SunChemical

HARTMANN

Sheetfed Offset
Web Offset

Printing auxiliaries

FOUNTAIN SOLUTION

Fundamentals of Offset Dampening

References
We would like to thank all companies and institutes for their friendly support with information material and pictures

Figure 1
POLYCHROME
Osterode

Figure 3
Dr. Herbert Bendlin
USF Deutschland GmbH
Prozess- und Abwasseraufbereitungssysteme

Figure 4
Dr. Herbert Bendlin
USF Deutschland GmbH
Prozess- und Abwasseraufbereitungssysteme

Figure 5
DRAABE GmbH
Hamburg

Figure 12
Krüss GmbH
Hamburg

Figure 13
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"Reduzierung des Alkoholgehaltes
im Feuchtmittel"
Art. Nr. 86438, 1993

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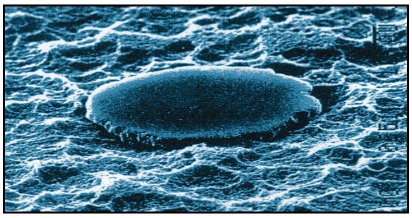
From Tap Water to Fountain Solution

During the last 30 years offset printing developed into the most important printing process. The key for this success is and always has been the high productivity and quality as well as the relatively easy production of the printing forme.

While typographic, gravure printing and screen printing base on physical principles, Senefelder already defined his printing procedure - lithography (the precursor of offset printing) - as "chemical printing process". Printing and non-printing areas are not separated by differences in height, but by varying wetting behaviours of the printing forme towards water and oil. The non-printing areas are hydrophilic, the printing areas are oleophilic. Figure 1 shows the typical structure of an offset printing plate.

Fig. 1: Structure of offset printing plate,



screen dot on non-printing aluminium oxide

Following this principle, the printing process does not only require ink, but also water. This water must show certain properties, which are reached by water treatment and special fountain solution additives, if necessary.

What kind of water quality is required for offset printing?

Depending on its origin, water can feature very different qualities and components. The assessment of a water quality with "good" or "bad" can possibly vary very much, because it is influenced not only by its components, but also by the intended use. Therefore...

... drinking water should be free of odour and taste, low in germs and relatively low in its natrium chloride content,

... cooling water should be free of corrosive salts

... washing water should be soft with respect to the needed detergents.

So what are the properties required of water used in the preparation of fountain solution? Mostly drinking water is used, only few companies have their own fountain. The regulation for drinking water leaves a large scope, which means that water qualities can be very different.

Below the typical components, the components relevant for printing are marked with *:

Salts/cations*:* Natrium, potassium, calcium*, magnesium* and traces of iron, manganese, zinc and aluminium

Salts/anions: Hydrogencarbonate*, chloride*, sulphate*, nitrate*, phosphate and silicate

Gases*:* Oxygen, nitrogen, carbon dioxide and organic combinations and microorganisms (drinking water < 100 germs/ml).

The influence of these components on the printing process as well as the recommended limits can be seen in figure 2. If the water quality significantly differs from these nominal values, a water treatment is recommended.

Water softening

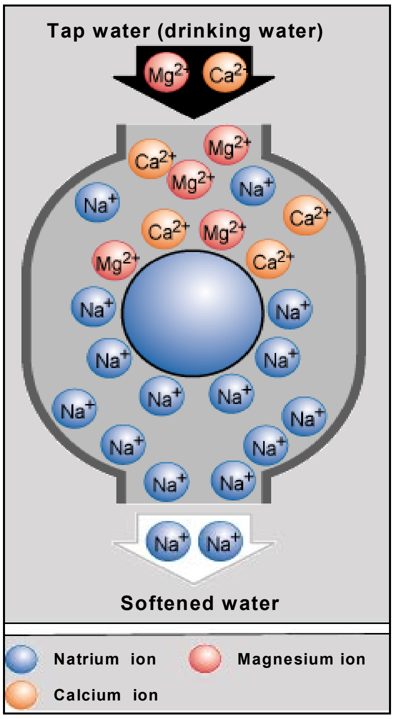
During this process the hardness causing components calcium and magnesium are replaced by indifferent ions (natrium) via a cation exchanger. The principle is shown in figure 3. The salt content remains unchanged or is slightly increased. Corrosive anions and the undesired portion of hydrogencarbonate in high concentrations are not removed. Possible variations in the water quality remain. According to these restrictions, the softening is only conditionally suitable for the

Ingredients	Influence/Problem	Rec. Concentr.
Hardness former Calcium Magnesium	Stripping, pH value, running blind of plate	ca. 8°-12° dH
Hydrogen carbonate	pH value	100-200 mg/l
Chloride	corrosion	25 ppm
Nitrate	corrosion	20 ppm
Sulphate	corrosion	50 ppm

Fig. 2: Typical components of tap water and their limits for offset printing

preparation of fountain solution. Ion exchangers have to be regenerated with a natrium chloride solution after a certain period of operation. The retained calcium and magnesium is

Fig. 3: Principle of water softening



again replaced by natrium and the process can start again. Residues of natrium chloride have to be removed (washed out) before the system can be used again.

Complete demineralization

The complete demineralization works on the principle of a ion exchanger. During this process all ions (cations and anions) are replaced by the components of the water, hydrogen ions and hydroxyl ions become water. The result is completely

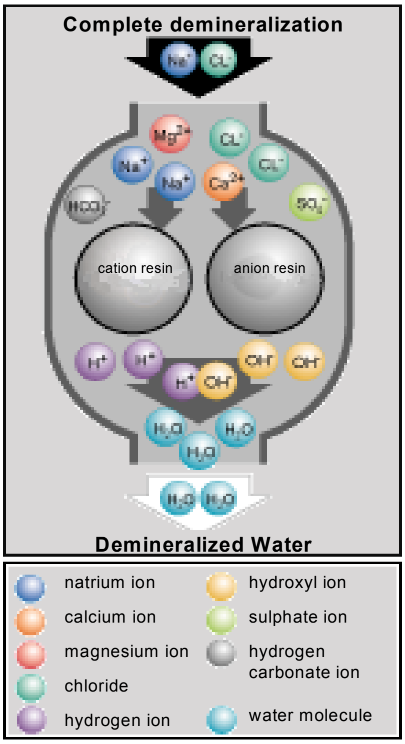


Fig. 4: Principle of complete demineralization

demineralized water, which e.g. is used in car batteries.
Figure 4 shows the principle of complete demineralization. Completely demineralized water is not suitable for offset print (see also "Treatment of demineralized water").
The ion exchangers of the complete demineralization must be regenerated with acid and lye. The waste water has to be neutralized before it is introduced into the sewage system.

Reverse osmosis

The reverse osmosis is comparable with a filtration, in this case the "filter" is a membrane. This membrane is only permeable for the small water molecules, but not for salts, microorganisms and other components. If water is directed under pressure past a membrane, the stream divides into two part streams:

- an almost saltfree water quality, which comes through the membrane and
- the very salty waste water, which is directed past the membrane.

Very hard water qualities have to be softened prior to the osmosis. RO-water also has to be treated for the preparation of fountain solution (see figure 5).

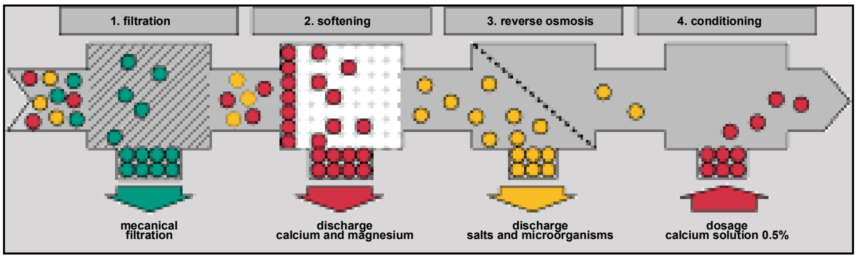


Fig. 5: Principle of process water treatment using the example of reverse osmosis

Treatment of demineralized water

Practical experiences show that water without hardness causing components is not very suitable for offset printing. This particularly applies, if no rehardening is done by the paper (see also "interactions of alkaline papers with acid fountain solutions"). Hardness causing components have a positive effect on the ink/water balance. Therefore hardness causing components have to be added to soft or treated water. The hardness should be in the range of 8-12°dH (dH - German hardness).
In this context two possibilities have to be discussed:

1. **Mixture with tap water:**
   This inexpensive solution can be used whenever the water quality is constant and no disturbing salts, e.g. corrosive chlorides, are available.
2. **Rehardening with AQUATREAT:**
   A special additive, which in addition to natural hardness causing components also contains preservatives.

The suitable water quality is one of the preconditions to guarantee an unproblematic printing process. In addition it is absolutely necessary that the fountain solution additive has been adjusted to the application. Nowadays modern fountain solution additives comply with a variety of requirements.

- Stabilization of pH value in a favourable range for printing
- Protection against corrosion of printing plate

pH Value and Conductivity

- Protection against formation of odour and slime in fountain solution circuit
- Specific setting of surface tension to improve wetting and control emulsification
- Prevention of insoluble calcium salts (stripping)
- Reduction of piling on blanket
- Reduction of IPA proportion
- Protection against corrosion (printing press)

Where does the term "pH value" come from?

There are different explanations for the derivation of the term "pH", e.g. lat. potentia hydrogenii or pondus hydrogenii. They all have in common the reference to hydrogen. The exact scientific definition - negative logarithm of hydrogen ion concentration (activity) is very abstract.

Figure 6 intends to show the correlations in a graph: The pH value is a measure for the acid concentration. Pure water, for example, has a pH value of 7, which means that acids and bases are "in balance". For pH values smaller than 7 the acid concentration is increasing and the

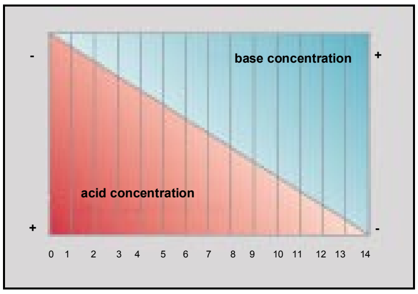


Fig. 6: Correlation between acid concentration and pH value

bases concentration is decreasing. Correspondingly pH values higher than 7 mean a higher base concentration and a lower acid concentration.

Solution	pH value
gastric liquid	0.9 - 2.3
lemon juice	2.2 - 2.3
vinegar	3.0 - 3.1
fountain solution	4.8 - 5.3
milk	6.4 - 6.7
water, pure	7.0
blood	7.38
sea water	7.8 - 8.2
soap	8.2 - 8.7
limewater	12.3

Fig. 7: Typical pH values of various solutions

Taking into consideration the definition for "common logarithm", a pH value change of one unit, e.g. pH = 5 to pH = 4 means a tenfold higher acid concentration. Consequently small changes in pH value may have a big influence. Figure 7 shows typical pH values.

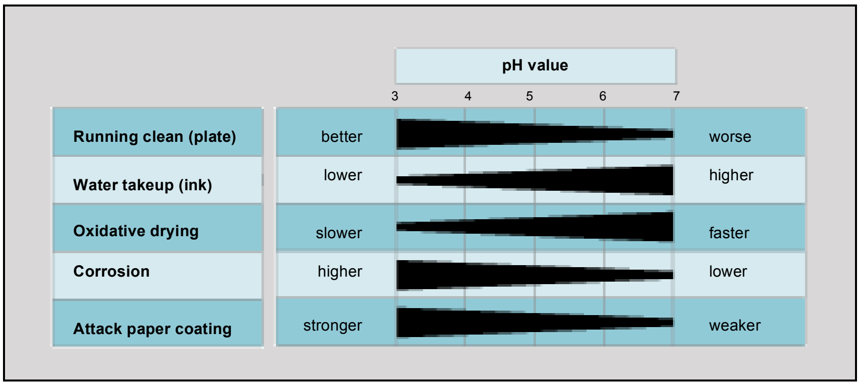


Fig. 8: The influence of pH value on printing properties

Importance for offset printing

The acid concentration in the fountain solution influences a variety of properties during the printing process (figure 8): Running clean of printing plate, water takeup/ emulsification of printing ink, oxidative drying of printing ink, durability of press materials and reaction of fountain solution with paper coating.

Taking all influences into consideration, a pH range of 4.8 to 5.3 has established for offset printing in Europe. Inks, fountain solutions and plates have been adjusted to this range, a fundamental change of the pH range requires a completely new adjustment of all components. Experiences from other countries, e.g. USA, show that the adjustment to other pH ranges is possible. However, each pH range can only be a compromise between all parameters.

Stabilization of pH value

To set and stabilize the pH value, fountain solution additives contain buffer systems, which consist of blendings from acids and bases. They only change the pH value minimally, if small quantities of acid or alkaline impurities are added and thus guarantee a constant pH value, even with exterior influences like paper or ink components in the water.

The quality of a buffer system is characterized by its buffer capacity (see figure 9). This buffer capacity provides a measure for the quantity

pH Value and Conductivity

of other substances, e.g. calcium carbonate from paper coating, can be added, without considerably changing the pH value.

Buffer systems show characteristic behaviours (figure 10): The concen-

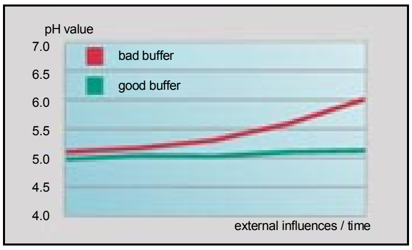


Fig. 9: Stabilization of pH value by good buffer capacity

tration of the buffer (fountain solution additive) and the pH value are in no

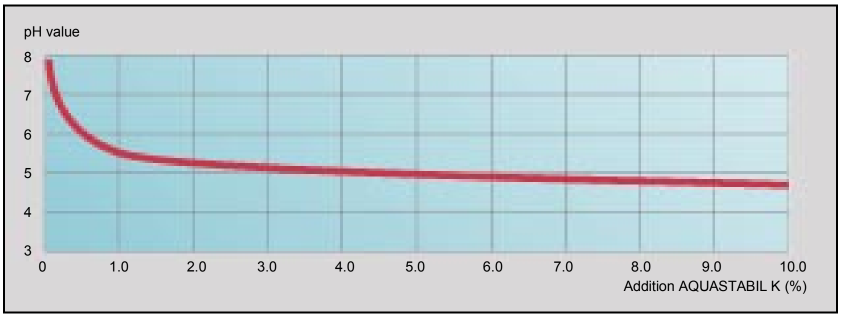


Fig. 10: Relation between pH value and added quantity

direct (linear) correlation. That is, the pH value cannot be used to examine the added quantity of fountain solution additive! Such a measure is only possible by measuring the conductivity.

Measurement of pH value

The pH value can be measured with electronic devices or with test strips. The common test strips show an accuracy of ca. +/- 0.5 pH units, i.e. a "measured value" of 4.8 can also be reached by a fountain solution with a pH value of 4.3. Due to these inaccuracies the measurement with an electronic device should be preferred. These devices show, depending on their purchasing price, an accuracy of +/- 0.1 to +/- 0.01 pH units. A calibration of the used devices should be possible.

What is "conductivity"?

Conductivity is a measure for the ability to conduct electric current. In solutions it is caused by breaking down salts in electrically loaded particles, so-called ions. The higher the salt concentration, the higher the conductivity. The conductivity is determined by the water quality and the used fountain solution additive.
The conductivity is not relevant for the printability, i.e. unlike for the pH value there is no favourable range for printing, above or below which printability problems occur. Despite this fact we recommend not to exceed a conductivity of ca. 1500 µS for freshly mixed fountain solutions. This recommendation is based on the correlation between conductivity and salt concentration: Higher conductivities (= higher salt concen-trations) may cause corrosion in printing presses.

Fig. 11: Conductivity as a function of added quantity

Conductivity and quantity of fountain solution additive

The conductivity is a direct (linear) measure for the concentration of the fountain solution additive and with restrictions can be used to determine the exactness of the dosage. In this context it has to be considered that tap water already has a conductivity which may influence the measuring result. Only demineralized water has (almost) no conductivity.

The conductivity is strongly influenced by the alcohol concentration (figure 11) as well as by impurities from ink and paper components. Therefore a determination of the concentration is only possible with freshly mixed fountain solutions and a constant alcohol concentration. On the other hand a regular measurement of the conductivity allows conclusions regarding the pollution level of the fountain solution, because: the conductivity increases with increasing pollution.

Detailed measurements of conductivity and pH value as well as the preparation of comparison curves are possible within the free Sun Chemical/HARTMANN fountain solution service.

Protection of printing plate

The printing plate mainly has to be protected in the non-printing areas. Each damage or chemical change results in acceptance of ink (toning). The plate protection prevents the so-called machine-down oxide. To a certain extent it is furthermore possible to protect the water-bearing layer against abrasion. In general, it is not possible to protect the copy layer with the fountain solution additive.

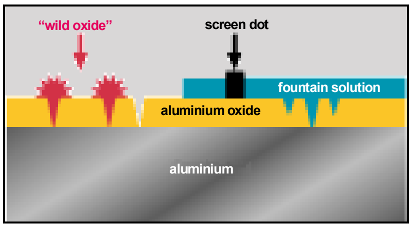


Fig. 12: Formation of plate corrosion

However, we have to point out that alcohol replacements may damage the layer of unbaked positive plates. Baked plates and negative plates are much less sensitive.

The water-bearing layer of the printing plate has the following composition (compare figure 12):

<u>**Basic material**</u>: aluminium
<u>**Non-printing layer**</u>: aluminium oxide

The aluminium oxide contains channels, which are separated from the basic material by a barrier layer. Some channels even reach the aluminium. In this case it is possible that the aluminium reacts with salts, water or air, once the printing plate starts to dry (machine stop or machine down-time).

The product of this reaction, so-called "wild oxide", is very voluminous and able to transfer ink, due to its composition and the fact that it clearly stands out. Such points are visible in the printed image. It is possible to wipe out the oxide, but the intervals in which the problem will come back, will become shorter and shorter.
Sun Chemical/HARTMANN fountain solution additives contain a special plate protection, which closes these channels and/or prevents the air admission by a sufficient film during machine down-times.

Antimicrobial effect

Due to their composition, their temperature and the constant ventilation, fountain solutions are ideal nutrient media for bacteriae, yeasts and fungi. This particularly applies to alcohol-free systems. These microorganisms are not pathogenic, i.e. not noxious but they can cause extensive interferences like odour formation, filling of systems with mud and blocking of nozzles and pipelines.

Our fountain solution additives contain substances which counteract the germ growth and thus counteract the above mentioned interferences. These biozides show a twofold effect: on one hand the immediate effect (desinfection) and on the other hand the long-term effect (preservation). The selection of the substances is subject to the rigid regulation for cosmetics.

Setting of surface tension

The wetting of solid surfaces, e.g. printing plates and rollers, is determined by the surface tension of

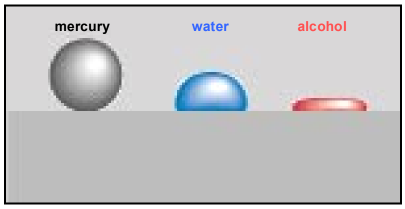


Fig. 13: The surface tension of liquids determines their wetting behaviour

the wetting liquids, e.g. fountain solution (figure 13). Liquids with high surface tensions, e.g. mercury, show very poor wetting properties, because their drops have a spherical shape. Therefore the liquid films they form tend to break up. Liquids with low surface tension, like alcohol, in the contrary have excellent wetting properties, because the liquid spreads across the surface.

What is the significance of this behaviour for offset printing? Fountain solutions with high surface tensions form big drops and therefore result in an uneven wetting of the printing plate. To form a closed fountain solution film a significantly higher quantity of fountain solution is required than with fountain solutions with low surface tension. Not all dampening constructions are able to transport such high fountain solution quantities. If they can transport such quantities, the ink is confronted with a water excess, which results in interferences with the ink/water balance.

Fountain solutions with low surface tension do not have these problems, because they form evenly thin, stable films. The required reduction of the surface tension in alcohol dampening units is reached by using isopropyl alcohol (IPA). The effect of IPA can be supported by wetting agents, which allow a reduction of the alcohol concentration. With special laboratory equipment (tensiometer) the exact surface tension can be determined, which allows a specific setting (see figure 14).

Alcohol reduction in offset printing

In addition to the mentioned reduction of the surface tension, alcohol has other important tasks, like increase of viscosity to improve the transport as well as the control of emulsification.

Alcohol evaporates during the printing process and therefore cannot concentrate, while at the same time it cools the printing press. While the use of wetting agents can also guarantee a good wetting, the lower viscosity (=worse transport) of alcohol reduced systems partly has to be compensated by an increased water transport.

The third important task of alcohol is the control of emulsification. Due to the nature of the printing process, ink takes up fountain solution and forms a water-in-oil-emulsion. Investigations of A. Rosenberg (FOGRA) show that this water takeup is realized in two steps:

1. First, the so-called bound water, extremely small drops, which are not even visible under the microscope, form. The printing plate is not yet running clean.

2. After the ink is saturated with this water, larger visible drops ("free water" or "surface water") form, which cause the printing plate to run clean.

Fig. 14: Tensiometer for the exact determination of the surface tension of fountain solutions

Between the free and the bound water a very sensitive balance exists, which frequently can only be reached by the use of IPA. Alcohol replacements can disturb this balance. The danger exists that the balance is shifted to the disadvantage of the free water so that the printing plate has trouble to run clean or is not running clean at all. This danger particularly applies for indirect dampening units, where ink and fountain solution come into very intensive contact at the bridge roller. This behaviour has to be taken into account when formulating alcohol replacement products.

The alcohol reduction should be realized in three steps:

1. Exact determination of the exact alcohol contents in the laboratory and possibly reduction to 10-14%. This step can be realized immediately, mostly without changing the fountain solution additive.

2. Reduction to 5-7%, when using a suitable additive. Before planning any further reductions the print shop should collect experience with this setting for an extended period of time.

3. Further reduction to a concentra-tion which still allows a stable quality print.

In this context the following recommendations should be considered:

- Exact setting of printing press
- Good cooling of fountain solution
- Increase of water feed, if necessary
- Periodic cleaning of circuit

- If necessary, use of baked plates
- Use of hydrophilic fountain rollers

In addition, the use of treated water and ceramic rollers have proved successful to some extent.

Specific Gravity Additive (g/ml)	Concentration Additive (%)	Real Alcohol Concentration (%)									
		4	6	8	10	12	14	16	18	20	22
1.05											
	2	3.1	5.1	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	13.9	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
1.20											
	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

Fig. 15: Influence of fountain solution additive on alcohol dosage. The values of the table are measured by areometer

Exact determination of alcohol concentration

The reduction of alcohol only makes sense, if the alcohol concentration can be determined exactly. Regretfully the usual alcohol determination is combined with uncertainties: Areometer and alcohol doser determine the quantity to be added via the specific gravity of the fountain solution. The specific gravity of the fountain solution is determined by the alcohol as well as by the fountain solution additive. Figure 15 shows, how big the influence of the fountain solution additive can be.

Exact determinations are only possible via gas chromatography or special sensors. Within the Sun Chemical/HARTMANN fountain solution service respective measurements are realized.

Interactions between alkaline papers and acid fountain solutions

Due to their manifold positive properties alkaline papers occupy a large range within the different paper qualities. In contrast to that, fountain solution additives are still acid. Therefore intensive interactions can be expected.

Alkaline papers contain calcium carbonate, which gives papers a good opacity. Furthermore this very inexpensive raw material offers good flow properties of the coating compound during the paper production. Papers, which contain calcium carbonate do not show the critical acid decomposition, typical for old documents.

Acid fountain solutions dissolve calcium carbonate, developing gas, which might cause the enrichment of calcium salts in the fountain solution circuit. This enrichment may cause a series of printing problems:

Increase of pH value
- Piling on blanket
- Stripping of ink rollers
- Running blind of printing plates
- Transparent residues and preci-pitations

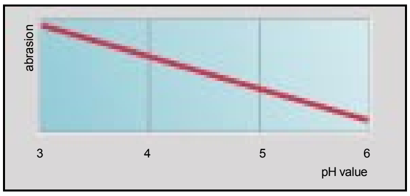


Fig. 16: Influence of pH value on abrasion of paper coating

Increase of pH value in fountain solution

Due to the reaction of the fountain solution with calcium carbonate the buffer substances are used up totally or partially. Therefore the buffer capacity of the fountain solution additive becomes more and more important. An increase of the added quantity improves the buffer capacity. However, it must not result in a decrease of the pH value, because this would intensify the destruction of the paper coating and a stabilization of the pH value could not be reached (figure 16).

Piling on the blanket

By the reaction of acid with coating particles the paper coating starts to dissolve, which causes a partial loss of the inner coherence of the paper coating. Loose coating particles may pile on the blanket. This error mostly becomes more evident in the last printing units. Special additives counteract this problem, by facilitating the removal of the coating components.

Requirements and Tasks in Offset Printing

Stripping of ink rollers

The calcium ions dissolved in the fountain solution react with the citrates frequently contained in the buffers and form insoluble salts.

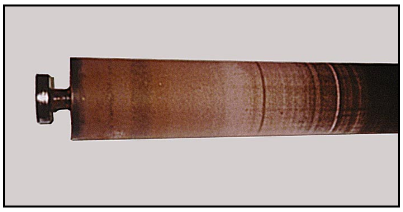


Fig. 17: Ink rollers with residues

These are stored in the pores of the ink rollers, which consequently become hydrophilic. The water infiltrates the ink film, the ink is displaced and the ink rollers partly do no longer transport ink (= stripping). The regeneration of stripped ink rollers can only be realized with special washing agents (ROLLERFIT), which are able to dissolve the insoluble calcium salts (see figure 17).

Running blind of printing plates

In addition to the mechanic wear the running blind of printing plates can also be caused by insoluble calcium salts. These hydrophilic salts deposit on the printing plate. The ink film on the copy layer is infiltrated by water, the ink is expelled and the ink is no longer transferred to the printing areas (running blind of printing plate). Special fountain solution additives with the following properties counteract these problems:

- low attack on paper coating

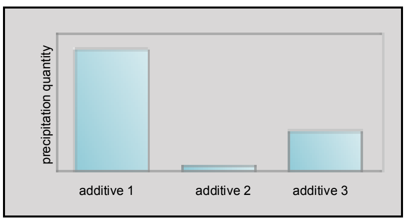


Fig. 18: Influence of fountain solution composition on formation of calcium salts

- prevention of insoluble calcium salts (see figure 18)
- good buffer capacity
- minimize piling on blanket

Corrosion in printing presses

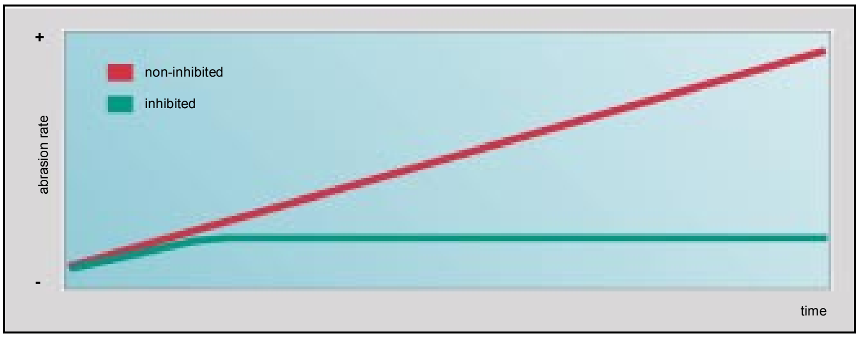


Fig. 19a: Determination of nickel mass loss. Theoretic behaviour of inhibited and non-inhibited systems

Fig. 19b: Determination of nickel mass loss. Practical behaviour of inhibited and non-inhibited systems

The corrosion behaviour in printing presses is decisive for the selection of the materials. Materials like steel, alloyed steel and nickel steel can be considered. Inhibited fountain solution additives can considerably reduce the corrosion of these materials. By electrochemical measurements and immersion trials, in which the loss of weight of a substance sample is determined, the corrosion behaviour is investigated in the laboratory. Figures 19a and 19b compare the theoretical and practical behaviour of inhibited and non-inhibited systems.
Non-inhibited systems show a constantly progressing mass loss. Inhibited systems, however, only show a light corrosion at the beginning, which rapidly reduces considerably. The use of corrosion inhibitors remains however without effect, if you do not consider other influences as well:

- Machine maintenance
- Water quality (we especially refer to the limits of 25 ppm for chloride as well as 50 ppm for sulphate and 20 ppm for nitrate recommended by the German printing association (Bundesverband Druck))
- Ink, paper and other consumer materials

The whole concept must be oriented on the protection against corrosion.

Modern Fountain Solution Research

Modern fountain solution additives are high tech products. In order to cope with the permanently changing and increasing requirements, well equipped laboratories are required. At SunChemical/HARTMANN we have the possibility to determine water takeup and ink/water balance with the LithoLab-Tester (figure 20) and to optimize them specifically.

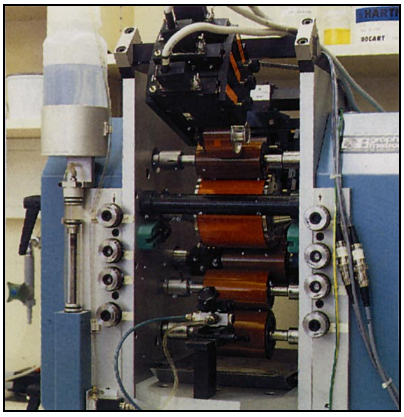


Fig. 20: LithoLab tester for investigation of ink/water balance

These investigations are supported by measurements with the Lithotronic measuring instrument (figure 21), which examines the rheology (flow and transfer characteristics) of the emulsion.

The specific setting of the wetting behaviour is realized by measurements with different tensiometers (see figure 14). The development of corrosion inhibited fountain solution additives is realized with an electrochemic setup. This extensive equipment allows a considerably better insight into the offset printing process.

Sun Chemical/HARTMANN fountain solution service

No water quality is identical with another one, because print job structure and general conditions can vary considerably. Furthermore the requirements regarding quality and productivity are constantly increasing. Therefore service and support by the suppliers are of decisive importance for print shops:

- Water analysis to evaluate the suitability for printing and the corrosiveness of the water
- Examination of dosage for additive and IPA as well as setting of reference curves (figure 22)
- Consultation for planning of water treatment systems and optimization of fountain solution supply
- Creation of a report concerning the bacterial status in large systems
- Comprehensive documentation, technical information and material safety data sheets.

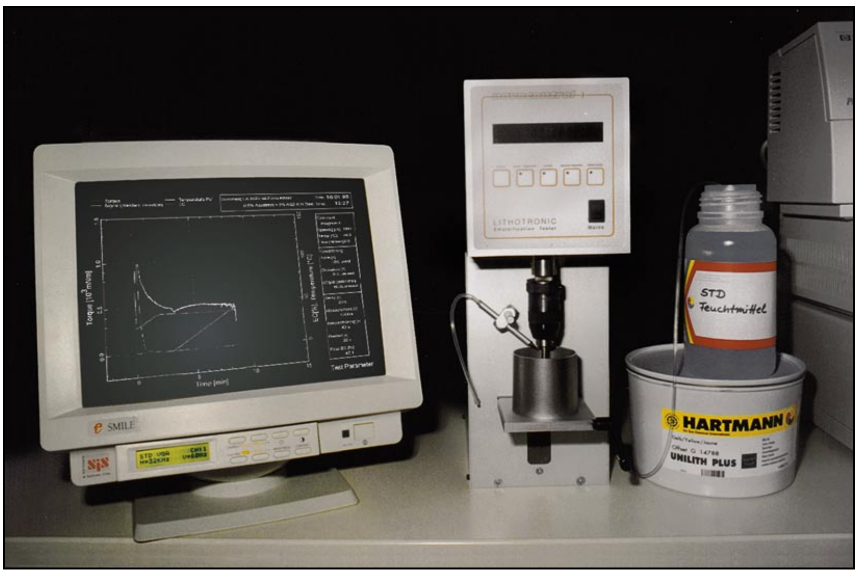
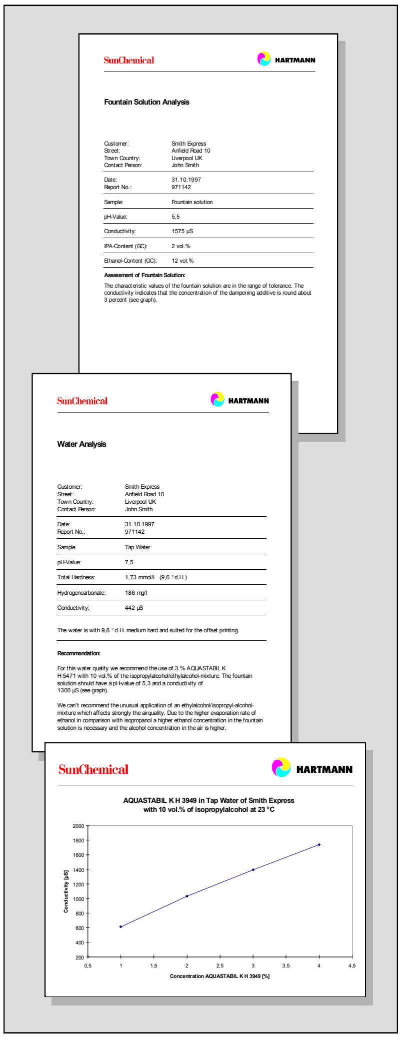


Fig. 21: Lithotronic to optimize ink/water emulsion



SunChemical HARTMANN

Fountain Solution Analysis

Customer:	Smith Express
Street:	Anfield Road 10
Town Country:	Liverpool UK
Contact Person:	John Smith
Date:	31.10.1997
Report No.:	971142
Sample:	Fountain solution
pH-Value:	5,5
Conductivity:	1575 µS
IPA-Content (GC):	2 vol.%
Ethanol-Content (GC):	12 vol.%

Assessment of Fountain Solution:

The characteristic values of the fountain solution are in the range of tolerance. The conductivity indicates that the concentration of the dampening additive is round about 3 percent (see graph).

SunChemical HARTMANN

Water Analysis

Customer:	Smith Express
Street:	Anfield Road 10
Town Country:	Liverpool UK
Contact Person:	John Smith
Date:	31.10.1997
Report No.:	971142
Sample	Tap Water
pH-Value:	7,5
Total Hardness:	1,73 mmol/l (9,6 ° d.H.)
Hydrogencarbonate:	186 mg/l
Conductivity:	442 µS

The water is with 9,6 ° d.H. medium hard and suited for the offset printing.

Recommendation:

For this water quality we recommend the use of 3 % AQUASTABIL K H 5471 with 10 vol.% of the isopropylalcohol/ethylalcohol-mixture. The fountain solution should have a pH-value of 5,3 and a conductivity of 1300 µS (see graph).

We can't recommend the unusual application of an ethylalcohol/isopropyl-alcohol-mixture which affects strongly the airquality. Due to the higher evaporation rate of ethanol in comparison with isopropanol a higher ethanol concentration in the fountain solution is necessary and the alcohol concentration in the air is higher.

SunChemical HARTMANN

AQUASTABIL K H 3949 in Tap Water of Smith Express with 10 vol.% of isopropylalcohol at 23 °C

Fig. 22: Documentation SunChemical/ HARTMANN fountain solution service

Problems,Causes, Actions

Problem	Definition	Possible causes	Actions
pH value	pH value outside the range 4.8-5.5 (heatset), 5.0-5.5 (sheetfed)	not enough fountain solution additive, wrong buffer setting; use of alkaline papers	verify/correct dosage; select product with acid setting; product with higher buffer capacity/lower attack on paper coating
Stripping	disturbed ink acceptance on ink rollers, no ink transfer	insoluble calcium salts from water, ink, paper (main source)	clean rollers with ROLLERFIT, use of fountain solution additive which counteracts stripping/insoluble calcium salts, set pH value at upper tolerance limit to pH 5.1-5.5
Residues/ precipitations	white residues/cristals in circuit or on plate and blanket	see "stripping"	see "stripping"
Running blind/plate	disturbed ink transfer from plate; disturbed ink acceptance of copy layer	see "stripping"	see "stripping", do not clean plate with ROLLERFIT, damage of plate possible
Plate wear	copy layer	wrong press setting; use of aggressive fountain solutions	check press setting 0.15 mm pressure plate/blanket; possibly plate or development error; positive plates are partly attacked by alcohol replacements: burn in plate, if necessary, change plate type or fountain solution
	non-printing area	wrong press setting; insufficient plate protection	see above; use of fountain solution additive with better plate protection
Plate corrosion	"Bubble formation" on plate and print	insufficient plate protection; also influenced by plate quality	use of fountain solution additive with better plate protection, if necessary, change plate type
Poor drying	prints do not dry or dry too slowly	ink unsuitable for substrate; pH value of fountain solution too low; influence of substrate; water takeup of ink too high	change ink type, e.g. do not use fresh ink on foils or low-absorbency substrates; set pH value at upper tolerance limit to pH 5.1-5.5; use special additive on foils, adjust ink to substrate, if necessary, change substrate. See also "emulsification"
Foaming	fountain solution foams on return	washing agent or similar in circuit, return output too high; strongly foaming fountain solution additive	mix new fountain solution, avoid washing agent in system, if necessary use defoamer, reduce return/pumping capacity, return below water surface, if necessary, change additive
Piling/blanket	within printed image: positive piling	ink tack/picking resistance of paper not adjusted to each other; attack on paper coating by acid fountain solution	if possible, reduce ink tack, if necessary, change paper quality; fountain solution additives with additive against piling; set pH value of fountain solution at upper limit to pH 5.1-5.5
	outside printed image: negative piling	ink/water balance, washing out of ink	coordinate fountain solution and ink, error is also influenced by paper quality (absorbency, coating components)

Problems,Causes, Actions

Problem	Definition	Possible causes	Actions
Running clean/plate	at start or after press stop printing plate does not or only slowly run clean	pH value too high; alcohol concentration too low; plate protection not sufficient; press setting not correct, ink/water balance disturbed	set pH value at lower tolerance range to pH 4.8-5.1, monitor ink drying and reaction with paper coating; examine alcohol concentration and correct if necessary; examine and increase added quantity of fountain solution additive if necessary; examine settings, possibly pressure of dampening rollers too low; adjust fountain solution/ink to each other
Toning	non-printing area transfers ink, partly only slight coloration. See also plate corrosion	pH value too high; plate protection not sufficient; plate insufficiently developed; ink transfer too high (rather smearing); residues on plate or blanket; alcohol concentration too low; ink/water balance; insufficient temperature control	set and examine pH value; examine and increase added quantity, if necessary; check plate development; reduce ink transfer; eliminate cause for residues; check alcohol concentration; check water takeup of ink, adjust fountain solution/ink; check temperature control of ink or dampening unit
Smearing	non-printing areas transfer ink	insufficient water transport, see "Toning"	check press setting, check alcohol concentration. See "Toning"
Flying	ink/water emulsion is transported to the roller edges and is flying	water takeup of ink is too high; press setting	check alcohol concentration, if necessary, adjust ink/fountain solution. See also "Misting"
Misting	occurs across the whole width of the roller, mostly pure (not emulsified) ink	rheology of ink; roller setting too strong; insufficient temperature control of inking unit	discuss rheology change of ink with ink manufacturer; check roller setting, check temperature control of form roller; check temperature control of inking unit
Emulsification	printing ink takes up water, emulsification is desired. Emulsification of too much water = instable emulsification	wrong roller setting; pH value too high; dosage of fountain solution too high; dosage of IPA too high; water too soft; too little ink consumption	check roller setting; check and set pH value (nominal: 4.8-5.3); check and set dosage of fountain solution additive; check and set IPA dosage; set hardness to 8-10°dH; also print ink consumption strip.
Instable emulsification		see "Emulsification"	see "Emulsification"
Microorganisms	formation of odour and slime in circuit	dosage of fountain solution additive too low; tap water (fountain or ion exchanger) contains too many germs; formation of resistant germs	before taking any measures, diligently clean the system (cleaning concentrate), check dosage of fountain solution additive, check water quality, change preservation agent if necessary
Dot gain		water takeup of ink too high; see "Emulsification"; adjustment ink/substrate	see "Emulsification"; adjust ink to substrate