Prisco®
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ANALOG REFRACTOMER

REFRACTOMETERS—FACT VS FICTION

Most printers would agree that ink, paper, plates and blankets are all key variables in offset lithography. Another key variable, the fountain solution, also plays a critical role in enabling the press to deliver the highest possible print quality. At PRISCO, the pressroom is our only business; fountain solution concentrates form a major part of our pressroom chemistry product line. Mixing fountain solution concentrates (like the ones sold by PRISCO) with water results in the fountain solution that is used on the press.

The ability to accurately measure the pH and conductivity of mixed fount in the pressroom has always been essential to good quality printing. More recently a third number referred to as the Brix Value (%) has also become popular.

Each PRISCO technical representative has the skills and instruments needed to measure all three of these properties. A previous Tech Solutions (#13) discussed pH and conductivity and the instruments used to measure these properties. This document, however, will discuss the Brix number (%) and the instrument called a refractometer that is used to determine what that number is.

REFRACTOMETERS AND THE BRIX NUMBER

When light enters a liquid, it changes direction; this is called refraction. Refractometers measure the degree to which the light changes direction; this is called the angle of refraction. Refractometers correlate refraction angles to refractive index values (nD) that have already been scientifically established.

Outside the pressroom, refractometers are used to determine the concentration of solutions of solids that are dissolved in water (e.g. brine or sugar solutions). In the pressroom, refractometer readings (Brix percentages) are only affected to a minor degree by the solids that have been dissolved in the mixed fountain solution which help generate the conductivity that we measure using a meter. They are, however, temperature dependent (see later).

POCKET DIGITAL REFRACTOMER

The type of instrument which has been adopted for use in press rooms is a specialized refractometer originally designed for the wine industry called a saccharometer.

Saccharometers do not read refractive indices directly but instead are calibrated to read out in the Brix scale, which indicates the percentage of fermentable sugar in solution. The vintner uses the saccharometer in the vineyard to determine when his grapes are adequately ripe and ready for crushing. The manual versions are rugged and portable, and readily lend themselves to use to in the pressroom. For our purposes, models reading in the 0 to 10 Brix range are the most useful.

None of the discussion in this document relates to the use of refractometers for measuring the concentration (dosage) of mixed silicone; this is a separate subject.

BRIX NUMBER VS FOUNTAIN SOLUTION COMPOSITION

Since refractometer readings are influenced by anything dissolved in the solution being measured, fountain concentrate and alcohol substitute solvents as well as dissolved solids can alter the angle of refraction. This in turn will affect the refractometer reading or Brix number. The contribution from dissolved solids is, however, much less than that from dissolved solvents.

A recent study using samples from both the field and the laboratory has allowed some general conclusions to be drawn regarding the data from using a refractometer to measure the Brix of fountain solutions that might be found in the pressroom.

For a two-step fountain solution, Brix is additive, with contributions from both the fountain concentrate and alcohol substitute. Using fount samples and press water from one of our two-step fount customers, we developed the following data tables:

One customer doses 3451U @ 3.5 opg and Alkaless 6000 @ 1.25 opg. His holding tank for the mix has a measured Brix of 0.9. The tables to the right show that the contributions from the fount (3451U) and alcohol substitute (Alkaless 6000) are additive.

3451U Dosage Study			
Opg	pH	Cond	Brix
1	4.10	664	0.0
2	3.98	1243	0.2
3	3.96	1781	0.5
4	3.93	2305	0.8
5	3.92	2800	1.0
6	3.91	3244	1.2
7	3.90	3736	1.4
8	3.90	4178	1.6
9	3.89	4596	2.0
10	3.88	5003	2.0

Alkaless 6000 Dosage Study			
Opg	pH	Cond	Brix
0.5	7.45	17.25	0.0
1.0	7.29	16.42	0.2
1.5	7.06	17.24	0.4
2.0	7.09	16.48	0.6
2.5	7.02	16.23	0.8
3.0	6.98	16.27	1.0

With a two-step fountain solution, multiple combinations of the two parts can be found that will yield a given Brix number, but only one combination may be capable of running the press to its optimum. Simply reading the Brix number of a reservoir is not a reliable indicator of its contents or whether the fountain concentrate / alcohol substitute dosages are correct for the press.

The alcohol substitute used has a significant effect on the Brix reading. As shown below, two-step founts based on Alkaless 6000 will tend to have low Brix numbers due to its unique solvents and relatively low dosage.

3451U + Alkaless 6000 Dosage Study						
Fount	Opg	Substitute	Opg	pH	Cond	Brix
3451U	3	None	-	4.00	1849	0.5
3451U	3	6000	1.5	4.00	1770	0.9
3451U	3	3000	3	3.98	1719	1.7
3451U	3	P	3	3.99	1724	1.6
3451U	3	R	3	3.99	1709	2.0

Solvent type and amount is the primary driver of Brix numbers. Contaminants, unless they contain solvents (examples of the latter include washes, MRCs, and plate cleaners), have a minimal effect on the Brix number of used fountain solutions as shown below.

	Fresh Mix			Used Mix		
Fount + Substitute	pH	Cond	Brix	pH	Cond	Brix
3451U + Alkaless 6000	3.91	2261	0.9	4.37	3001	0.9
3451U + Alkaless 6000	3.90	2022	0.9	4.08	2554	1.0

Aside from the two step 3451U and Alkaless 6000 with a Brix reading of 0.9, there are a number of one-step founts that could also be considered for use on the same presses. As can be seen below, the Brix numbers of these one step founts differ greatly. Therefore, there is a wide range of Brix readings capable of running a given press, and there is no one single ideal Brix reading as some vendors might imply.

Prisco One-Step Brix Readings				
Fount	Opg	pH	Cond	Brix
170-46	4.5	3.98	1938	2.4
150-134	4.5	4.03	1826	1.3
3452+2	6.0	3.89	1494	1.4
3551+2	8.0	4.39	1525	2.0
162-50	6.0	3.92	1076	1.7
Q CTP 122EU	6.0	4.90	1710	1.5

Fountain solution additives, if they contain solvent, may significantly affect the Brix number of the fountain solution reservoir. Consider the effect below of Prep-N-Plus on the Brix reading of mixed Webfount® 225N; Prep-N-Plus is an anti-piling additive based on ethylene glycol.

Fountain Solution Additives and Brix				
Fount	pH	Cond	Manual Brix	Digital Brix
WF 225N @ 4 opg	4.48	2808	0.6	0.6
WF 225N @ 4 opg + 2 opg Prep-N-Plus	4.59	2703	1.4	1.3

Refractometers are designed to yield the correct Brix % at 20° C (68° F). If the sample being measured has a different temperature, the number must be corrected to get the true value. After determining the Brix % of a reservoir at 15.5° C (60° F), subtract 0.3 to get the correct value. When comparing two or more Brix numbers, be certain they have been temperature corrected so that all are on the same temperature basis.

MONITORING BRIX IS CRITICAL FOR PRINT QUALITY

MAINTENANCE TIP

Refractometer readings are temperature dependent and only valid for the temperature of the liquid as it is being measured. All refractometers come with a chart that corrects the percentage reading from ambient to 20° C.

WHICH REFRACTOMER IS BEST FOR ME?

There are two types – manual and digital – and several different manufacturers for each. Choose the type you feel most comfortable with. Your PRISCO sales representative can handle this for you if you like. Different refractometers, if properly calibrated prior to use, yield the same reading regardless of whether they are digital or manual. Calibrate the device on a daily basis prior to its use.

USE IN THE PRESSROOM

In the pressroom, the refractometer is useful for roughly estimating the concentration, or dosage, of either a fountain concentrate or an alcohol substitute when it is being blended with water via a doser. Once the correct dosage (either one step or two step fount) has been established based on press performance, the measured Brix % at that point provides a convenient reference point if it is suspected the dosage has changed.

It may also be used as a quick check to determine if a hand-mixed batch of one step fountain solution is approximately correct in dosage (if a properly calibrated conductivity meter is not available). When comparing different batches of mixed two step fountain solution, however, be cautious when interpreting the numbers. A difference means that the mixed composition has changed. No change, however, could mean that the ratio has remained the same – it could mean that the two parts may have moved in opposite directions with the final Brix number remaining the same.

PRISCO has consistently maintained that the use of refractometers for accurate control of fountain concentrates and alcohol substitutes in the pressroom is not recommended. We also do not recommend the routine use of the refractometer for press-room troubleshooting of problems that are possibly related to consumables beside the fountain solution.

There are no published studies, for instance, which prove that one fountain solution Brix number is any more-or-less desirable than any other Brix number when diagnosing ink, coating or paper-related performance issues on press.

CONCLUSION

In this document, we have discussed another pressroom variable (Brix) and how it can be measured. As a leading manufacturer of both fountain concentrates and pressroom water management and control systems, PRISCO has always believed very strongly in educating its customers regarding control of the mixed fountain solution used on their printing presses.

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