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EXTRACTION OF URANIUM FROM IRON BOX SLUDGE

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EXTRACTION OF URANIUM FROM IRON BOX SLUDGE

I. INTRODUCTION

It was desired to establish the adaptability of iron box sludge, a residue recovered in the initial concentration of domestic ores, as a raw material from the production of high purity U_3O_8 . This report summarizes the experimental work on the extraction of uranium from iron box sludge and that on the removal of V_2O_5 and P_2O_5 from the solutions.

II. DISCUSSION

Iron box sludge was a by-product formed in the western processing of sand tailings. The acid liquors from the leaching of carnotite sands contained vanadium, which was reduced after the leaching step to insure complete precipitation of the values as green sludge. The reduction was accomplished with metallic iron, and some of the values were precipitated by localized neutralization of the acid. This precipitate was removed periodically from the launders and was called "iron box sludge". A typical analysis is as follows:

U_3O_8 - 12.5%

V_2O_5 - 2.36%

P_2O_5 - 2.65%

SiO_2 - 28.6%

Iron - 11.4%

Preliminary tests made in the laboratory had indicated that good extractions could be obtained with this material, without removing the metallic iron or adding an oxidizing agent. Small scale processing was therefore carried out in order to determine the optimum conditions for plant operation.

III. EXPERIMENTAL

In the experimental work, 100-lb. digestions of iron box sludge were made, using the regular plant procedure. They resulted in 99% extraction of the uranium, using the following amounts of reagents:

1 - 100 pounds Iron Box Sludge

2 - 100 pounds H_2SO_4 (66° Be) (pH 0.4)

3 - 180 pounds Na_2CO_3 (pH 9.3)

4 - 13.5 pounds $NaHCO_3$ (pH 9.1)

The filtration rate of the digest slurry was lower than customarily obtained with carnotite concentrates --- 3/gal./hr./sq.ft. for a 7/8 in. cake, in contrast to 4-6 gal./hr./sq.ft. with carnotite. Although the cake washed easily, it showed a greater tendency to crack than the regular carnotite feed. Blending carnotite concentrates with iron box sludge decreased the tendency to crack and increased the filtration rate. An equal amount of concentrate added to iron box sludge gave a filtration rate of 4.1 gal./hr./sq.ft.

Although a good extraction was possible without grinding the heads, it appeared desirable to grind the material before digesting. The tailings from unground heads contained 10% gravel larger than 48 mesh (based on heads) which would accumulate at the bottom of the digest tanks. A screen analysis of wet ground heads showed 10% greater than 48 mesh (essentially all metallic iron). If a continuous grinding circuit were used, this iron possibly would accumulate in the ball mill. This problem could not be accurately evaluated in the equipment available.

An analysis of the liquors from the digestion step showed 0.3 to 1.0% V_2O_5 and 5-10% P_2O_5 , both based on U_3O_8 . By adjusting the pH to 8.5-8.7 with H_2SO_4 and by adding 2-5 pounds $FeSO_4 \cdot 7H_2O$ (copperas) and 20-25 pounds $Fe_2(SO_4)_3$ (Ferrisul), the vanadium and phosphorus were decreased to <0.1% and <0.2%, respectively. The iron cake was washed with 2% $NaHCO_3$ solution to a final U_3O_8 concentration of 0.56%.

IV. SUMMARY

Iron box sludge can be treated in essentially the same way as regular carnotite concentrates. Slight modifications are necessary because of the presence of metallic iron and because there has been no soda ash roast to remove some of the vanadium and phosphorus.

Good extractions (99%) were obtained with the regular procedure. It was not necessary to add an oxidizing agent to the digest.

Filtration rates on this material were slightly lower than average for carnotites, and the cake had a greater tendency to crack in washing. Blending carnotite concentrates with the iron box sludge heads increased the filtration rate and decreased the cracking.

Because the iron in the heads dissolves as ferrous sulfate, the vanadium extractions were low (0.3-1.0% V_2O_5 based on U_3O_8); however, the phosphorus extractions were high (5-10% P_2O_5 based on U_3O_8). Addition of ferric and ferrous sulfates decreased the vanadium and phosphorus in solution to less than 0.1% and 0.2%, respectively.

In the processing of iron box sludge, there is the possibility that metallic iron might build up in the grinding circuit. If the material is not ground, gravel might accumulate in the digest circuit.