Print Media Academy

HEIDELBERG

Profi Tip
Dampening Solutions in Offset Printing

Foreword

DEAR READERS,

Next to the printing plate and the offset ink, the dampening solution represents the third significant factor in offset printing. Perfect print output – even during high print runs – results from the optimal interaction of these system components. The current guidebook is intended to help you to develop a general understanding of the dampening solution, its composition, and its application in the printing industry.

Sincerely yours,
the Team of the Print Media Academy

Print Media Academy

Contents

Dampening Solution and Dampening Solution Additives

- Ideally, the dampening solution should possess a water hardness of 8 ° dH to 12 ° dH and a pH-balance of 4.8 to 5.5.
- The typical dampening solution temperature ranges between 10 °C to 15 °C. At the same time, a printer must know that at low temperatures condensation water collects on tubes and in the dampening solution vats, and this may lead to the formation of water droplets.

Dampening solution additives are complex material systems with various components included to promote adequate emulgation and wetting (surface tension). They are important for pH-Balance adjustment and for stabilisation (buffer systems), protection against corrosion, for a cooling effect, and in avoiding slime formation (biocide).

IN VIEW OF THE WIDE-RANGING AND VARIED QUALITY OF WATER, SELECTING THE APPROPRIATE ADDITIVE IS ESSENTIAL.

The Basis: Water

Water found in nature is not clean, rather it contains numerous gasses and minerals. A printer uses tap water as the source material for his dampening solution. To assess the quality of water the water's hardness is measured, which largely depends on the quantities of calcium and magnesium present. In any case, the hardness of the water must be calculated before any additives are introduced, since hardness is no longer easily determined in a prepared dampening solution. Test-strips are used for a simple determination of the total water hardness. Determining the carbonate hardness is accomplished by means of an indicator solution (substances helpful in making measurements are available, for example, from Heyl Bros., Myron L, Merck, Neukum ...). At the same time, one should always remember that a measurement only represents a momentary "snapshot", and that the quality of the water can continue to fluctuate quite dramatically. Almost all manufacturers of dampening solutions will perform a water analysis on request.

Determining the Hardness of Water

Range of Hardness	**soft**	**medium**	**hard**	**very hard**
Overall Hardness measured in *mMol Earth Alkali-Ions	0–1,3	1,4–2,5	2,6–3,7	> 3,7
German Hardness Grade °d	0–7	8–14	15–21	> 21
English Hardness Grade °e	0–9	10–18	19–26	> 26
French Hardness Grade °f	0–13	14–25	26–37	> 37

Water Hardness

The proportion of lime in the water can cause problems during printing, for example:

- the inking rollers run blank (calcification)
- deposits on the rubber blanket
- impact on the pH-Balance
- fluctuation in the pH-Balance

Furthermore, an excess proportion of chloride, sulphate, or nitrate will promote corrosion.

The overall hardness of the water may be measured simply by using test strips. Dip the hardness-strip briefly (1 second) into the water, then read the results after two minutes.

In order to ensure that the dampening solution preparation possesses the the ideal degree of hardness, the principle of reverse osmosis for water desalinization is used. In the process, the water is pressed against a membrane. Water treated like this, emerges with a very low residual salt content. Subsequently, this osmosis water is reconditioned with salts, until it reaches a degree of hardness ranging from 8° dH to 12° dH.

pH-Balance

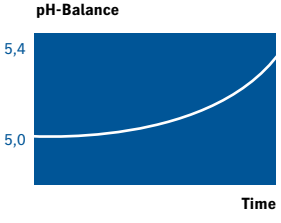
“pH” is derived from the Latin (Potentia Hydrogenii) and represents a logarithmic description of the concentrations of hydrogen ions.

In other words, the pH-Balance is a measure used to determine the acid or alkaline content of aqueous solutions. What type of acid or base is involved cannot be determined. A liquid with a pH-balance of 5 has 10 times more acid than a liquid with a pH-balance of 6. As a general rule, dampening solution additives are buffered, in order – for the most part – to neutralize external influences. A pH-Balance measure does not tell us very much about the quality of the dampening solution. The measure only shows, whether an additive is present or not. Naturally, in order to determine the quality of the dampening solution, its conductivity should also be determined.

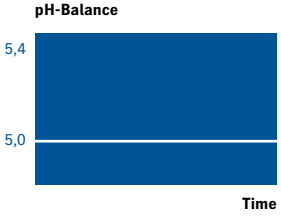
pH-Balance		**3 4 5 6 7**	
Free-rolling Plate	better		worse
Ink Water Absorption	less		worse
Oxidative Drying	slower		quicker
Corrosion	more		less
Attack on Paper Coating	stronger		weaker

pH-Balance and Buffer

In modern dampening solution admixtures, the correct pH-Balance is automatically predetermined, if dosages are mixed in according to instructions. Buffering prevents paper and ink from altering the pH-Balance.



Changes in pH-Balance from external influences when there is not sufficient buffering capacity



Stable pH-Balance with sufficient buffering capacity, even where there are external influences

The indicator strip used in measuring pH-Balance should be dipped in for one minute, and then compared with the color scale.

Conductivity = µS/cm

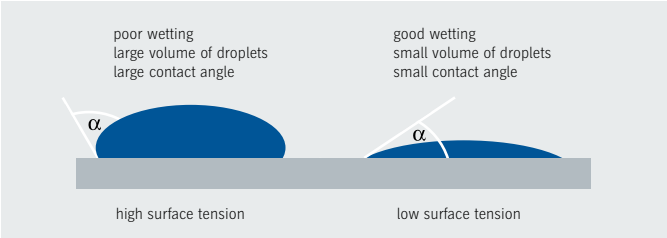
Conductivity describes how electricity is conducted through a liquid; impurities in the dampening solution allow conductivity to increase. Conductivity varies depending on the water and additives. The temperature, and the concentration of alcohol also influence conductivity. By increasing Isopropanol (IPA), conductivity declines. Modern conductivity gauges also measure for temperature. It is important that the conductivity gauge in the central dampening solution be regularly cleaned and recalibrated.

Conductivity should be determined using a “freshly prepared dampening solution”, so that this measure can then serve as a “benchmark” when the dampening solution is later exchanged. When the conductivity in the dampening solution has climbed by approx. 1000 µs/cm, this should be taken as a signal that it is time to change the dampening solution. In order to guard against printing problems, it is recommended that the dampening solution be renewed every 14 days. By introducing optional dampening solution filters (e. g. softflow), the useful life of the dampening solution can be substantially prolonged.

The pH-Balance, the temperature, as well as conductivity can be measured by means of a universal test control device. All electronic measuring instruments must be regularly re-calibrated.

Wetting the Plate

Gum arabic, glycol, glycerine, or alcohol may reduce the surface tension of the water. On the material safety data sheet included with each product, the manufacturer lists which agents are components of each respective dampening solution additive.



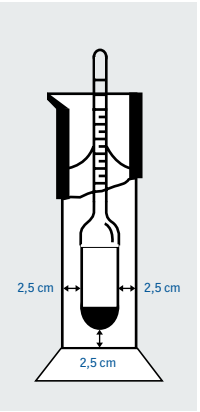
Alcohol is a very good wetting agent. Isopropanol, also referred to as IPA, lowers the surface tension, raises the viscosity of the dampening solution and in the process fosters film formation in the dampening unit. This produces a uniform wetness. Since IPA evaporates quickly, the ink dries faster. At the same time, the printing units are cooled by the evaporation cold. By adding IPA, production volume is raised, and the take-up of the dampening solution is supported. IPA helps to inhibit lathering.

Testing the Alcohol

The alcohol employed should be very clean. This can be checked with a simple test: fill a clean glass with equal amounts of water and alcohol. After 30 or 45 minutes, the liquid should be clear – cloudiness indicates that the alcohol is unusable.

Areometer Readings

The measuring spindle must clearly move, floating freely in a glass cube or something similar. No air-bubbles should be present on the measurement spindle or in the liquid. Transparent liquids are measured from "below". Read the measured values according to the %-volume values, and read the temperatures as well, calculating these using the %-volume values. The computed value is then verified against the table.



The areometer can be used to measure the IPA-content in the water. The device indicates percent by volume and by weight. Percent by volume should be principally measured. Since temperature plays an important role in determining IPA, please do pay careful attention to the temperature balance. Include the specific weight (density), of the dampening solution additive when making the determination (see the chart).

Determining the concentration of IPA

Density[1] of add. dampening solution	**%-proportion of add. dampening solution**	**measured IPA-concentration in %**									
1,05	2	3,1	5,0	6,8	8,7	10,5	12,4	14,2	16,1	17,9	19,7
	3	2,8	4,6	6,4	8,2	10,1	11,9	13,7	15,5	17,3	19,1
	4	2,5	4,3	6,0	7,8	9,6	11,4	13,1	14,9	16,7	18,5
1,10	2	2,5	4,3	6,1	7,9	9,7	11,4	13,2	15,0	16,8	18,6
	3	1,9	3,6	5,3	7,0	8,8	10,5	12,2	19,9	15,6	17,4
	4	1,2	2,9	4,5	6,2	7,9	9,5	11,2	12,8	14,5	16,1
1,15	2	1,9	3,6	5,3	7,1	8,8	10,5	12,2	14,0	15,7	17,4
	3	0,9	2,6	4,2	5,8	7,5	9,1	10,7	12,3	14,0	15,6
	4	0,0	1,5	3,0	4,6	6,1	7,6	9,2	10,7	12,3	13,8
1,2	2	1,3	2,9	4,6	6,3	7,9	9,6	11,2	12,9	14,6	16,2
	3	0,0	1,5	3,1	4,6	6,1	7,7	9,2	10,8	12,3	13,8
	4	-1,3	0,1	1,6	3,0	4,4	5,8	7,2	8,6	10,0	11,4
actual alcohol concentration in %		**4**	**6**	**8**	**10**	**12**	**14**	**16**	**18**	**20**	**22**

1) The specific weight of the dampening solution additive used can be found in the material safety data sheet.

Alcohol measurement

The measurement of alcohol in the central dampening solution is conventionally performed by using the density of the dampening solution (float gauge). However, the density of the dampening solution is not only influenced by the IPA-content, but also by the temperature, the kind of additive being employed, and the degree of pollution. Consequently, regular cleaning is vital. Modern measuring procedures, such as infrared or ultra-sound, are largely unaffected by foreign substances.

Drawbacks of Alcohol

- In addition, IPA encourages blank runs, in particular in the presence of very hard water, since IPA reduces the solubility of calcium salts.
- Too much IPA can breakdown the adhesive agent in the printing ink, dissolve the protective covering of metal pigments, and reduce lustre.
- IPA can attack the paper coating, which can lead to build-up on the rubber blanket.
- IPA belongs to that category of volatile organic compounds (VOC), which damage the atmosphere (ozone, summer smog).
- In addition to these, IPA can cause damage to your health.

Thinking “more does more”, printers often use more IPA than printing technology strictly requires. The highest amount of alcohol desirable ranges between 5–8 %. For health reasons and in order to protect the environment, try using as little IPA as possible. Check IPA concentrations and dampening solution additives once or twice weekly.

Preparing the Dampening Solution

Basically, there are three different variants of dampening solution

1. Water and additives for an older dampening system with plush rollers
2. Osmosis water, additives and alcohol for modern continuous-film dampening systems with unupholstered rubber rollers
3. Osmosis water and alcohol substitute for IPA-free printing

Mixture Dosage Calculations

Target Quantity	**100**		
– Additive Amount	**4**	Additive	**4**
– Alcohol Amount	**10**	Alcohol	**10**
= Water Amount	**86**	Water	**86**
Actual Amount	**100**	Actual Amount	**100**

Incorrect Dosage Calculations

Target Quantity	**100**		
Water	**100**	Water	**87,7**
– Additive Amount	**4**	– Additive Amount	**3,5**
IPA	**10**	IPA	**8,8**
Actual Amount	**114**	Actual Amount	**100**

Dampening Solution Printing Problems

BUILD-UP ON THE RUBBER BLANKET: Attack on the paper coating from acidic dampening solution

BLANK RUNS: Deposits on rollers, the rubber blanket, and the plate

PLATE DETERIORATION: The printing layer is destroyed, the additives are too aggressive. Incorrect machine calibration

PLATE CORROSION: Plate oxidizes, protection of the plates by means of additives is not sufficient

OVER EMULSIFYING: pH-Balance is too high, too much water, the water is too soft, the additives are too high, the rollers are incorrectly adjusted, too much IPA, very little ink reduction

LATHERING: Circulating detergent, runback performance set too high, additives are too foamy

POOR DRYING: pH-Balance too low, incorrect print substrate ink combination, pH-Balance of the substrate to be printed is too low

POOR FREEWHEELING: pH-Balance is too high, the IPA is too low, plate protection is insufficient, roller calibration is incorrect, ink/dampening solution mixture is not correct

SLIME, ODOR: An underdose of the additive, germ infested water, the formation of resistant bacteria

SMEARING: Too little dampening solution, dampening solution no longer fit for use, contaminated, incorrect machine adjustment

SPATTERING: Overemulsification, incorrect balance of ink/dampening solution

SCUMMING: pH-Balance too high, plate protection insufficient, plate poorly developed, ink-guide set too high, deposits on the plate or rubber blanket, IPA too low, the ink/dampening solution balance is incorrect, tempering is incorrect

TAPERED MULLERS: Too little hydrophylic substance in the dampening solution, chromium is taking the ink

ACCRETIONS: Wrong mix, over-emulsification, pH-Balance too high, IPA too low

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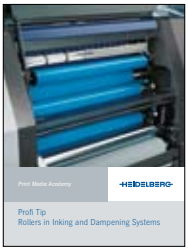

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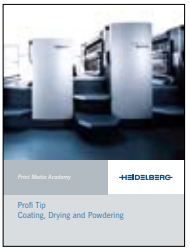

Coating, Drying and Powdering

Lackieren, Trocknen und Pudern

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Heidelberger Druckmaschinen AG
Print Media Academy
Kurfuersten-Anlage 52–60
69115 Heidelberg
Germany
Phone +49 6221 92-00
Fax +49 6221 92-4929
www.print-media-academy.com

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