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Marabu

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Function and Use of Marabu Additives and Auxiliaries for solvent-based Screen Printing Inks

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It is well known that screen printing lives from the variety and almost unlimited possibilities for use in industry as well as in the graphics field. Today, Marabu offers some 30 solvent-based ink systems. Each individual ink type has clearly defined properties and specific fields of use. These requirements are taken into account by Marabu when formulating the inks , selecting the right binder and additives. If different ink properties are required for special printing jobs, alterations can be made by the careful use of our auxiliary products.

There are some 60 auxiliaries available. In the following text, we would like to show their properties and describe their applications and benefits.

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Accuracy is essential when making additions of additives, and it is strongly recommended to use electronic scales. The data specified in the technical data sheets are applicable for each ink type.

Note

Each addition of an auxiliary will change the characteristics of the selected ink system. Therefore, an representative printing test must be carried out before starting the print run.
IMPORTANT. The following quantities to be added will be referred to by percentage weight and not by volume.

Warning

Overdosing will in most cases adversely effect the printing results and will lead to different problems such as levelling or loss of adhesion, especially for multicolour prints. For these reasons, a scale and accurate working are a necessity.

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1) Viscosity

By viscosity we mean how thin (low viscous) or thick(highly viscous) an ink system is or how it is adjusted. Before starting the print run, it is important to adjust the ink to the correct viscosity, as this will have an influence on ink levelling, sharpness of print, mesh opening, drying behaviour, possible printing speed and ink adhesion in some cases. Because there are varieties of machines and requirements in the market, all solvent-based inks are not formulated press-ready today.
Before printing is started, the viscosity of the ink must be adjusted by adding solvents. Single exceptions are the 2component "traffic shades" in the Marapur PU ink type. Generally, the following 'Rule of thumb' are applicable for solvent addition (thinner/ retarder) nominally at 20°C:

10-15%	1C-full-area ink for hand printing and flat-bed presses
15-20%	1C-full-area ink for cylinder printing
10%	1C-4-colour process ink for hand printing and flat-bed presses
15%	1C-4-colour process ink for cylinder printing
10%	2C-full-area ink (plus hardener) for hand printing and flat-bed presses
5%	2C-4-colour process ink (plus hardener) for hand printing and flat-bed presses

All shades of an ink type should be adjusted before and during production to a working viscosity, with two exceptions:

- Due to high pigment levels in Opaque Whites, the viscosity is always higher than for all other shades
- 4-colour process inks (within an ink series) are always more highly viscous than standard colours so that the printed process halftone "stands" optimally and cannot flow out.

Different ink types often have different working viscosities, depending upon certain requirements.

Thinners

Adding a thinner to the ink influences viscosity, flow properties, mesh opening, drying speed, block resistance, solvent power of the binder and dissolving power, and also - to a large degree - adhesion to the substrate. As the thinners are already included in the ink formulation their compatibility is thus guaranteed. It is not possible to cover all ink types with the two 'universal thinners' (UKV1 and UKV2). For specific reasons we have 13 different thinners available.
Technical data sheet, label of ink can, and range chart show the correct thinners per ink type.

Spray thinners

If the ink is applied by means of the spray method (spray gun), very fast evaporating spray thinners are available. Fast drying of the ink at the surface is critical, to ensure an even colour deposit.

Retarders

Retarders are also solvents, having a signifycantly higher evaporation value. However, whilst producing an improved mesh opening retarders cause slower drying of the ink and at the same time and reduced block resistance. Retarders are normally added together with the thinner for printing fine details and halftones, or where slow printing speeds are used.
Retarders also have an influence on ink viscosity (analogous to thinners) and are chosen for ink compatibility and adhesion to the substrate, in combination with thinners.

Product overview with characteristics

Each thinner or retarder consists of a mixture of solvents. Speed of evaporation of the printing ink is an important. Generally, thinners are faster than retarders.

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Thinners

	Evapo-ration	Solvent power	Flash point	Odour	Label-ling
GLV	slow	good	72°C	mild	Xn
LIGV	slow	good	40°C	mild	Xi
MMV	fast	low	34°C	mild	Xn
PLV	faster	good	36°C	mild	Xi
PSV	faster	low	32°C	mild	none
PUV	faster	good	47°C	medium	Xi
PV	slow	good	72°C	mild	Xn
QNV	slow	good	47°C	medium	Xn
SPV	med.	good	46°C	medium	Xn
UKV1	v.fast	v.good	43°C	strong	Xn
UKV2	fast	good	49°C	mild	Xi
UR3	v.fast	good	42°C	mild	Xn
YV	slow	satisf.	50°C	mild	Xn

Spray thinners

	Evapo-ration	Solvent power	Flash point	Odour	Label-ling
PSV	fast	low	32°C	mild	none
TPV	fast	good	44°C	mild	Xi
7037	v.fast	v.good	-4°C	strong	Xi, F

Retarders

	Evapo-ration	Solvent power	Flash point	Odour	Label-ling
SV1	Med.	good	82°C	mild	Xi
SV3	slow	low	91°C	mild	Xn
SV5	fast	v.good	77°C	mild	Xn
SV9	slow	low	102°C	mild	none
SV10	Med.	good	74°C	mild	Xn

Cleaners

	Evapo-ration	Solvent-power	Flash point	Odour	Label-ling
PLR	fast	low	15°C	Med.	Xi, F
UR3	fast	good	42°C	mild	Xn

(Xi = 'irritant', Xn = 'harmful', F = 'highly inflammable')

Remarks

The data in the "Evaporation" column is derived from the proportional figures of the relevant solvent. These are theoretically calculated values without considering the interactions occuring through solvent mixtures and the influence of binders. In practice, one may not draw a conclusion from the height of the evaporation value to the direct quality of mesh opening automatically. The "evaporation" value is a guide only and must be always controlled in practice.
The data in the "Labelling" column does not replace the complete and up-to-date information of the products detailed in the Safety Material Data Sheets and on the label. The data in the "Odour" column is subjective and may be judged differently from one person to another.

Further general recommendations

- The surface of Polystyrene is not solvent resistant and allows the solvents to penetrate to the inside of the material very quickly. We recommend the fast and mild thinner PSV for this application.
- Sprayed plastic parts with a high "tension potential" in the material, also require a very mild ink solvent to obtain good printing. We recommend the mild PSV here as well.

Transparent bases

Nearly all ink systems have a transparent base in their programs (GL 409, GN 409, GO 409, GR 409, LIG 409, LIM 409, LIP 409, LIS 409, MM 409, P 409, SL 409, SP 409 and SR 409), with the following application purposes:

- to decrease ink density for 4-colour-process shades
- to increase ink viscosity for standard and 4-colour-process shades
- to reduce flow properties of standard shades when printing of fine details, and in reversed-out printing

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Transparent bases always include the original binder of the relevant ink type and are, therefore, always compatible. They are manufactured with thickening agents, and, therefore, an addition of 5-20% to the shade reduces the flow ability (ink flow) with an increased viscosity at the same time. The shade may show a slight tendency to "smude". To obtain complete mixing, we recommend adding thinner and/or retarder to the transparent base first and then mixing with the colour shade.

Advantages
- higher thixotropy, flow property will thus be reduced
- viscosity is increased
- optimum compatibility
- standard product
- manual, easy addition is possible

Disadvantages
- opacity is reduced
- degree of gloss is somewhat reduced
- moulding ability is probably reduced
- available in most (not all) ink systems
- weather resistance is reduced
- homogeneous ink levelling is somewhat reduced
- reduction of the shade, depending on percentage addition

2) Thixotropy

The generic term "rheology" of an ink describes its flow properties and depends on the binders used as well as on the components used for thinning.
We distinguish between a "short" ink having a high thixotropy (poor flow ability) and 'poor' internal (wet) strength- this means that the ink tears very quickly when flowing down on a spatula (as yoghurt drops from a spoon) and a "long" ink having a low viscosity (high flow ability) and a 'high' internal (wet) strength, which holds the ink together for a longer time (as honey flows from a spoon). This varying behaviour of this flow characteristic, amongst other parameters (e.g. solids content of the ink), a central influence on ink transfer from the screen to the substrate, moulding behaviour, ink behaviour onto statically charged materials, mesh opening (and on contour definition of fine details), and 4-colour-process printing. Each ink system is actually optimised for the relevant application purpose regarding its rheological adjustment; it can, however, be changed through adding suitable auxiliaries. The advantage of ink systems having a high toughness is the tendency towards higher chemical resistance, provided that suitable binders were selected.

Thickening agent STM
Thickening agent STM is a thickener in the form of powder which significantly increases viscosity and thixotropy of a printing ink (reduced flow ability) when an addition of 1-2 % is made, and mixed by machine. This addition is useful when printing very fine details in positive and negative areas, in embossing (desired thick ink application) and when printing onto open-cell (absorbent) materials, e.g. non coated paper.

Advantages
- the inks do not 'slump'
- viscosity is increased
- ink density is not reduced
- universal use

Disadvantages
- machine-stirring is obligatory
- moulding ability is considerably reduced
- weather resistance is reduced
- degree of gloss is reduced
- ink levelling is not optimal

Retarder pastes VP
The VP-Paste is well suited for very fine printed motifs and for 4-colour-process printing. An addition of 10-15% supplementary to thinner and/or retarder keeps viscosity high, with improved mesh opening. The VP-Paste can be

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added to most of the solvent-based inks, except for the GL, P, PP, PU and PY ink types.

Here is an overview

Explanation: ↑ = increase ↗ = slight increase
→ = unchanged
↓ = decrease ↘ = slight decrease

Auxiliaries	STM	VP
Form and Addition	Powder 1-2%	Paste 10-15%
Viscosity	↑	→
Thixotropy	↑	↗
Opacity	→	↓
Ink levelling	↓	→
Degree of gloss	↓	↘
Remark	Machine-stirring	improves mesh opening

3) Matt coating

The degree of gloss of a solvent-based ink can be reduced through adding auxiliaries. There are two possibilities here:

Matting pastes ABM and PUM

With the addition of 10-30% of the universal ABM matting paste to the ink, the degree of gloss is reduced, according to the percentage used . As a result of this, a roughening of the ink surface is developed which reduces the reflection of the incident light and thus leads to a matt appearance. Depending on the quantityof ABM-paste added, opacity and abrasion resistance will be reduced. For Marapur PU ink systems, onespecific matting pastes is available for use (PUM), having the same matting properties.

Generally, the matting pastes to be added for 2C-inks (with hardener), e.g. Marapur PU, are added into the press-ready ink /hardener mixture first so that the ink/hardener ratio is not affected. As the degree of gloss is generally lower for the White/Opaque White shade, the quantity to be added must be reduced (10-20%). For Glass Ink GL, we do not recommend the ABM matting paste; the MP matting powder should only be used.

Matting powder MP

If a printing ink should have a matt surface, without causing loss of adhesion, this can be only achieved through adding the universal MP matting powder. An addition of 1-4% (max. 2% for White) is recommended. The MP-powder must be stirred into the ink by machine in this case. The MP-powder is actually a raw material which does not include an associated binder. It is, therefore, ideal for all ink systems, also for all 2C-inks.

4) Plasticizer resistance

Soft PVC is heavily loaded with plasticizer additives that are free within the material (10-40%) which can later migrate into the printed ink film after the printing process. A good Soft PVC ink has the ability to incorporate the plasticizer into the ink film, with still good block resistance and ink adhesion to the substrate. To improve this process, one can add 10-30% of matting paste (ABM, MSM or PUM) to the printing ink or matting powder MP as described above. Both possibilities achieve a roughening of the ink surface and the forming of small hollow spaces in the ink film, irrespective of incorporating a higher quantity of plasticizer. The addition of ABM or MP reduces the degree of gloss and the abrasive resistance of the ink film at the same time.

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5) Block resistance

If screen printing inks receive matt coatings through adding matting paste (10-30%) or matting powder (1-4%), the block resistance of the printed sheets in the stack will be increased. However, the degree of gloss and the abrasion resistance of the printed ink film is also reduced. It is also important to control the thinners and retarders used. For a good block resistance, do not use auxiliaries with low evaporation rates.

6) Elasticity

Generally, a printed ink film and a thin substrate (e.g. self-adhesive foil) have varying coefficients of expansion during the drying process or during later thermal stresses. This leads to additional tensions in the printed sheets, especially when it is cut or die-cut through the printed ink film. Care must be exercised in this case

Plasticizer WM1

1-5% of Plasticizer WM1 can be added to each 1C-ink system (except for Maraprop PP). This "de-stresses and flexibilizes" the printed ink film and minimizes the risks of "edge curling" or material shrinkage for self-adhesive foils. Plasticizers are extremely low-volatility substances which reduce the rigidity of binders. When printing several ink films onto a thin foil (e.g. for double-sided adhesives), a plasticizer must be evenly added in all layers (3-5 %). One should bear in mind that any addition of a plasticizer will reduce drying speed and, as a consequence, block resistance in the stack.

Control of solvent residues

If you subsequently cut or die-cut thin materials (e.g. self-adhesive foil) through the printed ink film, the flexibility of the binder used, the addition of a plasticizer, the content of the solvent residues in the printing ink is also critical. If the percentage is too high, the substrate and the ink film are still soft, shrinkage of the foil or "edge curl" after cutting or die-cutting will result. Here, we strongly recommend to use the least possible retarder, the best drying in a rack or in the warm air tunnel, or the longest possible drying time of the printed sheets before processing.

7) Ink levelling

Most of the ink systems contain levelling agents in the basic formula reducing the trapped air in the form of air bubbles as a result of squeegee movement or when stirring.
Levelling defects are often caused by a too high ink viscosity which can be avoided through adding more of thinners. If this does not lead to an improvement, the following auxiliaries are available:

Printing modifier ES (levelling agent)

The silicone-based ES auxiliary reduces the surface tension of the ink and has a defoaming effect. The quantity to be added must not exceed 1% (please use a scale!), as otherwise adhesion problems or problems of excess pressure are inevitable.

Printing modifiers VM1 and VM2

Both printing modifiers are free of silicone and are recommended for the ink types Glass Ink GL (VM1) and Marapoly P (VM2) in case of levelling problems. The effect in other ink systems is only so slight that adding thinner will have the same or a better effect.

8) Adhesion promotor

Polyolefins such as polypropylene must be pre-treated before starting printing. One possibility for pre-treatment is Primer P2.

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Primer P2

This special "solvent" is manually applied to the entire surface by means of a cloth or a spray gun before starting printing. It is then possible to print polypropylene with a 1C- or 2C-ink. The effect of the pre-treatment is dependent upon time and should be applied max. 1-2 days before printing.
In some special cases, an addition of 5-10% of P2 directly into the Maraprop PP printing ink has also been proven.

9) Pre-cleaning

Many materials such as soft PVC or powder/wet painted substrates are contaminated not by visible additives or plasticizers. Printing is consequently not effective onto the substrate but onto a form of separating layer which often has poor ink adhesion.

Tarpaulin Cleaner PLR

Using this mild alcohol-based cleaner, residues can be removed with the use of a cloth soaked in PLR, often resulting in better ink adhesion. Please change the cloth from time to time here, otherwise a pre-treatment will not take place but the residues will only be spread!

10) Hardeners

There are ink systems which can be both used as 1C and 2C-systems. For these "cross inks", ink adhesion onto difficult substrates as well as chemical and mechanical resistance can be increased through adding hardener, analogous as to pure 2C-system. It is important to know that the processing period of inks is always limited from 8 to 16 hours (except for hardener HT1) when adding hardener. For all appropriate ink systems, (cross-linked with polyisocyanate), three varyious hardeners are available:

Hardener H1 (previously PUH)

Hardener H1 is an aliphatic polyisocyanate reacting without yellowing and with a relatively flexible ink film, a long pot-life, and slow drying. Suitable for outdoor use.

Hardener H2 (previously PEMH)

Hardener H2 is an aromatic polyisocyanate which shows a rigid and tough ink film with quick drying and a shorter pot-life than H1. Hardener H2 can yellow when exposed to UV-radiation (outdoor use) which will be visible as varnish, white, and other light-coloured shades mixed with white.

Hardener HT 1

A heat-reactive hardener which reacts with the basic binder of the ink used. A forced drying at 150°C for 30 min, HT1 can be used instead of H1 or H2, provided the same quantity of hardener is added, and has the big advantage of a prolonged pot-life of up to 6 months!

Remarks about hardeners

Generally, all hardeners are sensitive to dampness and to high humidity. Therefore, the drying process of the ink must take place in the first 24 hours with a humidity as low as possible, otherwise parts of the hardener will react with the water and are no longer effective in a controlled ink reaction. Storage of the hardener units must also occur to the exclusion of humidity (the cans and tubes must be always completely closed after use!).

Furthermore, the degree of cross-linking (hardener with basic binder), which means subsequent chemical and mechanical resistance of the printed ink, is highly dependent on temperature for all 2C-systems. For a forced drying of the ink at 140°C for 20-30 min. directly after printing is finished, you will achieve an optimum ink cross-linking and thus the highest resistances. 2C-systems can also be dried at room temperature; the complete cross-

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linking will, however, take up to 7 days and may have a reduced resistance. On difficult substrates such as glass, some metals, thermosetting plastics, and high requirements, (e.g. dishwasher-resistance), forced drying of the ink in the oven can be necessary.

Hardeners GLH, YH and YH9

These hardeners are specific to ink types and can, therefore, not be used universally in other ink systems.
GLH is the cappropriate hardener for Glass Ink GL. The Hardeners YH and YH9 come exclusively into use for the Marapoxy Y ink type and are explained in the relevant Technical Data Sheets.

11) Result

Generally, all screen printing inks normally consist of the necessary auxiliaries. A modification of the inks should be rare. It is not our intention to train you to become an ink lab technician or to 'arouse the experimental fever' in you with this TechINFO, but we would like to give you an understanding of the few cases where ink modification is useful. There are many possibilities to influence an ink's behaviour positively, but there are also many way to adversely effect them.
For this reason, the well-considered and responsible way in dealing with the auxiliaries and the use of a scale is unavoidable. Auxiliaries seriously change the ink properties in some cases; a trial print is therefore absolutely necessary before you start the print run.

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