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February 15, 1979

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Tucson, Arizona 85703,
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Attention: Mr. D. Soderstrom

Dear Sir:

Re: Eimco Settling Tests on Anderson Ore

We submit herewith our report "A Comparison of Conventional and Eimco Hi-Capacity Thickeners for the Anderson Uranium Project".

As agreed, our assessment is based on assumed acceptance of Eimco's method for sizing of Hi-Capacity thickeners. On receipt and review of promised backup information from Eimco, we will forward a supplementary report evaluating their scale-up procedures.

We appreciate the opportunity to be of service. Please advise if we can supply additional information or clarification.

Yours very truly,

A.S. Hayden, P. Eng.

ASH:bm

Distribution:

Mr. D. Soderstrom - six copies

MINERALS EXPLORATION COMPANY

A Comparison of Conventional and Eimco Hi-Capacity Thickeners for the Anderson Uranium Project

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1. INTRODUCTION

1.1 Scope of Work

On October 20, 1978, A.H. Ross & Associates were advised by D. Soderstrom that Jesse Brodie of Envirotech Corporation, Denver, would be carrying out settling tests on Anderson leached ore pulp in order to submit a proposal to Minerals Exploration Company on the Eimco Hi-Capacity thickener. The tests were to be conducted at Hazen Research Inc., during the week of November 12. A.H. Ross & Associates were requested to review and comment on the Envirotech proposal when received, and to observe the settling tests if warranted.

It was determined from Jesse Brodie that standard cylinder tests would be conducted, repeating tests carried out in January 1978 except for adoption of a single liquid flocculant, Nalco 7871, as requested by Minerals Exploration Company. Estimation of required size of both standard and Hi-Capacity thickeners would be made subsequently by Envirotech in their offices. On this information, A.H. Ross & Associates decided that there would be little or no merit in observing the tests.

The Envirotech report was received by A.H. Ross & Associates on December 29, 1978 for review. Examination of the report revealed that the calculation procedure used by Envirotech for sizing the Hi-Capacity thickeners was not included in the report so that A.H. Ross & Associates were not able to review this particular aspect of the report. After contacting Mr. Brodie, he agreed to compile and send the necessary information.

In view of the delay occasioned by the above circumstance, it was agreed by J. Abramo that A.H. Ross & Associates would carry out optimization calculations, and capital and operating cost comparisons

on the initial premise that the Envirotech sizing of Hi-Capacity thickeners would be confirmed. This would be followed on receipt of the extra information by the assessment of the validity of the Envirotech procedure. It was recognized that the cost comparisons would be of doubtful merit if it should turn out that the Envirotech sizing could not be validated by A.H. Ross & Associates.

The present report summarizes the A.H. Ross & Associates analyses based on the yet unconfirmed acceptance of the Envirotech sizing of the Hi-Capacity thickeners. The significant conclusions have been transmitted verbally to Mr. Abramo.

1.2 Sources of Information

1. Envirotech Corporation report,
   "Thickening of Acid Leached Uranium Ore, Anderson Ranch, Arizona"
   December 1978.

2. Envirotech letter of December 13, 1978, accompanying their December 1978 report, giving budgetary prices for the conventional and Hi-Capacity Eimco thickeners of the sizes specified in the report.

3. Envirotech Corporation report,
   "CCD Thickening and Countercurrent Vacuum Filtration and Washing of Acid Leached Uranium Ore Residue from Anderson, Arizona",
   March 1978.

4. Morrison-Knudsen preliminary feasibility study for the Anderson project, December 1977.

5. Morrison-Knudsen final feasibility study for the Anderson project, July 1978.

6. Ralph M. Parsons feasibility report for the Red Desert Project, June 1976.

7. A.H. Ross & Associates report, "Metallurgical Summary and Mill Design Criteria for the Anderson Uranium Deposit", May 1978.

8. A.H. Ross & Associates worksheets for the design criteria report for the Anderson project, May 1978.

9. A.H. Ross & Associates file information.

2. SUMMARY

The data from tests and resultant thickener recommendations by Envirotech have been reviewed. The sizing of conventional thickeners has been verified by A.H. Ross & Associates, but until further requested information is received from Envirotech, there is no basis to verify the sizing of the Envirotech Hi-Capacity thickener.

On the initial assumption that the sizing of the Hi-Capacity thickeners can be verified, an economic optimization study has been made for both conventional and Hi-Capacity thickeners including capital costs, identifiable operating costs and soluble uranium losses.

The estimated capital costs for the optimum circuits are $8,174,000 for five stages of conventional thickeners, and $8,220,000 for two lines of six stages of Hi-Capacity thickeners. Operating cost differential between the two alternatives is difficult to define; however, the minimum cost difference is expected to approach $100,000 per year, in favour of conventional thickeners. On this basis, a five stage conventional thickener circuit is the preferred choice and is recommended.

3. ENVIROTECH SETTLING TESTS

3.1 Preparation of Leached Ore Pulp

The pulp for the Envirotech settling tests was prepared by Hazen Research Inc. from a 39/61% mixture of B and C ore composites respectively, as used for the Envirotech tests in January 1978. The grinding and leaching conditions used were designed to be those specified as optimum in the A.H. Ross design criteria report of May 1978 (Ref. 7) as follows:

Grind	1 - 2% + 28 mesh
% solids in leaching	40 - 42%
Acid	400 lb/ton added at start
Sodium Chlorate	3.2 lb/ton added at start, plus 3.2 lb/ton after 2 hours
Temperature	75° C
Time	6 hours

3.2 Envirotech Experimental Procedures

The leached ore pulp was maintained in suspension before settling tests by means of a small propellor agitator in an unbaffled beaker. A synthetic solution, simulating first stage CCD liquor, was prepared for diluting feed slurries to different desired percent solids. The synthetic solution was made up from sulphuric acid and magnesium sulphate to pH 1.0 and specific gravity of 1.06.

The settling tests were conducted in two liter graduated cylinders fitted with a slow-turning rake mechanism. Details of the experimental procedure used by Envirotech are given in their report (Ref. 1).

A number of batch leaches were made to supply enough pulp for eight first stage CCD tests, after which settled solids were repulped for second and third stage tests. A first set of four three-stage settling tests was carried out at 20% feed solids (Series A) and a second set was carried out at 10% feed solids (Series B).

3.3 Screen Analyses of Feed Pulps

Two screen analyses are reported on feed to the settling tests, one on Test A-1 and one on Test B-2. The data are reproduced in Table I, along with the screen analysis of the pulp used in the January 1978 settling tests.

Table I - Screen Analyses of Leached Ore

Mesh	% by Weight					
	Series A		Series B		Jan. 1978	
	direct	cum	direct	cum	direct	cum
+ 28	0.3		0		1.0	
- 28 + 35	2.8	3.1	2.2	2.2	3.0	4.9
- 35 + 48	8.4	11.5	7.7	9.9	9.7	14.6
- 48 + 65	8.6	20.1	10.1	20.0	9.0	23.6
- 65 + 100	8.1	28.2	9.8	29.8	7.4	31.0
- 100 + 150	5.5	33.7	6.2	36.0	6.1	37.1
- 150 + 200	6.2	39.9	7.9	43.9	5.6	42.7
- 200 + 270	6.8	46.7	6.9	50.8	5.4	48.1
- 270 + 325	2.7	49.4	4.9	55.7	3.1	51.2
- 325 + 400	2.2	51.6	5.5	61.2)		
- 400	48.4	100	38.8	100)	48.8	100

It may be noted that the Series A and January 1978 ore pulps were quite similar in -325 mesh fines whereas the Series B pulp is somewhat coarser.

3.4 Settling Data

In Table II calculated unit areas for conventional thickeners are summarized from the Envirotech report.

Additional information of possible relevance is the specific gravity calculated for the dry solids, from the weight of dry solids, weight and volume of pulp and specific gravity of liquid, all as measured on leached pulp prior to the first stage tests. The tabulated results are:

	s.g., g/cc		s.g., g/cc
Tests A1	2.372	Tests B1	1.635
A2	3.394	B2	1.575
A3	2.420	B3	1.672
A4	2.415	B4	1.601

For the A series, the calculated specific gravities are quite close to previously determined values for the ore. The very low values for Series B cannot be real. It is concluded that gas entrainment must have been responsible for an overestimate of pulp volume, which would lead to underestimating solids weight. It is probable that some decomposition of carbonates in the ore was still proceeding in the acid liquor, whereas the reaction has been completed in Series A. Initially, we were concerned that the measurements from settling tests would be biased in Series B but it was concluded that the proper measurements were made in spite of the assumed gas volume. Furthermore, it would require only about 2% by volume of gas in the pulp to cause the deviation in calculated specific gravity of solids, so that no significant error should arise.

The average terminal densities in these tests were less than in the 1978 tests. This is believed to be a function of the different flocculant used.

Table II - Envirotech Settling Tests

Test No.	Stage	From Test No.	Feed % Solids	Floc lb/t	Cumulative Floc lb/t	Terminal[1] % Solids	Unit Area,[2] ft^2/tpd for Underflow Solids Concentration of 38%	35%
A-1	1	-	20	0.19	0.19	42.3	20.20	15.38
A-2	1	-	20	0.41	0.41	39.7	10.60	8.60
A-3	1	-	20	0.61	0.61	38.9	10.41	8.31
A-4	1	-	20	0.83	0.83	37.6	10.67	8.93
A-5	2	A-1	20	0.40	0.59	38.4	7.45	5.35
A-6	2	A-2	20	0.30	0.71	35.7	10.12	8.31
A-7	2	A-3	20	0.20	0.81	30.2	10.22	8.31
A-8	2	A-4	20	0.10	0.93	36.7	9.02	7.38
A-9	3	A-5	20	0.05	0.64	38.8	10.60	8.31
A-10	3	A-6	20	0.10	0.81	37.7	7.45	5.54
A-11	3	A-7	20	0.15	0.96	36.5	8.60	6.64
A-12	3	A-8	20	0.20	1.13	35.5	8.73	6.89
B-1	1	-	10	0.22	0.22	43.2	8.49	7.50
B-2	1	-	10	0.47	0.47	41.6	6.51	5.34
B-3	1	-	10	0.68	0.68	43.4	7.30	5.91
B-4	1	-	10	0.58	0.58	35.8	9.07	7.50
B-5	2	B-1	10	0.33	0.55	41.5	6.70	5.34
B-6	2	B-2	10	0.28	0.75	32.8	8.09	7.10
B-7	2	B-3	10	0.11	0.79	34.6	9.66	9.06
B-8	2	B-4	10	0.22	0.80	33.5	8.87	7.50
B-9	3	B-5	10	0.055	0.60	38.3	6.90	5.51
B-10	3	B-6	10	0.09	0.84	34.5	8.28	6.90
B-11	3	B-7	10	0.17	0.96	37.8	7.30	6.70
B-12	3	B-8	10	0.13	0.93	32.4	11.24	9.85

(1) 1st stage tests were allowed to settle overnight. Other tests were terminated in 100 - 200 minutes.

(2) Unit is 1.25 times that calculated by the Kynch graphical method.

4. SIZING OF THICKENERS

4.1 Conventional

Unit areas for continuous thickening were calculated by Envirotech using the standard Kynch graphical procedure and are reproduced in Table II. Areas were calculated for possible design underflows of both 38% and 35% solids. The larger area requirements for 38% solids were selected for thickener sizing.

Although there is a great deal of scatter in the data, lower unit areas are indicated for Series B than for Series A. Series B was carried out at 10% solids and this seems to be the most likely reason for the better settling; however the feed to Series B contained fewer fines than Series A, which could also be a factor.

The flocculant requirement with Nalco 7871 is evidently much greater than with MG-200, as used in the 1978 tests, for a given degree of settling.

The present Envirotech recommendation for conventional thickener sizing is 7.0 ft^2/ton solids per day for a 38% solids underflow and a 10% solids feed, and contains a safety factor of 1.25 over that calculated directly from settling curves. This leads to a 140 ft diameter thickener per stage for 2200 ton/day design throughput.

Our review of the data gives no basis for disagreement with the Envirotech selection.

The present Envirotech recommendation, along with the comparative 1978 figures are given in Table III.

Table III - Comparison of Design Bases

	Present		1978	
	Eimco	and AHR	Eimco	AHR
Thickener Area per stage, based on first stage data, ft^2/tpd	7.0		7.5	7.0
Flocculant	Nalco 7871		DOW MG-200	
1st stage req'd lb/ton	0.60 - 0.65		0.25	0.15
3 stage total lb/ton	1.11 - 1.10		0.53	0.30
Underflow, % Solids	38		40	38

4.2 Hi-Capacity

As indicated in the Introduction of this report, the Envirotech method for calculating area requirements for Hi-Capacity thickeners, using the same settling data as for conventional thickeners, is not given in their report. The A.H. Ross & Associates comments on the apparent validity of the calculations will be prepared after receipt of supplementary information.

The Envirotech recommendation corresponding to that for conventional thickeners is two 52' 6" diameter thickeners in parallel per stage providing 1.97 ft^2 per stage at 2200 ton/day, for a 38% solids underflow, and a 10% solids feed. Flocculant consumption is shown as the same as for conventional thickening.

The calculated rise rate for liquors in these thickeners would be 0.59 gal/min-ft^2, but presumably is considered acceptable by Envirotech.

It is believed by A.H. Ross & Associates that it would be prudent to design for a somewhat lower percent solids in underflow with the

Hi-Capacity thickeners as compared to the conventional thickener, based on industrial experience with Enviroclear thickeners. For purposes of calculating soluble losses, an underflow of 36.5% solids has been used in A.H. Ross & Associates calculations, compared to 38% in conventional thickeners.

5. SOLUBLE LOSS IN CCD

5.1 Conventional Thickener Circuit

In May 1978, in preparation of the Anderson design criteria (Ref. 7), an economic optimum for number of thickeners was recommended. The recommendation called for 5 stages of thickeners with 38% solids underflow, and a pregnant liquor to ore ratio of 4.25/1. Soluble losses were calculated for a range of conditions, all based on 45% solids in feed to CCD and an overall washing efficiency of 85%. (The efficiency factor relates only to a mathematical model for CCD circuits developed by A.H. Ross & Associates).

In Table 3 of the Eimco report, recovery (rather than loss) of soluble values is given for a range of underflow % solids and number of thickeners, based on a pregnant liquor to ore ratio of 4.25, but with feed to CCD of 43% solids rather than 45%. The calculation formula differs also from that of A.H. Ross & Associates. In spite of these differences, the recoveries or soluble loss are in reasonable agreement between the two methods.

Because of changes since May 1978 in capital and operating costs, a new optimization study was carried out, in order to have an updated selection for comparison to that for the Hi-Capacity thickeners.

5.2 Hi-Capacity Thickener Circuit

In their report, Envirotech recommend one additional stage of thickening for Hi-Capacity thickeners as compared to conventional thickeners. They state that "this additional stage would compensate for surges and upsets that occur that would not be detected in the conventional units".

In order to carry out optimization calculations it is necessary to be able to calculate soluble loss explicitly. As noted previously an underflow density of 36.5% in Hi-Capacity thickeners is estimated as a reasonable expectation compared to 38% in conventional thickeners, other factors being equal.

For the purposes of soluble loss calculations, it was decided to equate the soluble loss for six stages of Hi-Capacity thickeners at 36.5% underflow solids to five stages of conventional thickeners at 38% underflow solids. Using this data, a matrix of soluble loss figures for the Hi-Capacity thickeners was calculated, covering pregnant liquor to ore ranging from 3.00 to 6.00 and number of stages from four to eight.

The soluble loss data calculated above were used in carrying out the economic optimizations.

6. CAPITAL COSTS

6.1 Envirotech Estimate

In their letter of December 13, 1978 (Ref. 2), Envirotech provided "budgetary prices" for the type and sizes of the thickeners recommended in their report (Ref. 1). This information is reproduced as follows:

Eimco Hi-Capacity Thickener (52' 6" diam)

	per unit
Mechanism, including drive, bridge, handrails and walkways, and all underwater steel	$68,200
Instrumentation, recommended for operation of Eimco Hi-Capacity thickeners	$14,000
Tank, including discharge cone and base platform for mounting of the thickener tank	$200,000
Total price	$282,200

Eimco Conventional 140' diam Thickener

	per unit
Mechanism, including drive, bridge, handrails and walkways, centre columns, and all underwater steel	$165,000
Tank, including discharge cone	$965,000
Total price	$1,130,000

The specifications include 3/8" thick vulcanized neoprene covering for all underwater steel and 3/8" thick vulcanized neoprene tank lining.

Although the Envirotech estimate for their mechanisms and instrumentation package are accepted, the price for the thickener tanks appeared to be out of line. An independent estimate was made by

A.H. Ross & Associates in the course of developing installed capital cost estimates for the CCD systems.

6.2 A.H. Ross & Associates Estimate

6.2.1 Thickener Tanks

6.2.1.1 Introduction

Erected costs of thickener tanks were estimated from A.H. Ross & Associates file data. Neoprene lined steel construction was assumed. The bases for the estimates are detailed below.

6.2.1.2 Conventional Thickener Tanks

(a) 140 ft diameter tanks, lined with 3/8" thick vulcanized neoprene are specified by Envirotech. Their estimate for each tank, including discharge cone, is

$965,000

(b) The M-K estimate for a 155 ft diameter by 10 ft rubber lined thickener tank (Ref. 4) was $456,300. After adjustment to 140 ft and for time escalation, the estimate becomes

$442,300

(c) The second M-K estimate (Ref. 5) was for a 140 ft by 10 ft thickener with ½ inch RL bottom and ¼ inch RL sides, for a cost of $504,400. After adjustment for 3/8" neoprene and time escalation, the estimate becomes

$568,000

(d) Another well established engineering firm in 1978 provided a client with an estimate for a 105 ft by 10 ft thickener tank, with ¼ inch RL, at $230,600. After adjustment for 3/8 inch neoprene and time escalation, the estimate becomes

$400,400

From consideration of the above estimates, a 140 ft diameter by 10 ft thickener tank on grade with 3/8 neoprene lining is estimated by A.H. Ross & Associates in January 1979 dollars at

$500,000

6.2.1.3 Hi-Capacity Thickener Tanks

(a) Envirotech estimate for a 52'6" diameter by 15' tank with discharge cone and platform, lined with 3/8" neoprene is

$200,000

(b) The M-K estimate (Ref. 4) for a 65' diameter by 15' clarifier tank, rubber lined was $123,160. After adjustment for tank size, 3/8" neoprene, and time escalation, but without a cone or platform, the estimate becomes

$131,700

(c) The second M-K estimate (Ref. 5) includes a pregnant liquor tank, 50' diameter by 28' in mild steel at $87,150. After adjustment for tank size, 3/8" neoprene lining, and time escalation, but without a cone or platform, the estimate becomes

$134,800

(d) From the same engineering firm noted previously a rubber lined clarifier tank of 80' diameter by 20' was estimated at $78,900. After adjustment for tank size, 3/8" neoprene and time escalation, the estimate becomes

$107,700

From consideration of the above, A.H. Ross & Associates' estimate for a 52'6" diameter by 15 foot thickener tank, with discharge cone but no platform is

$135,000

6.2.1.4 Comparison of Thickener Tank Costs

	Envirotech	A.H. Ross
Conventional, 140' x 10'	965,000	500,000
Hi-Capacity, 52'6" x 15'	200,000	135,000
	with platform	without platform

6.2.2 Installed Equipment Costs

Using reference (5) as a basis for costs where applicable, installed equipment costs are estimated as follows:

	Installed Equipment Cost	
	Conventional (1)	Hi-Capacity (2)
Thickener tanks	$2,500,000	$1,620,000
Mechanisms	$1,031,000	$1,022,400
Pumps	$ 374,400	$ 435,600
Miscellaneous tanks	$ 79,400	$ 120,200
	$3,984,800	$3,198,200

(1) 5 units

(2) 12 units

6.2.3 Capital Cost Summary

Total capital costs are estimated as follows:

	Capital Cost	
	Conventional	Hi-Capacity
Installed equipment	$3,984,800	$3,198,200
Piping	$ 797,000	$1,261,900
Instrumentation	$ 23,000	$ 168,000
Site development	$ 697,300	$ 559,700
Auxiliaries (primarily electrical)	$ 597,700	$ 946,400
Total Direct Cost	$6,099,800	$6,134,200
Indirect Cost	$2,074,200	$2,085,800
Total Estimated Capital Cost	$8,174,000	$8,220,000

The following items are excluded from the estimate:

(a) Flocculant mixing and distribution facilities (except flowmeters, clarification equipment and clarifier feed pumps, tailings pumps).
(b) Samplers, instrument panels and control room.
(c) Buildings.
(d) Contingency allowance.

7. OPERATING COST COMPONENTS

7.1 General

Due to the nature of this comparison, and a shortage of operating experience with Hi-Capacity thickeners, it is difficult to develop a realistic estimate of differential operating costs between the two alternatives. The major factors are discussed below.

7.2 Flocculant Consumption

The Envirotech report (Ref. 1) shows a consumption of 0.16 lb/ton of Nalco 7871 for the third stage of thickening. Assuming that this holds for each additional stage, then the Hi-Capacity thickener circuit will require about 0.16 lb/ton of flocculant more than the conventional circuit, because it will have one more stage. For 2,000 ton/day ore and $0.50/lb for the Nalco flocculant, the cost difference becomes

$58,400 greater cost for Hi-Capacity

7.3 Electric Power

Because of extra components, power costs will be higher for the Hi-Capacity circuit than for the conventional circuit. The magnitude of the difference will be relatively small, however, and is assumed to be insignificant.

7.4 Maintenance

There is no experience on Hi-Capacity thickeners but it is believed that the 12 thickener mechanisms and 39 pumps for the Hi-Capacity circuit would necessarily require more maintenance than the 5 thickener mechanisms and 28 pumps for the conventional circuit. To reflect this situation, an arbitrary allowance of $40,000 per year (approximately 0.5% of capital cost) has been assumed.

7.5 Operating Labour

It is assumed here that the labour force required to operate 12 Hi-Capacity thickeners is equivalent to that required for 5 conventional thickeners but much would depend on plant layout, degree of instrumentation, and the like. Any experienced difference in cost between circuits would favour the conventional thickener circuit.

7.6 Soluble Loss

As discussed elsewhere, the chosen basis for comparison of the two alternative circuits incorporates the assumption of equivalent soluble losses. While soluble loss for the conventional circuit can be estimated with confidence, use of a corresponding loss for the Hi-Capacity units is subject to error. The magnitude (and direction) of this possible error cannot be estimated at this time.

7.7 Summary

The following table summarizes the above discussion, and represents an estimate of the minimum differential cost assignable to the Hi-Capacity thickener alternative. The influence of possible error in soluble loss estimation is ignored.

	Annual Cost Differential	
	Conventional	Hi-Capacity
Soluble loss	-	-
Flocculant	-	$58,400
Power	-	-
Maintenance	-	$40,000
Labour	-	-
Total	-	$98,400

8. OPTIMIZATION OF CCD CIRCUITS

8.1 Conventional Thickener Circuit

8.1.1 May 1978 Recommendation

The conventional thickener circuit recommended by A.H. Ross & Associates in May 1978 (Ref. 7) was as follows:

No of stages	5
Diameter of Thickeners	140 ft
Unit area	7.0 ft^2/ton/day per stage
Underflow density	38% solids
Pregnant liquor/ore ratio	4.25

from which soluble loss was estimated at 1.75%

The physical variables entered into the optimization calculations included unit area of thickeners, underflow density, pregnant/ore ratio, and number of thickener stages. The effect on soluble uranium loss, flocculant consumption, sizing of solvent extraction equipment and solvent losses were the principal measured responses. Annual costs were totalled for uranium loss, operating costs, and capital costs amortized in 3.5 years. The recommended five stage circuit was close to the minimum of the cost curve. In fact, four stages were calculated to be optimum but because of inevitable down-time this would entail only three stages at times and losses would rise sharply; hence five stages were chosen.

8.1.2 Updated Optimization

The thickener sizing at 140 ft diameter remains the same based on the new Envirotech test-work. Underflow density is maintained at 38% solids. The pregnant/ore ratio was limited in May 1978 to a maximum of 4.25 to maintain a reasonable rise rate in

the thickener; this condition is still valid. In reassessing the optimum number of thickeners, the only option is to check changes in the value of soluble loss, flocculant consumption and capital cost, in moving from five stages.

The result of the new calculations is the same as before; with 4 stages as the indicated optimum but with 5 stages recommended for assured performance.

8.2 Hi-Capacity Thickener Circuit

A set of calculations was carried out in the same manner as for the conventional thickeners, using Eimco's specification of two 52' - 6" thickeners per stage.

The optimum number of stages was found to be five at a pregnant/ore ratio of 4.25, although the difference between five and six stages was very small. A higher pregnant/ore ratio would give a lower cost at five stages, but there is no experience at higher washing rates and it is not considered prudent for Minerals Exploration to "break new ground" with both a new type of thickener and a very high pregnant/ore ratio. A lower pregnant/ore ratio shifts the optimum to six stages. In view of the Envirotech recommendation for one stage of Hi-Capacity thickeners over that for conventional thickeners, and the other considerations noted, the A.H. Ross recommendation is for six stages of Hi-Capacity thickeners.

8.3 Comparison of Optimum Conventional and Hi-Capacity Circuits

	Conventional	Hi-Capacity
No of stages	5	6
Thickeners	5 @ 140'Ø x 10'	12 @ 52'6" x 15'
Underflow density, % solids	38	36.5
Flocculant Consumption lb/ton	1.35 - 1.45	1.50 - 1.60
Soluble loss	1.75%	1.75%
Capital cost	$8,174,000	$8,220,000
Net differences; $/yr		
flocculants		+ 58,400
Maintenance		+ 40,000
Operating labour		same

It is evident that without any consideration of risk factors in adopting the yet unproven Eimco Hi-Capacity thickeners that on cost alone the conventional thickener circuit is the preferred choice.