EFFECT PIGMENTS & METALLIC INKS:
COMPOSTABLE, DEINKABLE, CERTIFIED.

A member of ALTANA

ECKART

INTRODUCTION

The declared goal for sustainable and thus resource-saving handling of packaging and other consumer goods is the consistent implementation of a closed-loop economy in which the many different substrate materials used can be recycled as completely as possible. In the case of most printed products - including packaging - the paper and cardboard products are already recycled in a targeted manner. Through qualitative sorting, fibers for new high-quality papers can be recovered from papers and packaging materials using deinking processes, so that the use of virgin fibers can be significantly reduced.

Plastic substrates are also targeted for sorting and deinking for recycling. Furthermore, there are questions regarding composting of metallic inks and especially pigments whether they cause harm to bacterial flora for biodegradability of waste and the use of bio-based raw materials versus oil-based raw materials.

In this overview, ECKART will provide general statements regarding sustainability topics regarding

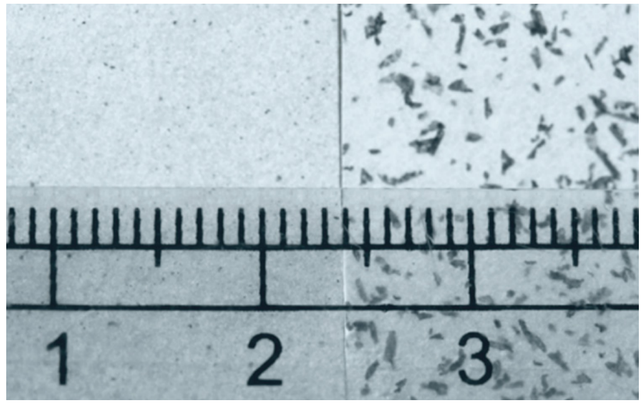
1. Metallic Inks in the De-Inking Process of Paper and Carton
2. Composting of Metallic Inks
3. Deinkability and Sorting of Plastics
4. Bio-Based Raw Materials in ECKART Inks

For more information, please contact **info.eckart@altana.com** or refer to your ECKART sales representative.

1. Metallic Inks in the De-inking Process of Paper and Carton

One of the recycling steps for paper and carton packages is to remove the ink from the package to get access to the clean paper fiber. This process is called de-inking. With regard to sustainable solutions for the design of packaging, there is no way around deinking when it comes to the recyclability of the substrates used. This process makes it possible to separate the high-quality cellulose components from the printing ink layer as well as unwanted substances such as adhesive components and thus feed them back into paper production as a valuable raw material.

To evaluate whether ECKART inks or metallic inks in general can be deinked, ECKART worked together with a deinking institute in Germany, called INGEDE. Their method number 11 shall represent the deinking process in which the collected paper fiber is evaluated on dirt specks after deinking (see picture). A low number of dirt specks shows a potentially well deinkable ink.



Dirt specks on paper pulp after deinking
"Recycled" printed metallic ink (left) vs. met-PET paper (right) in INGEDE Method No. 11 test

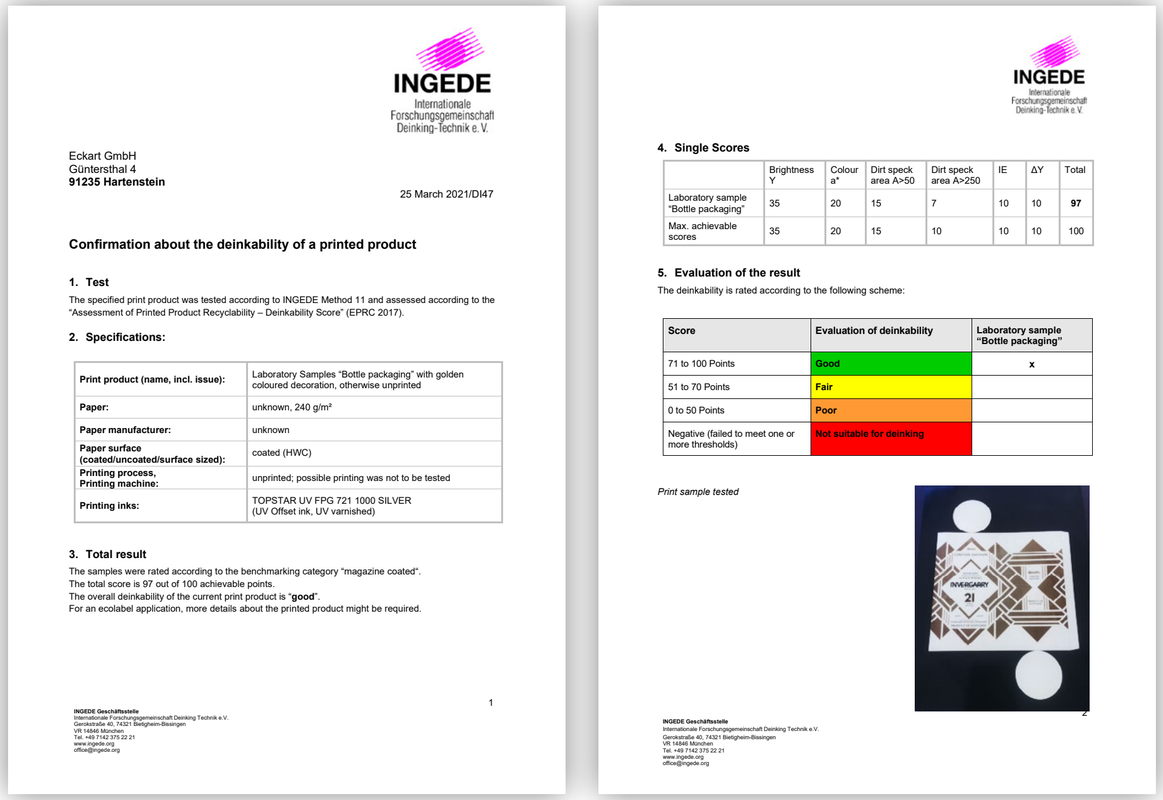
This is an internationally recognized test for evaluating the deinkability of printed paper and board materials and can be used as a meaningful test for the suitability of printing ink systems. The flotation process used in paper recycling is used here.

For the tests, the paper sample is first aged, then pulped under specific temperature conditions (40°C) for a set period in an alkaline deinking medium (caustic soda, sodium silicate, peroxide, soap / oleic acid). By mechanical disintegration, the fibers are transferred from ink particles and other paper ingredients into a suspension. By blowing in air bubbles, ink particles adhering to the bubbles are then carried to the surface where they can be separated from the fiber pulp.

Printing ink systems have different suitability for the deinking process. In general, oil-based printing inks have proven suitable for the recycling of newspapers, books and other graphic applications. Solvent-based inks, also for newspapers or as used in packaging printing, can also be de-inked well, the same as toner based office papers.

In the case of radiation-curing ink systems, it is considered that the chemical crosslinking and the strong anchoring on the substrate make deinking more difficult. During defibering, quite coarse particles are formed, which also tend not to float due to the hydrophilic character of the particles. This makes them more difficult to remove from the paper fiber pulp.

Water-based systems can create difficulties in some applications, especially when using soluble toners, as well as by discoloring the paper fiber. Some offset ink systems based on vegetable oils are also seen as critical for deinking, in some literature.



INGEDE
Internationale Forschungsgemeinschaft Deinking-Technik e. V.

Eckart GmbH
Güntersthal 4
91235 Hartenstein

25 March 2021/DI47

Confirmation about the deinkability of a printed product

1. Test

The specified print product was tested according to INGEDE Method 11 and assessed according to the "Assessment of Printed Product Recyclability – Deinkability Score" (EPRC 2017).

2. Specifications:

Print product (name, incl. issue):	Laboratory Samples "Bottle packaging" with golden coloured decoration, otherwise unprinted
Paper:	unknown, 240 g/m²
Paper manufacturer:	unknown
Paper surface (coated/uncoated/surface sized):	coated (HWC)
Printing process, Printing machine:	unprinted; possible printing was not to be tested
Printing inks:	TOPSTAR UV FPG 721 1000 SILVER (UV Offset ink, UV varnished)

3. Total result

The samples were rated according to the benchmarking category "magazine coated".
The total score is 97 out of 100 achievable points.
The overall deinkability of the current print product is "**good**".
For an ecolabel application, more details about the printed product might be required.

1

INGEDE Geschäftsstelle
Internationale Forschungsgemeinschaft Deinking Technik e.V.
Gerokstraße 40, 74321 Bietigheim-Bissingen
VR 14846 München
Tel. +49 7142 375 22 21
www.ingede.org
office@ingede.org

INGEDE
Internationale Forschungsgemeinschaft Deinking-Technik e. V.

4. Single Scores

	Brightness Y	Colour a*	Dirt speck area A>50	Dirt speck area A>250	IE	ΔY	Total
Laboratory sample "Bottle packaging"	35	20	15	7	10	10	**97**
Max. achievable scores	35	20	15	10	10	10	100

5. Evaluation of the result

The deinkability is rated according to the following scheme:

Score	Evaluation of deinkability	Laboratory sample "Bottle packaging"
71 to 100 Points	**Good**	**x**
51 to 70 Points	**Fair**	
0 to 50 Points	**Poor**	
Negative (failed to meet one or more thresholds)	**Not suitable for deinking**	

Print sample tested

2

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Example of a de-inking certificate tested by INGEDE Method No. 11

Besides the visual impression, INGEDE rates the result and certifies inks for good deinking capabilities, which would pass the recycling process.As a reference for the deinking capability of metallic inks in the recycling process, ECKART has sent in ink samples of various ink chemistries for testing purposes and obtained deinking certificates for solvent-borne, water-borne and UV offset inks.

All test results are obtained by using pure ECKART products. Different print setups, including primers, CMYK colors, overprint varnishes and formulations might affect the results in either direction.

The certificates for these test results are available on our website:
https://www.eckart.net/de/en/sustainability/sustainable-products/de-inking

2. Composting of Metallic Inks

ECKART has shown here with investigations according to INGEDE Method 11 that effectful printing with metallic pigments in various printing processes is very well suited for deinking. Thus, nothing stands in the way of reusing the substrates as raw materials for paper production.

If recycling is not possible by sorting within the framework of orderly material streams or is too costly in terms of energy, composting is an option instead of incineration or landfilling for suitable organic base materials. High demands are placed on substrates, printing materials and auxiliary materials such as adhesives in terms of their suitability for the composting process and their toxicological harmlessness to microorganisms and plant growth. Pigments and fillers used as additives per DIN EN 13432 (certification scheme additives harmless to the composting process 2020-08) do not themselves have to be biodegradable, but they must not impair the degradation process and plant growth according to a standardized test procedure, and they must comply with strict limit values for heavy metals and halogens.

For composting trials, ECKART cooperated with an institute to test the impact of pigment classes on bio-toxicity in the composting process. In the composting process mainly bacteria decompose organic materials. To pass the test, the bacterial flora must not be affected.

As the organic matrix of coatings and inks should not have bio-toxicity, ECKART tested only non-heavy metal-containing pigments.

PIGMENT TYPE	
LUXAN	Pass (up to 20% area coverage)
SYMIC	Pass (up to 10% area coverage)
Uncoated Aluminum Pigments	Pass (up to 20% area coverage)
Coated Aluminum Pigments	Pass (up to 20% area coverage)
Encapsulated Aluminum Pigments	Pass (up to 20% area coverage)

The safety and harmlessness of these products have been confirmed and certified at an addition quantity of up to 20% (up to 10% for SYMIC C001) in the product for the composting process. This gives manufacturers great flexibility in the formulation of inks and coatings to enhance packaging and consumer goods intended and suitable for composting with effective and decorative motifs without affecting the quality of the substrate after composting.

Results are shown on our homepage:
https://www.eckart.net/gb/en/sustainability/sustainable-products/compostability

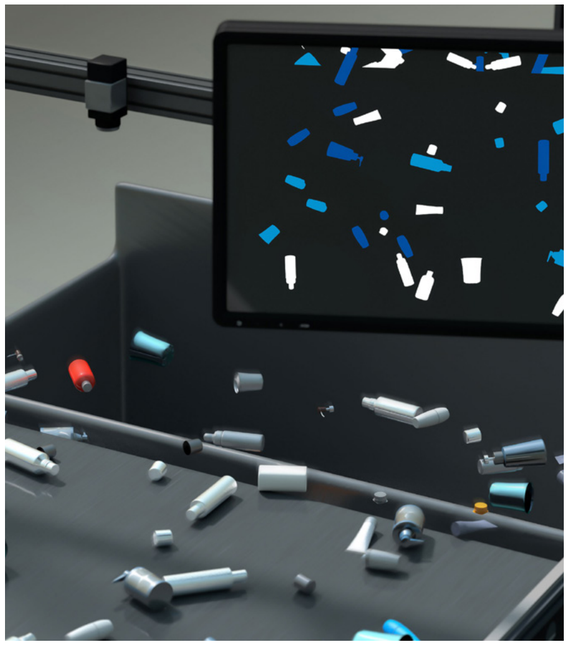
3. Deinkability and Sorting of Plastics
(Following North American standards)

Deinkability
During the recycling process, plastic packages are processed through a caustic wash stream to clean the plastic and remove labeling. During this process, the ink on any labeling has the potential to discolor the plastic pieces and/or the caustic wash solution. Both cases are unacceptable, as the discolored plastic will contaminate the final recovered plastic and the discolored solution has the potential to discolor plastic in the current or future batches of plastic.

A wide array of ECKART inks of varying chemistries (water-borne, solvent-borne, and UV-curable) and print applications were evaluated for deinkability following APR's guidance for testing the processing of PET. **All inks tested were found to NOT cause any discoloration of PET chips used in testing.** The removed ink does not stain the solution and quickly settles to the bottom of the test vessel.

ECKART believes its ink portfolio is well suited for applications that will undergo a typical recycling process at the end of the life of the product.

Sorting
As the drive for sustainability in the packaging industry becomes stronger, recyclability has become an important factor when considering various packaging products and their decoration. Plastic packaging is often co-mingled with other recyclables by consumers and sent to a material recovery facility. A metal detection test is commonly used to sort single-stream post-consumer recyclables into segregated materials that will be further processed and recycled.



To ensure ECKART metallic ink products will not interfere with material sorting, an independent lab conducted standard metal detection tests, outlined in American Plastics Recyclers' (APR) Sort B-03 test method. In these tests, PET bottles with labels printed with metallic inks containing various pigment types and coverage as well as PET bottles labeled with a metalized film were compared to determine the impact on sorting. The table below outlines the type of pigment, amount of ink coverage and degree of impact on sorting. Metalized film was also included in testing as a comparison.

All ECKART ink products tested were not detected – the containers could thus be sent for recycling. The ECKART ink products were labelled "APR Design Guide Preferred". On the contrary, the bottles with metalized film on them were flagged as "Detrimental to Recycling", per APR guidelines, a leading organization in plastics recycling.

PIGMENT TYPE	Coverage	Impact on Sorting
Aluminum Platinum dollar	100%	no impact
Aluminum Platinum dollar	50%	no impact
Aluminum VMP	50%	no impact
Aluminum Silver dollar	50%	no impact
Aluminum metalized film	100%	detrimental

4. Bio-Based Raw Materials in ECKART Inks

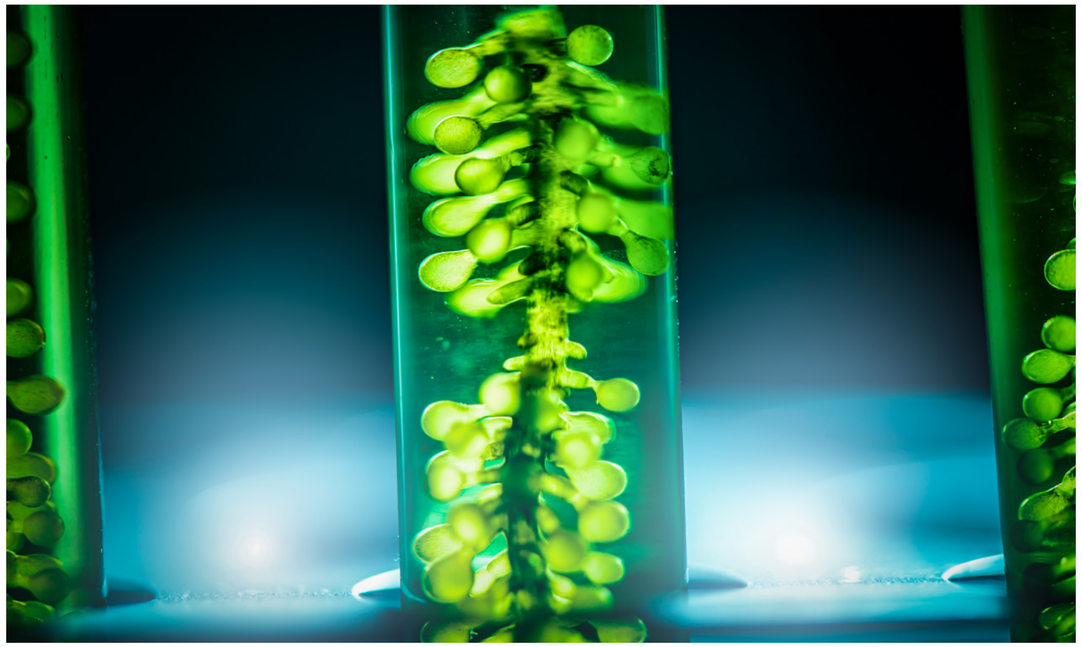
As a part of ECKART's sustainability strategy, the company tries to use high amounts of non-petrol-based raw materials, which ensures the independence of oil and reduces ECKART's consumption of oil-based raw materials.

To define the percentage of bio-based raw materials, a usual method for the definition is the C14-method, which is also used by archaeologists to define the age of historical findings. As oil was stored for millions of years, the amount of C14- is much lower compared to young organic compounds. For the raw material selection, ECKART sends formulation examples to an institute to measure the percentage of bio-based raw materials from the organic matrix (pigments excluded).

This table indicates ECKART's ink status. Especially in our modern FPG offset ink series, the amounts of bio-based raw materials are extraordinarily high.

	% bio-based raw materials
METALSTAR FPG 712 0871	76.8 ± 3.4
METALSTAR FPG 712 1004 Silver	75.8 ±3.4
METALSTAR SuperEco 102877 Pantone 2877	68.1 ± 3.4
METALSTAR Eco 10 0871 Pantone 871	50 ± 3.7
Flexo UV Gold 1 Experimental Product*	54.4 ±3.7
Flexo UV Gold 2 Experimental Product*	25.4 ± 4.3
Flexo UV Silver 1 Experimental Product*	41.3 ± 3.9
Flexo UV Silver 2 Experimental Product*	30.9 ± 4.1

*In addition, these lab UV flexo ink formulations with bio based raw materials were evaluated (lab scale only, not yet commercially available). Good results regarding the content of bio based organic materials were achieved, which shows that a considerable proportion of raw materials of fossil origin can be replaced.



ECKART GmbH
Guentersthal 4
91235 Hartenstein, Germany
Tel +49 9152 77-0
Fax +49 9152 77-7008
info.eckart@altana.com
www.eckart.net

ECKART America Corporation
830 East Erie Street
Painesville, Ohio 44077, USA
Tel +1 440 954-7600
Fax +1 440 354-6224
Toll-free: 800 556 1111
info.eckart.america.oh@altana.com
www.eckart.net

ECKART Asia Ltd.
Room 701-3, 7th floor C C Wu Building
302-308 Hennessy Road
Wan Chai, Hong Kong
Tel +852 3102 7200
Fax +852 2882 5366
info.eckart.asia@altana.com
www.eckart.net

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