



ANALYTICAL REVIEW OF DIGITAL VARNISHING AND FOILING TECHNOLOGY

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Abstract. *In this work the features and advantages of the digital varnishing with digital hot foil stamping technology are presented, including performance advantages, economic benefits for businesses, corresponding to modern trends and demands on the market. Prerequisites and reasons for the relevance of this technology in the context of modern printing market are revealed, using the example of equipment present on the Ukrainian market.*

Digital printing technologies are rapidly evolving, with digital printing increasingly capturing a larger market share. This growth is driven by a rising demand for shorter print runs, as manufacturers find it more advantageous to minimize stock levels of finished goods by producing only the required amounts, which allows to react to the most subtle shifts and fluctuations in market trends [1].

Nowadays not only the digital printing technologies gain more popularity, but also digital embellishment methods, digital varnishing and digital hot foil stamping in particular. Digital varnishing is a method of applying varnish to printed materials, achieved through the use of inkjet printheads followed by ultraviolet curing. The technology is based on the use of piezoelectric inkjet printheads that precisely dispense droplets of varnish, typically acrylate-based formulations, onto the surface of the printed substrate. The varnish used in this method is a photopolymer composition, meaning its polymerization is activated by exposure to light of specific wavelengths. The main advantage of digital varnishing is the capability to apply a layer of varnish with a wide range of thicknesses in a single pass, including selective varnishing, which enables the creation of both uniform and textured coatings for tactile effects [2].

This technology is exemplified by machines such as the MGI JETvarnish 3D [3]. It enables applying varnish layer with variable thickness ranging from 3 to 200 μm , producing volumetric 3D effects and various textures. During the varnishing process, inkjet printheads Konica Minolta KM1024i dispense microdroplets of varnish with volume ranging from 6 to 30 picoliters at a resolution of up to 360 dpi in the transverse direction. The high addressability and volume control provide a very precise application detailing, a crucial point for coating fine elements and selective varnishing.

In combination with the iFOIL S module, the system enables digital applying of metallic foil. A remarkable feature of the digital hot foiling technology is that the foil can be pressed to the volumetric varnish layer, creating visually appealing convex effects on the substrate. Also, in order to achieve additional level of shine and gloss, it is possible to apply an additional layer of varnish in a second pass. In general, it is possible to apply a layer of varnish on top of the previously applied layer, creating unique effects.



The primary advantages of the technology are as follows [4]:

- high-precision digital 2D/3D spot UV-coating device with integrated hot foil stamping unit, which maximizes productivity for the embellishment processes, providing both operations in a single pass;
- elimination of the need for plate and die creation, thus enabling the personalization of each print and providing significant economic benefits for ultra-short, short, and medium print runs, which is highly relevant to large businesses that can receive a sufficient amount of such orders;
- AI SmartScanner (AIS) system employing artificial intelligence for automated registration of varnish and hot foil for the inkjet heads on pre-printed sheets. This is achieved by including small vector graphics as markers in the blank margins of the sheet during artwork pre-print production, which are then used by the scanner sensors during varnishing and foiling to estimate the precise disposition of the substrate and align it perfectly with the varnishing and foiling design;
- digital hot foil stamping is capable of applying up to five foil colors in a single pass;
- enhanced protection from the UV radiation with lower energy consumption compared to traditional UV systems;
- no need in cleaning between runs due to the automatic printhead cleaning system.

Digital varnishing and foil stamping technologies can provide manufacturers with a significant competitive advantage by enhancing the value and uniqueness of their products, thereby satisfying personalization and individual customer service trends. In addition, this technology is ideally suited for embellishment of such products as books and magazines covers, brochures and catalogues, business cards and invitations, packaging and labels, photobooks and other premium-quality printed products etc. [5].

The integration of digital varnishing technology with digital hot foil stamping enables printing houses to offer their clients high value-added products, embellished with appealing visual and tactile properties. In the context of contemporary trends towards customization, product personalization, and the popularization of craft and niche-market products, the demand for digital technologies in both printing and post-press finishing processes is increasing and holds significant potential for further development and widespread adoption.

References

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