Sustainable printing lowers costs

Propyls make packaging printing more economical and environmental friendly

Dr Jens Klabunde; Sebastian Anton

Sustainable printing, where the consumption of printing ink and solvents can be reduced while maintaining or even improving quality, is not fiction: n-propanol, n-propyl acetate mixtures or pure n-propyl acetate (known as "Propyls") can replace conventional ethanol, ethyl acetate mixtures or pure ethyl acetate (known as "Ethyls") in gravure or flexo printing processes without any modification to existing press processes.

While offering at least the same – and frequently even better – print quality in both types of printing process, Propyls are on average 30% more economical in terms of solvent consumption while reducing ink usage by an average of 20%. Retardants such as Ethoxy propanol are not required for Propyls formulations. This offers considerable advantages when printing food product packaging. Improved process stability significantly reduces scrap percentages. Findings from studies conducted worldwide by chemical company Oxea have been confirmed by a recent research paper compiled by the HdM University of Media Studies in Stuttgart/Germany.

Medium evaporation rate solvents

Gravure is one of the most common printing process used for long-run jobs such as flexible packaging, magazines, catalogues or art prints. In comparison to other processes such as flexo or offset printing, gravure inks require a lower viscosity, i.e. they contain more solvent. Conventional solvents such as ethyl acetate evaporate fast and require retardants to reduce their evaporation rate. Pure n-propyl acetate or mixtures with n-propanol – i.e. Propyls – evaporate only moderately fast. Accordingly, gravure can avoid or reduce the use of retardants such as Ethoxy propanol both when mixing the printing ink and when refilling ink in the printing process.

While slower than Ethyls, the Propyls evaporation rate is still fast enough to ensure the printing ink dries properly during the process. As a result, levels of solvent loss are generally lower in the press. This means less refilling is needed during the printing process to maintain the correct ink viscosity.

Compared with conventional solvents, the slightly longer period required for drying in a propyl solvent system gives the pigments in the printing ink more time to distribute uniformly at the moment they are applied to the polymer film. When compared with solvent systems, this results in a higher colour density for the same quantity of pigment. Accordingly, the same printing quality can be achieved with less pigment, which in turn leads to a lower consumption of concentrated ink.

The point of using Propyls is, that you can produce the same colour density with a formula that has more solvent but less pigments than with Ethyls (less colour base). This means lower costs. This effect can be attributed to the different way in which Propyls solubilize the binder components. As a result, less of the valuable concentrated ink is needed to make the same volume of ready-to-use printing ink. This, in turn, leads to further savings due to the fact that the ink is generally more expensive than the solvents.

Advantages for flexo and gravure

In film printing with flexography or gravure, Propyls offer a 1:1 replacement for the Ethyls conventionally used. A simple swap is possible, with no further modifications needed. Print shops can continue to use the same printing ink, the same equipment and the same photopolymers or gravure cylinders as before. Especially in packaging printing, customers are demanding more sustainable printing from providers: with Propyls, print shops use less ink and less solvent while also producing a lower percentage of scrap. As a result, resources are conserved and emissions of volatile organic compounds (VOCs) are reduced due to the reduction of solvent. Productivity also increases while using the same machinery as before.

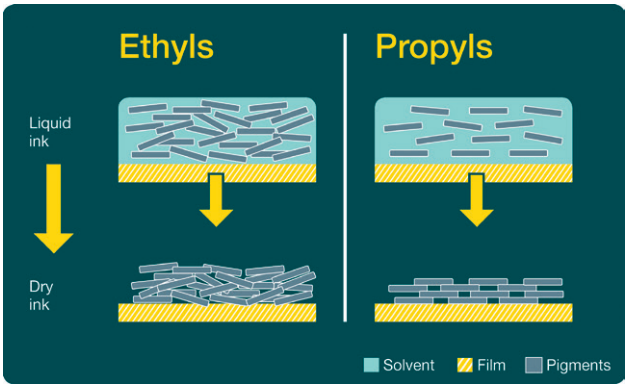
The advantages of Propyls have long been recognized worldwide. In North America in particular, Propyls have traditionally been favoured in flexo printing. In recent years, this trend has also gathered pace in Central and South America, and has been expanded to the use of n-propyl acetate in gravure printing.

Studies show potential savings of Propyls versus Ethyls

Several industrial studies published by the chemical company Oxea have examined the substitution of Ethyls for Propyls in flexography and gravure printing at ink shops and print shops. The studies looked at print runs of over 1243 miles and production periods of up to one month. In all of the studies, considerable savings in inks and solvents were achieved, simply by substituting Propyls for conventional ethyl-based solvent systems.

By using Propyls, study participants achieved major improvements in terms of increased cost-effectiveness while maintaining or

Drying characteristics of printing inks on films. Comparison between conventional solvent based on ethyl acetate (Ethyls) and solvent based on n-propyl acetate and n-propanol (Propyls)



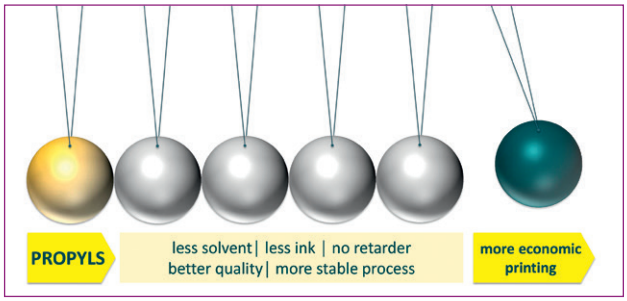
Source: Oxea

even improving print quality, and were able to reduce or avoid entirely the use of retardants such as Ethoxy propanol while preparing the base ink. Propyls feature the same chemical and physical compatibility as Ethyls with the typical binders such as nitrocellulose (NC) and polyurethane (PU). In the studies, advantages were demonstrated in terms of improved process stability, higher printing speeds and less scrap. Printed materials also contained a significantly lower volume of solvent.

In gravure, the delayed evaporation of Propyls lessens the incidence of cylinder cell "plugging" by lowering the tendency of ink to dry in the cells while simultaneously improving the reconstitution of dried-on ink. This effect is the main reason for the improvements to quality observed. Thanks to the slower evaporation rate of Propyls, it was possible to increase the speed of the press in many cases without compromising print quality. In several printing trials, Propyls demonstrated less foam formation tendency than Ethyls, especially with the colour black, which again led to improvements in quality. In a Brazilian study, one other advantage observed was improved colour stability due to lower water absorption.

Where solvents were reused, it was possible to utilize exactly the same procedure for concentration (activated charcoal bed), condensation or distillation. N-Propyl acetate also has another advantage over ethyl acetate: since the enthalpy of vaporization for n-propyl acetate is lower than for n-ethyl acetate, less energy is required for both vaporization and condensation. The higher boiling point of n-propyl acetate exerts a greater effect across the larger temperature differential of the cooling medium, which further promotes condensation. When considered in conjunction with the lower overall volume of solvent in the propyl-based recycling process, these effects lead to energy savings when reclaiming used solvent.

On the basis of the experience gained at industry customers, detailed models for replacing conventional solvents with moderately evaporating Propyls were developed at the HdM University of Media Studies (Stuttgart) in late 2017/early 2018. In the University's Print and Media faculty, a research group from partner association DFTA and a group led by Professor Armin Weichmann conducted test runs on a standard press under lab conditions with runs of 17,000 m in flexo and 10,000 m in gravure. The results, which definitively confirmed the previous insights gained by Oxea in the industry studies, documented comparable savings in solvents and printing inks while meeting the same high standards required for the output quality of the printed matter.



Source: Oxea

The table indicates the general conditions and results of the respective test runs with the different kinds of solvents

Test-Parameter								Savings		Quality		Performance increase		
Trial	Date	Technology	Machine	Ethyls solvent (EtAc: EtOH)	Propyls solvent (nPrAc: nPrOH)	Colors	Job size/ press-speed	Solvent (refill)	Base ink	Retained solvent	Quality	VOC/ smell	Speed	Scrap
Brazil	2015	Flexo	FW 1508-(Comexi)	20 : 70 (10% Methoxy)	20 : 50 (+30% EtOH)	8	74.8 km/ 250 m/min	-18%	-25%	–	better	–	+ 25%	–
Brazil	2015	Flexo	FX8 (Cerutti SpA)	20 : 70 (+10% Methoxy)	20 : 80	8	2,236 km/ 180 m/min	-27%	n.a.	-57%	better	-50%	+22%	-83%
Germany (HdM)	2017	Flexo	CI Flexpress 6S/8 (F&K)	5 : 85 (+10% Ethoxy)	5 : 95	5	17 km/ 220 m/min	-28%	-12%	-11%	equal	–	–	–
India	2017	Gravure	Rotomec (Bobst)	50 : 10 (+40% nPrAc)	90 : 10	6	1 month/ 400 m/min	-10%	-11.5%	–	better	much better	–	–
Mexico	2015	Gravure	n.a.	44 : 44 (+12% Ethoxy)	50 : 50	5	14 km/ 220 m/min	-48%	-23.8%	–	equal	–	–	–
Spain	2016	Gravure	R 970/2-8 (Cerutti)	EtAc mono-solvent	nPrAc mono-solvent	3	65.5 km/ 315 m/min	-2%	-53%	-43%	better	–	+11%	–
Germany (HdM)	2017	Gravure	Rotomec MW60 (Bobst)	60 : 30 (+10% Ethoxy)	80 : 20	4	11.6 km/ 180 m/min	-26%	-12%	-50%	equal	–	–	–
Germany (HdM)	2018	Gravure	Rotomec MW60 (Bobst	70 : 30	80 : 20	4	10 km/ 180 m/min	-55%	-18%	–	equal	–	–	–

HdM = Hochschule der Medien, Ethyls = Ethyl acetate oder ethanol or blends thereof; Propyls = n-propyl acetate oder n-propanol or blends of thereof; Monosolvent = pure ethyl acetat or pure n-propyl acetat; Ethoxy = Ethoxy propanol retarder (EP, 1-ethoxy-2-propanol); Methoxy = Methoxy propanol retarder (PM, 1-methoxy-2-propanol)

Source: Oxea