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APPENDIX I

The standard curve of silver solution by Atomic Absorption Spectrophotometer is shown in Fig. A1.

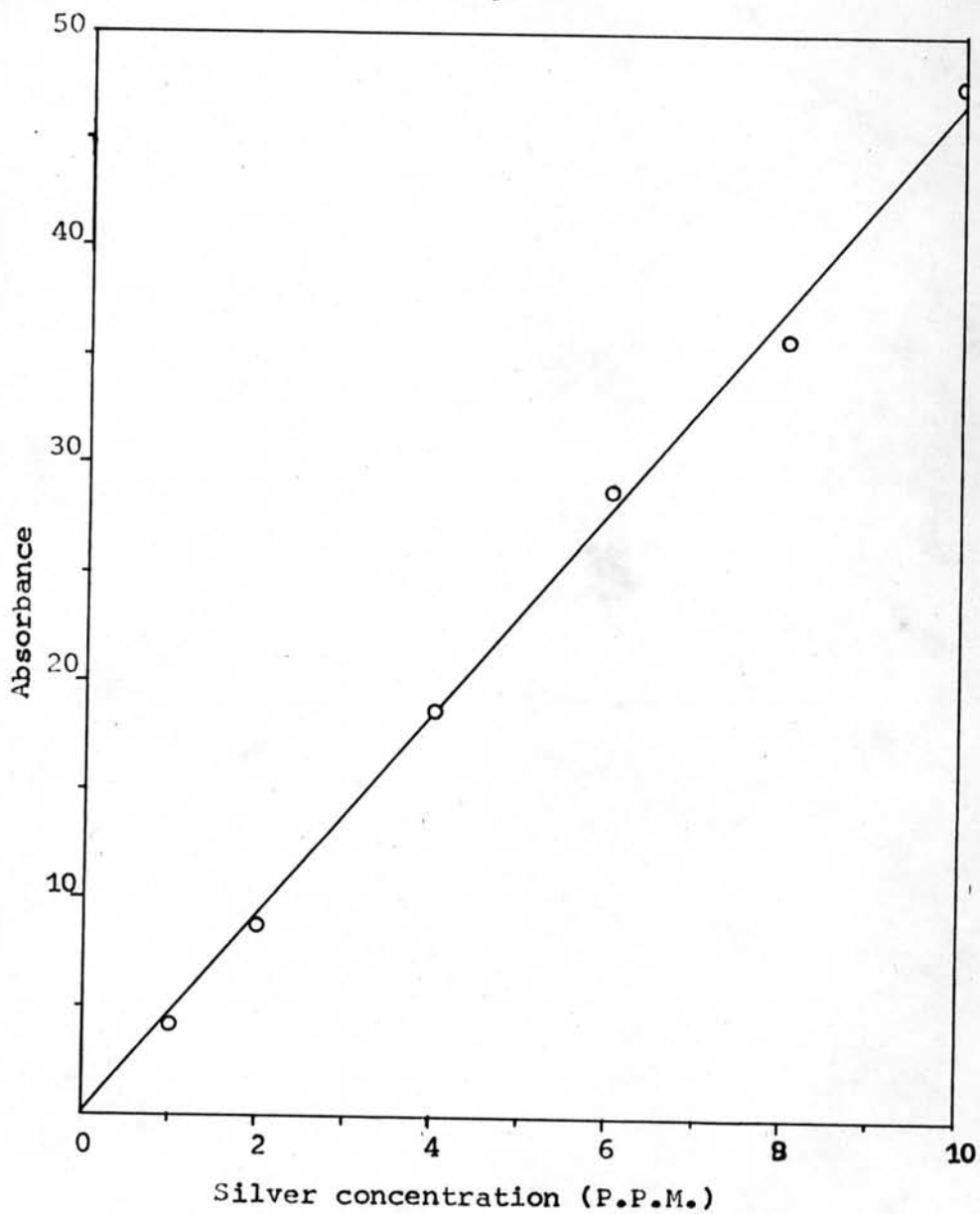


Figure A1. Standard curve of silver solution by Atomic Absorption spectrophotometer.

APPENDIX II

Silver price in Thailand from the news centre, Public Relations Department, Bangkok is shown in Table A.1.

Table A.1 Silver price in Thailand. (Baht)

Date	Purchasing prices per 15 grams.	Sale prices per 15 grams.
29 - Oct. - 79	151	152
3 - Nov. - 79	148	150
8 - Nov. - 79	146	150
20 - Nov. - 79	144	147
1 - Dec. - 79	142	147
8 - Dec. - 79	158	163
19 - Dec. - 79	173	178
26 - Dec. - 79	190	200
4 - Jan. - 80	195	205
16 - Jan. - 80	300	330
18 - Jan. - 80	340	360
24 - Jan. - 80	320	350
30 - Jan. - 80	250	270
2 - Feb. - 80	270	290
6 - Feb. - 80	210	240

Table A.1 Silver price in Thailand. (continue) (Baht)

Date	Purchasing prices per 15 grams.	Sale prices per 15 grams.
13 - Feb. - 80	225	250
22 - Feb. - 80	210	230
28 - Feb. - 80	220	240
19 - Mar. - 80	180	200
20 - Mar. - 80	150	170
22 - Mar. - 80	170	190

The silver price is based on 99.99% purity of silver

APPENDIX III

The percentage cost of silver recoverable from processing solution is compared with the original cost of Film and Paper used, as shown in Table A.2

Table A.2 The percentage cost of silver recovery.

Type	Size per unit	Cost per ⁺ 1,000 unit (Baht)	Cost of silver recoverable [*] (Baht)	Percentage cost recoverable
Aerial Film				
Color Negative Films	1 ft x 9 $\frac{1}{2}$ in.	108,890	4,758-5,291	4.37-4.86
Color Positive Films	1 ft x 9 $\frac{1}{2}$ in.	140,400	4,226-4,758	3.00-3.39
Color Print Films	1 ft x 9 $\frac{1}{2}$ in.	75,846	2,821-3,172	3.72-4.18
B & W Negative Films	1 ft x 9 $\frac{1}{2}$ in.	35,122	1,937-2,821	5.52-8.03
B & W Print Films	1 ft x 9 $\frac{1}{2}$ in.	20,640	883-2,288	4.28-11.08
Commercial and Professional Films and Papers				
Color Negative Films	8 x 10 in.	167,600	4,226-4,759	2.52-2.84
Color Prints	8 x 10 in.	18,200	181-249	1.00-1.37
B & W Negative Films	8 x 10 in	41,600	1,586-2,821	3.81-6.78
B & W Prints	8 x 10 in	12,280	351-702	2.86-5.72
Photofinishing Films and Papers.				
Color Negative Films	1-135/roll	93,000	3,704-4,506	3.98-4.36
Color Print	3 $\frac{1}{2}$ x 3 $\frac{1}{2}$ in.	3,600	68-102	1.88-2.75

Table A.2 The percentage cost of silver recoverable.(continue)

Type	Size per unit	Cost per ⁺ 1,000 unit (Baht)	Cost of* silver recoverable (Baht)	Percentage cost recoverable
B & W Negative Films	1-135/roll	42,000	1,234-1,767	2.89-4.15
B & W Print	$3\frac{1}{2} \times 3\frac{1}{2}$ in	2,000	34-68	1.66-3.33
Motion Picture Films				
Color Negative Films	1 ft x 35 mm.	8,400	702-883	8.36-10.52
Color Print Films	1 ft x 35 mm.	1,700	215-249	12.66-14.66
B & W Negative Films	1 ft x 35 mm.	3,880	419-634	10.80-16.35
B & W Print Films	1 ft x 35 mm.	3,640	283-351	7.78-9.64
Radiography Film				
Medical x-ray Films	14 x 17 in	120,000	5,284-10,570	4.40-8.80
Glass Plates				
B & W Photofabrication	1 ft x 1 ft	141,000	2,821-3,874	2.00-2.75

Average 4.98-6.60

+ These cost was listed in the Catalog of kodak photographic product P2 - 1 (1979 - 1980). Sale price ratio in March 1980 is 1 \$ per 40 Baht.

* Based on silver prices 170 Baht per 15 g. (from Appendix 2. Table A.1)

APPENDIX IV

Table A.3 Conversion Data For Current Density.⁽⁸⁾

Unit	Asd.	Asc.	Asf.	Asi.
1. Amp per sq.dm(Asd).....X	1	0.01	9.29	0.0645
2. Amp per sq.cm(Asc).....X	100	1	929	6.45
3. Amp per sq.ft(Asf).....X	0.108	0.00108	1	0.007
4. Amp per sq.inch(Asi).....X	15.5	0.155	114	1

APPENDIX V

Troy Measurement

It is customary in the U.K, USA. to express the weight of a silver or the silver content of a solution in troy ounces, but silver salts are treated as general chemicals and their weight expressed according to avoirdupois or metric scale, conversion factor is shown in Table A.4

Table A.4, Conversion factors for Metric and Troy Units. (15)

troy ounces.	avoir ounces	grammes
1.0	1.097	31.10
0.911	1.0	28.35
0.0322	0.0353	1.0

Concentration

1 troy ounces per gal. = 6.86 grammes per litre
 1 grammes per litre = 0.146 troy oz. per gal.

APPENDIX VI

Ideal design of small silver recovery system is shown in
Figure A.2

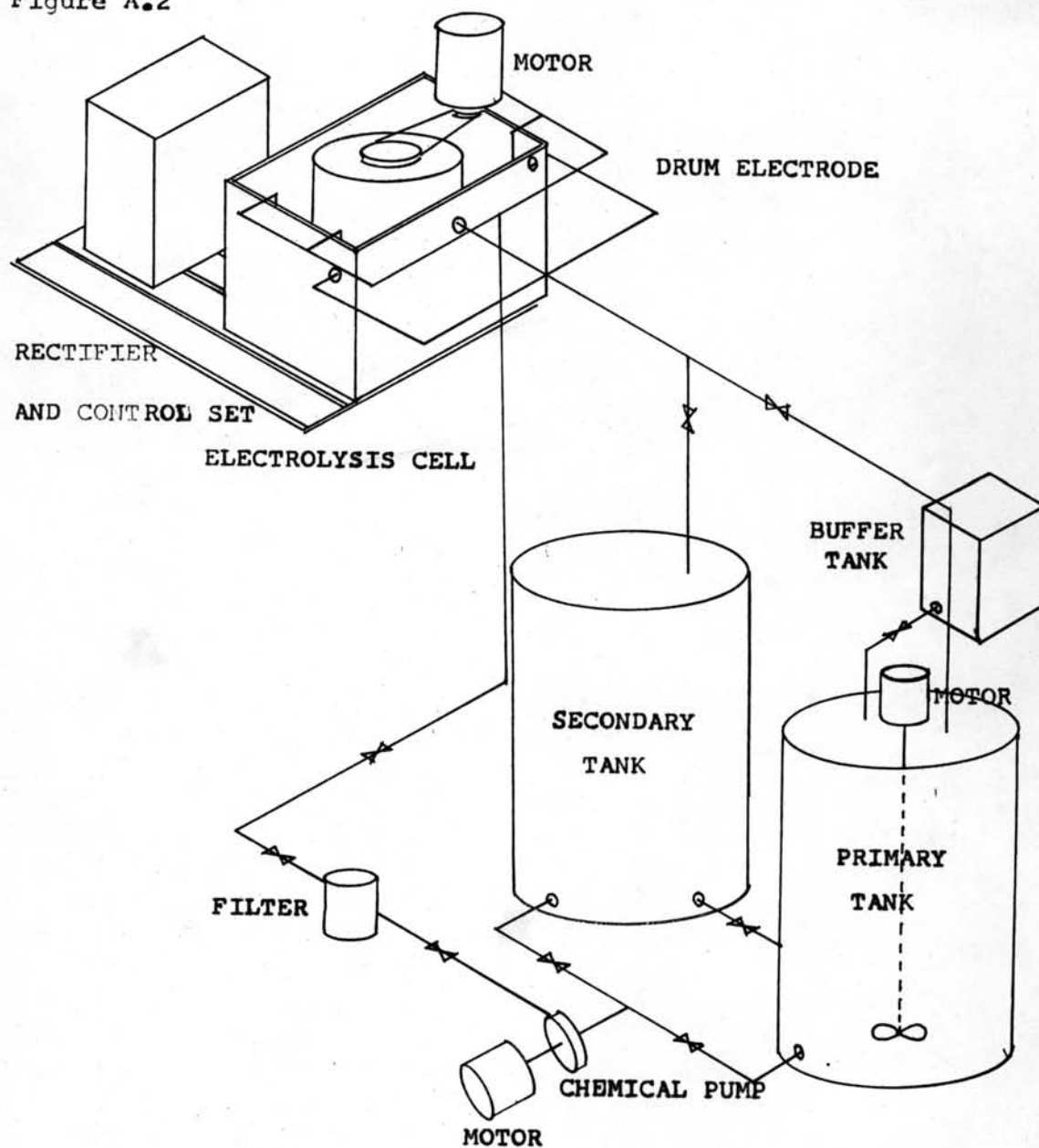


Figure A.2 Small silver recovery system

APPENDIX VII

The cost of material and equipment used for building a small silver recovery system is shown in Tables A.5, A.6 and A.7

Table A.5 The cost of d.c. power supply

d.c. output Volts.	d.c. output Amps.	Model	Prices in Baht ⁺
0 - 7	0 - 2	PAT 7 - 2	6,560
0 - 6	0 - 5	JMK 6 - 5M	19,160
0 - 6	0 - 10	JMK 6 - 10M	22,520
0 - 6	0 - 15	JMK 6 - 15M	24,600
0 - 6	0 - 22	JQE 6 - 22M	26,360
0 - 6	0 - 45	JQE 6 - 45M	31,200
0 - 6	0 - 90	JQE 6 - 90M	49,680

+ These cost was listed in the Catalog of Kepco power supplies 146 - 1278, by Dynamic Supply Engineering R.O.P., Bangkok.
Sale price ratio in March 1980 is 1\$ per 40 Baht.

Table A.6 The cost of cylindrical tank made of P.V.C.
having thickness 3 mm.

Capacity (litre)	Height (cm.)	Radius (cm.)	Prices* (Baht)
20	30	15	1,250
40	40	18	1,450
60	50	20	1,650
80	60	21	1,850
100	70	22	2,050
120	75	22.5	2,250
180	80	27	3,000

Table A.7 The cost of rectangular tank made of P.V.C.
having thickness 5 mm.

Capacity (litre)	Height (cm.)	Long x wide (cm.)	Prices* (Baht)
5	15	20 x 16	600
10	20	25 x 20	900
20	28	27 x 27	1,150
30	28	33 x 33	1,350
40	30	37 x 37	1,550
50	32	40 x 40	1,750

* Listed by Pipob Shop, Tanon Trup, Bangkok

Stainless steel Type 316 :

- Size 4 x 8 feet thickness 1 mm., price 5,200 Baht
- This price was listed by Ngeck Seng Chiang Import Ltd. Part, Bangkok.

Graphite

- Size 1 x 1 feet thickness 4 mm., price 180 Baht.
- This cost was listed by Asahi Co. Ltd.

Chemical pump (circulated pump)

- Head 0 Flow rate 4 litre per minute price 3,700 Baht
- Head 1.7 Flow rate 8 litre per minute price 4,200 Bath
- These price was listed by Praneepunt Co. Ltd. Sanampao, Bangkok.

Filter

- Cartridge Type diameter 7 cm, 40 micron price 800 Bath
- Cartridge Type diameter 13 cm, 30 micron price 1,500 Bath
- These prices were listed by Praneepunt Co. Ltd., Sanampao, Bangkok.

A.C.Motor

- Power $\frac{1}{8}$ hp, input 90 watts, 220 Volt price 300 Baht
- Power $\frac{1}{6}$ hp, input 125 watts, 220 Volt price 500 Baht
- Power $\frac{1}{4}$ hp, input 180 watts, 220 Volt price 700 Baht
- These prices were obtained by questionnaire.

SYMBOLS

$a_{\text{Ox.}}, a_{\text{Red.}}$	activity of oxidant and reductant
C	concentration of the electrolyte, g /l
C_i	concentration of species i, mole/cm ³
D	diffusion coefficient of electrolyte, cm ² /sec
D_i	diffusion coefficient of species i, cm ² /sec
E	electromotive force, volt
$E_{\text{app.}}$	voltage applied, volt
E_D	decomposition potential, volt
$E_{\text{o.c.}}, E_{\text{o.a.}}$	the overvoltage at cathode and anode, volt
E^0	standard potential, volt.
E_T	observed potential at temperature T, volt
F	Faraday's constant, 96,493 C/equiv
G_M	weight of the deposited metal, gram
H	depth of solution, cm
i	current density, Amp./cm ²
I	total current, Amp
K	conductivity, mho/cm
l	distance, cm
N_i	flux of species i, mole/cm ² -sec.
n_A, n_C	transport number
n	number of electrons in electrode reaction
R	resistance, ohm

R	universal gas constant, 8.3134 J/mole-deg
Re	Reynolds number
r	radial position, cm
r_i, r_o	radius of inner electrode and outer electrode
η	current efficiency, %
T	absolute temperature, deg K
T_a	Taylor number
t	time
U_A, U_C	migration velocity, cm/sec/v
U_i	mobility of species i, $\text{cm}^2\text{-mole/J-sec}$
W	weight of substance, g
W_m	gram molecular weight of substance
Y	distance from electrode, cm
Z_i	charge number of species i
ν	kinematic viscosity, cm^2/sec
ω	rotation speed, radian/sec
δ	Thickness of diffusion layer, cm

VITA

Captain Narong Tameeruks was born in Nonthaburi, Thailand, on December 21, 1951. He received a Bachelor's Degree of Science in chemistry from Chiangmai University in 1972. He received the Graduated Diploma of Nuclear Technology Engineering from Chulalongkorn University in 1975, the Certificate of Intelligence Photographic officer and Technical Instructor from U.S.A.F. in 1977. At the time writing this thesis, he is serving as an officer in R.T.A.F.

