KODAK Antifoggant , AF-2000

Process ECN-2

Technical Data and
Crossover Information
For Customers

Entertainment Imaging

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INTRODUCTION

➢-The proposed product is intended to replace the Eastman Anti-Fog N°9 which is currently being sold by Kodak in wetted powder form. Advantages and benefits are listed in the table I.

➢-Kodak Antifoggant, AF-2000 will be supplied in liquid concentrate.

➢-It will be available in a 2 X 5 LT plastic bottles case with mixing instructions on the label. (Fig 1) -Size: 307 x 155 x 320 mm (12.08 x 6.10 x 12.60 inches)

➢-Conversion from AF-9 to AF-2000 is simple: Same sensitometry in fresh and seasoned chemistry as with AF-9 (Fig 2) No need to dump tanks or change the way the lab works.

➢- Variations in AF-2000 concentration (-50% / + 50%) did not induce significant sensitometric changes as illustrated in Fig 3 to 4.

Table I -Features and Benefits

Features	Advantages	Benefits
Liquid concentrate	▪ Easy to use ▪ Goes in solution readily ▪ Less product loss from weighing errors	▪ Saves time – faster mixing ▪Less waste leads to more profitability ▪
Transportation	▪ Not explosive ▪ Not flammable ▪ Not regulated for transportation	▪ Easier and faster shipping ▪ Reduce the risk of disrupted supply.
Storage	▪ Not explosive ▪ Not flammable	▪ No restriction on the storage
Stability in developer	▪ Very good keeping stability in color developer : ▪ No need to add more AF-2000, even if the machine is idle for a period of time	▪ Better process control ▪ Higher quality
Made by Kodak	▪ Consistent chemical strength of solution. ▪ Full Kodak technical support .	▪ Higher quality process

BULK FORMULAS

1-Current Color Developer with AF-9

The following table gives the formulas and analytical specifications contained in The Manual for Processing Eastman Color Films (H24) –Module 7: Processing ECN-2

Constituent	Fresh Tank	Fresh and Seasoned Tank Analytical Specifications	Fresh Replenisher	Replenisher Analytical SpecificationsDeveloper
	(SD-49)		(SD-49R)	
Water 21 to 38°C (70 to 100°F)	850 mL		850 mL	
KODAK Anti-Calcium, No. 4	2.0 mL		2.7 mL	
Sodium Sulfite (Anhydrous)a	2.0 g	1.8 ±0.2 g/L	2.5 g	2.2 ±0.2 g/L
EASTMAN Anti-Fog No. 9	**0.22 g**	**0.22 ±0.05 g/L**	**0.30 g**	**0.30 ±0.05g/L**
Sodium Bromide (Anhydrous)	1.20 g	1.20 ±0.05 g/L	0.80 g	0.80 ±0.05 g/L
Sodium Carbonate (Anhydrous)	25.6 g		25.0 g	
Sodium Bicarbonate	2.7 g		0.6 g	
KODAK Color Developing Agent CD-3	4.0 g	3.9 ±0.1 g/L	5.5 g	5.2 ±0.1 g/L
Water to make	1 L		1 L	
pH at 25.0°C		10.25 ±0.05		10.32 ±0.05
Specific Gravity at 25.0°C (77.0°F)		1.029 ±0.003		1.028 ±0.003
Total Alkalinity (5 mL sample)		25.6 ±1.5 mL		23.6 ±0.5 mL

If the machine runs for less than 10 hours per day, modify the replenisher AF-9 concentration as follows:

Operating Time (hours/day)	Replenisher (g/l)
2 or less	0.46
4	0.42
6	0.38
8	0.34
10 or more	0.30

2-Color Developer with KODAK Antifoggant, No.2000 / AF-2000

▪Color developer with AF-2000 is prepared from bulk chemicals according to the formulas given below. Mixing instructions are displayed in fig 1.

▪AF-2000 is the last chemical added before water.

▪Follow all safety precautions and handling recommendation given in the instruction of Module 7 of H24 Manual.

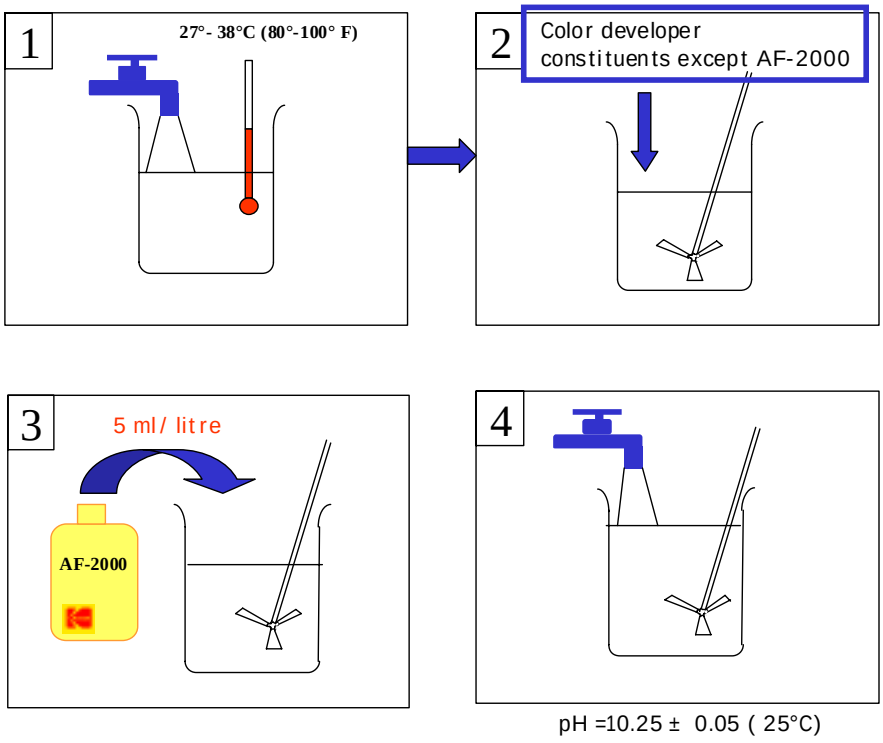
Constituent	Fresh Tank	Fresh and Seasoned Tank Analytical Specifications	Fresh Replenisher	Replenisher Analytical SpecificationsDeveloper
	Developer			
Water 21 to 38°C (70 to 100°F)	850 mL		850 mL	
KODAK Anti-Calcium, No. 4	2.0 mL		2.7 mL	
Sodium Sulfite (Anhydrous)a	2.0 g	1.8 ±0.2 g/L	2.5 g	2.2 ±0.2 g/L
Sodium Bromide (Anhydrous)	1.20 g	1.20 ±0.05 g/L	0.80 g	0.80 ±0.05 g/L
Sodium Carbonate (Anhydrous)	25.6 g		25.0 g	
Sodium Bicarbonate	2.7 g		0.6 g	
KODAK Color Developing Agent CD-3	4.0 g	3.9 ±0.1 g/L	5.5 g	5.2 ±0.1 g/L
KODAK Antifoggant, AF-2000	**5 ml**	**5 ± 0.1 mL**	**5.30 ml**	**5.30 ± 0.1mL**
Water to make	1 L		1 L	
pH at 25.0°C		10.25 ±0.05		10.32 ±0.05
Specific Gravity at 25.0°C (77.0°F)		1.029 ±0.003		1.028 ±0.003
Total Alkalinity (5 mL sample)		25.6 ±1.5 mL		23.6 ±0.5 mL

Because of the very good stability of AF-2000 in the color developer, no modification of the replenisher AF-2000 concentration is necessary if the machine is idle even during a long period of time.

MIXING INSTRUCTIONS

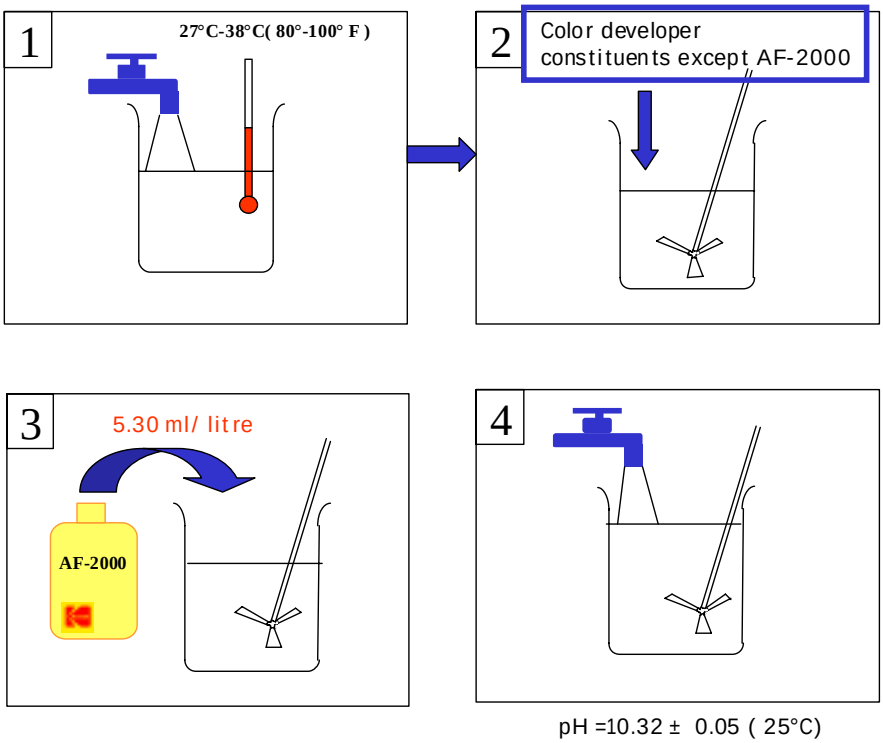
Fig 1

Mixing instructions for Tank - Color Developer ECN-2 with AF-2000



pH =10.25 ± 0.05 (25°C)

Mixing instructions for Replenisher -Color Developer ECN-2 with AF-2000



pH =10.32 ± 0.05 (25°C)

AF-2000 versus AF-9

▪Comparison of sensitometric performance has been performed in seasoned chemistry in a continuous processing machine.

▪The sensitometric curves , which are plotted in figure 2 represent an average of 7 runs for each films for TOD= 3min for both AF-9 and AF-2000.

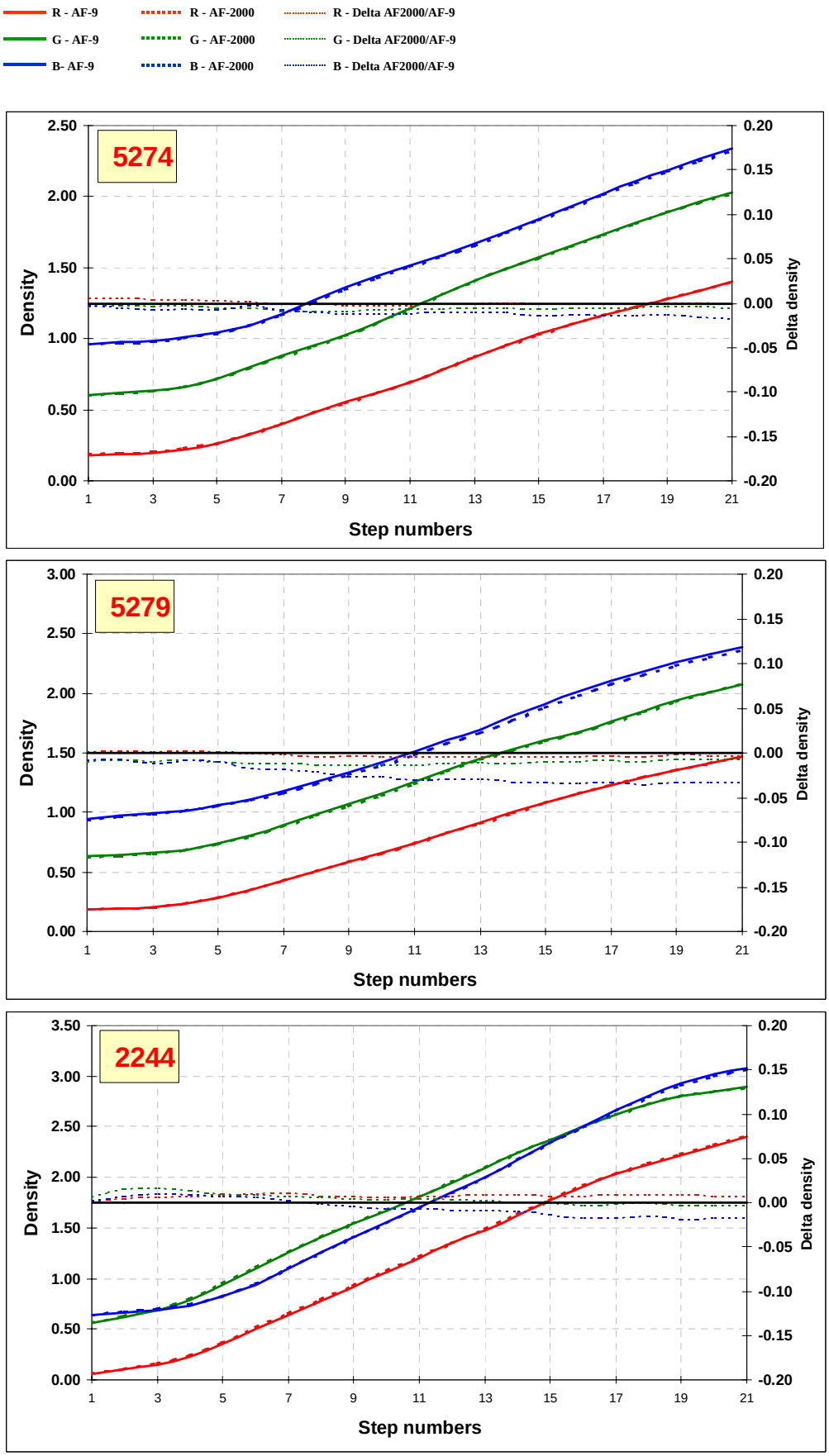
▪Concentration of antifoggant in color developer

AF-2000		**AF-9**	
Tank	Replenisher	Tank	Replenisher
5 ml / L	**5.30 ml/l**	**0.22 g/l**	**0.30 g/l**

The comparisons have been done on the following films:

Films
Kodak Vision 200T : 5274
Kodak Vision 500T :5279
EXR Color Intermediate :2244

Fig 2 -AF-2000 versus AF-9- TOD = 3 min



CHEMICAL VARIATIONS

Figures 7 through 9 illustrate some of the major photographic effects of AF-2000 variations on the following films.

Films
Kodak Vision 200T : 5274
Kodak Vision 500T : 5279
EXR Color intermediate: 2244

The range of variations is illustrated in the following table:

2.50 ml/ L	3.75 ml/ L	5ml / L	6.25 ml/ L	7.50 ml/ L
- 50%	- 25%	Standard level: 0	+ 25%	+ 50%

Each plot shows the effect of a change in AF-2000 concentration (horizontal axis), on the dye density of the processed film (vertical axis). These density plots are deviated against the standard level. (e.g., standard level 5 ml/l of AF-2000 is represented by a zero density deviation).

The magnitude of the changes shown in these plots should not be considered to be process control limits. The plots were derived from experiments using small laboratory machines in which all constituents were held constant except the AF-2000 level.

Hence, the figures should be used only as trend charts and guides. If two or more process variables are changed, the resulting photographic effect illustrated may not be additive.

Interactions can occur that produce effects other than those predicted by addition. The plots in this publication are representative only; they do not contain all possible solution problems.

From fig 3 and 4, we can observe that large variations in AF-2000 concentration in the tank did not induce significant sensitometric changes.

Fig 3-Effect of AF-2000 Variations

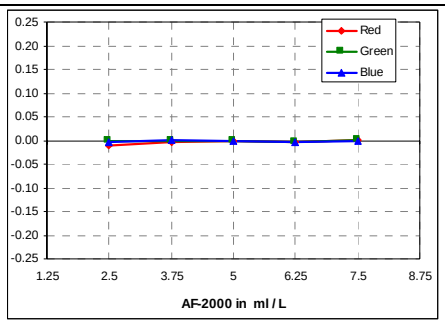
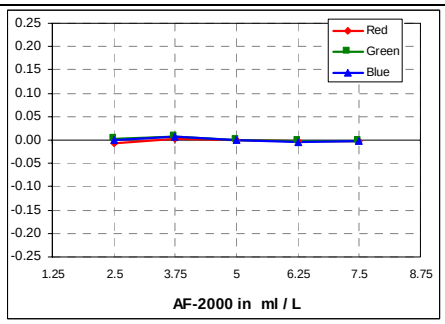
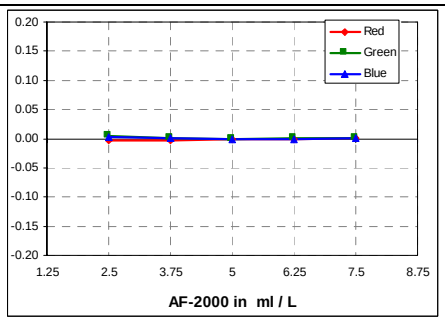
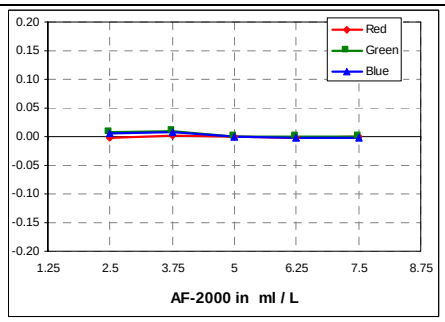
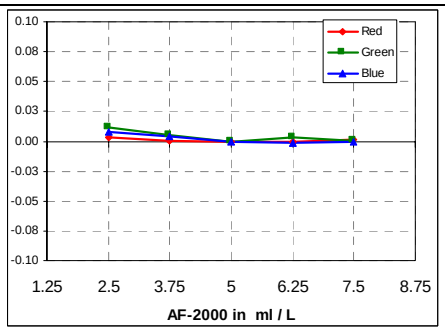
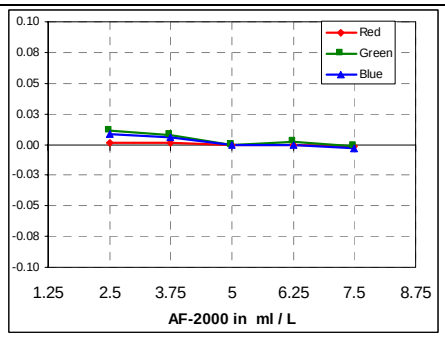
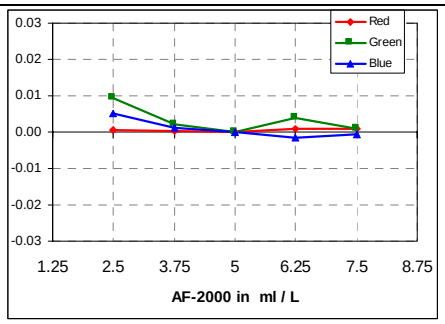
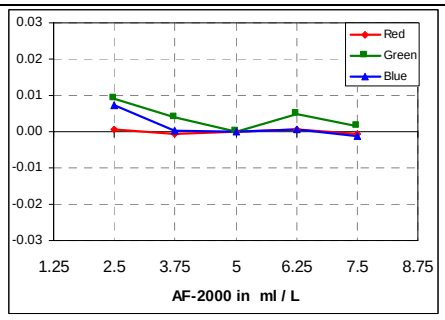
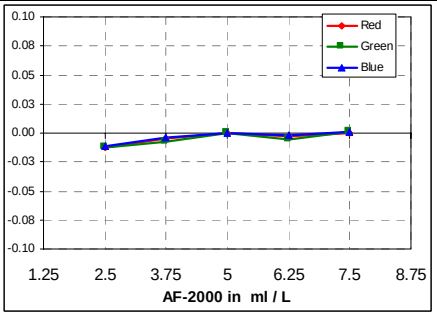
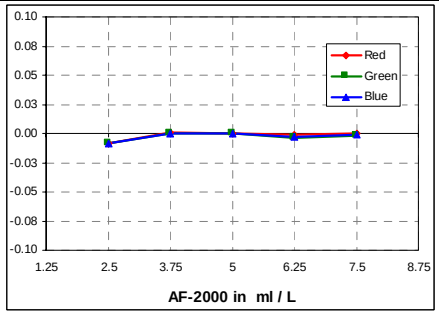
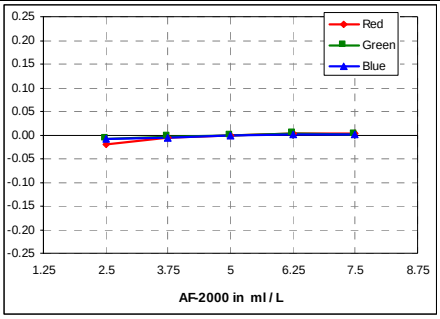
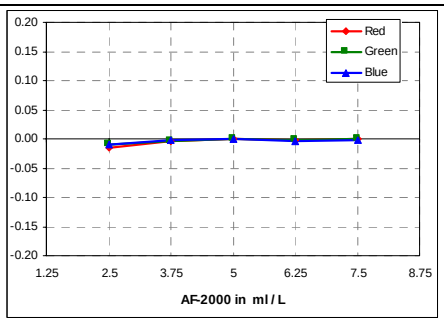
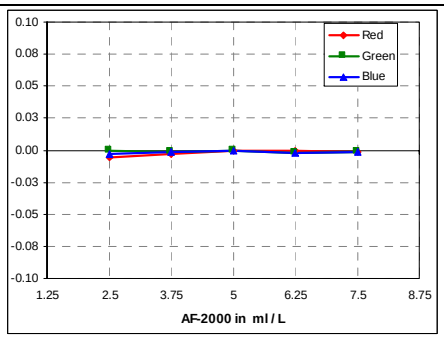
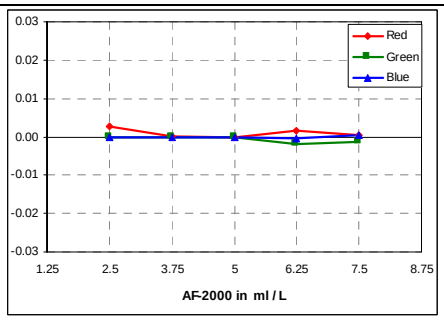
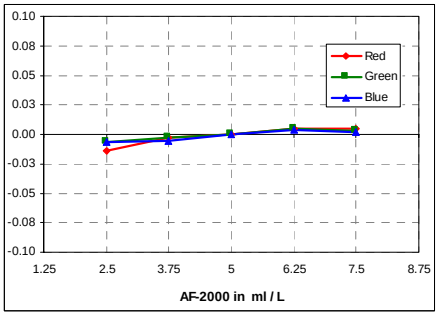
	5274	5279
HD		
MD		
LD		
Dmin		
HD-LD		

Fig 4-Effect of AF-2000 Variations

	2244
HD	
MD	
LD	
Dmin	
HD-LD	

ANALYTICAL PROCEDURE:SPECTROPHOTOMETRY

Spectrophotometric Determination of KODAK Antifoggant, AF-2000 in Developer

Process	ECN-2	ECP-2B	VNF-1/LC	RVNP
Formulas	SD49-SD49R	--	--	--

▪INTRODUCTION

Methyl Green is used to determine AF-2000. This method involves complexation of AF-2000 with Methyl Green. After the dye complex is extracted into dichloromethane , the absorbance is measured at 644 nm.
Sulfite and carbonate contained in the color developer were identified as interfering constituents.
Hydrogen peroxide is used to remove sulfite (Addition reaction of sulfite with methyl Green). Carbonate is eliminated from the color developer by adding phosphoric acid. Carbon dioxide must be completely removed.

Because of the low boiling point of dichloromethane (40°C)and because the extraction is sensitive to temperature, it is advisable to place volumetric glassware in a 22°C constant-temperature bath if the laboratory temperature is above 27°C.

An exhaust hood is recommended when using dichloromethane. Impervious extraction gloves, safety glasses, and observance of local safety regulations are necessary.

This method requires handling potentially hazardous chemicals. Consult the Material Safety Data Sheet for each chemical before use. MSDS's are available from your chemical supplier

▪RELIABILITY- 95 % CONFIDENCE LIMITS

Six fresh developer mixes containing 1.43, 2.86, 4.29, 6.71, 7.14 and 8.57 ml /l of AF-2000 were prepared. Each solution was analyzed each day 3 times for four days. Based on the 12 data points for each concentration, the 95% confidence was calculated. The results are displayed in the following table.

AF-2000 concentration in ml / liter of color developer	n	Mean	Standard deviation	95% CE
1.43	12	1.40	0.097	± 0.054
2.86	12	2.68	0.139	± 0.078
4.29	12	4.11	0.153	± 0.086
5.71	12	5.79	0.220	± 0.124
7.14	12	7.15	0.322	± 0.182
8.57	12	8.66	0.218	± 0.123

This method allows the determination AF-2000 in color developer replenisher and fresh tank developer (not containing AF-9).

Limitation: This method does not allow the determination of AF-2000 in seasoned color developer due to interfering compounds which are released by the films into the color developer.

AF-2000 analysis cannot be performed by this method when AF-9 is present in the color developer

▪SPECIAL APPARATUS

- pH Meter
  - Calomel reference electrode filled with 3.5 N KCl, CORNING Model 476002, or equivalent
  - pH Indicator electrode, CORNING Model 476024, or equivalent
- Constant-temperature bath (optional)
- Spectrophotometer with a tungsten lamp
- 1-cm Silica Cell (glass-stoppered)
- Exhaust Hood

Note: Use pipets and volumetric glassware meeting the "Class A" definition by the National Institute of Standards and Technology (NIST).

▪REAGENTS

Use ACS Reagent Grade reagents unless specified otherwise.
For instructions for the preparation of the required analytical reagents see Module 4, Reagent Preparation Procedures.

- Demineralized or distilled water
- Hydrogen peroxide, reagent ACS (30 wt % in water- without stabilizer)
- Dichloromethane (Methylene chloride-CH2Cl2), stabilized with ca 0.2 % ethanol, C.P.
- Phosphoric Acid, H3PO4, Concentrated, Assay 85% minimum. Reagent Grade, ACS Specifications
- Sodium Sulfate, Na2SO4, granular
- 3 g/l Methyl Green

▪PROCEDURE

1. Pipet 50.0 ml of sample (20°C<temperature < 25°C) into a 100 ml beaker

2. Add, from a tip-up pipet, 5 ml of hydrogen peroxide and stir vigorously the solution with a magnetic stirrer for 5 minutes.

4. Immerse the electrode assembly in the solution and add carefully phosphoric acid to adjust the pH of the solution to about 2.05 ± 0.05 .
Note: Phosphoric acid addition must be done slowly to avoid a violent carbon dioxide evolution

5. Once the pH has been adjusted, pipet 5.0 ml of the sample into a 100-ml conical flask containing a magnetic stirring bar.

6. While stirring, add 2.5 ml of Methyl Green solution.
7. While stirring vigorously without splashing, add, from a tip-up pipet, 10 ml of dichloromethane.

8. Stopper the conical flask, maintain the agitation for 15 s

9. Allow the layers to separate

10. Introduce about 0.3 g of sodium sulfate into a vial

11. Pipet carefully 5 ml of the lower layer (dichloromethane phase containing the AF-2000/ methyl Green complex) into the vial containing the sodium sulfate.(Drying of the organic phase)
Note: Dichloromethane phase does not have to contain any trace of aqueous phase otherwise higher results may be obtained

12. Stopper the vial and shake vigorously for few seconds, then proceed to the next step

13. Using a small portion of the solution (maximum 1.5 mL), rinse a 1-cm spectrophotometer cell, then fill the cell with the remainder of the solution. Rinse the outer surface of the cell with deionized water and wipe dry with a tissue. Ensure that gas bubbles are absent from the cell. If necessary, tap the cell to dislodge gas bubbles adhering to the cell walls.

14. Zero the spectrophotometer vs dichloromethane at 644 nm

15. Read the absorbance at 644 nm (The absorbance should be measured within 10 minutes or low results may be obtained.)

Repeat twice from 5 to 15 step and average the optical density values. If one of the values differs a lot from the other one, repeat from 5 to 15 step.

▪CALCULATION

AF-2000 concentration in ml /l = A x (Abs) + B

Where:
Abs = absorbance of the at 644 nm
B= the intercept obtained from the calibration equation
A= the slope of the calibration equation curve
The slope and intercept are obtained from a calibration equation derived according to calibration procedure.

Note: Each laboratory should establish its own calibration equation based on analysis of standards. APPENDIX A details this calibration procedure. Due to differences among spectrophotometers, each equation may be different. A significant bias may occur from both the experimental conditions (temperature, agitation) and use of an equation which was not established on the spectrophotometer used for the test.

[AF-2000 in ml / liter] = 3.839 x Abs + 0.0411

Calibration procedure

This appendix is used to establish the initial calibration, whenever equipment has been adjusted, or to recheck response every 6months.
Changes in experimental conditions such as temperature, agitation will necessitate to establish a new calibration equation.

A- Preparation of the standard

1. Prepared 1 liter of color developer whitout AF-2000 (solution 1)

2. Reffering to the table below, pipet the specified volume of AF-2000 into a 100-ml volumetric flask

AF-2000	0 ml	0.2 ml	0.4 ml	0.6 ml	0.8 ml

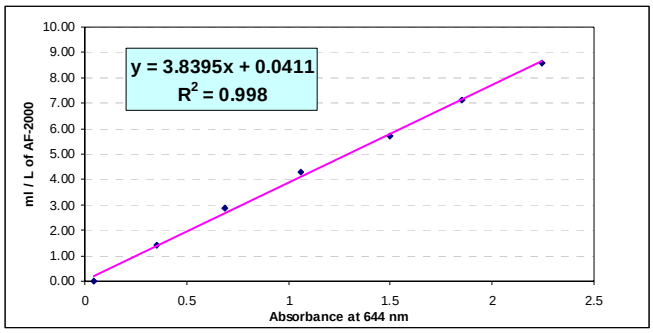
3. Add the appropiate volume of solution 1 into the volumetric flask to make 100ml.

B-Analyse the standard solutions by performing step 1 to 15 of the procedure.

The calibration equation is set up using known amounts of AF-2000 and plotting the AF-2000 used against the absorbances .Include the data for 0 ml/l of AF-2000 (Fig 1)

The graph below gives a typical calibration equation which has been obtained in KODAK

Research Lab (CHALON) during the design of the analytical method.



[AF-2000 in ml / liter] = 3.839 x Abs + 0.0411

▪REAGENT SPECIFICATION AND PREPARATION

▪ Hydrogen peroxide- H2O2
Reagent Grade , ACS (30 wt % in water) (without stabilizer)- Acros Organics (ref: 41188-5000)

Hazard Symbols: C
Risk Phrase: R 34 :Causes burns.
Safety Phrases: S 3 :Keep in a cool place, S 36/39 :Wear suitable protective clothing and eye/face protection,
S 45 :In case of accident or if you feel unwell, seek medical advice immediately (show the label where possible),
S 28A After contact with skin, wash immediately with plenty of water.

▪ Dichloromethane (Methylene chloride- CH2Cl2), stabilized with ca 0.2 % ethanol, C.P
Hazard Symbols: XN
Risk Phrases:R 40 : Possible risks of irreversible effects.
Safety Phrases: S 23 :Do not inhale gas /fumes/ vapour/ spray., S 24/25 :Avoid contact with skin and eyes., S 36/37 Wear suitable protective clothing and gloves.

Phosphoric Acid, H3PO4, Concentrated, Assay 85% minimum. Reagent Grade, ACS Specifications

Risk Description :R34Causes burns.
Safety Description :S26 :In case of contact with eyes, rinse immediately with plenty of water and seek medical advice. , S45 :In case of accident of if you feel unwell, seek medical advice immediately (show the label where possible

Sodium Sulfate, Na2SO4, Granular
Safety DescriptionS24/25 Avoid contact with skin and eyes.

• 3 g/l Methyl Green
Acros Methyl Green, certified 25 GR 414380250
Registry number: 14855-76-6
Safety Description: S24/25 Avoid contact with skin and eyes.

Preparation
1. Weigh 0.3 g of Methyl Green to the nearest 0.01g.

2. Place a 100 ml volumetric flask containing 80 ml of water on magnetic stirrer.

3. Add and dissolve Methyl Green (0.3 g)

4. Dilute to volume with distilled water, mix thoroughly until complete dissolution.

5. Tranfer as completely as possible the aqueous solution of Methyl Green (100 ml) to a separatory funnel.

6. Add approximately 100 ml of dichloromethane in the separating funnel. Stopper and shake separatory funnel for a few seconds, then vent through the stopper. Continue to shake vigorously for 30 seconds, venting occasionally.

7. Allow enough time for complete separation of the phases.

8. Discard as completely as possible the lower (CH2Cl2) layer from separatory funnel without losing any of the top (aqueous) layer containing Methyl Green.

9. Using the same separatory funnel, repeat steps 6, 7 and 8 until complete removal of crystal violet from the CH2Cl2 layer (no coloration).

10. Store the solution in stoppered polyethylene plastic or glass bottle in dark place at room temperature

11. Aqueous Methyl Green solution is stable for at least two months.

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CROSSOVER PROCEDURE

1) Run a control strip, while you are still on AF-9. Read your control strips and record the data.

2) Add an initial spike of AF-2000 of 5 ml/L to the developer tank containing AF-9 and adjust the pH to standard (10.25@ 25C). Run a second control strip and record the data. Note: it is unnecessary to dump the developer before starting.

3) Prepare a replenisher using AF-2000 and start normal processing runs.