhesive, ink | Type of installation replacement, b/c, add-on | Existing technology max. speed, ft/min (m/min) | Existing technology Energy used MMBtu/h (kW) | Spectra HE Ultra max. speed, ft/min (m/min) | Spectra HE Ultra Energy used MMBtu/h (kW) |
|---|---|---|---|---|---|---|---|---|
| 52 (1.32) | 1.27 (2) | 30 | Water-based adhesive | Add-on | 700 (217) | (145) | 1350 (411) | (20) |
| 71 (1.27) | 1.27 (2) | 30 | Water-based adhesive | Add-on | 700 (217) | (200) | 1400 (426) | (50) |
| 16 (0.4) | 2 (3.15) | 30 | Water-based ink | Replacement, b/c | 260 (81) | (37) | 387 (118) | (5.2) |
| 26 (0.66) | Overhead/ Tunnel dryer | 30 | Water-based ink | Replacement | 600 (186) | 1.0 (293) | 600 (183) | (45) |

***Table 1: Summary of the major operating parameters when Spectra HE Ultra replaced original drying technology, wide- and narrow-web.***

the company expanded its knowledge of combining hot air flow with strong acoustic oscillations and developed a product line of drying systems, *Spectra HE Ultra*, for that specific application. The drying system is an advanced convective or hot air-based system. However, in this case, the hot air acts like a skilled massager, by providing the boundary layer formed on the material with micro massage to make it more pliable and as a result, it makes drying more efficient. These systems are energy independent, can use hot air derived from an indirect or direct heating process, and preheat the air by an inline electric heater. Most important and a key element of accelerated drying is its ability to efficiently disrupt the boundary layer, formed on the material during the printing process allowing the process to be conducted with a lower operating temperature of the hot air at advanced web speeds.

### Benefits of acoustic drying technology

The benefits of the technology are not marginal (meaning 5–10%), rather they are considerable as follows:

- Up to a 70% increase in web speed – less residence time under the drying station means the press can operate at higher speeds.
- Up to a 75% reduction in energy consumption.
- The same or lower process air temperature – even with increased speed, the process air temperature will be the same or less than your current operation.
- Up to 50% less plant air for water-based applications. This means additional energy savings because plant air conditioning costs can be high. (Solvent-based solutions are limited by LFL considerations.)
- Up to a 67% smaller footprint – generally, the length of the new drying system will be significantly less than the current system.

The technology has applications for narrow- and wide-web operations as a replacement for existing equipment between colour drying sections (usually with a heavy ink load or adhesive loads), or as a booster section, where physical space allowed installation. In both situations, throughput increased from 50 to 85% with 17–20% of added energy. Accelerated speeds were registered on shrink film, thermally sensitive papers, with the utilisation of eco-friendly inks. It is important to note that other factors besides press speed must be taken into consideration. Improved drying is possible, but in most cases it was maxed out by limiting factors of maximum speed, wind and unwind, sufficient ink laying, etc. The *Spectra HE Ultra* drying systems can be adapted to any press, which utilises water or solvent-based inks or adhesives, where replacement of the drying section is possible, or can be added as an extended range where drying, coating, etc is a bottleneck.

It is important to note that the systems are very compact and may be of assistance to the operators whose footprint could be improved. Additional savings may apply to the reduction of material cost, due to more compact dryer, cost of labour to produce more material, less capital expenditures, etc. Also important to note is that maintenance managers become our best advocates, as the dryers are of an advanced design, but low in maintenance, which is a subtle, but noticeable contributor to the operational cost.

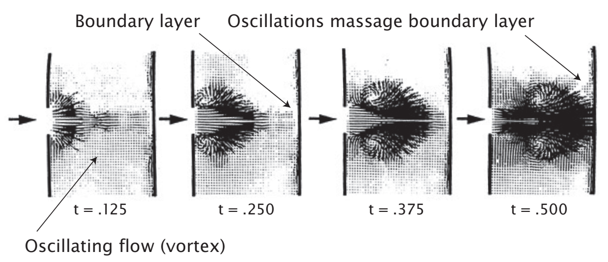


***Figure 2: Spectra HE Ultra drying system. Mechanism of enhancement by oscillations.***

### Conclusions

The *Spectra HE Ultra* drying systems can help printers increase their profit margins and meet production goals by improving drying as a bottleneck for increased speed operation of a gravure, CI and in-line flexo presses, offset presses, coaters, etc. due to the advanced nature of the design combined with low maintenance and high efficiency. ■

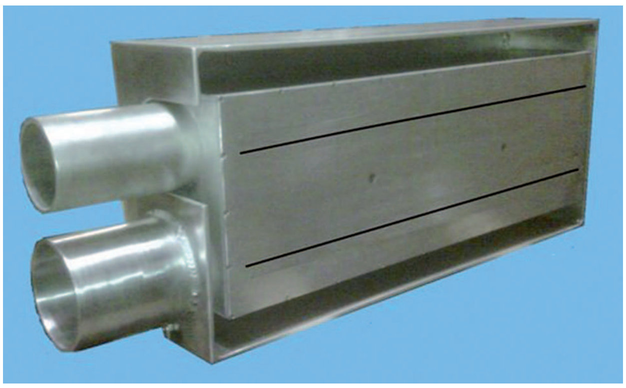

***Figure 3 (left): Control panel, blower on a movable cart with dryer section in background on right.***

***Figure 4 (right): Front view of a replacement of between colours dryer station, 26" (660 mm) web width.***