

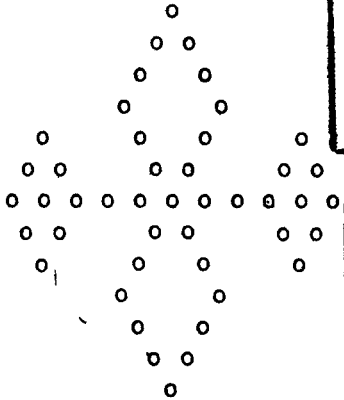
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PRECIPITATION OF SODIUM DIURANATE FROM PITCHBLEND E LIQUORS

CLASSIFICATION CANCELLED
DATE 1/12/56
For The Atomic Energy Commission
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Chief, Declassification Branch *te*



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February 4, 1947

H. Linde

Authorizing Official
Date: 9-27-47

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PRECIPITATION OF SODIUM DIURANATE FROM PITCHBLEND E LIQUORS

I. INTRODUCTION

In the treatment of carnotite concentrates, sodium diuranate was prepared by acidifying tricarbonat e liquors to eliminate carbon dioxide, and then precipitating the sodium salt by the addition of caustic. Direct precipitation of uranium by the addition of caustic to tricarbonat e liquors was used when pitchblende ores were processed, because this procedure was more effective in giving a product with a low molybdenum content. Tests of this method in the laboratory and Pilot Plant indicated that low uranium losses (0.2 to 0.3%) would be encountered with typical liquors if 1.7 to 2.0 lbs. of caustic were added for every pound of uranous oxide in solution. Since losses as high as 3% were incurred in plant operations, further work was undertaken, in an effort to reduce the uranium concentration in the waste liquors.

II. DISCUSSION

Uranium is soluble in alkaline carbonate solutions to a limited extent as sodium uranyl tricarbonat e. The uranium can be precipitated from solutions by the addition of an excess of caustic, the excess required being a function of the liquor composition. It was desired to determine the caustic consumption required for complete precipitation of uranium under plant operating conditions.

The investigation was carried out with tricarbonat e liquors, which were obtained from the processing plant. Previous treatment had included dissolving of the uranium content of the original feed material with sulfuric acid, followed by neutralization with soda ash. Lead had been removed by the addition of sodium sulfide, leaving the solution ready for the precipitation of sodium diuranat e. Five samples were obtained to cover variations in digestion procedure and type of feed.

III. EXPERIMENTAL

A. Effect of Process Variables

The five representative liquors were analyzed, and the uranium loss as a function of the caustic concentration was determined for each. The analyses are summarized below:

Concentration in Grams per 100 cc.

Liquor	U ₃ O ₈	Na ₂ SO ₄	Na ₂ CO ₃	NaHCO ₃	Na ₂ CO ₃ Equivalent to Na ₂ CO ₃ / NaHCO ₃
614	.725	2.00	1.76	1.15	3.20
616	.783	3.40	2.96	.46	3.86
617	.783	2.28	1.89	.48	2.50
618	.766	2.31	2.96	.50	3.60
688	.756	2.02	1.65	.59	2.39

2-0-80

One sample, No. 614, was treated with various ratios of caustic to uranosic oxide, after a number of treatments, and the amount of uranium which had not precipitated was determined. The effects of additional sodium sulfate and sodium carbonate and of dilution and concentration of the liquor were determined. In these tests the tricarbonate liquor was heated to 90°C., and a solution of caustic soda was added slowly. The suspension of soda salt was then digested for one hour and filtered. The results of these tests are summarized below:

Condition	Grams NaOH per Gram U ₃ O ₈				
	1.2 % U in Solution	1.4 % U in Solution	1.6 % U in Solution	1.8 % U in Solution	2.0 % U in Solution
1. Original liquor	9.90	.69	.20	.15	.12
2. Diluted to one-half original concentration	7.54	2.52	1.88	1.14	.58
3. Evaporated from .725 g. U ₃ O ₈ to 1.0 g. U ₃ O ₈ per 100 cc.	1.48	.22	.17	.11	.09
4. Addition of 2.5 g. Na ₂ CO ₃ per 100 cc.	12.3	3.87	1.35	.53	.32
5. Addition of 2.0 g. Na ₂ SO ₄ per 100 cc.	5.50	.74	-	.017	.014
6. Addition of 2.5 g. Na ₂ CO ₃ / 2.0 g. Na ₂ SO ₄ per 100 cc.	7.7	3.36	1.29	.52	.33

These data show that the original liquor gave low uranium losses when 1.6 g. of caustic were added for every gram of uranosic oxide. Dilution gave higher losses, whereas concentration gave lower losses. Increase of the soda ash concentration gave higher losses, but increase of sodium sulfate concentration gave lower losses. When both were increased, the effect was that of increase in soda ash concentration only.

Another variable, the amount of organic matter, was tested with liquor 616. This solution was digested with Douglas fir sawdust for 24 hours at 95° C., and a clear liquor was obtained by filtration. The liquor was dark in color, and soda salt precipitated from it was also very dark. That organic matter can hold up uranium is shown in the following table:

	Grams NaOH per Gram U ₃ O ₈				
	1.05 % U in Solution	1.22 % U in Solution	1.40 % U in Solution	1.57 % U in Solution	1.75 % U in Solution
Original	10.3	2.4	.79	.41	.22
Digested with Sawdust	36.4	17.5	5.0	2.23	1.78

3-9-80

It is probable that organic matter would not interfere to this extent in plant processing, for all the samples in this study had been processed in wooden tanks, and gave satisfactory results.

The time of digestion after the caustic addition was not critical. The loss after a one-hour digestion was the same as that after a seven-hour digestion.

B. Effect of Variations in Plant Solutions

The uranium losses were determined for each of the samples from the plant by using various ratios of caustic to uranium. The results are given in the following table:

Grams NaOH per Gram U ₃ O ₈	Percent of Uranium in Solution				
	614	616	617	618	688
1.05		10.3	3.7		
1.11				8.5	
1.20	9.9				.54
1.22		2.4	.75		
1.30				1.87	
1.40	.69	.79	.29		.28
1.49				.78	
1.57		.41	.24		
1.60	.20				.16
1.67				.34	
1.75		.22	.16		
1.80	.15				.15
1.86				.20	
2.00	.12				.15

The factor which appeared to be most important in determining the uranium loss was the concentration of sodium carbonate equivalent to the sodium carbonate and bicarbonate concentrations. The only discrepancy was between samples 616 and 618. The former was expected to show a higher loss for a given caustic ratio, but this was not found to be the case. This was probably due to the fact that No. 616 had a much higher sodium sulfate content than No. 618, since increases in sodium sulfate have been found to give lower losses.

Whereas the liquors differed markedly at low caustic ratios, losses were about the same for all when sufficient caustic was added.

IV. SUMMARY

This study proved that it is possible to obtain uranium recoveries of 99.8% by adding 1.8 grams of NaOH per gram U₃O₈ to representative samples of tricarbonat liquor. While less NaOH is effective with some liquors, the full amount is necessary to insure satisfactory recovery in all cases, if the caustic requirement is not to be determined for each liquor and if no rapid test for uranium in the filtrate is available. It would appear from these results that the losses which characterized this work were due to the addition of insufficient caustic.

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