EFFECTIVENESS OF A 1.5m THICK COVER OF SMELTER SLAG IN REDUCING RADON EMANATION FROM URANIUM TAILINGS.

P C Crouch, A D Johnston, G Palmer & W J Spehr*
South Australian Health Commission
GPO Box 1313 Adelaide South Australia 5001
*South Australian Department of Mines and Energy

ABSTRACT

A 1.5m thick cover of smelter slag was found to reduce radon emanation from uranium mill tailings by a factor of approximately 40.

INTRODUCTION

From 1955 to 1961, the South Australian Department of Mines operated a treatment plant at Port Pirie, approximately 200km north of Adelaide extracting uranium from concentrates from the Departments' Radium Hill mine, 300km to the north-east. Aproximately 200,000 tonnes of concentrate were treated during this time with the tailings and other process residues being stored in dams adjacent to the plant.

In 1982 the State Government decided to rehabilitate the site beginning with a proposal to cover the tailings dams. The 6 tailings dams covering an area of 22 ha were constructed on a clay base with clay retaining walls (See Fig 1.). The uranium tailings were confined to Dams 2,3,4 and 5. The tailings contained approximately 15 TBq of Ra-226 with an activity concentration of 75 Bq/g.

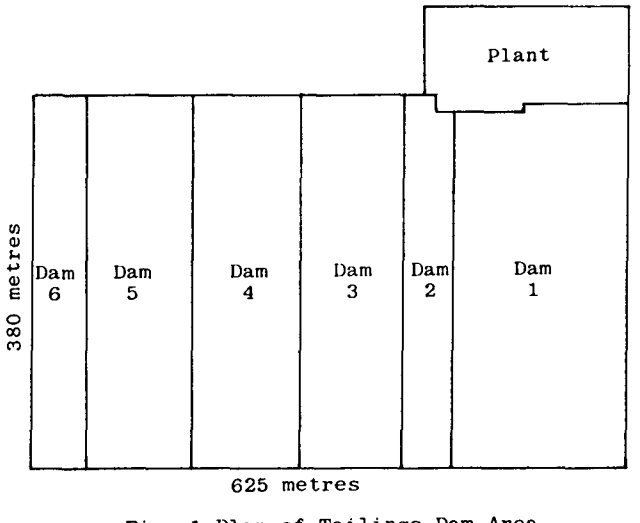

Fig. 1 Plan of Tailings Dam Area

The site is adjacent to a large lead smelter, and large quantities of smelter slag were available virtually free of cost. The slag is a sintered, granular material with 25% greater than 1mm and only 1% less than 100 μm. It has a density of about 1400 kg/m^3 uncompacted and 1900 kg/m^3 compacted, is freely draining and will not maintain a moisture content of more than a few percent.

Published results indicated that it would be a poor cover material as "sandy porous soil" has a reported half value layer for radon emanation reduction of 1.0m [1]. However an initial laboratory test indicated that the HVL for the slag was of the order of 0.3m, and so it was decided to conduct a field trial.

FIELD TRIAL

A test area (15m by 10m) was selected and the pre-cover emanation rate was measured. The area was then covered with slag to depths of 0.5m, 1.0m and 2.0m (see Fig. 2.).

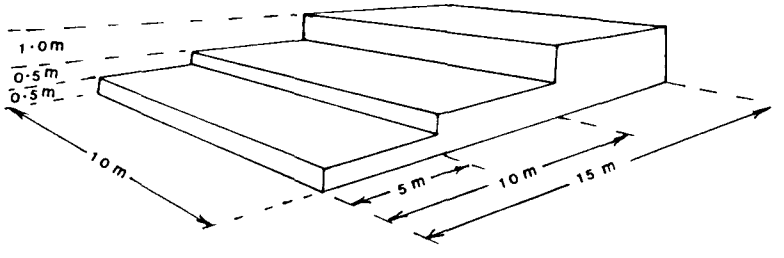

Fig. 2 Test Area Following Laying of Smelter Slag

After covering, emanation rates on each thickness and an uncovered 'control' area were measured. Both the charcoal canister [2] and drum accumulator [3] methods were used to measure emanation rate. The HVLs measured for the various layers were from 0.14m (0.5m cover) to 0.57m (2.0m cover). Some but not all of the variation could be explained by compaction - the 0.5m layer was compacted by vehicle movement in the laying of the other covers [4].

FULL COVER EFFECTIVENESS

As results of the field trial were sufficiently promising, it was decided to proceed with a full 1.5m cover of the tailings. A two year pre cover survey of the dams had shown a mean emanation rate of 5.0 Bq/m^2/s[4].

After the cover had been completed a further survey over a 12 month period indicated that the emanation rate had stabilised at approximately 0.12 $Bq/m^2/s$.

DISCUSSION

The initial slag cover of approximately 1.5m has been very effective in suppressing radon release from the Port Pirie tailings dams. The average annual emanation rate has been reduced by a factor of approximately 40 from 5.0 $Bq/m^2/s$ to 0.12 $Bq/m^2/s$. This represents an effective HVL for compacted slag of 0.28m, a value consistent with the laboratory trials and similar to that of compacted soil (0.3m)[1].

While there are presently no recommended Australian Standards for radon emissions from rehabilitated Uranium tailings piles, the value of 0.12 $Bq/m^2/s$ is well within the United States Environmental Protection Agency radon emission standard of 0.74 $Bq/m^2/s$[5].

The reasons for this relatively large reduction are not known, but an important factor is probably the increased moisture content of the tailings under the cover. The climate of Port Pirie is dry with hot summers, and the uncovered tailings become desiccated. The cover will maintain a higher moisture content in the tailings, so reducing the release of radon[6].

CONCLUSION

While not appearing at first to be a good cover material for Radon suppression, the smelter slag performed surprisingly well. The conclusion to be drawn from this experience: try what you have at hand, it might work!

REFERENCES

1. EPA Draft Environmental Impact Statement for Remedial Action Standards for Inactive Uranium Processing Sites. (40 CFR 192) EPA 520/4-80-011(1980).

2. Countess, R J "Rn-222 Flux Measurement with a Charcoal Cannister", Health Physics 31, p 455,(1976).

3. Tompkins, R W and Cheng, K C (1969) Can. Metall. Bull, 13 p. 56-62 (1969).

4. Spehr, W J - "The Effectiveness of Lead Smelter Slag in Suppressing the Release of Radon from a Uranium Tailings Dam" Radiation Protection in Australia 2. p 101 (July 1984).

5. EPA Proposed Disposal Standards for Inactive Uranium Processing Sites; (40 CFR 192). Federal Register Vol 46 No 6 p. 2562(Jan 1981).

6. Strong, K B, and Levins D M, "Effect of Moisture Content on Radon Emanation from Uranium Ore and Tailings". Health Physics, 42, p. 27, (1981).