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ALL PLASTICS?!?

One of the main reasons for the success of the screen and pad printing processes is that they can be used to decorate all kinds of plastics. "Plastic" materials were hardly used until the fifties of the 20th century. Since then we have been living in the so-called "plastics century". Plastics appear everywhere in various forms. As contrary to other printing processes you can use inks with many different raw material components by screen and pad process, these ink types are an ideal solution for printing of plastics. Coates Screen offers a variety of ink ranges for plastics applications. Printers however, often have to rack their brains about the huge variety of plastics with their miscellaneous printability properties. In the following article we intend to give you a general overview about this topic. Another article detailing the correct measures to determine the right type of ink for printing of plastics will be published at a later date.

PROPERTIES/FORMS/ APPEARANCE

Plastics often come in various forms, such as foils, plates, injection moulds, blow moulded parts etc. and in addition also in various degrees of hardness (elastic, plasticized, rigid). There are also blends of plastics and plastics produced with additives. All these factors will influence the printability and choice of ink type. Printing inks can trigger very sensitive reactions on some plastics (e.g. polystyrene injection moulds), whereas you will hardly have any problem with other plastics like PVC or PMMA. Then again some materials can only be printed after pre-treatment (polyolefines) while others require post-treatment (POM). There are also rare cases, where a material cannot be printed at all such as PTFE (polytetrafluorethylene), known as "Teflon®".

Names of Plastic Materials:

Names of plastics are either fully written (e.g. polyvinylchloride) or abbreviated (e.g. PVC). Others have trade names (e.g. Plexiglass™, Nylon, Delrin™). Depending on the name generally used in the industry in our publications (product data sheets, ink charts etc.) we either use the abbreviation, full name or sometimes even both. Abbreviations of plastics are always according to standard DIN EN ISO 1043-1.

Classification:

For classification/allocation of the various plastic types there are different possibilities. Generally in the screen and pad inks industry we classify plastics according to their properties:

- **thermoplastics**
- **(thermoplastic) elastomers**
- **duroplastics**

However, there are also materials such as PUR (polyurethane), which, depending on their make may be allocated to all three above mentioned classifications. Therefore, we basically always recommend to carry out printing trials on these materials.

THERMOPLASTICS:

Thermoplastics are quite familiar and frequently used in the screen and pad industry. In quite simple terms you could say, that anything you can melt or burn with a flame (a lighter is sufficient) is a thermoplastic material. Polystyrene or PVC materials will burn or melt quickly, that process will take a little longer with Plexiglass. This method can be used to identify unknown (pure) products. Plastics subjected to a flame test will show specific characteristics so that you can easily identify the plastic material. Thermoplastics will show different reactions to solvents as well, another property you can use to determine the type of plastic material. Polystyrene can easily be dissolved with thinners VD 40 or Additive A (both with a high dissolving power), PVC can be dissolved well. On the other hand polypropylene (PP) and polyethylene (PE) cannot be dissolved at all.

As already mentioned before, we will publish more details about this topic at a later date.

There are three groups of thermoplastics:

Homopolymers - consisting of only one type of monomer
Copolymers - consisting of several types of monomers
Polymer blends - consisting of mixtures of homopolymers and/or copolymers

HOMOPOLYMERS (Choice)

PS	polystyrene	PA	polyamide
PVC	polyvinylchloride	POM	polyoximethylene, polyacetal
PC	polycarbonate	PP	polypropylene
PMMA	polymethylmetacrylate	PE	polyethylene

PS, PVC, PC and also PMMA are quite easy to print. However, there is a risk of tension cracks after printing of injection moulds (especially those made of PS, less often PC and PMMA). Printing of **PA, POM, PP, PE** is much more demanding.

After production **PA** may absorb humidity, which will affect adhesion. Therefore pre-treatment by flame or hot air gun is recommended prior to printing.

To achieve good adhesion on **POM** flame-treatment of the ink layer is required after printing.

For good adhesion the surface tension of **PP** and **PE** materials has to be increased to > 40N/cm by flame, Corona or plasma pre-treatment. If resistance requirements are not very demanding you can also print PP materials without pre-treatment with our screen inks PP or pad inks TP/PP.

COPOLYMERS (Choice)

ABS	acrylnitrile-butadiene-styrene
ASA	acrylic ester-styrene-acrylnitrile
SAN	styrene-acrylnitrile

Generally **ABS, ASA** or **SAN** substrates are injection moulded parts which can easily be printed without any pre-treatment. However, copolymers are mixtures of plastics with varying amounts of ingredients and therefore they may exhibit strongly deviating printability properties. Tension cracks are a special issue with ABS and SAN substrates.

POLYMER BLENDS (Choice)

ABS/ PA	acrylnitrile-butadiene-styrene and polyamide
PC/ABS	polycarbonate and acrylnitrile-butadiene-styrene
ASA/PC	acrylester-styrene-acrylnitrile and polycarbonate

Polymer blends are identified by "+" or "/" sign set between the components.

Properties of the resulting plastic materials significantly differ from those of the original polymers. As amounts of the basic materials vary, printability should be determined by carrying out printing trials. Suitable ink ranges for PC/ABS polymer blends are Z/PVC or TP 313.

(THERMOPLASTICS) ELASTOMERS

Printers are also often confronted with thermoplastic elastomers (e.g. for soft balls) or soft-touch coatings such as TPE, TPU, TPC, TPO etc.

In that respect we refer to our article "Printing On Soft Materials" (Screen News 2014) or **www.coates.de / SN-online.**

DUROPLASTICS

Duroplastics are not very common for screen and pad applications. Duroplastics are rigid, glass-type polymeric materials which cannot be formed after production. They show a high thermal stability. The material hardly reacts when subjected to the flame test. If exposed to the flame for a longer period of time the material starts to show a slight charring reaction. Typical products made of duroplastics are ash trays and Resopal™ plates. Helmets for firemen, electronic compounds, pot handles, automotive parts and last but not least the Trabant coachwork are all made of duroplastics. These materials are extremely difficult to print, however you will often achieve good results using 2-component inks.

IDENTIFICATION BY RECYCLING CODE

Many plastic products (cans, bottles and also assembly elements) have a recycling code, mostly applied to the bottom, reverse or inner side of the product. Identification codes such as PS, PVC or PE etc. allow printers to identify the type of plastic material they are dealing with. Some plastics, such as PS, PC, PMMA etc. however, are combined in one identification code: "O" (Other). Exact identification is then only possible if the manufacturer has added a separate identification code.

PE
Polyethylene
Depending on sub-type also identified as PE-HD (High Density) or PE-LD (Low Density).
Used for oil cans, drinking bottles, silicone cartridges, buckets etc..

O
Combination Code (O = Other) for PMMA, PA, ABS etc.).
Printers are unable to identify the plastic material using this code.

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