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Process Waste Assessment: Color Print Processing (RA-4)

Kansas City Division

Paul Catlett

KCP-613-5303

Published May 1994

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**PROCESS WASTE ASSESSMENT:
COLOR PRINT PROCESSING (RA-4)**

Paul Catlett

Published May 1994

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EXECUTIVE SUMMARY

The Kodak RA-4 process is used to develop prints and overhead transparencies from photographic negatives. The assessment was based on usage, effluent discharge, and final disposition of waste generated by the process.

Two options explored were bleach-fix regeneration and the conversion to a digital image processing system. The RA-4 process is environmentally sound and generates a relatively small amount of waste. The bleach-fix option would provide only a small effluent reduction. The digital imaging conversion option, if fully implemented, could greatly reduce waste generated in the photo lab.

Kodak is constantly releasing product updates. The photo lab is moving into digital image processing as funding allows.

INTRODUCTION

This process waste assessment (PWA) was undertaken to determine quantitatively the materials being used in the Kodak RA-4 process and their ultimate destination, and to establish options for reductions in the usage of these materials involved in this process.

The Kodak RA-4 process is used to make prints and overheads from photographic negatives. The process develops a latent image which is formed on photographic paper by exposure to light. During the developing process the material passes through the developer bleach-fix, a wash, and the dryer. The wash water currently is being recycled by a Pacex water recycling system. The process for that system will be addressed in a separate PWA.

PROCESS ASSESSMENT

Methodology

Calculations used to determine the material usage in the photo lab were taken over a two-month period and then multiplied by six in order to arrive at a year's usage. The developer and bleach fix were collected and sent to the test lab for composition to determine exactly what materials were being disposed. Material costs were obtained from the previous year's usage. Waste disposal costs were obtained from the Industrial Wastewater Pretreatment Facility (IWPF).

MASS BALANCE FOR PROCESS RA-4 (Worksheet 5)

The material balance reflects the total materials in the Developing Process from 1-1-91 to 12-31-91. The mass balance assumptions used are given in the mass balance sheets.

WASTE STREAM SUMMARY

A waste stream summary is given in worksheet 6. The Kodak RA-4 Developer is composed of water, potassium carbonate, and triethanolamine. It is disposed to Waste Management. The bleach-fix, composed of water ammonium thiousulfate, sodium bisulfite, acetic acid, and ammonium (ethylenedinitrilo) ferrate III, is also disposed to Waste Management.

OPTION SUMMARY AND ANALYSIS

1. Regenerate Bleach-Fix

Exhausted bleach-fix would pass through a silver recovery unit where the silver would be removed from the solution. The bleach-fix would then be sent to a collection tank. When the collection tank is filled, the exhausted bleach-fix is then tested to confirm proper aeration. The bleach-fix regenerator solution is then added to the exhausted, de-silvered, aerated bleach-fix solution, making it ready for reuse.

Considering the low annual volume of bleach-fix used (405 gal.) and the low annual cost of disposal (\$2.55) versus the implementation cost of a silver recovery unit and the regeneration chemicals (approximately \$5,000) and the additional work-hours needed to maintain, test, and mix the regeneration chemicals, this option is fair at best.

2. Convert to Digital Image Processing

By scanning negatives, slides, or prints on a high quality computer scanner and then outputting the scanned images to a printer such as the Kodak XL 7700, a photographic quality print or overhead transparency can be produced. In time this process could eliminate the need for the RA-4 process. With the addition of digital (filmless) cameras, the need for two other processes would be greatly reduced.

The equipment needed for this conversion is all state-of-the-art technology and therefore expensive. A printer would cost approximately \$20,000 and at least two would be needed for the current volume of work. A high quality scanner would cost approximately \$25,000. Additional equipment would include two digital portable cameras at \$25,000 and at least one studio camera at \$43,000.

CONCLUSIONS

The RA-4 process is a safe, efficient process which generates a relatively small amount of easily treatable waste. The bleach-fix regeneration option seems expensive and labor intensive for the amount of effluent reduction it provides. The digital image conversion option, although very expensive, has the potential to greatly reduce the amount of effluent released by the photo lab.

RECOMMENDATIONS

Kodak sends the photo lab new product and information as it is developed which helps in the constant search for more efficient and less hazardous chemicals that can be used in the process.

The recent acquisition of the Macintosh computer, photo-retouching software, and the budgeting for more digital imaging equipment is helping to prepare the photo lab for the future.

PROCESS WASTE ASSESSMENT

PWA TEAM

PWA TITLE Color Print Processing (RA-4)

PWA ID CODE(S)

NAME	EMP. #	DEPT.	MAIL CODE	EXT.
-------------	---------------	--------------	------------------	-------------

*

*Team Leader

ADDITIONAL RESOURCES:

DEPT.	NAME	EXT.
--------------	-------------	-------------

ENVIRONMENTAL PROTECTION
ENVIRONMENTAL PROTECTION
EMISSION FACTORS
WASTE WATER PRETREATMENT

FIRE PROTECTION
INDUSTRIAL HYGIENE
FACILITIES ENGR(COST ENGR)
WASTE MANAGEMENT
SAFETY
MAINTENANCE(EQUIPMENT)
ANALYTICAL LAB TESTING

PROCESS WASTE ASSESSMENT

PROCESS DESCRIPTION

PWA TITLE Color Print Processing (RA-4)

PWA ID CODE(S)

PROCESS LOCATION

PROCESS DESCRIPTION

The Kodak (RA-4) process is a two solution process. As the paper or film enters the first solution (RA-4 developer), the latent image on the exposed material is developed. Development is the most critical stage of the process and must be done at 95°F± .5°. The paper or film then enters the RA-4 bleach-fix solution where the bleaching agent converts metallic silver formed by development to an ionic state. The fixing agent combines with the ionic silver to form a soluble silver complex. The fixing agent also dissolves any undeveloped silver halide that remains in the film or paper. The paper or film is then washed to remove processing chemicals.

MAJOR PRODUCTS (Optional): Color Photographic Prints & Overheads

WASTE STREAM AFFECTED:
(Circle One)

PLATING

SOLVENT

POLYMER

MISCELLANEOUS

PROCESS WASTE ASSESSMENT

PROCESS LAYOUT
(OPTIONAL)

PWA TITLE or PWA ID CODE(S)

SEE ATTACHED SHEET

8 X 10
CAMERA

CUBATAINER RACK

CHEMICAL
STORAGE

VIEWING
ROOM

ROYAL
PRINTER

E-6

C-41

PRINT
ROOM

PRINT
ROOM

MP3

OFFICE

STUDIO

RA-4

Entrance

PROCESS WASTE ASSESSMENT

PROCESS FLOW DIAGRAM

PWA TITLE or PWA ID CODE(S)

(INDICATE THE PWA ID(S) ASSOCIATED WITH THE PROCESS ON THE DIAGRAM.)

SEE ATTACHED SHEET

**PROCESS WASTE ASSESSMENT
 MASS BALANCE**

PWA TITLE or PWA ID CODE: Color Print Processing (RA-4)

			OUTPUT (LBS)								
MATERIAL STANDARD #	MATL/COMP. REACTION/PROD	INPUT QTY (LBS)	WASTE MGMT.	WASTE MGMT.	POINT SOURCE	FUGITIVE AIR	WATER (SANT.)	WATER (INDUST.)	INPUT TO ANOTHER PROCESS	PRODUCT (Retained on)	OTHER
SUPPORT STORES #	(If comp., % of total Mat.) List CAS #	From <u>1-1-92</u> To <u>12-31-92</u>	LIQUID *4	SOLID *5	AIR *6	*7	*8	*9	(Proc. ID) *10	*11	*12
98600190	Kodak (RA-4) Developer	4372									
	% 100										
	Water 7732-18-5	4044.1	3930.5			113.6					
	% 92.5		97.2%			2.8%					
	Potassium Carbonate 584-08-7	163.95	163.95								
	% 3.75		93.9%								
	Triethanolamine 102-71-6	163.95	163.95								
	% 3.75		100%								
	%										

* These are the process releases as coded in the directions for Worksheet 4.

PROCESS WASTE ASSESSMENT
MASS BALANCE

PWA TITLE or PWA ID CODE: Color Print Processing (RA-4)

			OUTPUT (LBS)								
MATERIAL STANDARD #	MATL/COMP. REACTIONPROD	INPUT QTY (LBS)	WASTE MGMT. LIQUID	WASTE MGMT. SOLID	POINT SOURCE AIR	FUGITIVE AIR	WATER (SANIT.)	WATER (INDUST.)	INPUT TO ANOTHER PROCESS (Proc. ID)	PRODUCT (Retained on)	OTHER
SUPPORT STORES #	(If comp., % of total Mat.) List CAS #	From <u>1-1-9</u> To <u>2-31-92</u>	*4	*5	*6	*7	*8	*9	*10	*11	*12
98600186 98600187	Kodak (RA-4) Bleach-Fix	3489	3489								
	% 100										
	Water 7732-18-5	2965.65	2880.39			85.26					
	% 85		97.1%			2.9%					
	Ammoniumthiosulfate 7783-18-8	261.675	261.675								
	% 7.5		100%								
	Sodiumbisulfate 7631-90-5	87.225	87.225								
	% 2.5		100%								
	Acetic Acid 64-19-7	87.225	87.225								
	% 2.5		100%								

* These are the process releases as coded in the directions for Worksheet 4.

*These are mixed together to form solution used in process.

PROCESS WASTE ASSESSMENT
MASS BALANCE

PWA TITLE or PWA ID CODE: (RA-4)

OUTPUT (LBS)

MATERIAL STANDARD # SUPPORT STORES #	MATL/COMP. REACTION/PROD (If comp., % of total Mat.) List CAS #	INPUT QTY (LBS) From 1-1-92 To 12-31-92	OUTPUT (LBS)								
			WASTE MGMT. LIQUID *4	WASTE MGMT. SOLID *5	POINT SOURCE AIR *6	FUGITIVE AIR *7	WATER (SANT.) *8	WATER (INDUST.) *9	INPUT TO ANOTHER PROCESS (Proc. ID) *10	PRODUCT (Retained on) *11	OTHER _____ *12
Ammonium (Ethylenedinitrilo) Tetraacetate Ferrate (III) 21265-50-9		87.225	87.225								
	% 2.5		100%								
98600113	Kodak Ektacolor Paper	2208		619						1589	
	% 100			28%						72%	
	%										
98600087 98600194	Kodak Duraclear Display Material	153		29						124	
	% 100			19%						81%	
	%										

* These are the process releases as coded in the directions for Worksheet 4.

**PROCESS WASTE ASSESSMENT
MASS BALANCE**

PWA TITLE or PWA ID CODE: Color Print Processing (RA-4)

OUTPUT (LBS)

MATERIAL STANDARD # SUPPORT STORES #	MATL/COMP. REACTION/PROD (If comp., % of total Mat.) List CAS #	INPUT QTY (LBS) From <u>1-1-92</u> To <u>12-31-92</u>	WASTE	WASTE	POINT	FUGITIVE	WATER	WATER	INPUT TO	PRODUCT	OTHER
			MGMT. LIQUID *4	MGMT. SOLID *5	SOURCE AIR *6	AIR *7	(SANT.) *8	(INDUST.) *9	ANOTHER PROCESS (Proc. ID) *10	(Retained on) *11	<u>recycled</u> *12
N/A	Cardboard Boxes	166		166							
	% 100										
N/A	Cardboard Cores	123									123*
	% 100										
N/A	Plastic Endcaps	30									30*
	% 100										
N/A	Plastic Bottles	36		36							
	% 100										
N/A	Glass Bottles	9		9							
	% 100										

* These are the process releases as coded in the directions for Worksheet 4.

*Returned to manufacturer for recycling.

PROCESS WASTE ASSESSMENT

WASTE STREAM SUMMARY

PWA TITLE or PWA ID CODE(S)

Color Print Processing (RA-4)

ATTRIBUTE	Process Release Code 4	Process Release Code 7	Process Release Code	Process Release Code	Process Release Code	Process Release Code
WASTE STREAM NAME	Process					
ANNUAL GENERATION RATE (lbs) From 1-1-92 To 12-31-92	Overflow					
Overall:						
Components of Concern:						
Water	6810.89	198.6				
Potassium Carbonate	163.95					
Triethanolamine	163.95					
Acetic Acid	87.2					
Sodium Bisulfite	87.2					
Ammonium Thiousulphate	361.7					
Ammonium (Ethylenedinitrilo						
Tetraaceto) Ferrate (III)	87.2					
DEPT. FINAL DISPOSITION	Waste Management	Air (Fugitive)				

PROCESS WASTE ASSESSMENT

WASTE STREAM SUMMARY

PWA TITLE or PWA ID CODE(S) Color Print Processing (RA-4)

ATTRIBUTE	Process Release Code <u>5</u>	Process Release Code _____	Process Release Code _____	Process Release Code _____	Process Release Code _____	Process Release Code _____
WASTE STREAM NAME						
ANNUAL GENERATION RATE (lbs) From 1-1-92 To 12-31-92						
<i>Overall:</i>						
<i>Components of Concern:</i>						
Cardboard Boxes	166					
Plastic Bottles	36					
Glass Bottles	9					
DEPT. FINAL DISPOSITION	Waste Management					

PROCESS WASTE ASSESSMENT

MATERIAL COST SHEET

PWA TITLE or PWA ID CODE(S) Color Print Processing (RA-4)

COST OF INPUT MATERIALS :

MATERIAL(S)	MS/SS NUMBER	COST PER UNIT	ANNUAL COST
RA-4 Developer Additive	98600189	\$ 8.00	\$ 240.00
RA-4 Developer	98600190	127.40	2540.00
RA-4 Developer Starter	98600185	6.73	13.46
RA-4 Bleach-Fix Additive	98600188	5.30	127.20
RA-4 Bleach-Fix, Part A	98600186	29.79	387.27
RA-4 Bleach-Fix, Part B	98600187	63.60	826.80
Ektacolor Paper	98600113	86.88	14,595.84
Duraclear OH Material (Sheet)	98600194	96.21	3,848.40
Duraclear OH Material (Roll)	98600087	271.00	6,504.00

OTHER INFORMATION:

COST OF DISPOSAL OF OUTPUT MATERIAL(S):

MATERIAL(S) / WASTE STREAMS	MS/SS NUMBER (If applicable)	COST PER UNIT	ANNUAL COST
RA-4 Developer/Liquid		\$6.29/1,000Gal	\$ 3.33
RA-4 Bleach-Fix/Liquid		6.29/1,000Gal.	2.55
Ektacolor Paper/Solid		14.00/1 Ton	4.33
Duraclear/Solid		14.00/1 Ton	.21
Packing Materials/Solid		14.00/1 Ton	1.47

OTHER INFORMATION:

PROCESS WASTE ASSESSMENT

OPTION DESCRIPTION

PWA TITLE or PWA ID CODE(S) Color Print Processing RA-4

OPTION NAME and DESCRIPTION:

(Include input materials or components affected. Optional- Include products affected.)

OPTION 2 : Digital Technology printing to eliminate wastes.
(liquid-acid and alkaline) being sent to waste management
Bleach-Fix Developer

Source Reduction X **Recycling/Reuse** _____
Procedure Change _____ **Other** _____

OPTION : Bleach-Fix regeneration would reduce amount of bleach-fix
disposed of.

Source Reduction _____ **Recycling/Reuse** X
Procedure Change _____ **Other** _____

OPTION :

Source Reduction _____ **Recycling/Reuse** _____
Procedure Change _____ **Other** _____

OPTION :

Source Reduction _____ **Recycling/Reuse** _____
Procedure Change _____ **Other** _____

OPTION :

Source Reduction _____ **Recycling/Reuse** _____
Procedure Change _____ **Other** _____

PROCESS WASTE ASSESSMENT

OPTIONS EVALUATION BY WEIGHTED SUMS METHOD

PWA TITLE or PWA ID CODE(S) Color Print Processing (RA-4)

CRITERIA	WEIGHT	OPTION # 2		OPTION # 1		OPTION # ____		OPTION # ____		OPTION # ____	
		R	R x W	R	R x W	R	R x W	R	R x W	R	R x W
REDUCTION IN WASTE'S HAZ.	7	10	70	5	35						
REDUCTION OF TREATMENT/ DISPOSAL COSTS	4	10	40	5	20						
REDUCTION OF SAFETY HAZ.	7	10	70	0	0						
REDUCTION OF INPUT MATERIAL COSTS	6	0	0	0	0						
EXTENT OF CURRENT USE IN INDUSTRY	7	3	21	6	42						
LOW CAPITAL EQUIPMENT	7	0	0	6	42						
LOW O & M COST	7	8	56	6	42						
SHORT IMPLEMENTATION PERIOD	5	5	25	7	35						
EASE OF IMPLEMENTATION	5	5	25	5	25						
SUM OF WEIGHTED RATINGS (R x W)			307		241						
OPTION RANKING		1			2						

PROCESS WASTE ASSESSMENT

OPTIONS SUMMARY

PWA TITLE or PWA ID CODE(S) Color Print Processing (RA-4)

Contact(s): _____

Waste Stream Affected (Circle One): **Plating** **Solvent** **Polymer** **Miscellaneous**

OPTIONS	OPTION SCORE	QTY. MATERIAL USED (LBS) 1-1-92 12-31-92 FROM TO (List Material)	ESTIMATED IMPLEMENTATION COST	FEASIBILITY	ANTICIPATED REDUCTION QTY	ESTIMATED COST SAVINGS
Digital Printing 2) Electronic	307	Dev. 4372 Blch-Fix3489	100,000.00	Fair	6681	0
Bleach-Fix 1) Regeneration	241	Bleach-Fix 3489	5,000	Fair	1745	0

PROCESS WASTE ASSESSMENT

REGULATORY REPORTING REQUIREMENTS

PWA TITLE or PWA ID CODE(S) Color Print Processing (RA-4)

MATERIAL NAME	Kodak (RA-4) Developer
MS/SS #	98600190
CAS #	N/A
STORAGE LOC (MFL)	300
PHYSICAL STATE	Liquid
STORAGE CODES	(F14), (N14)
ANNUAL USE CY 92	4372
MAX STORED	289 lbs.
PROCESS USE	Largest order plus 4

	COMPONENT _	COMPONENT _	COMPONENT _	COMPONENT _	COMPONENT _
COMPONENT	Water	Potassium Carbonate	Triethanolamine		
COMPONENT %	92.5	3.75	3.75		
CAS #	7732-18-5	584-08-7	102-71-6		
PHYSICAL STATE	Liquid	Liquid	Liquid		
ANNUAL USAGE	4044.1 lbs.	163.95 lbs.	163.95 lbs.		
MAX STORED	267.4 lbs.	10.8 lbs.	10.8 lbs.		
FUGITIVE EM	113.6	0	0		
POINT SOURCE EM	0	0	0		
STACK NO.	N/A	N/A	N/A		
DEPT. TREATMENT QTY(RECYCLING)	0	0	0		
DEPT. TREATMENT EFFICIENCIES	0	0	0		
WASTE MGMT. DISPOSAL QTY CY 92	4,044.1 lbs.	163.95 lbs.	163.95 lbs.		
OFFSITE RELEASES:					
AIR	0	0	0		
LAND	0	0	0		
WATER (IF KNOWN)	0	0	0		

PROCESS WASTE ASSESSMENT

REGULATORY REPORTING REQUIREMENTS

PWA TITLE or PWA ID CODE(S) Color Print Processing (RA-4)

MATERIAL NAME	Kodak (RA-4) Bleach-Fix
MS/SS #	98600186 98600187 THESE ARE MIXED TOGETHER TO FORM SOLUTION NEEDED IN PROCESS
CAS #	N/A
STORAGE LOC (MFL)	300
PHYSICAL STATE	Liquid
STORAGE CODES	(E14), (N14)
ANNUAL USE CY 92	3489 lbs.
MAX STORED	473 lbs.
PROCESS USE	Largest order plus 4

	COMPONENT 1	COMPONENT 2	COMPONENT 3	COMPONENT 4	COMPONENT 5
COMPONENT	Water	Ammonium Thiosulfate	Sodium Bisulfite	Acetic Acid	Ammonium (Ethylenedinitrilo) Tetraaceto Ferrate (III)
COMPONENT %	85	7.5	2.5	2.5	2.5
CAS #	7732-18-5	7783-18-8	7631-90-5	64-19-7	21265-50-9
PHYSICAL STATE	Liquid	Liquid	Liquid	Liquid	Liquid
ANNUAL USAGE	2965.65 lbs.	261.675 lbs.	87.225 lbs.	87.225 lbs.	87.225 lbs.
MAX STORED	402.05 lbs.	35.475 lbs.	11.825 lbs.	11.825 lbs.	11.825 lbs.
FUGITIVE EM	85.26 lbs.	0	0	0	0
POINT SOURCE EM	0	0	0	0	0
STACK NO.	-	-	-	-	-
DEPT. TREATMENT QTY(RECYCLING)	0	0	0	0	0
DEPT. TREATMENT EFFICIENCIES	0	0	0	0	0
WASTE MGMT. DISPOSAL QTY CY	2965.65 lbs.	261.675 lbs.	87.225 lbs.	87.225 lbs.	87.225 lbs.
OFFSITE RELEASES:					
AIR	0	0	0	0	0
LAND	0	0	0	0	0
WATER (IF KNOWN)	0	0	0	0	0

PROCESS WASTE ASSESSMENT

REGULATORY REPORTING REQUIREMENTS (COMPLETE APPLICABLE INFORMATION)

PWA TITLE or PWA ID CODE(S) Color Print Processing (RA-4)

SURFACE FINISHING OPERATION

MATERIAL NAME	N/A				
MS/SS #					
	COMPONENT	COMPONENT	COMPONENT	COMPONENT	COMPONENT
COMPONENT					
SUBSTRATE					
APPLICATION METHOD					
COATING TYPE					
COATING USE/RATE					
SOLV. % OF COATING					
THINNER AND % OF COATING AND THINNER MIXTURE					
STRIPPER AND %					

EMISSION CONTROL EQUIPMENT

TYPE	N/A
CE#	
PROCESS CONTROLLED	
EFFICIENCY	

DEGREASER/SPRAY EQUIPMENT

CE#	N/A
SOLVENT(S)	
CAPACITY	
DEPT./POST LOC.	

PROCESS WASTE ASSESSMENT

WASTE MANAGEMENT REGULATORY REPORTING REQUIREMENTS

PWA TITLE AND PWA ID CODE(S) Color Print Processing (RA-4).

Description of Waste Generation

(Optional: Attach Process Description, Process Flow Diagram and Mass Balance.)

As photographic paper is fed through the machine during this process, the developer and bleach-fix are replenished forcing the exhausted developer and bleach-fix out of the machine through overflow tubes. The exhausted solutions are collected separately and sent to waste management. The empty packages (cardboard, plastic and glass bottles) are also sent to waste management.

Is recycling performed within the department? Yes____ No X

Method of Recycling:

Is the reclaimed material returned to the department?
 Used by others____ Yes____ No X

If used by others, in what way?

Is the waste mixed with other wastes before it is sent to Waste Management?

Process Release Code	Waste Stream Name	Ind./EPA Haz. Waste No.	Yes/No	Materials Mixed or Comments
4	RA-4 Developer	No code listed	No	
4	RA-4 Bleach-Fix	*	No	*Reclaimed for silver
5	Kodak Ektacolor Paper	No code listed	Yes	Regular trash
5	Kodak Duraclear Display Material	No code listed	Yes	Regular trash

II

DATE

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8/23/94

END