2 CONTINUOUS, ROLLER-TRANSPORT, AND RACK-AND-TANK PROCESSORS

KODAK FLEXICOLOR Chemicals are designed for processing all Kodak color negative films. This section provides the steps and conditions and replenishment rates for processing films in continuous, roller-transport, and rack-and-tank processors. It also describes methods for calculating average replenishment rates for a mix of film types and sizes.

You may be able to use two process options to reduce chemical costs and minimize effluent discharge (see *Processing Options*).

For information about monitoring your process, see Section 5, *Process Monitoring and Troubleshooting*.

Note: Do not process KODAK VERICOLOR Slide Film / SO-279/5072 in a processor using FLEXICOLOR Final Rinse and Replenisher. To provide optimum image-stability performance for these films, use FLEXICOLOR Stabilizer III and Replenisher.

USING PROCESS C-41

Steps and Conditions

The processing steps and conditions for Process C-41 in continuous, roller-transport, and rack-and-tank processors are similar to those for other types of processors.

Table 2-1 Steps and Conditions—Continuous, Roller-Transport, and Rack-and-Tank Processors—Process C-41

Solution/Step	Time* min:sec	Temperature °C (°F)	Comments
FLEXICOLOR Developer Replenisher LORR —or— FLEXICOLOR Developer Replenisher	3:15	37.8 ±0.15 (100.0 ±0.25)	Recirculate and filter. Agitate with nitrogen or turbulation. Film must be completely immersed.
FLEXICOLOR Bleach III Replenisher	4:20 to 6:30	38 ±3† (100 ±5)	Recirculate and filter. Agitate and aerate with oil-free air.
Wash	1:05	24 to 41‡ (75 to 105)	
FLEXICOLOR Fixer and Replenisher§ —or— ELECTROSILVER Fixer and Replenisher LORR	4:20	38 ±3† (100 ±5)	Recirculate and filter. Agitate with oil-free air, nitrogen, or turbulation.
Wash	3:15¶	24 to 41 (75 to 105)	
FLEXICOLOR Stabilizer III and Replenisher —or— FLEXICOLOR Final Rinse and Replenisher	1:05	24 to 41 (75 to 105)	
Dry	As needed	Not over 60 (140)	

* Includes immersion time and transfer time to the next tank. Keep transfer times to 20 seconds or less.

† If you increase the bleach and fixer times to 6:30 or longer, you can extend the bleach and fixer temperature range to 24 to 41°C (75 to 105°F).

‡ In some processors, a lower wash-water temperature may affect solution temperatures in adjacent tanks. Longer warm-up times may be needed. If it affects developer temperature during processing, you may need to use a higher wash-water temperature.

§ Use a two-stage (two-tank) countercurrent fixer, preferably with the same time in each tank. Agitation and filtration in each tank are required. If your processor has a single fixer tank, using in-line electrolytic desilvering will decrease the safety margin for adequate fixing.

¶ If your squeegees are efficient enough to maintain a low fixer carryover, you can reduce the wash time to 2:10.

Agitation

As chemicals in the emulsion are consumed, agitation helps remove byproducts and replace them with fresh solution. Inadequate agitation reduces solution activity. Agitation can be provided by solution turbulation or by a gaseous-burst system.

Developer—If your processor provides agitation by solution turbulation, the flow rate and the design of the turbulator bars must provide even agitation throughout the developer tank to optimize the HD – LD value of the control strip.

With gaseous-burst agitation systems, use only humidified nitrogen that has a purity of at least 99 percent. Do not use air; it will oxidize the developer. The gaseous-burst distributor must provide an even burst throughout the developer tank with an average bubble size of 4 mm in diameter (e.g., a "pea-size" bubble). The amount of gas pressure used varies with tank size and distributor design, but it should be enough to raise the solution approximately 1.5 cm (5/8 inch) during the burst. The burst should last 2 seconds with a frequency of 6 bursts per minute (2 seconds on/8 seconds rest). You can adjust the burst rate to optimize the HD – LD value.

Bleach—Agitation of the bleach is required to ensure good bleaching and prevent problems such as leuco-cyan dye and retained silver. You can provide agitation for the bleach by solution turbulation or by using a gaseous-burst system. Use oil-free compressed air for gaseous-burst systems at a frequency of 6 bursts per minute with a 2-second duration. For more information about aerating the bleach, see *Bleach Aeration in Process C-41* at the end of this section.

Fixer—You can provide agitation for the fixer by solution turbulation or by using a gaseous-burst system. Use nitrogen or oil-free compressed air for gaseous-burst systems at a frequency of 6 bursts per minute with a 2-second duration. If you use air, be sure to turn it off when you are not processing film so that the fixer does not become oxidized.

Final Rinse/Stabilizer—Agitation by solution turbulation is *optional.* **Do not** use gaseous-burst agitation for stabilizer or final rinse; the solution will foam severely.

Filtration

Processing solutions and wash water may contain some insoluble materials. If you don't filter out these materials, they can build up on film, tank walls, rollers, and lines, and can damage film. Generally, filters with a porosity of 10 to 30 microns are effective for solutions and wash water, and filters with a porosity of 15 microns are effective for incoming water supplies.

You can use the following filter materials with processes that use FLEXICOLOR Chemicals:

- bleached cotton
- cellulose with phenolic resin binder
- fiber glass with phenolic resin binder
- polypropylene
- spun polypropylene
- viscose-activated carbon
- viscose rayon with phenolic-resin binder (**do not** use in the developer)
- activated carbon

Polypropylene is the most acceptable filter-core material and one of the least expensive. This material has no photographic effect, but the surfactants used to produce the polypropylene yarns may affect your process. Therefore, monitor your process carefully when you first change filters. Replace filters regularly as part of routine maintenance.

Replenishment Rates

The replenishment rates in Tables 2-2, 2-3, and 2-4 are given for the most commonly used unit for the type of processor listed.

- Table 2-2 rates are in millilitres per linear foot and linear metre of film.
- Table 2-3 rates are in millilitres per square foot or metre of film.
- Table 2-4 rates are in millilitres per roll or sheet of film.

Starting Replenishment Rate—The developer replenishment rates given in the tables are starting-point recommendations; they are subject to change depending on the mix of film types processed and other variables of the processing system. Replenishment rates depend on the film type, the amount of exposure, and the presence/absence of sprocket holes.

You can use a single rate for processing all films by determining an average rate that reflects the relative percentages of the different films and sizes that you process. Verify this mix often to be sure that it hasn't changed.

An average starting replenishment rate for FLEXICOLOR Developer Replenisher LORR in a finishing lab that processes a typical mix of 135 Kodak color negative films and ADVANTIX Film* is 5.4 mL/ft (17.7 mL/m).

Carryover—The replenishment rates for secondary solutions must balance the carryover rate of the preceding solution to maintain chemical concentrations and pH level. If carryover is excessive and you do not increase the replenishment rate to compensate, problems such as retained silver and leuco-cyan dye can occur. For rack-and-tank processors, the bleach, fixer, and stabilizer/final rinse replenishment rates reflect the higher carryover rates typical for this type of processor. Typical carryover rates are as follows:

Continuous and Roller-Transport Processors (with efficient squeegees)	
Film Type	**Carryover Rate**
110, 126, 135, 35 mm, and 46 mm film sizes	10 mL/ft^2 (107.5 mL/m^2)
Other roll- and sheet-film sizes	12 mL/ft^2 (129 mL/m^2)

Rack-and-Tank Processors	
Film Type	**Carryover Rate**
110, 126, 135 film sizes	14 mL/ft^2 (150 mL/m^2)
Other roll- and sheet-film sizes	16 mL/ft^2 (172 mL/m^2)

Wash Rates—The wash rates given in Tables 2-2, 2-3, and 2-4 are for the first wash and for a two-stage countercurrent final wash. If the final wash is a single stage, use twice the rate given in the table. If your processor does not meter water for the unit area of film (see Table 2-5), adjust the wash-water rate for the maximum film load you process, and then operate at this rate. Do not use average rates. For the first wash, you can use the overflow from the second wash instead of fresh water.

* In the U.S., this mix is approximately 40 percent KODAK GOLD 100 and 200 Films; 46 percent KODAK MAX 400 and MAX ZOOM 800 Film; 14 percent KODAK ADVANTIX Films, and 6 percent all other Kodak color negative films.

Table 2-2

Replenishment and Wash Rates for Continuous and Roller-Transport Processors, mL/ft (mL/m)*				
KODAK Film/ Film Size	**FLEXICOLOR Developer Replenisher LORR**	**FLEXICOLOR Developer Replenisher**	**FLEXICOLOR Bleach III & Bleach III HV,† Fixer,†‡ Stabilizer, and Final Rinse Replenishers†**	**Wash Water§**
ADVANTIX Bright Sun & Flash				
24 mm	2.9 (9.5)	5.8 (19.0)	6.3 (20.7)	230 (750)
ADVANTIX Versatility, **ADVANTIX Black & White 400**				
24 mm	3.4 (11.2)	6.8 (22.4)	6.3 (20.7)	230 (750)
Bright Sun, Bright Sun & Flash, ROYAL GOLD 200, PROFESSIONAL PORTRA 160NC/VC, PROFESSIONAL PORTRA 100T				
135	5.0 (16.4)	10.0 (32.8)	9.2 (30)	330 (1080)
120/220	9.5 (31.2)	19.0 (62.3)	19.2 (62)	580 (1900)
35 mm perf	5.5 (18.0)	11.0 (36)	9.2 (30)	330 (1080)
35 mm unperf	7.4 (24.3)	14.8 (48.6)	9.2 (30)	330 (1080)
46 mm unperf	7.1 (23.3)	14.2 (46.6)	12.0 (39)	430 (1400)
70 mm perf	10.4 (34.1)	20.8 (68.2)	22.0 (72)	650 (2130)
70 mm unperf	10.8 (35.5)	21.6 (71.0)	22.0 (72)	650 (2130)
MAX Versatility, MAX Versatility Plus, ROYAL GOLD 400, Black & White Film, GOLD (110), PROFESSIONAL PORTRA 400NC/VC/UC, PROFESSIONAL PORTRA 400BW, PROFESSIONAL PORTRA 800, PROFESSIONAL T400 CN, Commercial Internegative, VERICOLOR Slide Film				
135	6.3 (20.7)	12.5 (41.0)	9.2 (30)	330 (1080)
110	5.3 (17.4)	10.6 (34.8)	4.2 (14)	150 (490)
126	9.4 (30.8)	18.8 (61.6)	9.2 (30)	330 (1080)
120/220	14.2 (46.6)	28.3 (92.8)	19.0 (62)	580 (1900)
35 mm perf	6.9 (22.6)	13.7 (44.9)	9.2 (30)	330 (1080)
35 mm unperf	9.3 (30.5)	18.5 (60.7)	9.2 (30)	330 (1080)
46 mm unperf	11.3 (37.1)	22.6 (74.1)	12.0 (39)	430 (1400)
70 mm perf	14.4 (47.2)	28.8 (94.5)	22.0 (72)	650 (2130)
70 mm unperf	16.9 (55.4)	33.8 (110.1)	22.0 (72)	650 (2130)

* To convert the rates to millilitres per minute, multiply the linear rate (millilitres per foot or metre) by the processor speed (feet or metres per minute).
† Assumes the use of efficient squeegees.
‡ For ELECTROSILVER Fixer Replenisher LORR, multiply the rate given for FLEXICOLOR Fixer and Replenisher by 0.31.
§ Rates are for first wash and a two-stage countercurrent final wash. Double these rates for a single-stage final wash.

Table 2-3

Replenishment and Wash Rates for Roller-Transport Processors, mL/ft² (mL/m²)				
KODAK Film/ Film Size	**FLEXICOLOR Developer Replenisher LORR**	**FLEXICOLOR Developer Replenisher**	**FLEXICOLOR Bleach III and Bleach III HV, Fixer, Stabilizer, and Final Rinse Replenishers**	**Wash Water***
ADVANTIX Bright Sun & Flash, ADVANTIX Versatility, ADVANTIX Black & White 400				
24 mm	41 (441)	82 (883)	80 (861)	2900 (31000)
Bright Sun, Bright Sun & Flash, ROYAL GOLD 200, PROFESSIONAL PORTRA 160NC/VC, PROFESSIONAL PORTRA 100T				
35 mm	47 (506)	94 (1012)	80 (861)	2900 (31000)
120/220	47 (506)	94 (1012)	95 (1023)	2900 (31000)
Sheet	58 (622)	116 (1245)	107 (1152)	5500 (59000)
MAX Versatility, MAX Versatility Plus, ROYAL GOLD 400, Black & White Film, GOLD (110), PROFESSIONAL PORTRA 400NC/VC/UC, PROFESSIONAL PORTRA 400BW, PROFESSIONAL PORTRA 800, PROFESSIONAL T400 CN, Commercial Internegative, VERICOLOR Slide and Print Film				
35 mm/46 mm	65 (700)	130 (1400)	80 (861)	2900 (31000)
110, 126	91 (980)	182 (1960)	80 (861)	2900 (31000)
120/220, 70 mm	65 (700)	130 (1400)	95 (1023)	2900 (31000)
Sheet	82 (861)	160 (1722)	107 (1152)	5500 (59000)

* Rates are for first wash and a two-stage countercurrent final wash. Double these rates for a single-stage final wash.

Table 2-4

Replenishment and Wash Rates for Rack-and-Tank Processors, mL per roll or sheet*				
KODAK Film/ Film Size	**FLEXICOLOR Developer Replenisher LORR**	**FLEXICOLOR Developer Replenisher**	**FLEXICOLOR Bleach III and Bleach III HV, Fixer,† Stabilizer, and Final Rinse Replenishers**	**Wash Water‡**
ADVANTIX Bright Sun & Flash				
24 mm x 15 exp	6.7	13.4	24.0	1180
24 mm x 25 exp	10.3	20.6	34.0	1670
24 mm x 40 exp	15.5	31.0	48.6	2390
ADVANTIX Versatility, ADVANTIX Black & White 400				
24 mm x 15 exp	7.9	15.8	24.0	1180
24 mm x 25 exp	12.2	24.4	34.0	1670
24 mm x 40 exp	18.5	37.0	48.6	2390
Bright Sun, Bright Sun & Flash, ROYAL GOLD 200, PROFESSIONAL PORTRA 160NC/VC, PROFESSIONAL PORTRA 100T				
135-12	9.6	19.3	29.0	1600
135-24	17.8	35.6	48.0	2500
135-36	26.1	52.1	66.0	3500
120	25.4	50.8	66.0	3100
220	51.2	102.4	130.0	6200
4 x 5 inches	8.2	16.4	17.0	1600
8 x 10 inches	32.8	65.6	67	6400
MAX Versatility, MAX Versatility Plus, ROYAL GOLD 400, Black & White Film, GOLD (110), PROFESSIONAL PORTRA 400NC/VC/UC, PROFESSIONAL PORTRA 400BW, PROFESSIONAL PORTRA 800, PROFESSIONAL T400 CN, Commercial Internegative, VERICOLOR Slide and Print Film				
135-12	12.2	24.4	29.0	1600
135-24	22.7	45.3	48.0	2500
135-36	33.1	66.1	66.0	3500
110-24	14.1	28.1	14.0	740
126-24	24.8	49.6	34.0	1800
120	37.8	75.5	66.0	3100
220	75.5	151.0	130.0	6200
4 x 5 inches	11.2	22.4	17.0	1600
8 x 10 inches	44.8	89.6	67.0	6400

* To convert the rates to millilitres per rack, add the rate for each roll on the rack.
† For ELECTROSILVER Fixer Replenisher LORR, multiply the rate given for FLEXICOLOR Fixer and Replenisher by 0.31.
‡ Rates are for first wash and a two-stage countercurrent final wash. Double these rates for a single-stage final wash.

Table 2-5 Film Areas

Roll-Film Size	Area per Roll ft² (m²)
135-12 (full roll)	0.255 (0.0237)
135-12 (minus tongue)*	0.248 (0.0230)†
135-24 (full roll)	0.427(0.0397)
135-24 (minus tongue)*	0.420 (0.0391)†
135-36 (full roll)	0.599 (0.0557)
135-36 (minus tongue)*	0.592 (0.0551)†
1 ft 135	0.115 (0.0100)†
120	0.543 (0.0504)
220	1.094 (0.1020)
1 ft 120/220	0.2025 (0.0188)
110-12	0.078 (0.0073)
110-24	0.131 (0.0122)
1 ft 110	0.0525 (0.0049)
24 mm x 15 exp	0.2004 (0.0186)
24 mm x 25 exp	0.2823 (0.0262)
24 mm x 40 exp	0.4049 (0.0376)
1 ft 24 mm	0.0787 (0.0073)
1 ft 126	0.114 (0.0106)
1 ft 46 mm	0.151 (0.0140)
1 ft 70 mm	0.230 (0.0214)

* Tongue removed between perforations 10 and 11.
† To adjust for sprocket holes, reduce the area by 6.66 percent.

Sheet-Film Size (Inches)	Area per Sheet ft² (m²)
2 1/4 x 3 1/4	0.0508 (0.0047)
3 1/4 x 4 1/4	0.0959 (0.0089)
4 x 5	0.139 (0.0129)
5 x 7	0.243 (0.0226)
8 x 10	0.556 (0.0516)
11 x 14	1.070 (0.0990)

Calculating Replenishment Rates for Rack-and-Tank Processors

To calculate replenishment rates for rack-and-tank processors, follow this procedure:

1. Keep a record of the number of rolls of each size you process and the number of racks used for a period of time, such as a week or a month. Include all racks—even those that are only partially filled.
2. Multiply the total number of rolls of each size by the replenishment rate in millilitres per roll for that size (see Table 2-4.) This will give you the total replenisher volume needed for each roll size.
3. Add the replenisher volumes for all film sizes determined in step 2. This gives you the total replenisher volume used for *all* sizes. Divide this volume by the number of racks used (from step 1) to obtain the average replenishment rate per rack. Film populations and process conditions can change; check your film population and these calculated rates often. Monitor these rates with your control-strip plots.
4. To calculate wash rates, add the wash-water volume for all film sizes. Divide this total volume by the number of minutes the film is in the wash (for all wash tanks). This will give you mL/min. Convert to litres per minute or gallons per minute.

EXAMPLE:

During one week, a lab processes 483 rolls using 125 racks. To calculate the average rate per rack for FLEXICOLOR Developer Replenisher, they follow the steps above. First they record the number of rolls of film of each type and size that they process. Then they multiply the total number of rolls of each type and size processed that week by the corresponding replenishment rate from Table 2-4 to obtain the total volume for that film type and size. Then they calculate total volume of replenisher used by totalling the amounts for all film sizes. By dividing that amount by the number or racks used that week, they obtain the average replenishment rate per rack. They use the same method to calculate the rate per rack for the other solutions.

The calculation for the developer replenishment rate is shown in Table 2-6.

Table 2-6 Replenishment-Rate Calculation

Film Type	Size	Number of Rolls	Replenishment Rate mL/roll	Total Replenisher Volume mL
PROFESSIONAL PORTRA 160NC/VC	220	124	102.4	12,698
PROFESSIONAL PORTRA 400NC/VC/UC	220	202	151	30,502
PROFESSIONAL PORTRA 400NC/VC/UC	135-36	49	66.1	3,239
PROFESSIONAL PORTRA 160NC/VC	120	34	50.8	1,727
PROFESSIONAL PORTRA 400NC/VC/UC	120	50	75.5	3,775
PROFESSIONAL PORTRA 800	135-36	24	66.1	1586
			TOTAL	53,527

Total Number of Racks Used = 125

Average Developer Replenishment Rate per rack = 53,527/125 = 428 mL/rack

Push-Processing KODAK PROFESSIONAL PORTRA Films

KODAK PROFESSIONAL PORTRA 400UC and PORTRA 800 Films are designed so that you can push-process them to higher exposure indexes. You can push-process PORTRA 400UC Film to an exposure index of 800, and PORTRA 800 Film to exposure indexes of 1600 and 3200, and produce negatives that yield good-quality prints.

To push-process these films, extend the developer time according to Table 2-7. Keep all other process times the same as those for a normal process.

Table 2-7 Developer Time for Push Processing

Exposure Index	Developer Time (min:sec)
PROFESSIONAL PORTRA 400UC Film	
EI 400	3:15
EI 800 (Push 1)	3:45
PROFESSIONAL PORTRA 800 Film	
EI 800	3:15
EI 1600 (Push 1)	3:45
EI 3200 (Push 2)	4:15

PROCESSING OPTIONS

You may be able to use two processing options that will reduce chemical discharge and may reduce chemical costs. These options are bleach regeneration and closed-loop fixer desilvering. Bleach regeneration reduces chemical costs and requires only a modest capital expenditure and/or processor modification.

If you need assistance in determining if these options are suitable for your processing laboratory, contact your Kodak field representative. If your lab has other needs not covered in this manual, your Kodak field representative may also be able to help.

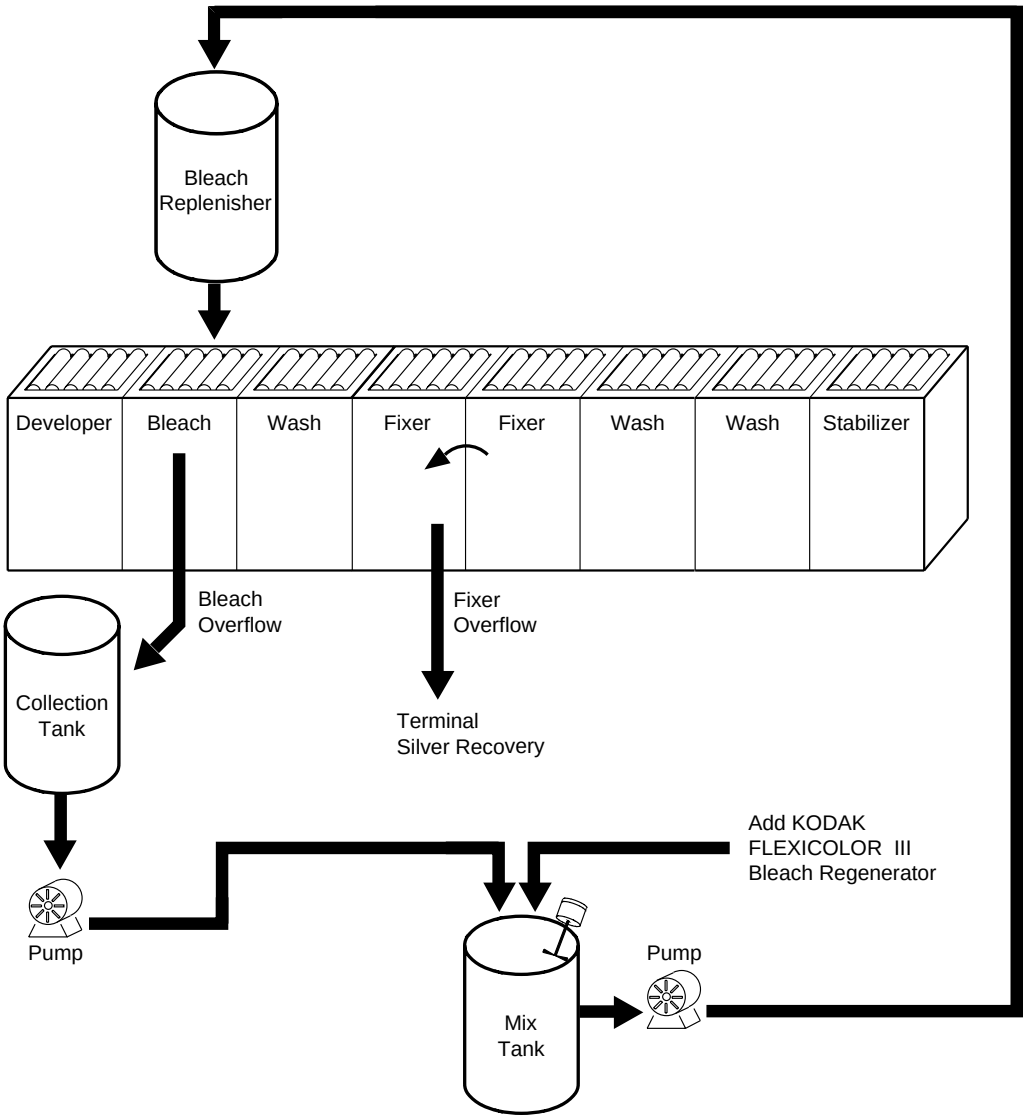
Regenerating KODAK FLEXICOLOR Bleach III

It is easy to regenerate your Process C-41 bleach overflow to useable bleach replenisher. Regenerating your bleach overflow can significantly reduce chemical costs, and reduce the amount of iron, ammonia, and COD in the overall effluent. To regenerate your bleach, simply collect the overflow from the bleach working tank of the processor, then add FLEXICOLOR Bleach III Regenerator or FLEXICOLOR Bleach III HV Regenerator as per directions. Use FLEXICOLOR Bleach III Regenerator to regenerate bleach overflow from a rack-and-tank, roller transport, or low- to mid-volume continuous processor. Use FLEXICOLOR Bleach III HV Regenerator to regenerate the bleach overflow only from a high-volume continuous processor, such as a cine processor that processes 3,000 or more rolls of film a day.

Use the same processing steps and conditions as those listed in Table 2-1. Once the bleach overflow is regenerated, use it as replenisher at the same rates given in Tables 2-2, 2-3, and 2-4.

As with normal bleach replenishment, it is very important to check the replenishment rate, check that bleach aeration is sufficient, and minimize developer carryover into the bleach. Too much developer carryover can dilute the bleach and raise the pH, which reduces bleach activity. In continuous processors, keep the squeegees well maintained to minimize developer carryover. You can check the concentration of regenerated bleach by measuring its specific gravity (see *Check Your Mixes with Specific-Gravity Measurements* in Section 1). Specific gravity specifications for FLEXICOLOR Bleach III and FLEXICOLOR Bleach III HV are listed in Table 1-5.

Figure 2-1



Option 1

F002_0200DC

Desilvering Fixer in a Closed-Loop System with KODAK ELECTROSILVER Fixer and Replenisher LORR

KODAK ELECTROSILVER Fixer and Replenisher LORR is specially designed for systems that electrolytically desilver fixer in a closed-loop system. By using this type of system with ELECTROSILVER Fixer and Replenisher LORR, you can reduce the fixer replenishment rate by over 60 percent and reduce the BOD, ammonia, and sulfates in your overall processing effluent. Sulfite analysis and pH measurements are not needed when you desilver and replenish ELECTROSILVER Fixer and Replenisher LORR according to directions.

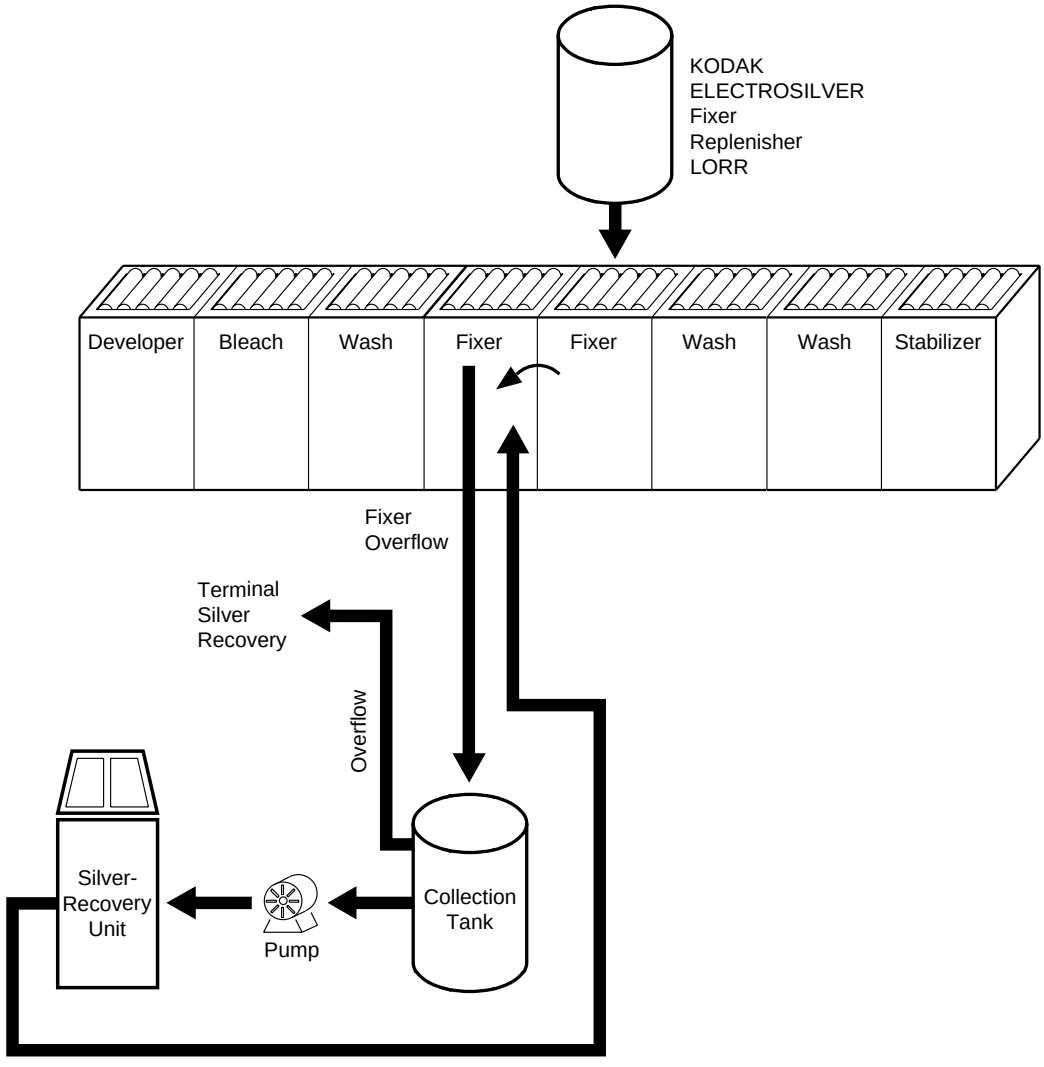
Use the same processing steps and conditions as those listed in Table 2-1. To determine a replenishment rate, multiply the rate given for FLEXICOLOR Fixer in Table 2-2, 2-3, or 2-4, by 0.31.

The silver concentration of the *first* fixer tank solution must be maintained at 0.5 to 1.2 grams per litre. If you desilver to lower concentrations, silver sulfide may form, resulting in poor plating on the drum of the electrolytic cell. Silver sulfide may also carry back into the fixer and wash, causing dirt in the fixer and on the film. Monitor the silver concentration of the first fixer tank solution regularly, and *do not* reduce the silver below 0.5 g/L.

Silver concentrations that are too high affect fixer efficiency and can also result in a loss of silver when excess silver is carried into the wash.

Note: The recirculation rate of a closed-loop system should be equivalent in volume to 3.5 to 5 turnovers of the first fixer tank per hour.

Figure 2-2



Option 2

F002_0201DC

BLEACH AERATION IN PROCESS C-41

Proper aeration of the bleach tank solution serves three purposes:

1. It oxidizes the bleach solution completely. (Inadequate oxidation leads to an increase in ferrous iron concentration and eventually to leuco-cyan-dye formation in some films and/or retained silver.)
2. In rack-and-tank processors, it agitates the solution for uniform stopping and bleaching action.
3. It completely oxidizes developer carryover in the bleach tank.

To provide complete oxidation of ferrous iron, the aeration rate for the bleach should be directly proportional to the film load entering the tank solution. As a general guideline for aeration, use Figure 2-3, a graph of approximate aeration rates for continuous processors. We have also listed some general guidelines for rack-and-tank processors.

Figure 2-3 shows that the aeration rate for continuous processors varies with film load. You can easily calculate film load (square feet of film per minute) by multiplying the machine speed (ft/min) by the area of the film per length (ft^2/ft). See Table 2-5. In most cases, it is best to adjust aeration rates to handle the maximum film load and then operate at this rate without any further adjustment.

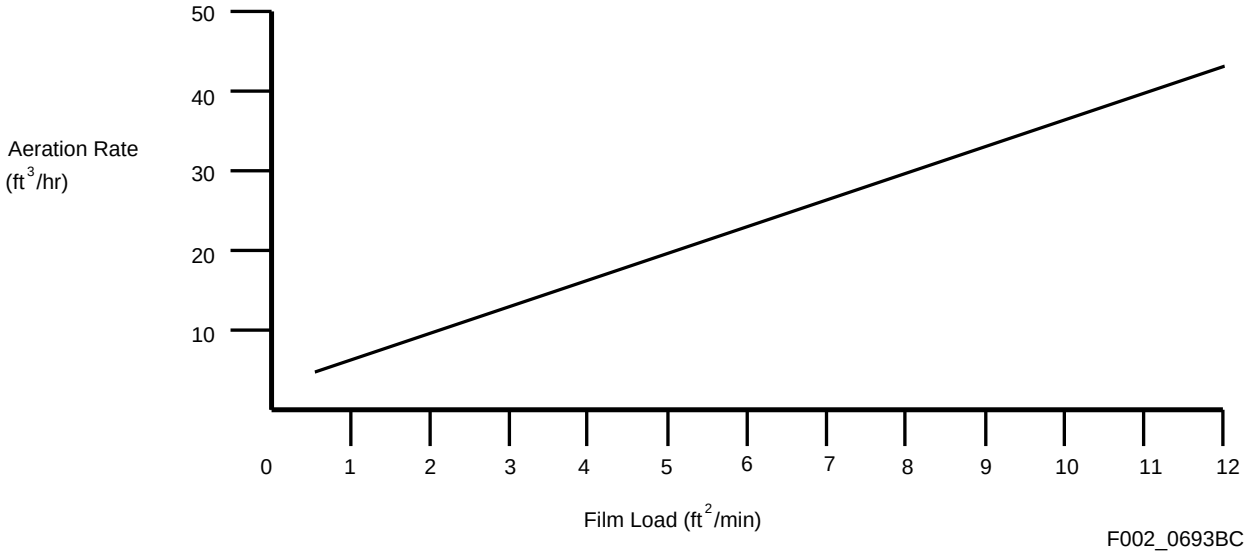
The aeration rates for rack-and-tank machines in Table 2-8 are in terms of bursts of oil-free air per minute. This starting-point rate should handle the maximum film load in most rack-and-tank processors.

Table 2-8

Bleach Aeration Rate for Rack-And-Tank Processors (Oil-Free Air)	
Air Flow Rate	Six bursts per minute, each lasting for a duration of 2 seconds
Distributor Bar	$^3/_{16}$ inch ID
Hole Diameter	0.65 mm (0.026 in.)
Tank Width	13 inches
Tank Depth	3 feet
Hole Spacing	Variable (to achieve uniform bubbling at solution surface): 10 holes averaging 1.12 inches apart on each side of bar

Bleach Aeration Rate for Continuous Processors (Oil-Free Air)	
Distributor Bar	$^5/_8$ inch ID
Hole Diameter	0.75 mm (0.030 in.)
Tank Width	16 inches
Tank Depth	3 feet
Hole Spacing	13 holes 1 inch apart on top of bar

Figure 2-3 Bleach Aeration Rate for Continuous Processors



The information in the aeration-rate graph is valid *only* for the conditions specified, i.e., at specific distributor-hole diameters and hole spacing. In general, the required aeration rate decreases with decreasing bubble size or increases with increasing bubble size. The number and spacing of holes in distributor bars should provide adequate agitation of the tank solution. Also consider the following:

- Decreasing the hole diameter or the hole spacing for bubbles does not always decrease the required aeration rate. If bubbles become small enough or are too close together, they tend to coalesce and form larger bubbles, decreasing efficiency. Also, very small bubbles often create a fine mist on the top of the solution, which increases the risk of bleach contamination of the developer.
- To minimize the risk of bleach contamination of the developer, use the white-paper test to determine if a problem exists. The white-paper test is a simple but effective method for measuring spattering of solution. Place a sheet of white paper between the developer and the bleach tank at the top of the tank wall. If, after an hour of operation with normal aeration and recirculation, you detect bleach deposits on the paper, bleach agitation is excessive. Find an alternate method of aeration or cover the bleach tank.
- Maintain uniform agitation throughout the tank by placing distributor bars or spargers to provide adequate bubbling over the entire solution surface. Holes in distributor bars for continuous processors should be uniformly spaced and not more than 2.5 cm (1 in.) apart. Rack-and-tank processors, however, may require variable hole spacing to compensate for pressure differences and provide uniform agitation from air bursts. The length of distributor bars will vary with tank size, but in general, the bar should extend approximately the entire width of the tank. Consider decreasing the hole spacing or using additional distributor bars in tanks where agitation is inadequate.

In many processors, the bleach is aerated by a venturi effect (aspirator) of the recirculation pump. Inspect for the following when you use this method:

1. Be sure foam is minimal.
2. Use the white-paper test to ensure that no bleach is foaming back or misting into the developer.
3. Check for tar (rapidly oxidized color developing agent) in foam. Opening the aspirator too much may produce severe tar along with foam. When this occurs, close the aspirator to reduce foam.