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Notes on the precipitation of gold from cyanide solution

Charles Adrian Burdick

Harry Wade Connelly

Department: Mining Engineering

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NOTES ON THE PRECIPITATION OF GOLD FROM CYANIDE SOLUTION.

C. A. Burdick.

H. W. Connelly.

Approved.

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This work was to determine the Potassium Cyanide and the Zinc consumed in the precipitation of Gold from cyanide solutions by zinc dust.

Writers on the zinc dust method give much detail but omit data on the consumption of potassium cyanide and of zinc in the process. Julian and Smart in their book, "Cyaniding of Gold and Silver Ores", say that in the treating of 15 tons of strong cyanide solution, carrying 6.0 oz. gold per ton 19 lb. zinc dust were used, and for 14 tons of weak solution, 17 lb. of zinc dust were used, making 36 lb. of zinc dust added for 29 tons of solution or 1.24 lb. zinc dust per ton of solution. They do not say whether there was zinc in the precipitate. The above solutions were reduced to 2 dwt. of gold plus silver per ton of solution.

For our work the precipitation was in each case made in 300 c.c. of solution. A gold cyanide solution was used which contained per c.c. 0.041 mgm. of gold (1.197 oz. per ton of solution) and 0.0012% KCN. To obtain for each test the desired varying amounts of gold and of potassium cyanide, a solution, with no gold, but containing 7.3% KCN was added to the above mentioned gold solution as required.

In the first experiment the amount of zinc dust and of potassium cyanide was kept constant while the gold was varied from 1.00 oz. per ton to 0.005 oz. per ton of solution. The solution contained 0.20% of potassium cyanide and 0.46 lb. of zinc dust was used per ton of solution. The zinc consumed was 0.19 to 0.23 lb. per ton of solution. The zinc consumed increased slightly with the increase of gold in the solution. By plotting the oz. gold per ton of solution and the pounds of zinc consumed we get a straight line. See curve No. The KCN consumed ranges from 0.62 to 0.80 lb. per ton of solution. Plotting the potassium cyanide against the gold we get a straight line. See curve No. 2 The percentage gold recovered rapidly increased until the solution containing 0.30 oz. of gold per ton of solution was reached. At this point the recovery under our condition is a maximum (77.%) From here the recovery decreased slightly as the solutions increase in gold. See curve No. 3

In the second experiment the amount of zinc and of gold in the solution are kept constant, while the amount of potassium cyanide was varied from a 1.00%

solution to a 0.005% solution. The gold solution was 0.50 oz. gold per ton and 0.46 lb. of zinc dust was used per ton of solution. The gold extracted increased rapidly up to the 0.05% KCN solution and it remained constant at 78% as the solution increased in percent of potassium cyanide. See curve No. The zinc consumed was fairly constant between 0.21 lb. and 0.302 lb. per ton of solution. See curve No. The amount of potassium cyanide consumed increased more slowly as the solution grew stronger potassium cyanide.

In experiment three the strenght of the solution in potassium cyanide and in gold was kept constant at 0.20% and 0.50 oz. respectively. To this solution varying amounts of ammoniacal sopper hydroxide were added. The precipitation in each case was made with 0.46 lb. of zinc dust per ton of solution. Increasing the amount of copper decreases the amount of gold precipitated, but there was no regularity in the decrease of the gold recovery. There was consumed from 2.9 lb. to 3.9 lb. of potassium cyanide per ton of solution treated. See curve No. 7 The zinc consumption, as might be expected, increased regularly as the solution was made stronger in copper. See curve No.

In order to determine how high percent the extraction of gold could be made with varying amounts of gold and 0.20% KCN solution, solutions similar to those in experiment No.1. were made and 3.0 lb. of zinc per ton of solution was used in the precipitation. The excess zinc was washed onto the filter and the solution passed thru so as to bring the solution into most intimate contact with the zinc. It was found that the solutions could thus be reduced to 0.018 oz. per ton of solution.

TABLE NO. I

Amount of Au Constant
" " Zn "
" KCN Varying

Sol. No.	Au oz. per ton Before	Au oz. per ton After	Au ppted oz/ton	% Au Recovy	Lbs Zn ton/Sol. Before	Lbs Zn ton/Sol. After	Zn Consumption %/ton	% KCN in Sol. Before	% KCN in Sol. After	KCN Consumption #/ton
1.	1.00	0.26	0.74	74.0	0.46	0.234	0.226	0.20	0.159	0.040
2.	0.80	0.20	0.60	75.0	"	0.227	0.233	"	0.160	0.038
3.	0.60	0.14	0.46	76.7	"	0.247	0.213	"	0.162	0.036
4.	0.40	0.092	0.308	77.0	"	0.266	0.194	"	0.164	0.034
5.	0.20	0.044	0.156	77.0	"	0.257	0.203	"	0.166	0.033
6.	0.10	0.039	0.001	61.0	"	0.263	0.197	"	0.167	0.033
7.	0.07	0.030	0.04	57.0	"	0.263	0.197	"	0.167	0.031
8.	0.04	0.025	0.015	40.0	"	0.263	0.197	"	0.169	0.031
9.	0.02	0.0168	0.0032	16.0	"	0.267	0.193	"	0.169	0.031
10.	0.01	0.0094	0.0006	6.0	"	0.269	0.191	"	0.169	0.030
11.	0.005	0.0049	0.0001	2.0	"	0.267	0.193	"	0.169	0.031

TABLE NO. II

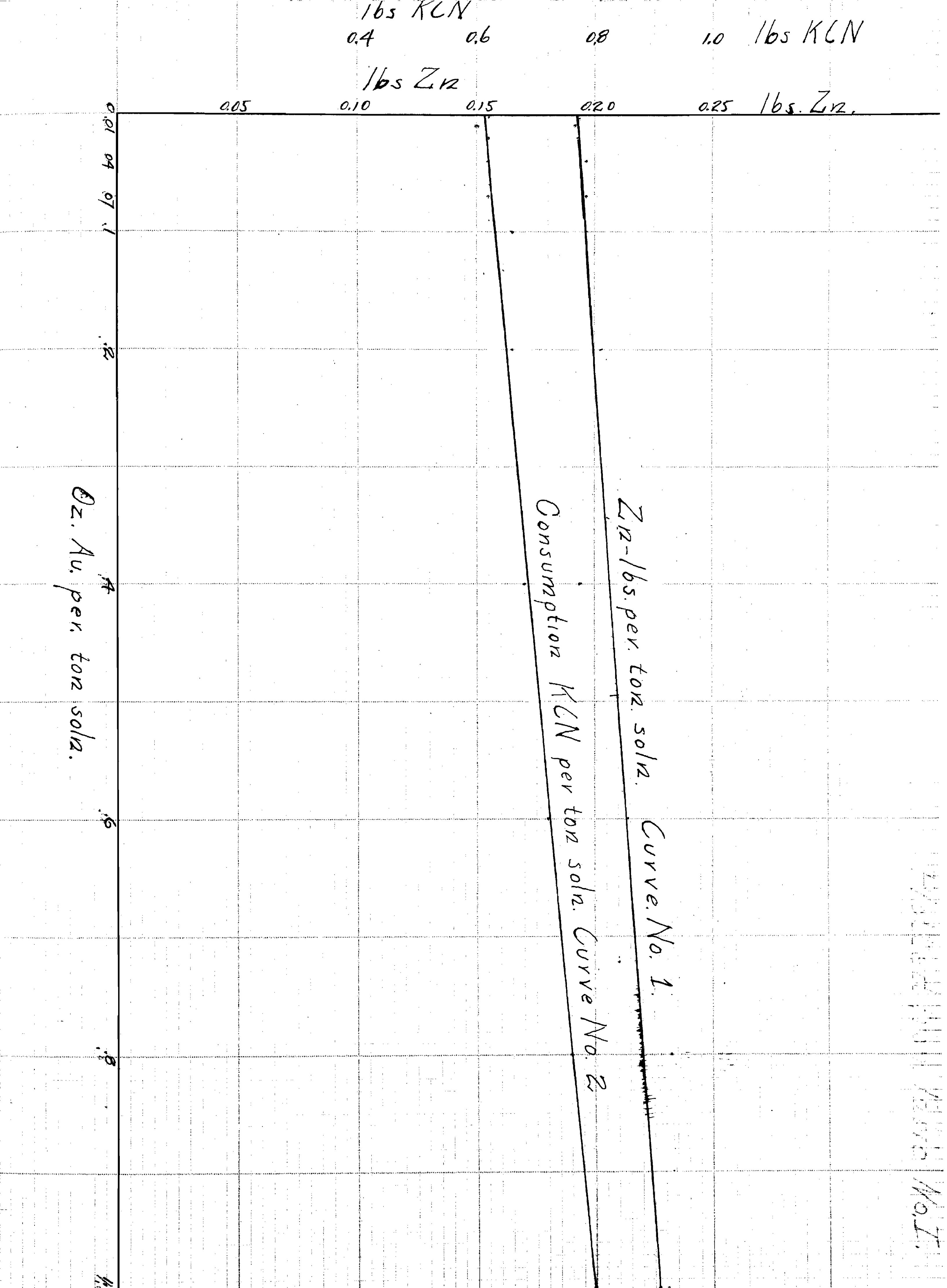
Amount of Au Constant
" " Zn "
KCN Varying

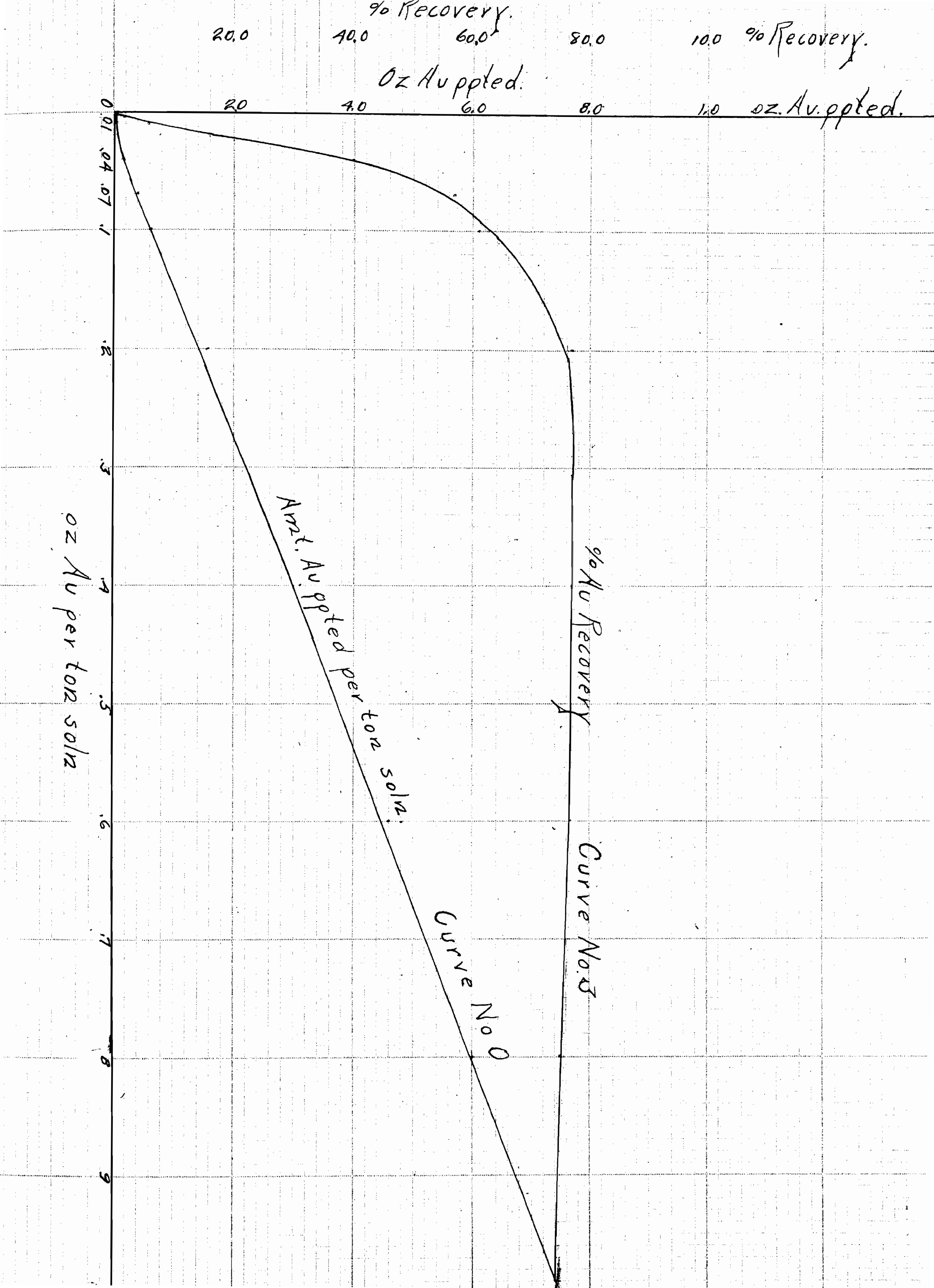
Sol. No	Au oz per ton		Au ppted	% Au	Lbs Zn per ton		Zn Con-sumption	% KCN in Sol.		KCN Con-sumption
	Before	After	oz/ton	Recov'y	Before	After	#/ton	Before	After	#/ton
1.	0.50	0.110	0.390	78.0	0.46	0.218	0.242	1.00	0.958	0.042
2.	"	0.108	0.392	78.2	"	0.238	0.222	0.80	0.758	0.042
3.	"	0.105	0.395	79.0	"	0.230	0.230	0.60	0.560	0.040
4.	"	0.110	0.390	78.	"	0.240	0.220	0.40	0.362	0.038
5.	"	0.108	0.392	78.2	"	0.260	0.200	0.20	0.165	0.035
6.	"	0.106	0.394	78.8	"	0.268	0.192	0.10	0.066	0.034
7.	"	0.105	0.395	79.0	"	0.290	0.170	0.08	0.051	0.029
8.	"	0.109	0.388	77.6	"	0.303	0.157	0.05	0.028	0.022
9.	"	0.200	0.300	60.0	"	0.315	0.145	0.03	0.016	0.014
10.	"	0.225	0.275	55.0	"	0.345	0.115	0.01	0.0075	0.0025
11.	"	0.305	0.195	39.0	"	0.390	0.070	0.005	0.0030	0.0020

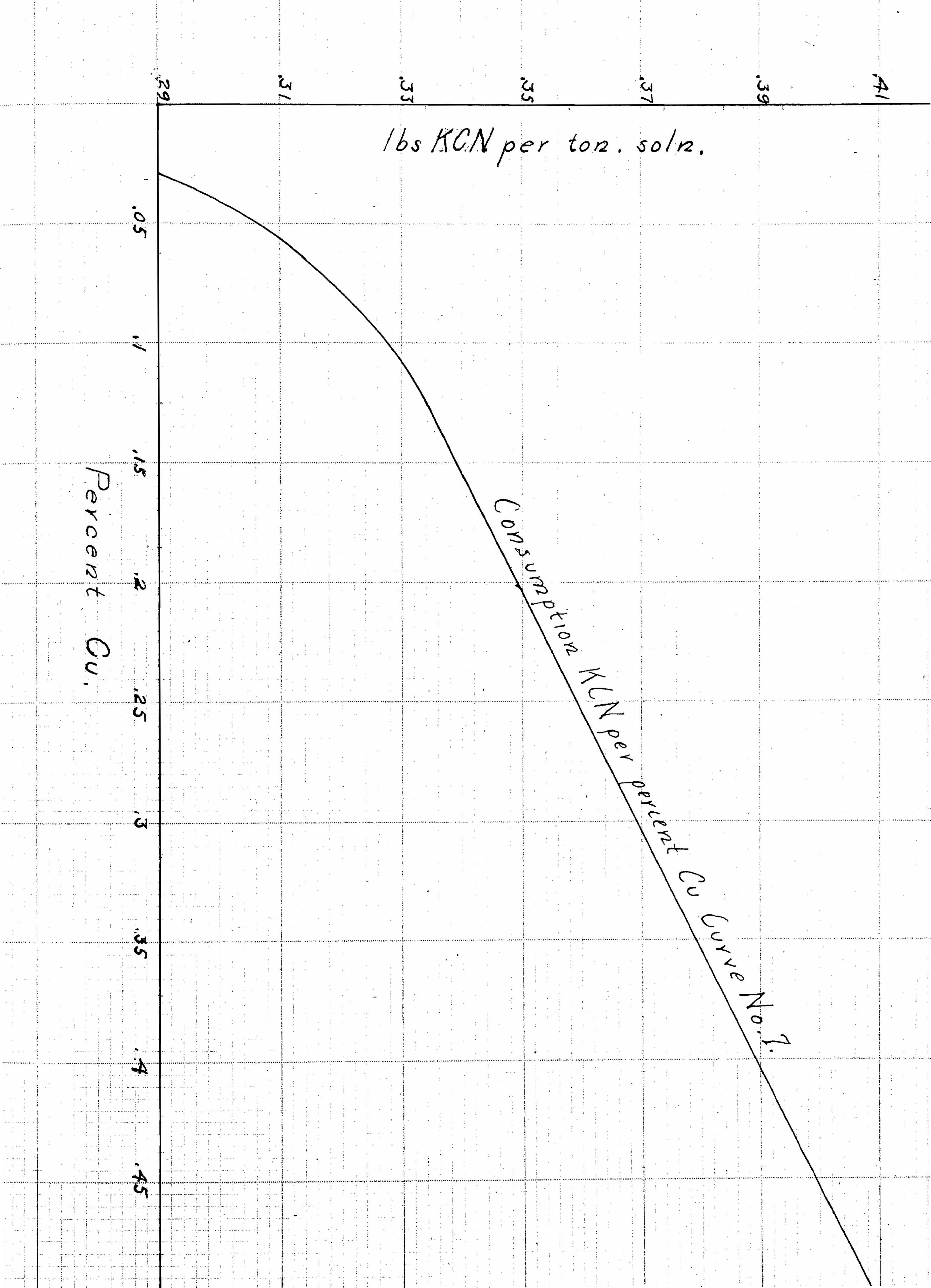
TABLE NO III

Amount of Au Constant
" " Zn
" " KCN
" " Cu Varying

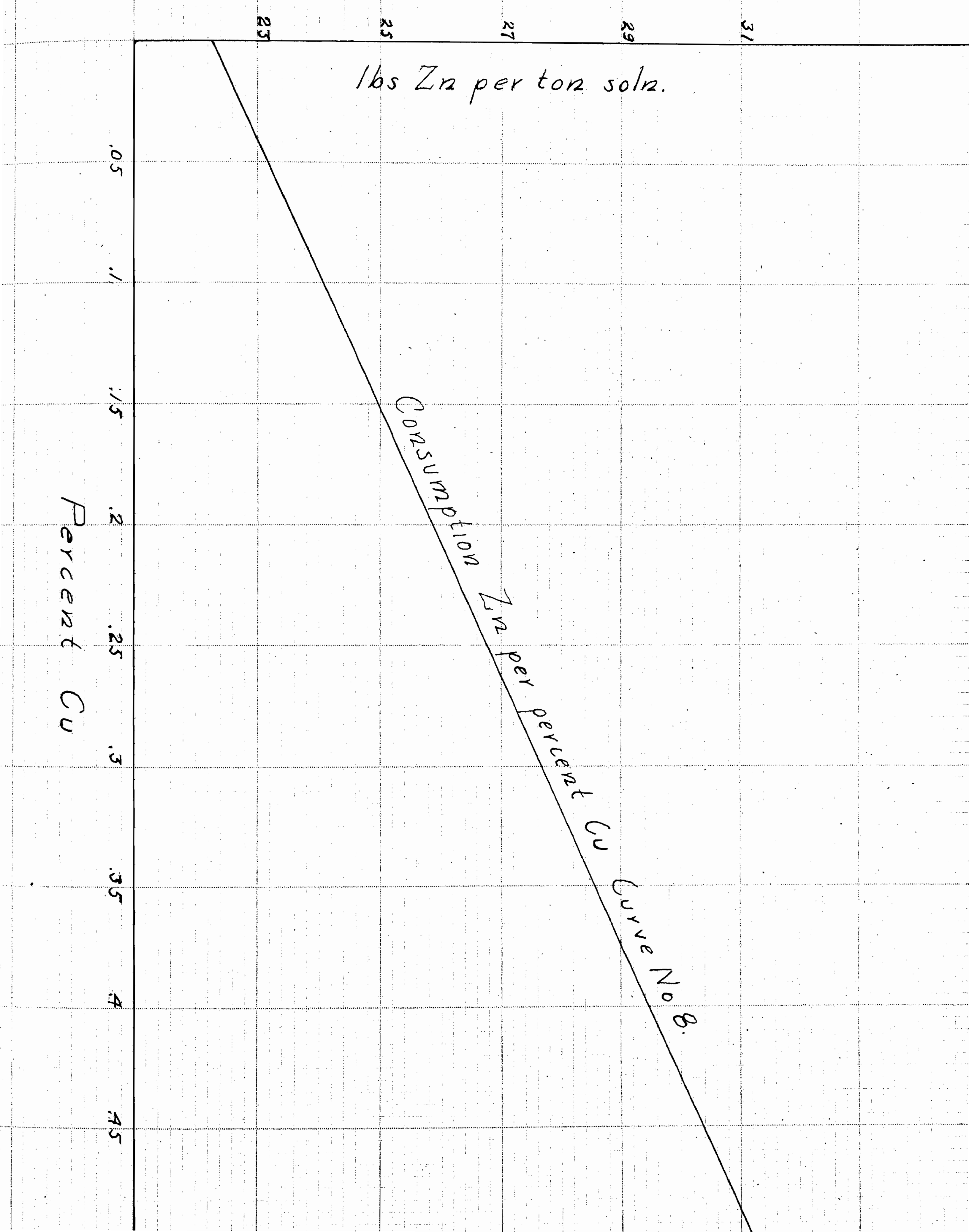
Sol No	Au oz per ton		Zn lb per ton		KCN % Sol.	KCN lbs/ton		% Cu
	Before	After	Before	After		Before	After	
1.	1.0	0.40	0.41	0.216	0.2	0.2	2.92	0.0312
2.	"	0.31	"	0.236	"	"	3.14	0.0624
3.	"	0.40	"	0.245	"	"	3.34	0.124
4.	"	—	"	0.255	"	"	3.46	0.189
5.	"	—	"	0.265	"	"	3.58	0.250
6.	"	0.92	"	0.278	"	"	3.74	0.310
7.	"	0.98	"	0.292	"	"	3.84	.372
8.	"	0.87	"	0.302	"	"	3.94	.436

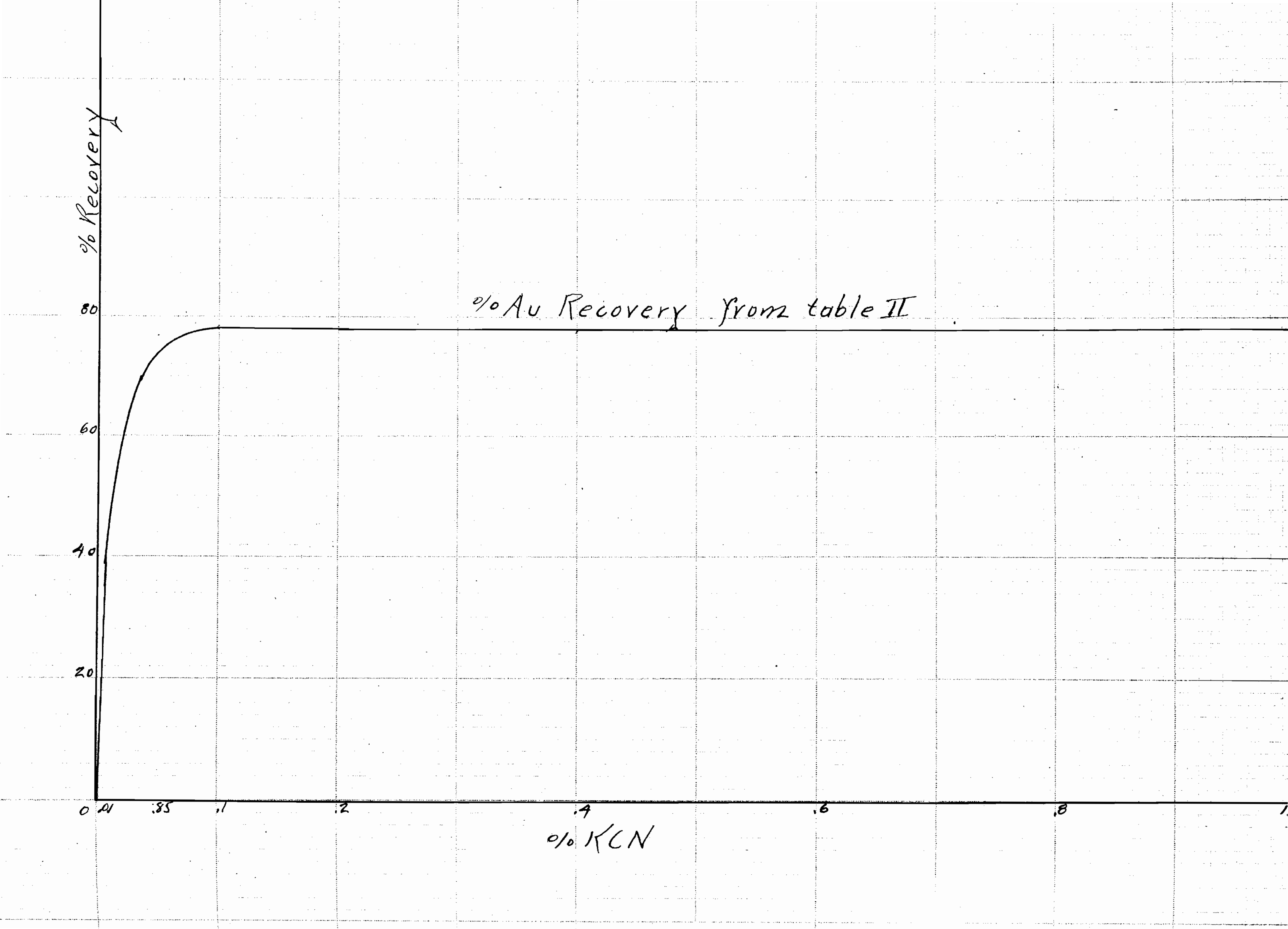

lbs KCN
0.4
0.6
0.8
1.0
lbs KCN
lbs Zn
0.05
0.10
0.15
0.20
0.25
lbs. Zn.
0
.01
.04
.07
.1
.2
.4
.6
.8
Zn-lbs. per ton soln. Curve No. 1.
Consumption KCN per ton soln. Curve No. 2
Oz. Au. per ton soln.

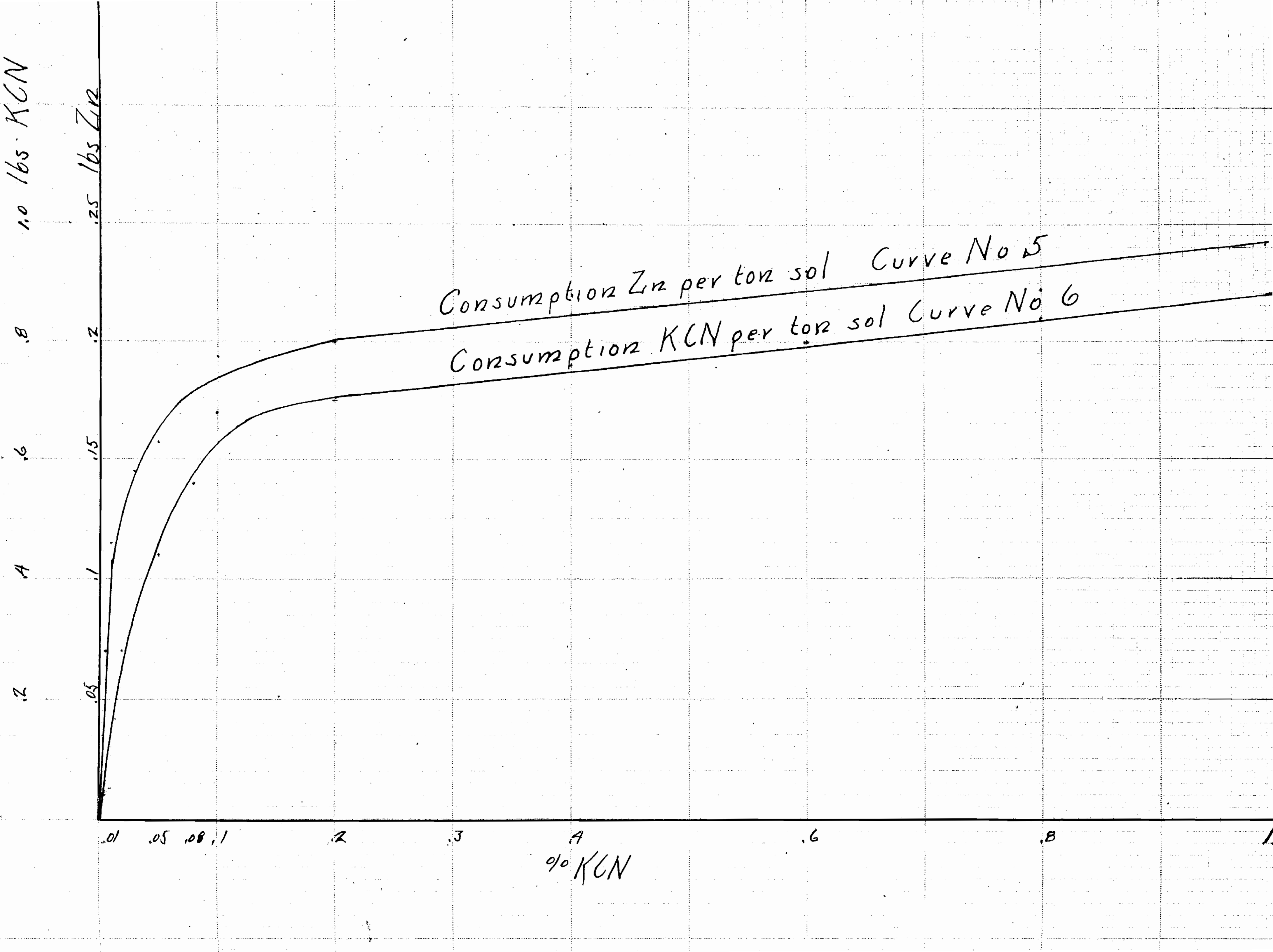

% Recovery.
20.0
40.0
60.0
80.0
10.0
% Recovery.
Oz Au ppted.
0
20
4.0
6.0
8.0
1.0
oz. Au. ppted.
.01
.04
.07
.1
.2
.3
.4
.5
.6
.7
.8
.9
oz Au per ton soln
Amt. Au ppted per ton soln.
% Au Recovery
Curve No 3
Curve No 0



lbs KCN per ton. soln.
Percent Cu.
Consumption KCN per percent Cu Curve No. 7.
.29
.31
.33
.35
.37
.39
.41
.05
.1
.15
.2
.25
.3
.35
.4
.45


lbs Zn per ton soln.
23
25
27
29
31
Percent Cu
.05
.1
.15
.2
.25
.3
.35
.4
.45
Consumption Zn per percent Cu Curve No 8.


% Recovery
% Au Recovery from table II
80
60
40
20
0
.01
.05
.1
.2
.4
.6
.8
% KCN



1.0 lbs KCN
.25 lbs Zn
.2 .4 .6 .8
.05 .1 .15 .2
Consumption Zn per ton sol Curve No 5
Consumption KCN per ton sol Curve No 6
.01 .05 .08 .1 .2 .3 .4 .6 .8
% KCN