

Breakthrough in furniture coating with UV LED curing

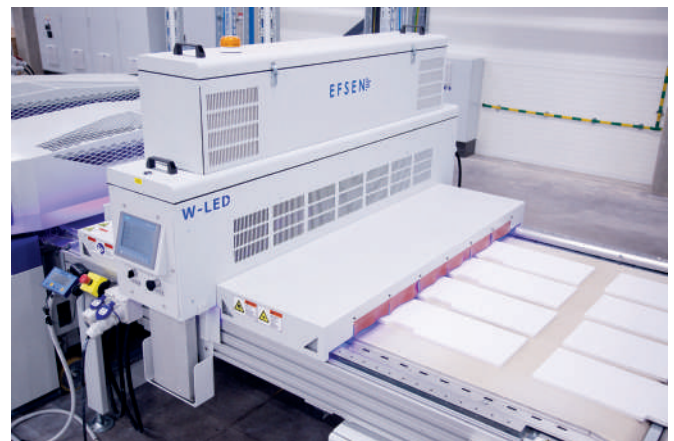
First intelligent UV-LED based high-speed furniture coating line going into service utilizing inline UV monitoring and control.

SC Freda, Lithuania's oldest furniture company founded in 1880, has started production on their new high-speed furniture coating line. SC Freda specializes in manufacturing flat pack furniture from chipboard, MDF and cellular lightweight construction panels. The surfaces range from decorated paper surfaces with clear UV varnish, to highly pigmented UV coating systems. SC Freda is a major supplier for IKEA manufacturing multiple product series.

As a measure to increase their manufacturing capacity, SC Freda expanded with a new production facility, featuring a high-speed production line with UV-curing. This new line must comply with the high IKEA quality and process control standards, to supply superior products. In addition, sustainability and energy efficiency are important topics that are taken into consideration to ensure a strategic, long-term investment, and to stay in forefront of sustainable manufacturing.

EFSEN UV & EB TECHNOLOGY, founded in 1986, are experts in radiation curing technology, with extensive experience in measuring and integrating UV-curing equipment for a wide range of applications and industries. Due to the strong heritage of furniture production in Denmark and its neighbouring countries, it has been natural for EFSEN to develop a unique understanding for optimizing curing solutions for the wood and furniture industry. With an innovative and dynamic team, EFSEN always thinks a step further in order to design solutions that are not only user friendly and safe but that also provides an energy efficient, long lasting, stable process to consistently deliver high performance products.

EFSEN and Freda has been working on optimizing UV for many years, and the discussions about the super-efficient and intelligent UV line started between Freda and EFSEN in 2017. There have been many things for Freda to consider, with cost efficiency, superior product quality and maximized production capacity being some of them. Their intention to implement modern, effective and environmentally friendly production process was key directives from the start of the project.



W-LED with ICAD®

At EFSEN, this challenging request was highly appreciated. It was clear that the only reasonable way to supply a highly efficient and future-proof production line would be with UV-LED curing. While UV-LED curing in the wood industry is nothing unique anymore, the current UV-LED curing production lines are only using a fraction of the capability the UV-LED technology can offer. EFSEN wanted to go one step further, not limiting the use of UV-LEDs to gelling positions, which is how UV-LEDs are used in most lines. The intention was to change the whole process to UV-LED curing on all positions except the final top coat cure.

The price / performance of conventional Mercury lamps can't be matched yet for the final layer, due to the challenges of formulating price competitive UV-LED curing top coatings that meets the high resistance and colour accuracy requirements of a top coat.

Curing the sanding sealer with LED only is an industry first, and such a challenging task goes beyond what an equipment supplier can accomplish alone. With the high-power output of LEDs today, the primary limiting factor of the technology, and also the main cost driver, is the coating itself. Therefore, it was a benefit that Akzo Nobel was the designated coating supplier for this project. Akzo Nobel, a leading manufacturer of wood coatings, is known as an innovative company with extensive R&D capabilities. Already from the first discussions Akzo Nobel agreed into a cooperation to develop a UV-LED curable process which with as much UV-LED as possible, without a negative impact in coating price or properties. EFSEN has been working closely with Akzo Nobel, sharing not only the technical expertise, but also utilizing the chemical expertise of David Ivarsson, the EFSEN chemist, highly specialized in UV-LED formulations. In direct contact with Akzo Nobel, it was possible to develop a new curing process, replacing all conventional UV systems with the exception of Mercury lamps at the end of the production line. A key decision to make this a reality, was the choice of 365 nm LED for the sanding position.

Going through the normal coatings process, starting with sealing of the surface with two clear coats, following up with sanding the surface, and then proceeding to build the colour with multiple layers of base coats, to finally finish it off with a top coat, the challenge has been to find a process solution with only one LED unit in each position, replacing multiple conventional UV lamps on each station.

The conventional line setup which was the starting point at SC Freda is as follows, with 50 m/min as the target speed:



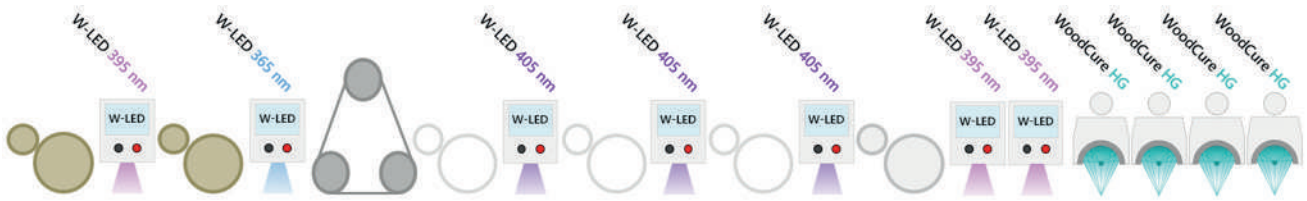
- Step 1: Sanding primer, gelled with 1x 120W/cm Hg-lamp
- Step 2: Sanding primer, cured with 2x 120W/cm Hg-lamps
- Step 3: Base coat layer 1, gelled with 2x 120W/cm Ga-lamps
- Step 4: Base coat layer 2, gelled with 2x 120W/cm Ga-lamps
- Step 5: Base coat layer 3, cured with 2x 120W/cm Ga-lamps
- Step 6: Top coat, cured with 3x 120W/cm Ga-lamps & 3x 120W/cm Hg-lamps

The biggest difficulties to be considered have been the surface cure in front of the sanding station.





It is critical that the coating cures well enough not to clog the sanding.

Furthermore, there will run both white and dark grey base coats, which include titanium dioxide pigment that absorbs a lot of the UV irradiation up to 400nm.

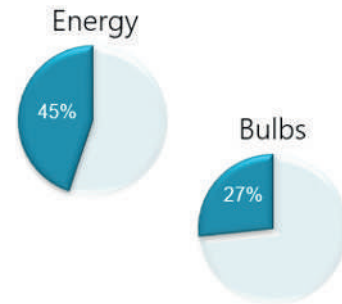
EFSEN solved these challenges together with Akzo Nobel by defining the optimal LED wavelength on each station, ensuring a perfect match with the chemistry for optimal curing. The final setup also uses height adjustable LEDs to adjust the gloss level of the top coat. With the low temperature of an LED-cured process in combination with the full control of the UV uniformity with EFSENs proprietary ICAD® Technology, the process runs with very high gloss stability. Furthermore, the low running temperature prevents issues with edge band glue melting, which can otherwise be a problem.



Energy efficiency is a major requirement for any modern installation. The calculation below shows that 55% energy saving could be realized by selecting UV-LED systems rather than conventional mercury-based systems. In addition, the long lifetime and reduced maintenance required with UV-LED systems, helps to maximize the uptime of the production line. The standby power consumption of conventional UV-lamps (which has not been taken into account in the calculations below) is eliminated when choosing UV-LED, increasing the actual efficiency further.

Energy consumption
 Before: (6  + 9 ) x 18 kW = 270 kW
 After: 7  x 7 kW + 4  x 18 kW = 121 kW

Bulb exchange (250 days/year, 3 shift production)
 Before: 60 Bulbs / year
 After: 16 Bulbs / year



In addition to the LED systems, EFSEN's conventional UV lamp system, the WoodCure, provides some nice benefits. Due guided cooling and superior temperature control, in combination with state-of-the-art reflectors and power supplies, they provide an exceptionally high intensity and a maximized lifetime. These systems are utilizing reflector cassettes which allow for a very quick and convenient cleaning and bulb change. With only 25% stand-by power level, they feature some of the markets lowest stand-by power consumption.



EFSEN WoodCure



EFSEN WoodCure

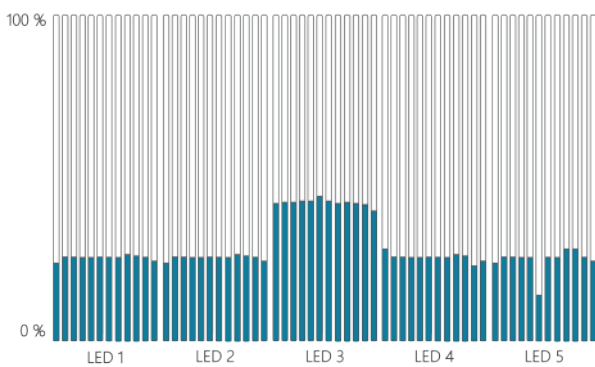
But even after ensuring that the chemistry and the light sources works in synergy, fulfilling the application requirement, LED-curing presents a unique obstacle to overcome in order to ensure long term process stability. UV-LEDs, in difference to conventional UV systems, consist of thousands of individual light sources and each of them are slightly different. Measuring the light source at a few defined positions, as it is being done at conventional light sources, will not give the required process security. During the lifetime of the LED, a deviation will occur, such as a defect segment, damaged optics or dirt on the lens that would have a negative impact on the output, hence the cure. If this would happen in a position away from the measuring point, it would not be recognized in a normal measurement.

But defect segments, damage or dirt are not the only reason why an in-line process control would be a huge benefit for UV-LED systems. Even if UV-LEDs lasts much longer than mercury based UV lamps, they still age. This means they lose power over their lifetime. This aging is very temperature sensitive, requiring a perfect balance of the cooling within the UV-LED system. The aging might also be different from chip to chip, something resulting in that deviations within the UV-LED System will become bigger over the lifetime. Furthermore, any replacement LED-modules would have a higher power output compared to remaining modules.

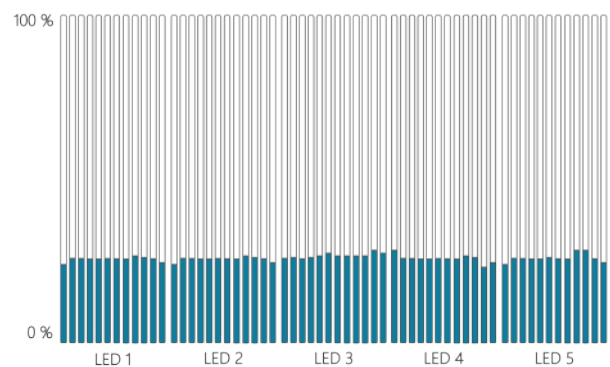
EFSEN solved this process stability issue with the proprietary ICAD® inline process control which is integral part of all EFSENs UV-LED products. ICAD® is an inline control which is continuously measuring the UV output of the lamp across the width of the whole line. It recognizes deviations of the emitted UV power and is automatically adjusting the individual UV LED arrays to produce a homogeneous UV-distribution over the whole width of the UV LED system. Deviations of <5% can easily be reached using ICAD® technology. This technology is capable to measure inline during production, something that has been confirmed by countless hours of production testing.



By utilizing EFSENs ICAD® technology, SC Freda is able to have a continuous control of the UV output being applied during actual production. All this information generated by ICAD® can be extracted to provide a complete history of UV output, which can be used for quality documentation of the production batch. If required the documentation can be made for each piece of product individually, showing the actual UV energy being applied to each individual product.



ICAD® measurement before power level adjustment



ICAD® measurement after power level adjustment



SC Freda decided to choose EFSEN's W-LED systems incorporating ICAD®. The W-LED is a "all in one" unit, where power supplies, PLC control and cooling air supply are all included into an "easy to maintain" housing. This saves space around the line, as no external electrical cabinets are required. W-LED is made with the user in mind. It is easy to install and use, only requiring a power and PLC connection.

The integrated cooling air blowers forward filtered cooling air to the LED modules taking care that the LED modules are not getting dirty to guarantee optimal cooling of the LED modules increasing the lifetime further. This filtered cooling is very important under the normal condition inside a wood processing plant. Exchanging the air filters of a W-LED can be done without tools, for a fast and easy filter replacement utilizing standard filter cassettes.

The W-LED comes with optional electrical height adjustment, sensors which activate the W-LED when a product arrives, safety sensors to deactivate the conveyor in case a bended part is getting stuck and customized light shields which are designed to fit onto the conveying system.

A stable, robust production method that ensures a high-quality end product that meets the requirement is the target. The W-LED, with integrated UV-LED modules, and the ICAD® measuring system provides a state-of-the-art solution which is unique in the market, providing complete UV control, all the time.



About SC "Freda"

SC "Freda" - the oldest furniture company in Lithuania. It started as a sawmill in 1880, January 25th. SC "Freda", on July 13th 1992, registered as a furniture manufacturing company. Current SC "Freda" counts its years of existence since 2001 March 2nd, when it was acquired by new owners - JSC "Baltic Furniture Group". On 2011 SC "Freda" separated from JSC "Baltic Furniture Group" and independently and successfully operates till now.

SC "Freda" manufactures flat pack furniture from chipboard, MDF (medium density fibreboard) and cellular lightweight construction panel. The main part - the living room and hallway furniture. The major part of the chest of drawers, as well as shoe boxes and the like. This furniture is made by staining pigment ink or coating decorated paper.

