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TASMANIAN URANIUM ORE
CHWALCZYK'S PROSPECT

PRELIMINARY REPORT

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CHEMICAL RESEARCH SECTION

TASMANIAN URANIUM ORE - CHWALCZYK'S PROSPECT

PRELIMINARY LEACHING INVESTIGATIONS

MATERIAL EXAMINED : A parcel of ore weighing about 120 pounds was received in two drums containing approximately the same amounts. The whole parcel was crushed to pass a 10 mesh screen and mixed. Representative portions were taken from the bulk ore and ground as required. The bulk sample was given the designation T.1.

SAMPLES FOR TREATMENT : It was not possible to investigate the effect of ore particle size on leaching efficiency owing to the limited funds available. Leaching tests were therefore carried out on ore ground to approximately 50 per cent minus 200 mesh as that size has been shown to be satisfactory with other uranium ores. Details are as follows.

Sample T. 1a - 500 g. portions of the bulk sample were ground in a ball mill to approximately 50 per cent minus 200 mesh. The samples were forwarded in the wet state and were not dried before leaching.

Screen Analysis :-

	<u>Mesh</u>	<u>per cent</u>
	+ 35	0.4
-35	+ 48	4.7
-48	+ 65	12.4
-65	+ 100	16.9
-100	+ 150	12.1
-150	+ 200	6.7
-200		46.8

Chemical Analysis :-

U₃O₈ 3.97 per cent.

LEACHING TESTS

1. LEACHING WITH SULPHURIC ACID

Two types of leach were investigated, namely;

- Constant acidity
- Fixed acid addition.

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1.1 - Constant Acidity Leaching :

The samples were leached at a pulp density of 50 per cent solids and a temperature of 40°C. The acidity was maintained at the required pH value by addition of sulphuric acid from a burette. Manganese dioxide was added as an oxidant as required in order to keep the "redox" potential of the liquor above the value required for efficient leaching. It has been shown that a "redox" potential of about 400 millivolts is required in an acid leach of ore containing uranium in its lower state of oxidation, i.e. as uraninite or pitchblende.

Conditions of leaching and results are shown in Table 1.

TABLE 1.
LEACHING AT CONSTANT ACIDITY

<u>LEACHING CONDITIONS :</u>	Acidity	controlled pH as indicated.		
	Pulp density	50% solids.		
	Temperature	40°C.		
	Time	as indicated.		
	Agitation	mechanical, continuous.		
TEST No.	T.1a/1	T.1a/4	T.1a/6 ^{x1}	
Acidity (pH)	1.5	1.0	1.0-1.3	
MnO ₂ lb/2000 lb. ore	20	25	25	
"Redox" potential				
Initial m.v.	below 100	below 100	below 100	
Maximum "	420	430	400	
Final	380	410	360	
Total H ₂ SO ₄ lb/2000 lb.	105	155	155	
Final residue U ₃ O ₈ %	0.44	0.21	0.25	
<u>Leaching efficiency %</u>				
<u>Time in hours</u>				
2	73	90	-	
5	79	-	-	
7	89	95	93	
24	-	-	94	
<u>Liquor composition, assuming 3000 ml. from 1000 g. ore.</u>				
Ferric iron, Fe ⁺⁺⁺ g/l.	0.29	0.73	0.32	
Ferrous iron Fe ⁺⁺ "	1.11	0.71	1.9	
Titanium dioxide, TiO ₂ "	0.04	n.d. x2	n.d.	
Silica, SiO ₂ "	0.17	0.20	n.d.	
Phosphorus pentoxide P ₂ O ₅ "	0.08	0.15	0.10	
Uranium Oxide, U ₃ O ₈ "	11.3	12.1	12.0	

^x1 - Maintained at pH 1.0 for 7 hrs. then continued leaching without further addition of acid or oxidant.

Total leaching time 2¹/₄ hours.

^x2 - n.d. = not determined.

1.2. - Fixed Acid Addition Leach :

One leach was made with all of the acid added at the beginning of the test. Conditions and results are shown in Table 2.

TABLE 2.
FIXED ACID ADDITION LEACH

Leaching <u>Conditions</u> :	Pulp density	50% solids
	Temperature	40°C.
	Time	7 hours.
	Agitation	mechanical, continuous

TEST No.	T.1a/5
H ₂ SO ₄ 1b/2000 lb.	250
MnO ₂ 1b/2000 lb.	20
"Redox" potential	
Initial m.v.	below 100
Maximum "	415
Final "	390
Final residue U ₃ O ₈ %	0.16
<u>Leaching Efficiency per cent</u>	
<u>Time in hours</u>	
2	91
5	94
7	96
<u>Liquor composition, assuming 3000 ml. from 1000 g. ore.</u>	
Fe ⁺⁺⁺ g/l.	0.45
Fe ⁺⁺ "	1.79
P ₂ O ₅ "	0.13
U ₃ O ₈ "	12.5

1.3 - Discussion :

Leaching at pH 1.5 did not result in good leaching efficiency. Better results were obtained with leaches at pH 1.0 for an acid consumption of 155 pounds per short ton. There was little apparent benefit gained from a fixed acid leach using 250 pounds acid per short ton and the amounts of impurities dissolved were greater (see section on U₃O₈ recovery from liquors). The leach which was continued for 2¹/₄ hours (T.1a/6) gave an apparently lower overall leaching efficiency than the

7-hour leach. This is probably due to the fact that control of acidity by pH measurement is difficult in the lower scale regions and consequently different amounts of acid could be added. In actual fact only 135 lbs/short ton were added up to 7 hours in leach T.1a/6 whereas 155 lbs. were added in the same period in leach T.1a/4.

It is probable that the expected yield for a leach at about this acid level would be in the range 93-95 per cent. Leaching with more acid should only be considered if some means other than direct precipitation of product were to be used, e.g. ion exchange.

2. LEACHING WITH CARBONATE SOLUTION

The ore was leached with a solution of sodium carbonate and bicarbonate at boiling point. Potassium chlorate was added as oxidant to one leach. Details are shown in Table 3.

TABLE 3.
LEACHING WITH CARBONATE

Leaching Conditions:

Carbonate solution : 5% Na₂CO₃ - 5% NaHCO₃
 Pulp density : 17 per cent solids
 Temperature : boiling
 Time : 4 hours.

TEST No.	T.1a/2	T.1a/3
Sample weight grams.	10	10
Oxidant added "	Nil	5
Leaching efficiency % U ₃ O ₈	40	50

It is apparent from the results of these tests that leaching with carbonate solutions is not satisfactory even in the presence of a large excess of soluble oxidizing agent.

No further tests were conducted on this type of leach.

RECOVERY OF URANIUM FROM LIQUORS

1. DIRECT PRECIPITATION FROM LEACH LIQUOR

This was the only procedure investigated in the preliminary tests. Several different methods of precipitation were used for the acid liquores resulting from the various leaches.

It can be seen that, although the products obtained by the split precipitation procedure are somewhat lower in phosphate than those obtained by other means, the product grade falls below 50 per cent U_3O_8 . In addition, some uranium is lost in the precipitate at pH 3.5 and would have to be recovered. The procedure is not recommended for this ore sample. Direct precipitation with ammonia or magnesia gives products with grades of between 50 and 65 per cent U_3O_8 , depending on the composition of the leach liquor and the temperature of ignition of the product.

CONCLUSIONS AND RECOMMENDATIONS :

The preliminary tests have shown that the uranium is readily leached by dilute sulphuric acid solutions with added oxidant. The consumption of acid is low; of the order of 150 - 200 pounds per short ton of ore. It is considered inadvisable to increase this amount owing to the increase in the amounts of impurities dissolved. The leaching efficiency for the recommended leach is in the range of 93 - 95 per cent and this is achieved in a relatively short period of time (about 7 hours). Leaching for longer periods (T.1a/6) results in solution of more impurities and lower product grade.

The uranium can be recovered by direct precipitation with magnesia or ammonia. The product thus obtained contains more than 50 per cent U_3O_8 and about 1 per cent P_2O_5 . It should be realised however that these results are dependent upon the ore containing 4 per cent U_3O_8 and if this value were to fall it is likely that the grade of products would be lower. In this event it is considered that recovery of uranium by ion exchange would be possible although no test work has been carried out to date.

RECOMMENDATION BASED ON PRELIMINARY INVESTIGATIONLEACHING :

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|---|--|
| Size of grind | - need not be finer than 50% minus 200 mesh. |
| Pulp density of leach | - About 50% solids. |
| Temperature of leach | - Satisfactory at 40°C. |
| Leaching Time | - Not more than 7 hours required. |
| Oxidant | - Manganese dioxide as required to maintain "redox" potential at 400 millivolts. |
| Acidity | - Constant, pH about 1.0 |
| H ₂ SO ₄ required | - 150 - 200 pounds per short ton. |
| Agitation | - Continuous mechanical agitation. |

URANIUM RECOVERY FROM LIQUOR :

Direct precipitation at pH 6.5 with MgO or NH₄OH.

Ignition of product at 450°C.

These results and recommendations refer only to the sample investigated.

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