**Reduction of Energy Consumption in Forest Industries** (by Dr. Ernst Kürsten**)**

Permanently rising energy costs and the climate change problem make energy saving measures a priority topic industry today. Cutting-edge technology could result in savings of up to 90 percent in the life-cycle costs of individual components such as electric motors, and up to 70 percent in ancillary equipment including pumps, fans, compressed air technology and cooling systems. The Hannover Fair (April 21$^{st}$ – 25$^{th}$, 2008) offered valuable advice on how to achieve this in the brand-new "Energy Efficiency Tunnel".

With reference to the new special display "Energy Efficiency in Industrial Processes", Thorsten Herdan, Managing Director of the German Engineering Federation (VDMA) Energy Forum, commented: "Energy efficiency has always played a major role in the mechanical and plant engineering industry. Even if there is an initial rise in investment costs, it is the life-cycle costs that are ultimately the crucial factor - they will decrease and eventually result in a reduction in the price of products. Energy efficiency is becoming an increasingly important parameter for all production processes and thus for all customers of the mechanical and plant engineering sector. In the future, energy efficiency will influence purchasing decisions. This is one of the topics that will be addressed in the Energy Efficiency Tunnel. Energy efficiency is also fundamental to the generation of power and heat. Energy efficient turbines and motors, for example, can reduce $CO_2$ emissions during power generation and thus help to conserve resources. However, we must also consider the importance of increasing the energy efficiency of system components. Efficient pumps, compressors and drives can make a significant contribution to shrinking $CO_2$ emissions."

Even though in many of the Indian forest industries a lot of work is still being done manually, there are potentials to reduce the consumption of energy and by this to save money. Especially when new investments are being planned, its makes sense to consider the potentials of energy savings, which are being presented here.

1. Use of wood waste for heat and electricity generation

Picture 1: Waste wood might meet all power and heat needs of a wood processing plant if more efficient technology is applied.

In Germany, in 2004 forest product industries were able to meet their power requirements by 20 - 40% and their demand for heat by 80 - 90% from their own wood residues. When taking into account the often low quality of sawn timber (= high percentage of waste), the lower grade of mechanisation and the warmer climate it might be possible that wood industries in India could be completely energy self-sufficient in terms of electricity and heat supply. This is an interesting perspective with special regard to the frequent power cuts. To achieve energy autonomy a combined heat and power plant (CHP) is necessary that efficiently makes use of the wood residues. In economic terms this earlier made sense in bigger units only, as a study for sawmills in Austria had demonstrated some years ago (WKO 2003). But the upcoming Stirling-CHP technology may offer new opportunities for even smaller forest industries as here electricity can be generated economically from wood waste by traditional boilers, updraft gasification or in form of pellets (Betz 2007). The Stirling Danmark company is offering solutions with an electrical output ranging from 35 - 500 kWe electricity and 140 - 2,000 kWth heat. The company is focussing on the CHP and on the diesel genset off-grid market, claiming that the costs today (21 €-cent/kWh) of the Stirling technology are already lower than for diesel (22 €-cent/kWh) and will decrease to 16 €-cent/kWh within three and 12 €-cent/kWh within five years (Jagd 2008). The promising economic perspectives of small biomass-fired CHP-plants were approved by a two-years study funded by the German Government (Thomas 2008).

To match the energy demand with the supply of wood residues, or simply to reduce production costs, energy saving measures should be implemented anyway.

## 2. Potentials for energy savings and application of solar energy in wood seasoning

Proper wood seasoning is a basic precondition for the processing of high quality products and a means to reduce wood losses. In India, many old drying chambers with brick walls are in use, which are wasting energy and destroying timber because they cannot be regulated properly.

A first step to solve these problems would be insulate the walls and the doors. Secondly waste heat recovery by cross-flow heat exchangers can reduce the energy cost considerably. Investments in the adaptation of ventilation speed to the actual drying progress by digital control have pay-back periods of 6 – 24 month. Finally by vacuum-drying not only the energy consumption can be reduced by about 50%, but also the drying-times are much shorter (Hildebrand-Brunner 2008).

A major contribution to reduce the consumption of thermal energy and also the electricity needs for wood seasoning could be the construction of a solar-assisted timber dryer. The world market leader Thermo-System has installed some of such dryers for sawn timber in Latin America, Thailand and Dubai with capacities between 60 and 2000 $m^3$. Table 1 is showing a comparison of the energy requirements of a conventional and a solar-assisted dryer. The drying time is a little bit longer for the latter (25 – 30 days), but investment, energy and total costs per $m^3$ of sawn wood were less than half (300 US-$/$m^3$, 2-3 US-$/$m^3$, respectively 8-9 US-$/$m^3$, based on prices in Brazil in 1999) (Bux et. al. 2001). With today´s energy prices this calculation should look even better. In economic calculations wood waste should not be regarded as free of costs, because it could be sold and used elsewhere, especially in India.

**Table 1:** Comparison of power input, electrical and thermal energy consumption of the solar-assisted timber dryer in comparison to conventional high temperature drying systems based on drying of 27 mm thick *eucalyptus grandis* boards from 60 to 11 % d.b.

| | Conventional* | Solar** |
|---|---|---|
| Installed electrical power, $W/m^3$ | 150-210 | 40-50 |
| Installed thermal power, $kW/m^3$ | ~ 1,8 | ~ 0,6 |
| Electrical energy consumption, $kWh/m^3$ | 90-110 | 20 - 40 |
| Thermal energy consumption, $GJ/m^3$ | ~ 3 | ~ 1 |

* Brunner-Hildebrand GmbH, Germany 1996, Gloor Engeneering GmbH, CH 1996; ** CAF Sta. Bárbara Ltda, Brazil 1997

Picture 2: Small solar wood drying kiln developed at the Forest Research Institute, Dehradun.

3. Energy savings in production lines

Motors are being used everywhere and they mostly offer the greatest power-saving potential (Varughese, A. 2008):

- The simplest and most obvious method of saving motor energy is simply **to turn it off when it is not needed**. Motors often run un-noticed when they are not needed, increasing energy costs.

- Another simple method of reducing motor energy costs is to **reduce the speed** of the driven equipment, especially pumps and fans. Energy consumption of pumps and fans varies according to the third power, so small change in speed can make big changes in energy consumption.
- For maximum performance and greatest energy efficiency, **lubricate drive trains** like bearings, chains and gears etc; keep drive belts at their proper tension, clean fan blades, check pump impeller blades for wear, replace the filters regularly etc. Most maintenance actions pay for themselves with longer lasting equipment and less downtime even without the energy savings
- Some loads driven by motors do not need to operate at the same speed all the time. These types of loads offer big opportunities for saving by **moderating their speed according to their load.**
- A significantly **oversized motor** will run at low efficiency, increasing energy costs. Motors loaded below 50% are candidates for replacement provided other conditions are met like starting torque requirements, intermittent loads, availability of a lower capacity motor in spare etc. In some of the cases, the motors can be made to run on star connection to save energy
- When replacing an existing motor or when specifying new equipment, consider **using a high efficiency motor**. High efficiency motors use better quality materials and are manufactured to higher quality specifications than standard efficiency motors. The major benefit of these motors is comparatively less drop in efficiency with respect to the load factor on the motors.

Modern pneumatic solutions are also contributing to more efficient utilization of energy through the combination of sophisticated individual components and intelligent overall systems. Energy can be lost from many locations within a system during generation and utilization of compressed air. Firstly there should be no leaks at all! The use of electronic open loop controls permits optimization of speed and even of air consumption. During idle running, cylinder strokes may be driven at reduced pressure for example, and it does not even noticeably slow the system down, thanks to sensitive pressure control. If the system needs full power available, then this power is supplied immediately via the dynamic electropneumatic pressure control. If the correct pressure is always available for the task in hand, then the energy consumption can be reduced by up to 25 percent (Bosch Rexroth AG 2008)

General rules for efficient suction/extraction systems (BMU 2006):

- Be consistent in closing slides to machines that are not in operation
- Switch off wood-processing machines and associated extraction units when not in use
- Regularly monitor the maximum pressure drop in the filter
- Use high-efficiency ventilators with high rpm-speed
- Feed extracted air back in.
- Perform a regular inspection and maintenance of the system and its components.

Varnishing also offers saving potentials in the forest product industries (BMU 2006):

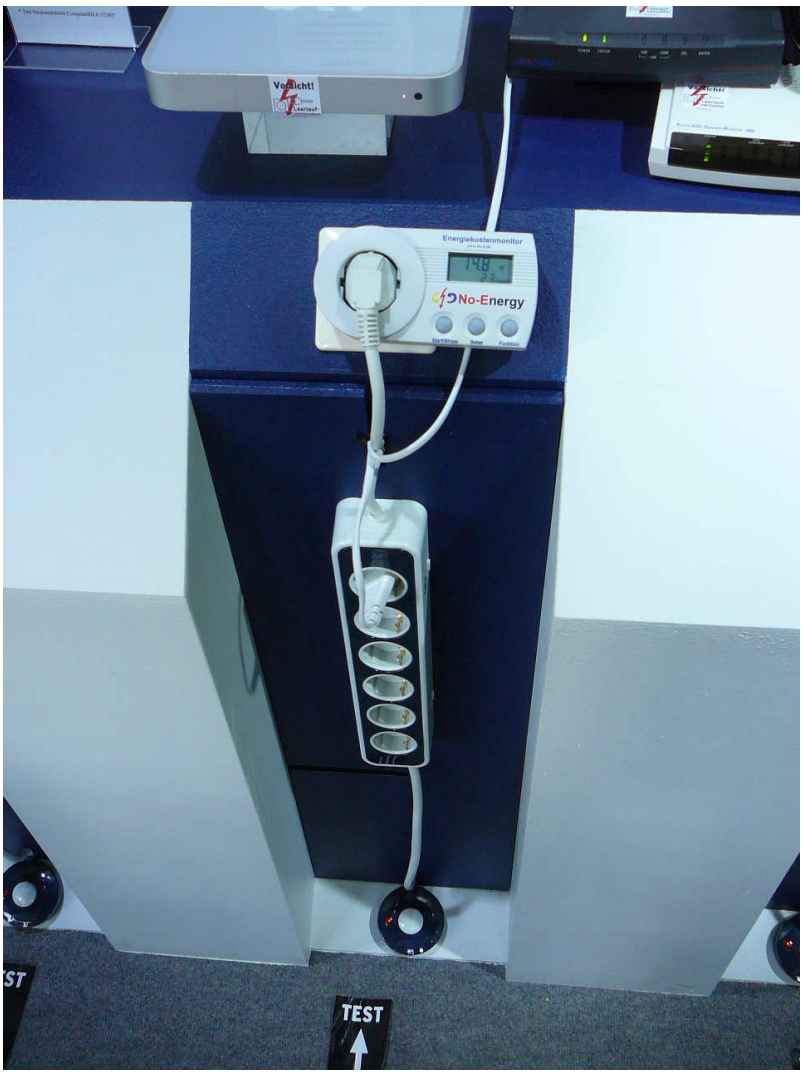
- Recover and use room air and waste heat from other applications
- Switch off the waste air extraction system for spray booths during pauses between spraying
- Optimise the configuration of infra-red and UV heaters
- Avoiding heating up any parts of the unit as far as possible
- Keep atomisation pressure as low as possible

4. Reduction of energy wastage in the office

The basic way to reduce the energy consumption in an office is to switch off unused appliances and lamps. But even in a standby-modus or even if they are disconnected many modern office machines like computer, copier, printer etc. are still spending a considerable amount of electrical energy. This waste can be reduced by special devices as show in picture 3. Another approach is to change the light sources. A conventional 60-watt filament bulb produces nearly five times more heat for the same light as the equivalent 11-watt energy-saving bulb. In general, the more waste heat you generate in a hot climate, the more energy you need for cooling. So any effort to reduce electricity consumption in the office will be paid off a second time by reduced air condition needs.

The European Commission has created an eco label (Flower) to help consumers to identify environmental friendly and energy saving products (EC 2008)

- Eco-labelled computers use less electricity during use and stand-by.
- They have easily accessible on-off switches.
- Desktop computers offer a “sleep” mode, during which no more than 4 watts of energy are consumed (5 watts for laptops).
- When connected to the power supply but turned off, computers sporting the Flower consume less than 2 watts of energy.




Picture 3 (left): With an energy cost monitor (“No-Energy”) office appliances can be checked for energy consumption in stand-by modus or even after disconnection. To avoid this waste you can use a multiple socket with can be comfortably switched off by foot switch (→ “TEST”), as being demonstrated at the Hannover Fair 2008.

In India, an energy labeling programme for appliances was launched in 2006, and comparative starbased labeling has been introduced for fluorescent tubelights, air conditioners, and distribution transformers. The labels provide information about the energy consumption of an appliance, and thus enable consumers to make informed decisions. Almost all fluorescent tubelights sold in

India, and about two-thirds of the refrigerators and air conditioners, are now covered by the labeling programme. This is part of the activities of the Bureau of Energy Efficiency (BEE), a statutory body under Ministry of Power Government of India, within the framework of the Energy Conservation Act, 2001.

The BEE has also initiated the development of a draft Energy Conservation Building Code for large, new commercial buildings; the initiation of a process for the development of energy consumption norms for industrial sub sectors; and an annual examination to certify energy auditors and energy mangers. These experts shall help companies to analyse and implement energy saving measures. On the BEE-website lists of certified energy managers and auditors and more information are available (http://www.bee-india.nic.in/).

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