ACRYLAC®

Information on ACRYLAC water-based coatings

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General

This Technical information sheet provides information on the processing, application, drying, viscosities (draining times) and organoleptic characteristics of water-based coatings. The technical details of specific water-based coatings can be found in the respective Technical information sheets.

Application-related information on the use of water-based coatings

Storage and shelf life

ACRYLAC water-based coatings must be stored in a cool but frost-free place.

Avoid storage temperatures in excess of 40 °C, because they promote significant increases in viscosity.

The coating has a shelf life of 6 months from delivery as long as the container is not opened. After opening the container, the coating should be used up as quickly as possible. If water-based coating is stored over a longer period of several weeks, this can lead to slight increases in viscosity due to the formation of structures in the coating. The original viscosity can usually be obtained again by stirring the coating thoroughly. Only in exceptional cases will it be necessary to adjust the viscosity by diluting with water. A rule of thumb as regards dilution: a 1 % addition of water dilutes the coating by 5 seconds.

The characteristics of the coating are not adversely affected by such adjustments (max. 5 % water). Water-based coatings should preferably be stored at room temperature (see above). Our water-based coatings are supplied ready to use, in sealed containers.

The coating must be stirred well and its viscosity checked (draining time from a 4-mm DIN flow cup) before use. The coating systems contain components of different densities in order to give them the various physical properties demanded of the film once it has dried. If the coatings are stored over a longer period, some specific constituent components (e.g. waxes) may separate. This phenomenon occurs particularly in larger receptacles (containers).

This is why it is necessary to stir the coating thoroughly before use, irrespective of the type of coating. Otherwise, the result could be inconsistencies in respect of rub resistance, surface slip properties and gloss over the production run.

Freeze stability

ACRYLAC water-based coatings contain water as a solvent and can freeze at temperatures below 0 °C. As a basic rule, a storage temperature above 0 °C should be adhered to.

Frozen coatings may be able to be recovered and used under certain circumstances.

The important thing in such cases is that frozen coatings are thawed slowly at room temperature in their original container. They may only be used once they have reached room temperature, been thoroughly stirred and their draining time (viscosity) checked and corrected if necessary. You must make sure that the coating has a homogeneous and clot-free consistency.

Depending on the circumstances under which the coating has frozen and been thawed out again, certain of its properties may alter irreversibly, and the **huber**group is not able to provide any guarantee or assume any liability for its use.

Viscosity of water-based coatings (measured in acc. with DIN 53 211)

Water-based coatings are set in our production process to an optimum processing viscosity. In practice, a draining time of 40 s from a 4-mm flow cup per DIN 53 211 has proven to be the optimum setting.

In the case of water-based coatings, it is the draining time from a 4-mm DIN flow cup that is measured rather than the actual viscosity. The exact measuring method is defined in DIN 53 211 and the standards that have followed it. If it should become necessary to reduce the viscosity of a coating for reasons related to a particular application, do so by diluting with water, stirred it in slowly. Maximum

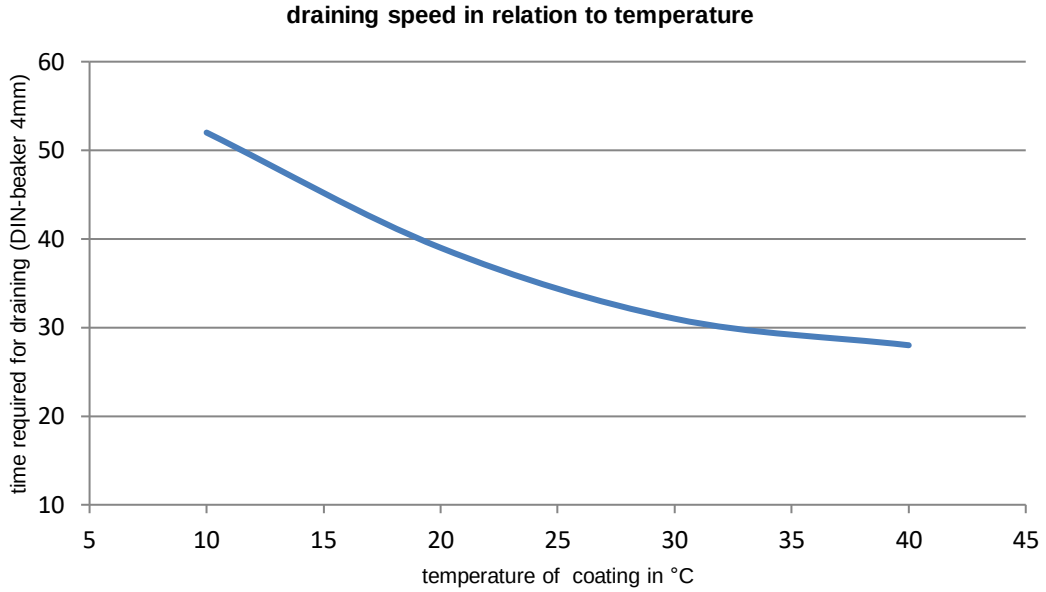
dilution must not exceed 5 %, otherwise this could impair important functions of the coating. If you wish, we can supply you with graphs of the draining time shown as a function of the degree of diluting of our coatings. The viscosity specified has been adjusted for a temperature of 20 °C. Large variations in temperature lead to noticeable differences in viscosity. The purpose of measuring a draining time for a coating is to obtain a parameter with which flow behavior can be assessed easily and accurately enough for operational purposes.

End users may need to determine the draining time:

- Prior to and during processing
- To measure coatings diluted in-house
- To ensure precise measurement, the criteria cited in DIN 53 211 must be observed:
- Use a flow cup compliant with 53 211-4 (100 ml capacity)
- The coating must be stirred thoroughly prior to measuring
- According to the DIN norm, the temperature of the coating and DIN flow cup must be 23 ± 0.5 °C prior to measurement. In accordance with the delivery agreement with the supplier, a temperature of 20 °C is commonly used.

Example of the correlation between temperature and draining time on the basis of

ACRYLAC **GLOSS S 57G1300**.



Measuring draining time with a 4-mm DIN flow cup (DIN 53211)

Water-based coatings often display apparent thixotropic characteristics after extended storage (pseudo plasticity), leading to an apparent increase in draining time. The same applies when the coating has become "foamy" due to vigorous agitation or pumping. The following procedure is therefore recommended when determining the draining time of water-based coatings:

- Measure the temperature of the sample and DIN 53 211-4 cup and adjust if necessary
- To reduce thixotropic, stir the coating thoroughly without introducing air
- Measure the draining time using a stopwatch
- Stop timing as soon as the stream of liquid beneath the outlet nozzle breaks for the first time.

Only through accurate measurement it is possible to prevent unnecessary or excessive dilution of coatings, which can degrade their properties during processing (foaming) or even after drying (e.g. decrease in gloss, reduced rub resistance).

Film forming

On decisive influence on the ability of the applied coating to form a film is the processing temperature of the coating. Our water-based coatings are generally formulated for a minimum film forming temperature ("MFT", see DIN 53787) of between + 5 and + 10 °C. For safety reasons, the coating should be allowed to adjust to room temperature before it applied. Working at a temperature below the MFT usually leads to wetting and adhesion problems. These problems can also arise if air at a temperature below 40 °C is blown on prior to stacking in order to promote drying (e.g. air blade). In this case, the problems are caused by the extraction of heat through evaporation.

Processing instructions

If applied too quickly, water-based coating tends to squeeze out at the rear edge of the sheet. It is therefore absolutely essential that you cut out the board backing under the rubber blanket to the size of the surface being coated, in order to eliminate squeeze beads that might tend to stick. The backing should be cut out to a size smaller than the sheet format. Coating must not be applied beyond the edge. The installation of suitable IR radiators and hot-air blades with air extraction is essential.

Applying from indirect systems

The essential difference between indirect and direct application is the fact that indirect systems involve a longer transport path for the coating, since it travels via the plate cylinder. The drying speed of coatings for such systems therefore often needs to be reduced in order to prevent premature and tackiness. If a water-based coating is applied from systems that allow the dampening unit to be converted to coating devices, we recommend that you replace the fount roller with a coating application roller with a hardness of approx. 45 Shore and the fount pan with a coating pan. When applying from the fount pan of an offset press, the fount pan and fount rollers must be cleaned thoroughly. A separate fount roller set should be available. Careful adjustment of the fount rollers promotes uniform application of the coating. If the sheet does not occupy the entire width of the press, we recommend attaching suitable squeeze rollers or blades to the fount pan rollers. This counteracts any build-up or drying of coating on rollers, the printing plate or the rubber blanket.

Applying from direct systems

In this case, the coating film is transferred directly from the forme roller to the forme cylinder and from there to the stock. It is generally advisable to work with compressible rubber blankets that are not too soft. Make sure that the coating is applied uniformly and at the correct rate. Too little coating can lead to piling and inadequate levels of protection and gloss. Too much coating can lead to splashing and drying problems in the stack.

Applying by means of screen roller and chambered doctor blade

This type of coating unit with a flexographic configuration, where nothing but the pickup volume and the screening determine the amount of coating transferred, is now the main type of unit in use. It can be altered only by changing the screen roller. The following guideline gives an idea of the amount of coating transferred: About 30 - 50 % of the stated pickup volume of the screen roller is transferred to the substrate, e.g. if the pickup volume is 10 cm^3, 3 to 5 g/m^2 of wet coating will be transferred. This means that the pickup volume of the screen roller must be approx. 13 cm^3/m^2 in order to transfer the same amount of coatings in conventional direct coating systems, which transfer a maximum of 6 g/m^2 of wet coating.

Preventing drying during processing

On the one hand, water-based coatings need to form a tack-free film as quickly as possible in the stack; on the other hand, they must not begin to dry and pile in the application system. Obviously, the correct drying time is an important criterion governing the quality of a water-based coating. In terms of press engineering, incipient drying can be counteracted as follows:

- By pumping the coating in a continuous circuit
- By dripping water onto the rollers edges
- With indirect systems, by attaching blades and roller blades to the pickup and metering rollers.

- While printing, pay particular attention to areas where no coating is being picked up, i.e. particularly at the plate edges. If coating builds up there, wash as soon as possible, otherwise dried coating could create problems.

Cleaning the press

Prior to longer interruptions in productions, the plate and rubber blanket must be thoroughly cleaned by washing. Cleaning can be simplified by adding approx. 5 % ACRYLAC Cleaner 10 T 0045 to the water used for washing. In concentrated form, this solution will remove even dried-on coating residues. The cleaning solution is miscible with water in any proportion.

Most modern application systems include pieces of equipment or functions which make manual cleaning easier. Before the press stops and after the printing units have shut down, a few sheets are run through the coating applicator with the coating application roller shut off, in order to remove coating.

Never use ordinary wash-up solutions that contain naphtha, petroleum, turpentine or other similar substances.

Coating application rate, gloss

The amount of coating applied (wet film thickness) basically depends on the application system:

- Indirect system 2 – 4 g/m2
- Direct system 3 – 6 g/m2
- Coating unit with screen roller 3 – 10 g/m2
- Coating machine 8 – 20 g/m2

As a rule, the coating application is set such that inspection in raking light reveals a smooth, continuous coating and no squeezing at the edges. The amount of coating to be applied also depends to a great extent on the absorbency of the stock. One considerable difficulty is the fact that there is at present still no way to determine and display the coating film thickness online.

The following offline methods are in general use:

- Consumption measurement
- Gloss measurement with prior calibration

These measurements must be performed on a standardized basis on specimen sheets. The degree to which coatings and inks have dried has a great influence on gloss measurements. This is due to the "drawback effect", i.e. a reduction in gloss after coating application. It often makes sense to use quick-setting, intensive inks. The gloss achieved with water-based coatings is always greater with wet-on-dry application than with wet-on-wet. Consistent amounts of coating (i.e. film thicknesses) can be applied by coating units equipped with screen roller/chambered doctor blade systems. The coating film thickness is determined by the pickup volume of the screen roller. Such systems ensure greater reliability in application.

Areas left blank in coated surfaces and gluing of coated surfaces

Solvent-based systems are not recommended for downstream processing of coated surfaces (e.g. solvent-based adhesives for film lamination), because the solvent causes the coating film to swell. This results in decreased adhesion to the stock. Coated surfaces are suitable for gluing if appropriate water-based adhesives are used. Any manufacturer of water-based adhesives can supply products suitable for this purpose. Despite good gluing capability, the folding-carton production sector today almost always leaves blank areas when coating. The reason for this is that the water-based adhesives set considerably faster directly on the uncoated, absorbent stock. As a result, shorter cycle times can be achieved in packaging machinery.

To leave blank areas when coating, proceed as follows:

- Compressible rubber blankets with a thick rubber layer can be "stripped", that is cut out, to the correct shape.
- Make up a "Nyloprint" letterset plate (preferable for indirect coating).
- Make up a soft photopolymer plate (Nyloflex, Cyrel) for direct coating.
- Glue a suitable film onto an aluminium plate and then cut it out to size (risk of film detachment with longer print runs).

To prevent the blank areas from "filling in", avoid excessive coating application.

Fastness properties of inks

Water-based coatings are generally slightly alkaline and in some cases contain small quantities of solvent (alcohols). In this case, the offset inks used must be solvent-resistant (ethanol), but also alkali-resistant because the inks could otherwise suffer an unwanted change in colour when coated. Please consult your ink supplier in this regard.

Practical experience has shown that the risk of colour changes increases when these inks are used proportionately in mixed colour formulae. The lower the concentration, the higher the risk of a change in colour.

Whenever coating such inks, you should, after starting the print run, always check the stack for any changes in colour, because it is not possible to simulate actual practical conditions during laboratory testing.

Alternatives using suitable "fast" pigments do not have identical shades and colour purity is lower. One exception is Process Magenta. Despite low alkali fastness, such inks can be coated with water-based coatings without any problems.

Bleeding due to a lack of fastness must in this connection not be confused with a normal change in colour after coating because the bronzing effect of the uncoated ink is cancelled out.

Printing stocks

In the folding-carton sector, essentially the only stock in use today is coated board, whereas paper stocks predominate in the commercial sector. That said, metallized papers and films are also coated.

One major problem still remains the poor dimensional stability of paper as a printing stock where moisture comes into play. Water-based coating contains a great deal of water. Stocks that are to be coated with a water-based coating should therefore have a grammage of no less than approx. 90 g/m^2. It is very important that you tell us what stock you are going to use, so that we can help you chose the precisely the right water-based coating for the job.

Drying of water-based coating

Principle of the drying process

Water-based coating systems dry exclusively by physical processes. They contain about 55-70 % water. The better and quicker this water can be absorbed into the stock and evaporate, the faster the drying process will be. In the stack, an additional advantage of an absorbent stock is that its reverse side can also take up moisture. Problems that arise - despite drying aids (IR lamps, hot air) - when inline-coating stocks such as board film-lamination on the reversed side can be attributed to the absence of this absorption capacity. Water-based coatings dry partly by absorption and partly by evaporation of their water content.

The amount of drying that occurs by evaporation of the water is, depending on the substrate, relatively small. The importance of these two processes on absorbent stocks can be expressed roughly as follows:

- Absorption 40 – 70 %
- Evaporation 30 – 60 %

Film formation in water-based coatings is largely complete even when 20 - 30 % of the water is still present in the coating "immobilization point"). The time necessary for drying is determined by the:

- Absorbency of the stock
- Output oft he press‘ dryers
- Specific properties of each coating

Drying aids

For a given stock, drying can be accelerated only if residual water is quickly evaporated from the coating film. This can happen, however, only if the evaporated water is also removed from the surface.

- A combination of a hot-air blade and infrared radiator is a reliable way to promote drying. Simultaneous use of short- and medium wavelength infrared radiation (IR lamps) effects rapid energy transfer and therefore rapid heating of the coating and the stock surface. The hot air, with its relatively low level of humidity, serves primarily to "scrape off" of the water-vapor-laden boundary layer above the coating and carry it away. Cold air is unsuitable, since evaporative cooling can damage the coating film.
- The hot air, which is now carrying water vapor, must be extracted. The volume of air extracted should correspond to at least the volume of hot air blown in.
- The flow of hot air and the output of the IR lamps are optimum when the following temperatures are measured in the delivery stack:
- Paper: approx. 8 - 10 °C above the temperature in the feeder stack
  Board: approx. 10 - 12 °C above the temperature in the feeder stack
  (assuming an optimum room or stack temperature of 20 °C)
- The temperature in the delivery stack must be measured using a fast-responding instrument, so that the drying equipment can be set such that the temperatures stated above are not exceeded.
- At high press speeds, an extended delivery is advantageous as it aids installation of the drying equipment and makes it more effective.
- Excessive short-wavelength IR radiation can cause blocking in the stack, especially if thick ink films are being printed. In particular, dark inks are heated up a lot and cause "sticking" in combination with the coating film. As a general rule, the stack temperature should not be allowed to exceed 35 °C.

General

1. The basic principle is always to dry only to the point where the stack is tack-free. The use of even more energy is inefficient and can in the worst case increase to impermissibly high levels.
2. Non-absorbent stocks, or stocks with low absorbency, require measures to accelerate drying and the use of special water-based coatings.
3. Ink coverage > 250 %: In the case of very high ink coverage, we recommend you use quick-setting, intensive inks, if necessary under colour reduction (UCR) of the repro, and the use of special water-based coatings.
4. Only special water-based coatings with wet blocking resistance are allowed to be used for double-sided coating. We recommend you allow a drying time of 8 to 16 hours before performing the second pass.
5. Cooling the sheets with cold air after they have passed through the drying section usually has little effect. If air stream cooling is used, dehumidified air should be used.
6. The hot air used for drying must not interfere with the operation of the spray powder unit. The powder unit therefore always be installed immediately downstream of the drying section.
7. In presses equipped with an air cushion drum, the filter cartrige should be replaced frequently, so that the air flow can provide an intial "pre-drying" effect.

Our product portfolio includes a comprehensive range of coatings with different drying and gloss properties. Your contact at the **huber**group can provide you with more information.

Properties of water-based coatings

Rub resistance

The drying speeds of water-based coatings are set so that the coatings are tack-free in the stack with standard wet film thickness. Nevertheless, light spray powdering - preferably with starch powder - is required for very thick ink films with wet-on-wet application. The rub resistance of coated products depends to a great extent on the stock and the quantity of coating applied, and is reduced by powdering. Rub resistance should not be tested until 48 hours after application. Avoid using calcium carbonate powder.

Heat sealing resistance

Since heat sealing resistance depends on a number of parameters, we recommend testing on a case-by-case basis under field conditions. The following details are required for testing:

- Sealing temperature (° C)
- Sealing time (s)
- Pressure (bar)
- Film type
- Number of film plies

Finishing with hot-stamping film

The adhesion of hot-stamping film depends on the substrate used (paper on board) as well as the type and degree of dryness of the ink printed on the substrate. As a rule, most high-gloss and standard coatings can be finished with hot-stamping film. Different hot-stamping films have also been found to vary in their suitability. If special substrates are used (in particular, cast-coated or mother-of pearl stocks), it is advisable to carry out a test prior to starting the production run. In cases of doubt, laboratory tests may also be helpful.

Effect of moisture and package contents

When moisture will be acting on a coating film, a coating with particularly good wet blocking resistance must be used; for example, when coating on both sides and laminating printed, coated paper onto board, moisture can cause the coating layer to begin to redissolve. In such cases, coatings with very good wet blocking resistance must be used, since otherwise blocking will occur. Coatings must always be appropriately tested in cases where package contents (moisture, grease, alcohol, surfactants, alkalis, etc.) may have an influence on the folding carton.

Organoleptic characteristics

Extensive investigations have shown that water-based coatings can be classified as low on odour. The test method used was the "Robinson test" as specified in DIN 10 955 (Testing of packaging materials and packaging for foodstuffs) which is also standard in the food industry. Despite this, there have been reports of cases in which a definite odour was perceptible in the stack - especially after coating of coated papers intended for products such as food wrappers and board - and about which complaints were made.

The table shows a typical example:

Stock	Odour evaluation without coating	With coating
Paper 1	0.5 – 1.0	1.0 – 1.5
Paper 2	1.0 – 1.5	3.0 – 3.5

Although the same coating was used under identical conditions, there are considerable differences between the two stocks. The reason was found to be that a number of grades of paper and board generate a relatively strong odour when they become moist or as a result of interaction with components of coatings. We therefore recommend that you conduct preliminary tests similar to the Robinson test to determine whether or not the stock selected is suitable.

Use on food packaging

The legal requirements laid down with respect to the manufacture of food packaging that complies with relevant legislation and is food-friendly are numerous and extensive.

One of the chief desires of the **huber**goup is to be the perfect partner, helping them to produce attractive, fit-for-purpose and fully compliant food packaging. Over the past few years, we have rolled out a series of printing-ink systems that offer the highest level of safety possible from inks for printing food packaging. One of these systems is our ACRYLAC-MGA water based coating series.

If you would like more information, please visit our dedicated packaging inks website:

Occupational health and safety and environmental protection

Classification

As a general rule, water-based coatings do not fall within the criteria laid down in EU Directives designating substances required to be classified as hazardous. Further details can be found in the respective and most recent safety data sheet.

Safety instructions

Avoid contact with skin and eyes. Wash contaminated skin thoroughly with water. If contact with eyes occurs, rinse thoroughly with water and consult a doctor if necessary. Further details can be found in the respective and most recent safety data sheet.

Disposal of water-based coatings, wastes containing water-based coating and waste water

- Water-based coatings must never be dumped into sewage systems. The same applies to residues and to water that has been used to clean coating units and associated equipment. Water-based coatings generally belong to water endangerment category 1 (WGK 1). Specific procedures must be discussed with the relevant local authorities, since there are no uniform guidelines on this subject.
- Left-over coating and residues must be disposed of as special waste.
- Left-over coating should not be mixed into freshly delivered material. Depending on the condition of the left-overs, this can result in flocculation and problems due to dried coating, microbiological contamination or incompatibilities.
- When cleaning with solvents or special agents, observe all hazard warnings and safety instructions applicable to these products.